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Preliminary planning and engineering report

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Jilalan Station Yard Upgrade and Bypass Line – Stage 1 Expansion
Preliminary Planning and Engineering Report
Queensland Rail

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Executive Summary

During October 2006, Connell Hatch was commissioned by Queensland Rail (QR) to undertake engineering and planning services related to QR's proposed expansion of the Jilalan rail yard at Sarina, Queensland. The objective of this commission was to progress the design of the proposed expansion to an advanced stage and commence critical stakeholder approvals.

Following concept design work, previously undertaken by Connell Hatch, QR produced concept drawings E/J122 and E/J123, which formed the basis for preliminary design.

Survey

Existing survey data was supplemented with new survey to enable the design to be progressed. Due to changes to the proposed layouts, additional survey will be required to enable detailed design to progress.

Hydrology and Hydraulics

The existing assessment of Plane Creek was reviewed and updated to include the latest concepts. Hydraulic modelling was carried out on the two other significant waterways, which intersect the proposed rail (ie Willy Creek and Elizabeth Creek). Assessments were made of other minor cross drainage requirements as a result of the proposal.

Rail Alignment Design

A check of the concept horizontal geometry was carried out and confirmed that it generally conformed to QR standards. Minor changes were made as required.

A significant deviation from the existing rail alignment was considered at the northern end of the study area. This allowed the proposed Smyths Road underpass to be constructed without impacting on the coal rail traffic.

A preliminary vertical grading was applied to the alignments in order to prove the concept, obtain property acquisition requirements and to better assess the civil quantities. The required level of the bypass line bridge over the North Coast Line resulted in a much higher alignment than originally anticipated. Using the maximum permitted longitudinal grade of 1.0%, it became apparent that the proposed southern tie in to the existing Goonyella Branch Line would extend several hundred metres beyond that originally proposed.

A construction sequence was developed at the southern tie in that would allow the coal rail traffic to be maintained during the entire construction of the expanded facility. This created some potential conflicts with the Oonooie Substation, immediately south of Oonooie Road, however these issues are expected to be resolved in the next design phase.

Miscellaneous Works

Preliminary designs of the structures for the wagon maintenance, provisioning and locomotive maintenance facilities were provided by QR for inclusion in the report.

The access to the new facility is now proposed to be located from Gurnetts Road. A bridge is required over the bypass and provisioning lines as a result.

Power supply is required to be provided to the new wagon maintenance and provisioning buildings. Preliminary discussions with Ergon indicate that this may be possible to take this supply from existing powerlines in Gurnetts Road. This would eliminate the need to provide power distribution infrastructure from the existing yard to the new buildings.

Various realignments of external power distribution infrastructure will be required as a result of the proposed yard upgrade.

General Civil Works

Additional geotechnical field testing and laboratory testing was carried out as part of the study. This was undertaken to obtain a better appreciation of the expected in-situ materials and the potential impacts of these materials. In the vicinity of the large cutting, the bore logs were extremely variable and a distinct rock surface was not able to be determined. The geotechnical results were utilised during the preliminary design, however various assumptions were required to accommodate the variability in the results.

A preliminary assessment has been made of the potential drainage requirements for the new roads and rail tracks.

Roadworks and Bridges

A traffic assessment, jointly administered by QR and Sarina Shire Council, was carried out by Connell Hatch. This study identified the potential impacts on the surrounding road network as a result of the proposed Jilalan expansion. It also assessed the impacts that the expected increase in rail traffic might have on level crossings in the area.

Presentations were made to a working group, including stakeholders such as QR, Sarina Shire Council, CSR, Canegrowers and Main Roads.

Several bridges are proposed as part of the works. These include:

- Smyths Road Underpass
- Armstrong Beach Road Overpass
- Oonooie Road Overpass
- Bridge for Provisioning and Bypass Lines over North Coast Line and Cane Tram Tracks
- Site Access Bridge Over Provisioning and Bypass Lines

Land Acquisition

An assessment of the land acquisition requirements was carried out based on the designs prepared during this study. A series of plans were produced to identify which lots were affected and to what extent.

Environmental Approvals

The study involved the preparation of an Impact Assessment Statement (IAS) and Draft Terms of Reference (TOR) for the Environmental Impact Statement (EIS). These documents are being reviewed by the Coordinator General for “significant project” status. If the project acquires “significant project” status, an IES will still be required.

1. Introduction

During October 2006, Connell Hatch was commissioned by Queensland Rail (QR) to undertake engineering and planning services related to QR's proposed expansion of the Jilalan rail yard at Sarina, Queensland. The objective of this commission was to progress the design of the proposed expansion to an advanced stage and commence critical stakeholder approvals.

Over the preceding twelve months, Connell Hatch undertook for QR the following work, which was documented in two Preliminary Reports issued earlier in 2006:
- Jilalan Station – By Pass Line – Land Take Concept Study
- Jilalan Station – Rail Yard Upgrade – Land Take Concept Study

Following consideration of the above consultancy works, concept drawings E/J122 and E/J123 were produced by QR and formed the basis for described works for inclusion in a preliminary design. This report describes the outcomes of the preliminary study.

The outputs from the study are as follows:
- Geotechnical report
- Survey model suitable for taking forward into subsequent stages of the project
- Transportation Planning and Traffic Engineering report
- Preliminary design documentation for consultation purposes
- Planning report including preliminary general arrangement documentation for the upgrade scheme (similar standard of documentation to that produced for the previous studies)
- Capital Cost Estimate to approx +/- 30%
- Aerial photograph covering affected area of the works.

These deliverables are included in this report, with the exception of the Capital Cost Estimate, which is the subject of a separate report.

2. Basis of Design

Preliminary design has been based on the design criteria and assumptions listed below.

2.1 Design Criteria

2.1.1 Rail

Vertical Alignment

- Minimum VC length is 40 m. Minimum radius is 5000 m. Whichever is greater.

New By-Pass and Running Lines

Maximum Grade	1 in 100
Ruling Grade	1 in 200
Minimum Grade	No minimum (ie can be flat, making allowance for drainage
Depth between top of rail and top of formation	724 mm (track type 60- 4) for Bypass Roads; 674mm (track type 60-3) for Mainline Realigning and Provisioning Yards

Yard Track

Maximum Grade	1 in 200 depending on location
Minimum gradient	No minimum (ie can be flat, making allowance for drainage
Depth between top of rail and top of formation	624 mm (track type 60.2) for Wagon Maintenance and Turning Angle

Horizontal Alignment

Design speed for by-pass line	80kph
Minimum Radius for by-pass line	550 m
Minimum Spiral	No change to what is on QR scheme drawing
Cant Development	To be introduced later in design stage

Formation Design

Generally as per QR standard drawings 2567 to 2572	
Embankment Batter (V:H)	1:1.5 (to be confirmed in detailed design)

2.1.2 Roads

Listed below is the design criteria applied to the design of roads as per Austroads ‘Guide to the Design of Rural Roads’ and ‘Guide to Traffic Engineering Practice – Part 5: Intersections at Grade’.

Table 2-1 Road Configurations

Criteria	Armstrong Beach Road	Smyth's Rd Underpass	Smyth's Road	Gurnetts Road	Rail Yard Access Road	Access to Sammut property	Internal Yard
Lanes	2	2	2	2	2	1	2
Lane Width	3.5	3.1	3.1	3.5	3.5	3.5	3.5
Shoulder Width	1.5	1.5	1.5	1.5	1.5	2.0	
Design Speed km/h*	80	20	80	100 (70 at southern end)	60	80	40
Pavement	Sealed	Sealed	Refer Section 10.1	Refer Section 10.1	Sealed	Unsealed	Sealed
Design vehicle	19 m Semi-trailer						

* To be confirmed in detail design.

Refer to drawing SK-C-062 for typical road cross sections.

2.1.3 Design Parameters

The following design parameters have been assumed for the planning study for the bridges on the Jilalan Rail Upgrade.

Item	Parameter	Description
1	Design Code	• AS 5100 – Bridge Design Code
2	Matters for Resolution	• To be developed
3	MCRS01	• Design of road bridges over rail
4	Traffic load	• Rail – 300A12 • Road – SM1600, HLP400
5	Pedestrian Live Load (where applicable)	• 4 kPa
6	Barrier level	• Medium
7	Barriers	• 1100 mm high, single slope concrete barriers with extension to 2000 high for anti-throw requirements.
8	Geotechnical	• Refer geotechnical investigation report
9	Vertical Clearances (to be confirmed by QR prior to Detailed Design)	• Rail over Smyths Rd – 4.8 min. 5.2 to be considered during Detailed Design. • Bridge over electrified rail (with concrete sleepers) – 6.1 min to top of rail • Bridge over non-electrified rail (with concrete sleepers) – 5.4 min to top of rail at NCL
10	Horizontal Clearances	• 3.5 min centreline of track to structure typical • 3.0 min centreline of track to structure at the tramway location
11	Rail cross section	• Maintenance access tracks – 3 m wide and cess drains 2 m wide are provided as noted on the drawings.

Nomenclature in this report is open flange super T girders (or Tee Roff girders) are referred to as super T girders.

2.1.4 Rail Drainage

Minor Track Drainage

Refer Section 7.3.

Cross Drainage

- Immunity to top of formation during 50 year ARI event
- Immunity to rail during 100 year ARI event
- Minimum pipe size to be 900mm diameter
- Runoff Treatment.
  - It has been assumed that treatment of runoff collected within the rail yard will be treated prior to release into natural watercourses. The need for treatment needs to be confirmed as part of the environmental assessment and taken into account during detailed design.

2.1.5 Road Drainage

Design of road longitudinal drainage to be sized for the 10-year ARI storm event and conform to:

- Sarina Shire Council standards
- Austroads - Road Runoff and Drainage – Environmental Impact Management
- Austroads – Guidelines for Treatment of Stormwater Runoff from the Road Infrastructure

Cross drainage shall be located in areas where existing flows are interrupted by embankment roadworks and sized for the 10 year ARI storm event (to be confirmed by Sarina Shire Council).

3. Survey Model and Data

The original survey of the existing yards was supplied by Queensland Rail in AutoCAD format. The survey was re-coded and input into 12D.

New areas were surveyed to supplement the existing survey. These areas included:

- The area east from the railway embankment to Gurnetts Road and detail of Elizabeth and Willy Creeks
- Detail of Plane Creek from the railway embankment to the causeway across Plane Creek
- Extension of the railway from the Symths Road level crossing, north to the rail crossing over Plane Creek including the area east to the high water mark
- Approx 400m east of Smyth's Road south to Armstrong Beach Road
- Detail of the Armstrong Beach Road overpass and north approx 200m
- Detail of Oonooie Road west for approx one kilometre
- Additional detail about the CSR ethanol plant and existing rail in that area
- Detail west from the rail to the existing Willy dam and north to Armstrong Beach Road

The survey extents are shown on SK-C-10 to SK-C-21 (inclusive).

3.1 Workplace Health and Safety

This survey was carried out in accordance with the WH&S Act and Regulations. Hazard identification and risk assessment was undertaken. QR protection officers were employed whilst surveying rail tracks.

3.2 Notice of Entry

Permission to enter private properties was obtained by QR.

3.3 Public Consultation and On Site Liaison

Consultation with relevant property owners was undertaken by QR.

3.4 Compiled Survey Data

The survey data includes new data as collected by Connell Hatch and previous surveys conducted by third party(s).

3.5 Limitations on Data

Due to the fact the data is a compilation of surveys by various organisations and personnel over the past four years, inconsistencies between the data sets may be present.

3.6 Deliverables

The deliverable for the survey data consist of the following:

- 12D ASCII files.

All survey data has been processed in 12D with outputs into MX Genio and AutoCAD drawing formats. Existing survey data was converted and re-coded into Main Roads Standard (MRS) coding format.

3.7 Horizontal Datum

Primary Horizontal Survey Control for the project has been based upon the Project Co-ordinate System values for Permanent Survey Marks 124484, 124469,124468, 124455 and 124485.

Project Coordinates for these stations and other control stations are listed in Appendix A.

Locality Sketches for these stations are also contained in Appendix A.

3.8 Vertical Datum

Primary Vertical Survey Control for the project is based on the AHD values for the permanent marks noted above.

3.9 Cadastral Boundaries

Field inspection and survey of key reference marks have determined the boundaries of lots abutting the railway line. The boundaries have then been overlayed onto the detail survey drawings based upon this information and title dimensions.

3.10 Data Processing

Data processing was carried out using 12D in two separate projects, (1) Survey by Connell Hatch (2) previous survey, which was re-coded to Main Roads Standard codes.

4. Hydrology / Hydraulics

4.1 Introduction

A preliminary hydrologic and hydraulic assessment was carried out for the proposed Jilalan Yard Upgrade. The study area included the Goonyella Branch Line between approximate Chainage 17.3 km and Chainage 24.8 km, and includes all contributing catchments. This section outlines the extent of the investigation for cross drainage requirements due to external catchments,

Recommendations for drainage infrastructure are provided accordingly.

4.2 Study Data

Data used in this analysis included:

- Detailed survey of Queensland Rail assets within the study area
- Digital contour data with 1m interval for areas surrounding Jilalan Station Yard supplied by Queensland Department of Natural Resources and Mining (NRM)
- Intensity Frequency Data (IFD) for Sarina derived in accordance with Australian Rainfall and Runoff (ARR, 1987)
- Queensland Urban Drainage Manual (Neville Jones & Associate, 1993)
- Queensland Rail Standard Drawings
- Road Drainage Design Manual (Department of Main Roads, June 2002)

4.3 Methodology

This drainage assessment was undertaken as summarised below:

- Identification of drainage routes within the study area
- Delineation of catchments contributing flows to Jilalan Station Yard
- Determination of flood discharges from contributing catchments using the Rational Method
- Preliminary assessment of appropriate drainage options
- Hydraulic analysis of proposed drainage options manually and in some instances with HEC - RAS and
- Review of hydraulic analysis outcomes
- Recommendations for drainage

4.4 Hydrologic Analysis

4.4.1 The Rational Method

Preliminary catchment investigation indicated that all catchments generating flow to the study area could be classified as small. Additionally, no catchments relevant to this investigation were gauged resulting in an absence of recorded stream flow data for flood frequency analysis or calibration of sophisticated runoff routing hydrologic models.

The Rational Method is a simple method commonly used in Queensland to estimate peak discharges for drainage design in smaller catchments. The Rational Method was adopted to derive peak discharges for all catchments in this study, with the exception of Plane Creek.

Time of Concentration

The Bransby Williams method was adopted to determine the time of concentration in this analysis.

Coefficient of Runoff

Rainfall intensity for the 1 hour duration event with an Annual Exceedence Probability (AEP) of 1 in 10 for the Sarina area was determined to be 76 mm/hr.

The coefficient of runoff for catchments with the fraction impervious of 5% for standard duration events up to and including that with an AEP of 1 in 100 have been listed in Table 4-1 and Table 4-2 respectively for Rail and Road contributing catchments.

Table 4-1 Coefficients of Runoff Rail Catchments

AEP (1 in X)	Coefficient of Runoff
1	0.57
2	0.60
5	0.67
10	0.71
20	0.75
50	0.82
100	0.85

Table 4-2 Coefficients of Runoff Road Catchments

AEP (1 in X)	Coefficient of Runoff 5% Fraction Impervious	Coefficient of Runoff 10% Fraction Impervious	Coefficient of Runoff 90% Fraction Impervious
1	0.57	0.58	0.70
2	0.60	0.61	0.75
5	0.67	0.68	0.84
10	0.71	0.72	0.88
20	0.75	0.76	0.92
50	0.82	0.83	1.01
100	0.85	0.86	1.06

Design Rainfall Data

Intensity Frequency Duration (IFD) rainfall data adopted for the study area was determined in accordance with the procedures outlined in Australian Rainfall and Runoff (IEAust, 1987) for the Sarina area. IFD data for Sarina has been presented in Appendix B.

4.4.2 Catchments

Land use for all catchments was classified in accordance with the Sarina town plan, Sarina Planning Scheme, 2005. Fraction impervious for land use was adopted in accordance with Queensland Urban Drainage Manual (Neville Jones & Associates, 1993).

Rail Cross Drainage Catchments

The study area was determined to command a total of 10 catchments, delineated in Drawing SK C 092, that discharge runoff to the proposed railway in the study area. The characteristics of each have been listed in Table 4-3.

Table 4-3 Rail Cross Drainage Catchment Characteristics

Catchment	Area (ha)	Equal Area Slope (%)	Land Use	Fraction Impervious (%)
Willy Creek (B)	566	1.4	Rural	5
Willy Dam (B)	167	1.9	Rural	5
Elizabeth Creek (B)	280	1.7	Rural	5
Oonooie Creek (B)	104	1.4	Rural	5
CH:5380 (M)	38.8	1.3	Rural	5
CH:950 (B)	1.9	0.22	Rural	5
CH:1300 (B)	2.4	0.27	Rural	5
CH:1250 (B)	2.4	1.6	Rural	5
CH:200 (M)	7	1.1	Industrial	90
CH:2400 (M)	23	1.4	Industrial	90

Note:

- (M) : Maintenance Line
- (B): Provisioning/Bypass

Road Cross Drainage Catchments

Catchments discharging runoff to realigned or upgraded roads in the study area have been listed in Table 4-4.

Table 4-4 Road Cross Drainage Catchment Characteristics

Catchment	Area (ha)	Equal Area Slope (%)	Land Use	Fraction Impervious (%)
Smyth’s Road CH 150	0.85	1.1	Industrial	90
Smyth’s Road CH 460	0.22	0.8	Industrial	90
Smyth’s Road CH 800	0.85	1.62	Industrial	90
Smyth’s Road CH 950	1.04	1.1	Industrial	90
Smyth’s Road CH 1460	2.09	0.27	Industrial	90
Smyth’s Road CH 1750	1.11	2.4	Industrial	90
Smyth’s Road CH 2210	3.02	0.96	Industrial	90
Gurnetts Road CH 30	17.01	3.79	Industrial	90
Oonooie Road CH 380	Portion of Oonooie Creek Catchment		Rural	5
Oonooie Road CH 940	Portion of Oonooie Creek Catchment		Rural	5
Oonooie Road CH 1190	Portion of Oonooie Creek Catchment		Rural	5
Armstrong Beach Road	45.64	1.16	Rural	10

4.4.3 Estimated Peak Discharges

Application of parameters discussed in Section 4.4.2 to the Rational Method yielded the peak discharges presented in Table 4-5. Only estimated peak discharges for events with AEP of 1 in 100, and 1 in 50 have been presented for rail and AEP of 1 in 100 and 1 in 10 for roads.

Rail Cross Drainage Estimated Peak Discharges

Peak discharges for catchments reporting to the proposed railway formations in the study area have been listed in Table 4-5.

Table 4-5 Rail Cross Drainage Estimated Peak Discharges

Catchment	Q_{100} (m^3/s)	Q_{50} (m^3/s)
Willy Creek (B)	95	80
Willy Dam (B)	45	38
Elizabeth Creek (B)	58	50
Oonooie Creek (B)	28	24
CH:5380 (M)	12.6	10.8
CH:950 (B)	0.7	0.6
CH:1300 (B)	1.0	0.8
CH:1250 (B)	1.5	1.3
CH:200 (M)	2.7	3.1
CH:2400 (M)	10.3	8.8

Note:
- (M) : Maintenance Line
- (B): Provisioning/Bypass

Road Cross Drainage Estimated Peak Discharges

Table 4-6 presents the peak discharges approaching realigned roads within the study area.

Table 4-6 Road Cross Drainage Estimated Peak Discharges

Catchment	Q_{100} (m^3/s)	Q_{10} (m^3/s)
Smyth’s Road CH 150	0.66	0.35
Smyth’s Road CH 460	0.21	0.11
Smyth’s Road CH 800	0.64	0.34
Smyth’s Road CH 950	0.81	0.43
Smyth’s Road CH 1460	1.01	0.54
Smyth’s Road CH 1750	0.81	0.43
Smyth’s Road CH 2210	2.28	1.21
Gurnetts Road CH 30	7.16	3.8
Oonooie Road CH 380	Portion of Oonooie Creek Catchment Flow	
Oonooie Road CH 940	Portion of Oonooie Creek Catchment Flow	
Oonooie Road CH 1190	Portion of Oonooie Creek Catchment Flow	
Armstrong Beach Road	22.58	13.81

4.5 Rail Cross Drainage

Fundamental constraints for selection of culverts include:

- Formation flood immunity for an event with an AEP of 1 in 50
- Rail flood immunity for an event with an AEP of 1 in 100

Culverts located in existing formation were also considered when adopting new culverts.

4.5.1 Proposed Rail Cross Drainage Structures

Proposed works for the Jilalan Station Yard Upgrade include:

- Wagon maintenance tracks east of the existing track
- Bypass and provisioning tracks further to the east of the wagon maintenance tracks

Elizabeth and Willy Creeks

Approximate separation distances between the downstream toe of the maintenance formation and the upstream toe of the provisioning / bypass formation are:

- 117m for Elizabeth Creek
- 117m for Willy Creek

Due to the distance between rail formations, separate cross drainage structures have been proposed for each formation and are discussed in Sections 6.3 and 6.4 for Elizabeth and Willy Creeks respectively.

Flow discharging from the maintenance formation culvert would be conveyed to the bypass formation culvert through an excavated channel, discussed below.

Proposed Cross Drainage Details Elizabeth and Willy Creeks

The proposed cross drainage details for Elizabeth and Willy Creeks have been listed in Table 4-7 and presented in Drawings SK C 031 and SK C 032.

Table 4-7 Proposed Cross Drainage Details Elizabeth and Willy Creeks

Catchment	Culvert Type	Dimensions	Number	Length Maintenance (m)	Length Bypass (m)
Elizabeth Creek	RCBC	3.0 x 2.1	3	131	78
Willy Creek	RCBC	3.0 x 2.1	8	92	67

Oonooie Creek – CH:6300

The formation at Oonooie Creek will completely envelope the existing formation. The existing culvert arrangement at this point consists of two different sized culverts in series separated by a short opening:

- 2 of 3.0m x 2.1m RCBC with length 11.1m
- 2 of 2.7m x 1.8m RCBC with length 7.6m

The proposed arrangement for this location has been presented in Table 4-8.

Table 4-8 Proposed Cross Drainage Details Oonooie Creek, CH:6300

Catchment	Culvert Type	Dimensions (m)	Number	Length (m)
Oonooie Creek	RCBC	3.0 x 2.1	2	50

Note from Table 4-8 that the different sized culverts currently in position have been replaced with one size only. Refer to Drawing SK C 033.

Catchment CH:5380

The existing formation at this point will remain unchanged and forms the southern extremity of the proposed maintenance formation.

The proposed provisioning / bypass formation, to be constructed adjacent to the existing formation, will result in a toe to toe distance of around 5m. The culvert cell under the existing formation discharges to a drain which will be enveloped by the proposed provisioning / bypass formation.

The proposed culvert arrangement for this location has been presented in Table 4-9 and located on Drawing SK C 032.

Table 4-9 Proposed Cross Drainage Details Catchment CH:5380

Catchment	Culvert Type	Dimensions (m)	Number	Length (m)
CH:5380	RCBC	3.0 x 2.1	2	58.2

Catchments CH: 1750, 1300, 950

These 3 cross drainage points are located along the bypass formation adjacent to Smyth's Road. Contributing catchments are small and peak discharges comparatively low.

Culvert arrangements proposed for these areas have been listed in Table 4-10. Refer to Drawing SK C 030.

Table 4-10 Proposed Cross Drainage Details Catchment CH:950, 1300, 1750

Catchment	Culvert Type	Dimensions (m)	Number	Length (m)
CH:950	RCP	2.7	1	49
CH:1300	RCP	1.2	1	55
CH:1750	RCP	0.9	1	41

The proposed culverts will not be connected to the existing culverts. This will allow the area between the formations to enter the cross drainage system.

Catchment CH:200

A culvert located on the Maintenance line will be required at the northern end of the rail yard to drain the area between the proposed track and the existing track.

The proposed culvert arrangement for this location has been presented in Table 4-11.

Table 4-11 Proposed Cross Drainage Details Catchment CH:200

Catchment	Culvert Type	Dimensions (m)	Number	Length (m)
CH:200	RCP	1200	1	20

Catchment CH:2400

A culvert located on the Provisioning/Bypass line will be required at the northern end of the rail yard to drain the area between the proposed track and the existing track.

The proposed culvert arrangement for this location has been presented in Table 4-12.

Table 4-12 Proposed Cross Drainage Details Catchment CH:2400

Catchment	Culvert Type	Dimensions (m)	Number	Length (m)
CH:200	RCBC	3 x 2.1	2	20

4.6 Rail Cross Drainage Hydraulic Analysis

Hydraulic analysis of cross drainage structures was undertaken to review performance.

HEC-RAS was used for structures along:
- Elizabeth Creek
- Willy Creek

Manual hydraulic calculations for structures located at:
- Oonooie Creek
- CH:5500
- CH:940
- CH:1300
- CH:1700

4.6.1 HEC-RAS

The steady state backwater model, HEC-RAS (USACE) was used to analyse the Elizabeth and Willy Creek systems.

Branches

Survey and aerial photography were used to map the course of Elizabeth Creek and Willy Creek, approaching and throughout the subject site. The HEC-RAS layout used can be seen in Figure 5.1.

Cross Sectional Data

Cross sections were extracted from:
- detailed site specific survey data
- digital contour data with an interval of 1.0m

Sections were located at irregular intervals along the waterways to suitably define the topography of each waterway.

Manning’s Roughness Coefficient

Appropriate values for Manning’s ‘n’ were adopted based on:
- Site visit
- Aerial photography
- Recommendations from VT Chow, 1957

A value of 0.06 was adopted to reflect:

- Channels with long grass and weeds
- Sugar cane cultivation adjacent to creeks

A value of 0.04 was adopted for areas where rock protection was proposed.

Upstream Boundary Condition

Estimated peak discharges derived in Section 4.4 were applied to the upstream extremity of the creeks investigated.

Downstream Boundary Conditions

The downstream reaches of the creeks under investigation were terminated at a level above any tidal influence. The downstream grade for normal depth was adopted as the downstream boundary condition for all creeks investigated.

4.6.2 Elizabeth Creek Hydraulic Analysis

The proposed Elizabeth Creek cross drainage plan has been presented in Drawing SK C 090 and consists of:

- 3 of 3.0m x 2.1m RCBC extending under the maintenance formation with a length of 131m
- 3 of 3.0m x 2.1m RCBC under the provisioning / bypass formation with a length of 78m
- 158m of excavated channel between the culvert cells

Elizabeth Creek Culvert Cells

Hydraulic characteristics for the proposed Elizabeth Creek culvert cells have been listed in Table 4-13.

Table 4-13 Hydraulic Characteristics of Proposed Elizabeth Creek Culverts

Culvert	Formation Level (mAHD)	Q_{100} (m^3/s)	Head Water Level (mAHD)	Tail Water Level (mAHD)	Culvert Control
Maintenance	15.08	58.3	14.3	12.18	Inlet
Provisioning / Bypass	13.27	58.3	11.84	11.07	Outlet

Key points to note from Table 4-13 include:

- Peak flood levels at culvert inlets are below formation levels
- The entire peak discharge for the 100 year event is conveyed

A high velocity of 5.13m/s was noted in the downstream extremity of the maintenance formation culvert due to a super critical flow regime. The corresponding depth of flow is 1.24m resulting in a water surface level of 11.72mAHD. However, the flow regime is sub critical immediately downstream of the culvert with a level of 12.18mAHD. A hydraulic jump forms and velocity is decreased to an acceptable 2.4m/s immediately downstream of the outlet.

Appropriate scour protection is recommended at all culvert inlets and outlets, however consideration should be given to additional protection wherever a hydraulic jump may form.

Elizabeth Creek Excavated Channel

A straight excavated channel has been proposed to replace the natural channel. Reasons for channel excavation include:

- Provide for efficient hydraulic conveyance between culvert cells
- Avoid works associated with aligning the existing channel with the preferred culvert alignment
- Future extension of culvert if required

The Channel dimensions have been provided in Table 4-14.

Table 4-14 Elizabeth Creek Excavated Channel Dimensions

Bed Width (m)	10.6
Channel Grade (%)	0.78
Batter Slope	2
Channel Protection	Dumped Rock

The Elizabeth Creek drainage design has allowed for installation of a connecting culvert should future development be required. Channel design considerations to this end include:

- Channel bed grade of 0.78% the same as for each culvert
- Bed width sufficient to accommodate culvert requirement
- Excavation follows the alignment of the culverts

For the 100 year event, velocities within the excavated channel vary between 2.4m/s with a depth of 1.75m at the upstream extent to 1.5m/s with depth 2.57m at the inlet to the bypass formation culvert cell. Flow is sub critical.

Rock protection of the channel bed and banks is recommended to prevent scouring.

The meanders of the original Elizabeth Creek channel (including vegetation) not excised by the proposed drainage alignment will remain in their existing state and open to the excavated channel.

Discharge to Gurnetts Road

Points to consider regarding flow between the Elizabeth Creek bypass formation culvert cell and Gurnetts Road include:

- Flow discharges 38m upstream of Gurnetts Road
- The proposed alignment discharges the flow into the existing channel bank at an angle of approximately 35 degrees
- Flow is sub critical
- A maximum velocity of 1.4m/s occurs in the area immediately upstream of Gurnetts Road
- Gurnetts Road is subject to regular inundation

To protect channel banks against the direct discharge, gabions will be installed while the bed of the channel will be protected by rip rap.

Flow will cross Gurnetts Road in a similar manner to the existing regime.

Hydraulic analysis of the proposed Elizabeth Creek drainage arrangement has demonstrated that the 100 year flood can be safely conveyed through the rail yard. Additionally, the characteristics of flow leaving the property and crossing Gurnetts Road remain essentially unchanged from existing patterns.

4.6.3 Willy Creek Hydraulic Analysis

The peak discharge for an event with an AEP of 1 in 100 for Willy Creek downstream of the existing rail formation was estimated to be 139.8m3/s. This consists of Willy Creek itself and the peak discharge from the adjacent catchment, Willy Dam.

The proposed Willy Creek cross drainage has been presented in Drawing SK C 091 and consists of:

- 8 of 3.0m x 2.1m RCBC extending under the wagon maintenance and provisioning formation with a length of 92m
- 8 of 3.0m x 2.1m RCBC under the bypass track formation with a length of 69m
- 110m of excavated channel between the culvert cells

Willy Creek Culvert Cell

Hydraulic characteristics for the proposed Willy Creek culvert cells have been listed in Table 4-15 for the 100 year design event.

Table 4-15 Hydraulic Characteristics of Proposed Willy Creek Culverts

Culvert	Formation Level (mAHD)	Q_{100}	Head Water Level (mAHD)	Tail Water Level (mAHD)	Culvert Control
Maintenance	15.90	139.8	11.33	10.62	Outlet
Bypass	13.64	139.8	10.61	9.95	Outlet

It can be concluded from Table 4-15 that:

- Peak flood levels at culvert inlets are below formation levels
- The entire peak discharge for the 100 year event is conveyed

Scour protection is recommended at culvert inlets and outlets.

Willy Creek Excavated Channel

It has been proposed to replace the existing Willy Creek channel with an excavated channel between the maintenance and bypass formations to:

- Maintain the culverts on a single alignment and grade for potential future extension and connection of the culvert cells
- Provide for efficient hydraulic conveyance between culvert cells

Proposed channel dimensions for the excavated section of Willy Creek have been provided in Table 4-16

Table 4-16 Willy Creek Channel Dimensions

Bed Width (m)	27.2
Channel Grade (%)	0.5
Batter Slope	2
Channel Protection	Dumped Rock

Hydraulic characteristics for the excavated channel include:

- Flow is sub critical
- A maximum velocity of 0.88m/s occurred at the upper extremity of the channel with an associated depth of 4.4m
- Velocity at the downstream end of the channel was 0.78m/s with a depth of 4.84m

Willy Creek Discharge To Gurnetts Road

Discharge from the Willy Creek bypass formation is directed into the original creek channel alignment approaching Gurnetts Road. The provisioning / bypass formation culvert is located 38m upstream of the road.

The reach of Willy Creek between the provisioning / bypass formation and Gurnetts Road was modified similarly to the excavated channel upstream. Channel modifications have resulted in a reduction of flow velocity to around 0.8m/s with negligible variation in flood depth.

Scour protection in the form of rip rap has been specified for the area between the culvert outlet and Gurnetts Road.

The drainage arrangement proposed for Willy Creek is suitable to convey the 100 year flood through the rail and provide flood immunity for rail assets for events up to that with an AEP of 1 in 100. Variations to flow characteristics at Gurnetts Road are negligible.

4.6.4 Oonooie Creek

Flow generated from the Oonooie catchment approaches the rail formation as a broad sheet flow and is conveyed through two culvert cells located approximately 400m apart. An even flow split has been assumed between the two culvert cells resulting a peak discharge through each of 14.2 ms3/s.

The existing formation at Oonooie Creek will be elevated and widened to accommodate the additional requirements of the Jilalan Rail Yard upgrade. The existing culvert arrangements will be removed as part of the proposed formation upgrade and replaced with:

- 2 of 3.0m x 2.1m RCBC with length of 46m

Flows to the south of this culvert cell are beyond the scope of this study and have not been investigated. Hydraulic characteristics for the Oonooie Creek culvert cells have been listed in Table 4-17

Table 4-17 Hydraulic Characteristics of Proposed Oonooie Creek Northern Culverts

Culvert	Formation Level (mAHD)	Q_{100}	Head Water Level (mAHD)	Tail Water Level (mAHD)	Culvert Control
Formation	22.9	14.2	18.74	1.1	Inlet

Note from Table 4-17 that:

- The formation remains immune from the 100 year flood event
- The entire peak discharge for the 100 year event is conveyed

Suitable scour protection has been specified at culvert inlet and outlets.

4.6.5 Plane Creek

An hydraulic analysis of Plane Creek, Hydraulic Assessment Report Jilalan Station Yard Upgrade, was undertaken for and presented in the Connell Hatch Jilalan Station – Rail Yard Upgrade, Land Take Concept Study (September, 2006).

The analysis was reviewed and the updated report has been included in Appendix C.

A key objective of the Plane Creek hydraulic analysis was to determine the hydraulic characteristics and impacts of an underpass proposed under the existing rail embankment in the vicinity of Smyth's Road. This underpass has since been discounted as a rail crossing option for the following key reasons:

- Geometrical considerations regarding vertical and horizontal track alignment
- Drainage of the structure
- Redirection of significant discharges to areas less prone to flooding

The current proposal involves construction of an underpass under the new formation, slightly to the west of the existing formation. This will result in a small reduction in flood plane storage, although this is considered negligible in the scheme of the flood volume and overall flood plane storage.

The hydraulic model was updated to reflect the new embankment and underpass. The resulting water levels were within 10mm of previous results

4.6.6 Waterway at CH:5380

The current rail formation at Chainage 5380 will remain unchanged for the upgraded maintenance tracks and the existing culvert will remain. Cross drainage for the proposed provisioning / bypass formation at this location will require:

- 3 of 3.0m x 2.1m RCBC

Hydraulic characteristics for the proposed Waterway CH:5380 culvert cell have been listed in Table 4-18

Table 4-18 Hydraulic Characteristics of Proposed Waterway CH:5380 Culverts

Culvert	Formation Level (mAHD)	Q_{100}	Head Water Level (mAHD)	Tail Water Level (mAHD)	Culvert Control
Maintenance	Existing Culvert Cell				
Provisioning / Bypass	24.66	12.9	19.87	18.23	Inlet

Note from Table 4-18 that:

- The formation remains immune from the 100 year flood event
- The entire peak discharge for the 100 year event is conveyed

Suitable scour protection is recommended at culvert inlet and outlets.

4.6.7 Minor Catchment Cross Drainage Structures

Structures selected for the proposed provisioning / bypass formation at CH:350, CH: 950, CH:1300, CH:1750 and CH:2400, and for the maintenance formation at CH:200 command relatively small catchments. Proposed drainage structures have been listed in Table 4-19 and can be located on Drawing SK C 030.

Table 4-19 Minor Catchment Drainage Structures

Catchment	Culvert Type	Dimensions (m)	Number	Length (m)
CH:350 (B)	RCP	0.9	1	40
CH:950 (B)	RCP	2.7	1	49
CH:1300 (B)	RCP	1.2	1	55
CH:1750 (B)	RCP	0.9	1	41
CH:2400 (B)	RCBC	3 x 2.1	2	20
CH:200 (M)	RCP	1.2	1	20

Note:
- (M): Maintenance Line
- (B): Provisioning/Bypass

Each structure is located adjacent to its corresponding existing structure in the existing formation.

Hydraulic characteristics of the proposed culverts have been listed in Table 4-20.

Table 4-20 Hydraulic Characteristics of Proposed Culverts

Culvert	Formation Level (mAHD)	Q_{100}	Head Water Level (mAHD)	Tail Water Level (mAHD)	Culvert Control
CH:350 (B)	9.5	0.88	6.14	4.9	Inlet
CH:950 (B)	13.9	4.8	10.95	9.26	Inlet
CH:1300 (B)	14.2	2.7	13.2	12.3	Inlet
CH:1750 (B)	15.4	1.9	13.7	12.4	Outlet
CH:2400 (B)	15.885	10.3	15.4	14.7	Inlet
CH:200 (M)	18.886	3.1	18.46	16.8	Inlet

Note:
- (M): Maintenance Line
- (B): Provisioning/Bypass

An opportunity exists to reduce the size of the 2.7m RCP at CH:950 during detailed design, as preliminary assessments indicates that 1.5m RCP may be acceptable.

A distance of several meters exists between the proposed and existing formations. The new culverts will be separated from the existing to allow for drainage between formations. Therefore each new structure will require wing walls and concrete apron.

A rock lined drain will be formed to facilitate efficient flow between the culverts and minimise the risk of erosion.

5. Rail Alignment Design

A review of QR's alignment options as presented in the preliminary scheme drawings E/J122 and E/J123 was undertaken as part of this study. Generally, the yard layout and alignments identified by QR have been adopted and refined in line with the design parameters outlined in Section 2.1 Design Criteria.

5.1 Bypass Tracks

The bypass tracks run along the eastern side of the Jilalan Yard, west of Gurnetts Road. The design includes 2 bypass tracks and 2 provisioning tracks with allowance in the design for a third bypass track to be constructed in the future.

The standard QR track spacings have generally been maintained throughout this study with 4.2 metres between the new Bypass Tracks and 6.5 metres to the future third bypass. The centreline spacing between the new Provisioning Tracks is 4.2 metres. The exception to this is at the southern junction with the main line. This is discussed in Section 5.1.3.

The vertical alignment of the new tracks is generally mild with grades less than 0.5%. However, to achieve the required clearance of 5.4 metres over the existing North Coast Line, the approach grade on either side of the crossing of the NCL and tramway has been increased to the maximum 1%.

Through the provisioning sheds the vertical grade of 0.205% is constant for 1,860 metres. On both sides of the provisioning sheds, the clear distance between turnouts is 2,100 metres, which will hold a typical Goonyella length train with allowance for float.

The major points in relation to the alignment are highlighted below.

5.1.1 Northern Junction with Main Line

- At the northern end of the Jilalan yards, at Main Line Ch 17.27 km, approximately 270 metres south of the Plane Creek bridge, the new alignment for the Bypass Tracks deviates from the existing Main Line.
- The existing at grade crossing of Smyths Road is eliminated; replaced with a new grade separated crossing where Smyths Road is directed under the new rail
- The new track can be constructed without interference with operation traffic on the existing alignment

5.1.2 Major Earthworks

Approximately 670 metres south of Armstrong Beach Road, the new trackwork passes into a cutting, 800 metres long, that reaches a maximum depth of about 16 metres. An embankment, up to 10 metres in height, where the new tracks cross over the NCL, lies just south of the cutting. The major points in relation to these features are:

- In the construction of the first stage of this development, it is proposed that the width of the cutting be extended to allow for the future construction of the third bypass track
  - This will assist in the generation of sufficient material for embankment construction
  - It may be difficult to widen the cutting for the third track later when bypass lines are under traffic

- The third bypass track earthworks are not included as part of the first stage earthworks embankment construction
  - This will reduce the amount of embankment material required in the Stage 1 construction
  - Will be easily constructed later when the third bypass track is built
  - Similarly, bridge structures over NCL and cane tracks are not included for the future third bypass track.

- Gurnetts Road runs along the eastern side of the Jilalan Yard close to the top of the proposed deep cutting. The standard QR section for deep cuttings includes 5 metre wide benches with a cut slope of 1.5h:1v. The use of this standard cut section results in the top of the cutting encroaching on Gurnetts Road. In this study, as shown on the typical section on Drawing No. SK-C-044, it has been elected to steepen the cut batter and remove benches from the cut face at the deepest part of the cutting to eliminate the impact on the road. As described in Section 4 of this Report, the cut material will be capable of standing at this steeper batter slope. An alternative to this would be to realise the bypass tracks further to the west.

- Boreholes in the vicinity of the cutting site were inconclusive as to the profile of the rock surface. Rock was found at varying depths below the surface but due to the large variations in depth, it was not possible to determine a consistent rock profile. Refer to Section 4 of this report, Geotechnical.

5.1.3 Southern Junction with Main Line

- QR presented two layout options for the southern junction.
  - In the first option, the initial construction could be carried out without affecting the existing infrastructure. However the future construction of the third bypass track would require that the NCL be slewed sideways. This is not required in the second option.

    We have reviewed both options and believe that, with the abovementioned exception neither has significant advantages over the other – operationally, construction, grading or geometry.

    For further development and presentation in this report, we have selected the second option that does not require slewing of the NCL.

- The new track centerline spacing between all tracks at the southern junction with the existing line is 4.2 meters as shown on the QR layout and the land requirements have been determined on this standard. **At detailed design, this should be reviewed to consider increasing the spacing between the coal lines and the North Coast Line to 6.5 metres.**

- The southern junction with the main line is at approximate Main Line Ch 24.8 km, just north of Tommy Creek, which is about 300 metres further south than the junction point shown on the QR preliminary scheme.

- The change in location is due to the location of the rail bridge over the NCL and the falling grade of the existing track into which the new line is to match. Working back from the NCL crossing at a maximum grade of 1% has forced the junction further south.

- The location of the turnouts shown on the QR scheme has also moved further south to ensure that they do not clash with the vertical curve on the existing alignment.

- Due to the closeness of the new track to the existing tracks and that the new bypass tracks are now relatively higher than the existing NCL and Coal Tracks than previously assumed in the QR scheme, there is insufficient space, for construction.

  To provide more room for construction, the alignment of the new wagon maintenance tracks has been moved slightly to the west with no affect on the operational capacity of the tracks.

- Where the new wagon maintenance tracks pass by the QR Substation (located on the western side of the rail, south of the existing Oonooie Rd crossing), the centerline clearance to existing electrical equipment is approximately 12 metres. It should be noted that this is within the existing substation compound fenceline. Along this section of track (approximately 160 metres in length) there is insufficient space to run the maintenance access road.

In the next stage of design, and when more detailed survey is available, further consideration should be given the new track alignment and grading adjacent to the Substation. Consideration may also be given to eliminating the access road at the conflict and diverting the road either around the substation or to the eastern side of the new wagon maintenance tracks via a QR occupation crossing.

- A possible construction sequence, shown on Drawing No. SK-C-046 has been developed. This will allow the traffic on both of the existing coal tracks and the NCL to be maintained during construction.

- A typical cross section showing the proposed level differences between the existing and proposed tracks in this area is shown on Drawing No. SK C 045.

5.2 Wagon Maintenance Tracks

- The new Wagon Maintenance Tracks are located between the new Provisioning Tracks and the existing Jilalan Yard
- The design allows for 4 wagon storage tracks passing through the maintenance sheds and 2 other wagon storage yards bypassing the sheds. The length of clear track on either side of the wagon sheds is 480 metres. The clear length for wagon storage on the other 2 tracks is 960 metres.
- The vertical grade along the wagon maintenance tracks is level through the maintenance sheds and generally conforms to the maximum grade of 1:200. An exception to this is at the approach to the southern junction with the existing main line where the existing track is at 1:54.

5.3 Wagon Turnaround

As part of this study, Connell Hatch was required to were to review and comment on the proposed train turnaround located on the southwestern end on the yard.

- The turnaround comprises a triangle of two, 140-metre radius curves. Past the triangle, the length of clear track between the toe of switch and buffer stop is 75 metres. This length is sufficient to accommodate two wagons and two locomotives.
- The entire turnaround will be on embankment of about 1 to 2 metres height
- There is sufficient space at the proposed location for the turnaround, although the required property acquisition may impact on the viability of the remaining lot to produce cane.
- The volume of earthworks is estimated to be 16,000 cubic metres of embankment while the area of land required is approximately 1.81 ha

6. Miscellaneous Works

6.1 Provisioning and Maintenance Facilities

In accordance with QR concept drawing E/J122, a new provisioning facility is proposed on two new dedicated tracks, adjacent to the proposed Bypass tracks at approximately Ch3500 (refer SK-C-036). This will replace the existing facility, shown on SK-C-037. Project Services have carried out conceptual design of the proposed provisioning shed, the details of which are shown on SK-01.

A demountable building is proposed to be located adjacent to the new provisioning shed, to provide amenities for train crew, prior to and following a change in crew shift. Details of this structure were not available for inclusion in this report.

A new wagon maintenance facility is proposed to replace the current facility, located within the existing Jilalan yard. The new facility will be located over four (4) new dedicated tracks at approximate Ch 1800 (shown on SK-C-040). An additional two tracks, which bypass to the west of the the wagon maintenance shed, will provide additional wagon storage. Project Services have carried out conceptual design of the wagon maintenance building, the details of which are shown on SK-03 and SK-04. These designs include a mezzanine level, with offices and other facilities to accommodate additional maintenance personnel.

The existing wagon maintenance building is proposed to be upgraded to facilitate locomotive maintenance functions. Project Services have undertaken conceptual design of the building works, shown on SK-02.

QR have provided indicative water and power requirements for these structures, which are discussed below, however it is recommended that all operational requirements, be confirmed during detailed design and incorporated into the project scope.

6.2 Water Supply

QR have advised that the water supply to the existing locomotive and wagon maintenance facilities is likely to be sufficient for the proposed new locomotive facility.

QR have also advised that the new wagon maintenance, provisioning and crew amenities facilities are, in total, likely to require a similar quantity of water to the existing facility (ie 20 to 28 kL/day).

Fire fighting capacity will be required at the new facilities. It is recommended that two options be considered during subsequent design:

- Connect to the fire main within the existing facility and provide a new main to the proposed buildings
- Provide a water tank with a reserved capacity to satisfy the fire fighting requirements

The need for a booster pump to provide the required pressure and flow should also be investigated.

6.3 Electrical Works

Objectives

This report addresses the electrical infrastructure requirements for the Queensland Rail Jilalan Station Yard upgrade, which includes the addition of both a *provisioning shed* and *train operations and rolling stock building*. It has been estimated that the upgrade will add approximately 827kVA load to the Ergon Energy network.

The following is a list of drawing numbers referenced within this section:

Drawing No.	Title
SK C 030	Jilalan Yard General Arrangement (Sheet 1 of 4)
SK C 031	Jilalan Yard General Arrangement (Sheet 2 of 4)
SK C 032	Jilalan Yard General Arrangement (Sheet 3 of 4)
SK C 033	Jilalan Yard General Arrangement (Sheet 4 of 4)
SK E 080	Ergon Energy project indicative electrical network plan
SK E 081	Ergon Energy project indicative electrical network plan
SK E 082	Ergon Energy project indicative electrical network plan
SK E 083	Ergon Energy project indicative electrical network plan

Existing Infrastructure

Existing electrical and communications infrastructure in the area affected by the Jilalan Station Yard upgrade consists predominantly of Ergon Energy 11kV overhead conductors and some optical fibre. It is recommended that a *Dial Before You Dig* be carried out to determine the location of any other electrical and communications infrastructure in the project area.

Ergon Energy electrical network plan *SK E 080* indicates that an 11kV feeder (feeder #1) crosses Plane Creek to supply two customers via HV/LV pole 4214923 (substation 1500) and HV/LV pole 4214926 (substation 7999).

Ergon Energy electrical network plan *SK E 081* indicates that an 11kV feeder (feeder #2) running adjacent to Armstrong Beach Rd currently supplies the Jilalan Station Yards via HV/LV pole 4039939. This feeder crosses the existing rail to supply a customer via HV/LV pole 4039948 (substation 1129), and continues in a north-east direction until it intersects Gurnetts Rd, at which point it follows the road both to the north and south, supplying numerous other customers. Gurnetts Rd terminates at Armstrong Beach Rd to the north. The 11kV overhead supplies additional customers adjacent to Armstrong Beach Rd and the connecting Smyths Rd.

The 11kV overhead running adjacent to Gurnetts Rd, south of the existing Jilalan Station Yards is the closest electrical infrastructure to the proposed *Provisioning Shed* and *Train Operations and Rolling Stock building.* From a supply perspective, cross-referencing drawing *SK C 031* with *SK E 081* shows HV pole 4039954 to be nearest the *Provisioning Shed,* whilst cross-referencing drawing *SK C 032* with *SK E 081* shows HV pole 4039967 to be nearest the *Train Operations and Rolling Stock building*.

Ergon Energy electrical network plan *SK E 082* shows an 11kV feeder (feeder #3) which terminates at a dam and is unaffected by the project works. This electrical network plan also shows an 11kV feeder (feeder #4), which can be seen on drawing *SK E 083* to be supplying a number of customers around the Oonooie Rd rail crossing.

Optical fibre is present in the area adjacent to the cane tram tracks (see drawing *SK C 032*). Preliminary investigations indicate that this is QR communications infrastructure but this is yet to be confirmed.

Infrastructure Upgrades

Construction of bypass and wagon maintenance roads along with the re-routing of existing vehicular roads is expected to require upgrades to certain existing infrastructure.

Feeder #1

Proposed bypass road construction and the re-routing of Symths Rd may require the following adjustments to existing electrical infrastructure supplied by feeder #1 (see drawing *SK C 030* and *SK E 080*):

- Modification of the 11kV connection between poles 4214922 and 4214926 to ensure adequate clearance for the proposed bypass and Symths roads.
- Note that HV/LV pole 4214923 (substation 1500) is assumed to remain.

Feeder #2

Proposed bypass and wagon maintenance road construction and the re-routing of Symths and Gurnetts roads may require the following adjustments to existing electrical infrastructure supplied by feeder #2 (see drawings *SK C 031*, *SK C 032*, *SK E 080*, *SK E 081*):

- Removal of HV/LV poles 4060526 and 4040046, and LV pole 4040047. Premises supplied by the aforementioned are assumed to be removed for construction of the above.
- Removal of the LV connection between HV/LV pole 4040046 (substation 2885) and LV pole 4040048.
- Modification of the 11kV connection between HV pole 4060525 and substation 10366 to ensure adequate clearance for the proposed bypass roads.
- Modification of the 11kV connection between HV poles 4039983 and 4060525 to ensure adequate clearance for the proposed Gurnetts Rd relocation.
- Modification of the 11kV connection between HV poles 4039983 and 4039982 to ensure adequate clearance for the proposed Gurnetts Rd relocation.
- Remove and replace HV pole 4039981 as required for the construction of the northern end of the wagon maintenance roads. It should be ensured that the 11kV connection between the previous and HV pole 4039982 provides adequate clearance for the proposed bypass roads. Connect the new HV pole 4039981 to HV pole 4039980 as appropriate.
- Remove and replace HV pole 4039947 as required for construction of the proposed QR access tracks.
- Modification of the 11kV connection between HV pole 4015895 and HV/LV pole 4015896 (substation 7164) to ensure adequate clearance for the proposed bypass and wagon maintenance roads.

Feeder #3

Feeder #3 not affected by the project works.

Feeder #4

Proposed bypass and Oonooie road construction may require the following adjustments to existing electrical infrastructure supplied by feeder #4 (see drawings *SK C 033*, *SK E 082*, *SK E 083*):

- Remove and replace HV pole 4060604 as required for construction of the proposed Oonooie Rd. It should be ensured that the 11kV connection between the previous and HV pole 4060602 provides adequate clearance for the proposed bypass and Oonooie roads.
- Remove and replace LV pole 4060603 as appropriate to allow for construction of the proposed bypass roads.

Optical fibre

Construction of the proposed bypass roads may require the removal and relocation of optical fibre, which is located adjacent to the cane tram tracks as shown in drawings *SK C 032* and *SK C 033*.

Supply of Provisioning Shed and Train Operations and Rolling Stock building

It is recommended that electricity supply to the *Provisioning Shed* and *Train Operations and Rolling Stock building* be made via separate connections to the 11kV supply running adjacent to Gurnetts Rd. This will require the installation of additional 11kV overheads from Gurnetts Rd to the points of supply, along with appropriate transformers.

An application for network connection should be made to Ergon Energy to confirm the capacity of the network to supply the estimated 827kVA of load. The 827kVA load is expected to be divided in the following proportions:

- 900A (647kVA) – Train Operations and Rolling Stock building
- 200A (144kVA)– Provisioning shed
- 50A (36kVA)– Ancillary services for demountable building

Ergon Energy has been informed of the intent to supply the above infrastructure. They are currently investigating the capacity of the existing electrical network to supply the load.

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6.4 Sewage Treatment

The existing Jilalan facility has a licence to release treated effluent to receiving waters. This is subject to a number of quality characteristics including:

- 5-day Biochemical Oxygen Demand (mg/l)
- Suspended Solids. (mg/l)
- pH. (pH Units)
- Dissolved Oxygen (mg/l)
- Anionic Surfactants
- Oil and Grease
- Total Copper
- Free Residual Chlorine (mg/l)

It is likely that the development of the wagon maintenance, provisioning and crew change facilities will require either a new sewage treatment plant and/or disposal of sewage to an off site treatment plant.

If a new treatment plant is adopted a new licence is likely to be required to discharge effluent to the receiving waters. This would be confirmed during the EIS process and would be potentially subject to more stringent discharge quality requirements.

Alternatively, a storage and pump out facility could be installed. Sewage would be drained (or pumped if required) to one or more storage tanks. An appropriately licensed contractor would then be required to empty the tanks.

A third option would be to explore the possibility of expanding the existing treatment plant and perhaps operating under the existing licence. While the capacity of the existing plant is not clear, it is understood that the existing licence is suitable for 100 to 1500 equivalent persons (EP). This is well within the expected staffing numbers of the expanded facility.

It is recommended that a detailed assessment of sewage treatment/storage options be considered during detailed design and in conjunction with the EIS process.

7. General Civil Works

7.1 Geotechnical Investigation

A geotechnical investigation was carried out to supplement the findings obtained from the previous studies. It provides additional information to identify likely subsurface conditions, subsurface material properties and groundwater conditions for assessment and recommendations regarding earthworks, preliminary foundation design, excavatability and further investigation requirements.

The document "Preliminary Geotechnical Investigation – Jilalan Station Bypass" (February 2007) should be referenced for details of the investigation. Refer Appendix D.

7.2 Road Cross Drainage

The proposed Jilalan Rail Yard Upgrade includes realignment for sections of the following roads:

- Smyth's Road
- Gurnetts Road
- Oonooie Road
- Armstrong Beach Road

Cross drainage measures have been proposed where required and are described in this section.

Suitable scour protection measures are recommended for all inlets and outlets.

All road cross drainage has been designed in accordance with QUDM and Sarina Shire Council requirements.

7.2.1 Smyth's Road

Culverts proposed for Smyth's Road have been listed in Table 7-1 and located on Drawings SK C 030 and SK C 031

Table 7-1 Culverts Proposed for Smyth's Road

Smyth's Road Chainage	Type	Size (m)	Number of Cells	Length (m)
150	RCP	450	1	20
460	RCP	450	3	30
800	RCP	450	1	30
950	RCP	450	2	30
1460	RCP	450	3	30
1750	RCP	450	3	30
2210	RCP	900	1	30

7.2.2 Gurnetts Road

The culverts proposed for Gurnetts Road has been listed in Table 7-2 and can be seen on Drawing SK C 031.

Table 7-2 Culverts Proposed for Gurnetts Road

Gurnetts Road Chainage	Type	Size	Number of Cells	Length (m)
30	RCP	1200	1	60

7.2.3 Oonooie Road

Culverts proposed for Oonooie Road have been listed in Table 7-3 and located on Drawing SK C 033.

Table 7-3 Culverts Proposed for Oonooie Road

Oonooie Road Chainage	Type	Size	Number of Cells	Length (m)
380	RCBC	0.9m x 0.6m	10	30
940	RCBC	3m x 1.2m	2	35
1190	RCBC	2.1m x 2.1m	2	30

The primary purpose of the culvert cell proposed for CH:380 is to allow runoff to enter the existing farm dam while that proposed for CH:940 is essentially a hydraulic balancing structure. The culvert at CH:1190 is for cross drainage of Oonooie Creek.

Additional hydraulic investigation is recommended for this area during detailed design.

7.2.4 Armstrong Beach Road

An existing culvert is located under Armstrong Beach Road at the proposed location of the Smyth's Road / Gurnetts Road intersection. It has been proposed to relocate this structure immediately to the east of the proposed intersection and upgrade it as required.

The proposed culvert has been detailed in Table 7-4 and can be located on Drawing SK C 031.

Table 7-4 Culverts Proposed for Armstrong Beach Road

Type	Size	Number of Cells	Length (m)
RCP	1200	4	30

7.3 Rail Yard Drainage

7.3.1 Overview of Rail Yard Drainage

Rain falling directly onto Jilalan Rail Yard will permeate into the ballast and percolate to the formation before continuing in the downstream direction. For intense, longer duration events significant volumes of water will be conveyed within and beneath the ballast.

A drainage network consisting of inlets, pits, branch and trunk pipes and drains has been proposed to intercept flows within the ballast and on the formation surface.

Flows within the ballast (including those along the formation surface) would be intercepted by "jump ups." Jump ups are essentially pits with cylindrical covering grates extending vertically into the ballast. The openings in the top and wall of the grate allow water to enter but exclude ballast material. Jump ups would be located in ballast beside tracks but not between a pair of tracks.

Proposed jump ups are in accordance with Queensland Rail standard drawings 2291 and 2292.

In wider, potentially trafficable areas of the formation where ballast would not be placed, field inlets have been proposed. Proposed field inlets are in accordance with Queensland Rail standard drawings 2287 and 2288.

Water received into the 'jump ups' would discharge to a collection pipe that services several others 'jump ups' and field inlets along a particular drainage alignment. Each drainage alignment would be, generally, perpendicular to the tracks.

The collection pipes discharge to:

- A trunk drainage pipe where the formation at that point is in cut
- An open drain where the formation is in fill

Flow discharging from the formation to a drain will not be allowed to run along the formation batter but be delivered to the drain via a lined drain to avoid scouring.

The ultimate point of discharge would generally be into Willy or Elizabeth Creeks depending from where the flow originated.

7.3.2 Jump Up Inflow

Standard Queensland Rail drawings indicate that each 'jump up' will discharge to its collection pipe through a 225mm diameter orifice.

The maximum discharge from the jump up to the collection pipe was estimated during preliminary hydraulic analysis based on the following assumptions:

- Inflow to the collection pipe was orifice controlled
- 50% blockage would occur
- Maximum hydraulic head within the jump up was 0.5m

7.3.3 Rail Yard Catchments

Catchment delineation was dictated by a requirement to drain the rail yard efficiently for events up to that with an AEP of 1 in 10. Consideration was given to:

- Rail layout
- Formation grade
- Field inlet and jump up inflow capacity
- Collection drain alignment

7.3.4 Estimated Peak Discharges

The Rational Method, as outlined in Section 4.3, was used to estimate peak discharges for the formation catchments.

7.3.5 Rail Yard Drainage Layout

Collection drains were located at 30m intervals following consideration of the points in Sections 7.3.2 through 7.3.5.

The formation drainage layout has been presented in Drawings SK C 093 and SK C 094 and demonstrates:

- Field inlet and jump up locations
- Collection drainage alignment
- Trunk drainage alignment
- Proposed discharge area protection works

7.3.6 Runoff Quality and Quantity

Runoff Quantity

Variations to the existing catchments through which the proposed formation will be constructed are minimal. Subsequent redirection of runoff is negligible and Elizabeth and Willy Creeks remain the legal points of discharge for the main areas of the proposed Jilalan Station Yard Upgrade. These creeks converge to form a single water way about 300m downstream of the legal point of discharge. The resultant water way continues for approximately 700m more before discharging to its ultimate receiving waters of Llewellyn Bay.

Downstream of the point of discharge, the water way route passes through agricultural land only.

Change in land use for the proposed development will result in a negligible increase in runoff potential.

It is considered highly unlikely that the negligible increase in peak discharge at the legal point of discharge would result in a negative impact to downstream areas.

Therefore flow detention has been considered unnecessary and no detention basin has been proposed.

Runoff Quality

The current land use for the study area is agriculture. Historically, agricultural runoff water quality is high in nutrient pollutants and suspended solids.

In accordance with typical management practices it is likely that runoff from the developed site will be treated to improve water quality before leaving the site.

Water quality measures include:

- Grassed swales
- Bio retention or wetland areas

Additional measures are also likely to be required for hydrocarbon and sediment removal. These need to be addressed during Detailed Design and should reference work currently under design on the existing yard in order to maintain a consistent approach.

The proposed measures would be included within the drainage network upstream of the legal point of discharge. Treatment measures would not be proposed on line in Elizabeth or Willy Creeks.

The EIS for the Jilalan Station Yard Upgrade is expected to recommend measures to achieve the required level of treatment. These measures will be included in the detailed design of the drainage network.

8. Roadworks and Bridges

8.1 Traffic Assessment

The proposed Jilalan development will potentially impact on several roads surrounding the facility. Connell Hatch was engaged jointly by QR and Sarina Shire Council to carry out a traffic assessment to investigate potential traffic issues relating to these roads, which include:

- Smyths Road
- Armstrong Beach Road
- Gurnetts Road and
- Oonooie Road

The study was also required to assess the impact of additional rail traffic on the existing public level crossings at Oonooie Road and Smyths Road. In addition to the public crossings, all level crossings classified as “occupation crossings” between Hay Point and Farquar Rd, were also included in the study.

The study involved liaison with several stakeholders, including:

- QR
- Sarina Shire Council
- Mackay Canegrowers Ltd
- CSR and
- Main Roads

A working group was formed and included representatives from these organisations. The initial meeting of the working group was held at Sarina Shire Council on 14 November 2006, where the representatives received a briefing on the scope of the study and were offered the opportunity to provide relevant information.

Following the preparation of a draft report, the working group reconvened on 6 February 2007, where Connell Hatch presented the draft findings. The working group was then given an opportunity to provide feedback before the preparation of the final report.

The final report was presented to a Council meeting Sarina Shire Council on 26 February 2007.

The key outcomes of this report were:

- Increase in rail traffic would not impact on queuing at occupation crossings, although closure times would increase
- Grade separating the rail crossing at Smyths Road will eliminate the impact of rail traffic on the crossing
- Smyths Road will need realigning to facilitate the expanded yard
- Gurnetts Road traffic will increase at the northern end due to traffic generated by the new Jilalan facility. This section of road will be sealed.
- The recommended access to CSR’s Oonooie facility, when the existing Oonooie Road level crossing is closed, is via a new overpass over the Goonyella Branch Line, North Coast Line and cane tram track

The report entitled “Jilalan Traffic Assessment” (February 2007) should be referenced for further details. Refer Appendix E.

8.2 External Roads

8.2.1 Smyths Road

The proposed realignment of Smyths Road is shown on drawings SK-C-050 to SK-C-054.

The existing Smyths Road level crossing is proposed to be replaced by a grade separated road underpass structure. It was considered necessary to realign the road between the Plane Creek causeway and the underpass for two reasons:

- To provide a more appropriate approach angle at the underpass
- To maximise the elevation of the rail and therefore maximise clearance under the structure

The realignment does not pass through the existing rail embankment (as proposed during previous studies) as there is a significant difference in flood levels on each side of the embankment. Any opening in this embankment would result in excessive velocities and potential scour on the downstream side during major flood events.

The proposed underpass would be free from inundation during the Highest Astronomical Tide (HAT), however the immunity to flooding is estimated to be less than the 1 year Average Recurrence Interval (ARI).

It is acknowledged that the Plane Creek causeway is subject to closure twice daily due to tidal influences. It is not intended, however, that the causeway be upgraded as part of the Jilalan project as it not impacted by the proposed rail works.

The existing section of Smyths Road, on the eastern side of the rail line, is proposed to be realigned to facilitate the new rail bypass tracks. Parts of the proposed alignment are extremely flat and the preliminary road grading adopts a 1V in 200H grade to assist with road drainage. The resulting large embankments could be minimised during detailed design, however were adopted for this study as conservative designs for the land take assessment.

The proposed Jilalan development will not result in an increase in road traffic along Smyths Road. It is therefore considered appropriate that the existing road standard be adopted for the realigned road. Accordingly, it is not proposed that the realigned Smyths Road be sealed. Council have however requested that a seal be provided between the intersection with Armstrong Beach Road, for a distance of approximately 100m to the north. It should also be noted that QR's property negotiations may result additional bitumen seal along Smyths Road.

8.2.2 Armstrong Beach Road Intersection

The realignment of Smyths Road and Gurnetts Road will result in the relocation of their intersection with Armstrong Beach Road. The intersection is located on a straight section of the Armstrong Beach Road alignment in order to maximise sight distances. A preliminary plan layout and longitudinal section are shown on SK-C-060 and SK-C-061 respectively.

A culvert exists under Armstrong Beach Road at the proposed intersection location. It is intended that this will be relocated and upgraded as appropriate. This will also necessitate the realignment of a small section of channel on the downstream (northern) side of the culvert.

8.2.3 Gurnetts Road North

The proposed Jilalan works will require the realignment of Gurnetts Road, between the new intersection with Armstrong Beach Road and the existing road, approximately 700m to the south (refer SK-C-055).

It is proposed that this new section of road will be sealed, along with a further 200m of the existing Gurnetts Road to provide fully sealed access into the new facility.

8.2.4 Gurnetts Road South

A truncation of the existing Gurnetts Road is proposed at the southern end of Gurnetts Road, near the proposed rail bridges over the North Coast Line and cane tram tracks (refer SK_C_056). This is intended to mitigate a potential conflict between the proposed rail embankment and the existing road. The actual alignment of this truncation may be refined during detailed design, however the design shown in the figure was adopted as conservative for the purposes of assessing land acquisition requirements.

It is not intended that this section of new road be sealed.

8.2.5 Oonooie Road

The primary uses of Oonooie Road and the Oonooie Road public level crossing are to provide access to the CSR ethanol/fertiliser plant from the Bruce Highway and to provide access to the Oonooie cane siding for the farmer on the south western side of the level crossing. The crossing is actually three crossings in series ie, the road crosses the Goonyella Branch Line, the North Coast Line and the cane tram tracks.

The proposed upgrade of the Jilalan facility will further increase the number of Goonyella Branch Line tracks across the Oonooie Road level crossing. This, combined with the expected increase in coal rail traffic, will serve to increase the already problematic queuing at the crossing.

The issue was addressed during the Jilalan Traffic Assessment (refer Appendix E), which considered two options:

- Closure of the Oonooie Road public level crossing and diversion of road traffic along Gurnetts Road and Armstrong Beach Road
- Closure of the Oonooie Road public level crossing and provide an overpass over the three rail systems.

The traffic assessment identified the overpass as the most appropriate option.

In order to minimise the cost of the proposed structure, it was proposed to locate the overpass where the three rail systems converged. This is approximately 450m south of the existing crossing location and necessitated the realignment of Oonooie Road, shown in concept on SK-C-057 to SK-C-058.

On the western side of the rail, the proposed alignment passes to the south of an existing dam and will separate the farm from the dam (refer General Arrangement SK-C-033). It is possible that negotiations with the landowner may result in changes to the road and or overpass designs.

On the eastern side of the rail line, the proposed alignment will need to cross the cane track again, this time at a level crossing. The new road would then pass to the west of the CSR facility and match into the southern end of Gurnetts Road. CSR have requested input into the ultimate arrangement of the road layout in this area and it is recommended that their input is sought during initial stages of the detailed design.

8.3 Internal Roads

The concept drawings developed by QR, assumed that the access into the site would be from the western side of the rail, north of the Armstrong Beach Road bridge. Connell Hatch was informed that this option was not be considered in the study as the appropriate land could not be easily acquired. An alternative access was to be investigated from Gurnetts Road, on the eastern side of the yard.

A significant aspect of an access from Gurnetts Road is that it requires a grade separated structure across the provisioning and bypass lines. This will eliminate potential lengthy delays as trains would block a level crossing while being provisioned.

The provisioning and bypass lines are in a significant cutting along a significant portion of Gurnetts Road. An access location was chosen at Ch 3000, which provided the minimum clearance over the rail, while minimising the width of the cutting to be spanned.

The proposed internal road was varied from the alignment shown on the concept drawing (refer SK-C-031). The new location allows the following:

- Future expansion of the wagon maintenance storage tracks to the east without needing to relocated the access road
- Provision of a level crossing across a single wagon maintenance track
- Access to the existing carpark on the eastern side of the existing Jilalan Station
- Access to the proposed wagon maintenance facility
- Access to the proposed provisioning and crew change building.

8.4 Bridges

8.4.1 General

The structures defined in the drawings and the report, are concept structures for the planning process. Other structural layout may be possible when detailed design is carried out.

8.4.2 Drawings

The following drawing list is referenced in this report.

Drawing Number	Title	Description
SK C 070	Smyths Road Underpass	General Arrangement
SK C 071	Armstrong Beach Road Bridge	General Arrangement
SK C 072	Rail Yard Access Road Bridge	General Arrangement
SK C 073	NCL & Tramway Bridges	General Arrangement
SK C 074	Oonooie Road Bridge	General Arrangement

8.4.3 Bridge Descriptions

The following sections describe the individual bridge structural forms.

Smyths Road Underpass

The Smyths Rd Underpass carries the bypass tracks across the revised Smyths Road alignment.. The bridge has a total length of 25 m. The rail alignment has been offset to the existing alignment, to enable the new bridge to be constructed without impact on the existing rail services.

The road alignment at the bridge site is straight. The bridge has 1 x 25 m span.

The abutments consist RC headstock on bored piles with spillthrough embankments.

The geotechnical conditions consist of dense alluvium at approximately 5.5 m below natural surface. This requires bored piles for the abutments.

The superstructure consists of standard1600 deep QR T girders. A walkway will be provided along the full length of the bridge.

Drawing SK C 070 refers.

Armstrong Beach Road Bridge – Option 1

The existing Armstrong Beach Road Bridge is a 2 lane, 75 m long, 7 span bridge. The provision of the new bypass tracks beneath Armstrong Beach Road requires the extension of the existing Armstrong Beach Road Bridge.

The existing bridge does not conform to current design standards for road alignment, bridge design, QR clearance requirements and QR impact protection.

The road alignment for the extension of the bridge would be sub standard for a new road.

The extension of the existing Armstrong Beach Road Bridge has not been considered any further at this stage.

Armstrong Beach Road Bridge

To avoid the disruption to Armstrong Beach Road and to provide a bridge to current bridge standards, an alternative option has been considered. This requires the complete realignment of Armstrong Beach Road, such that the bridge can be constructed off line.

The bridge consists of two sections separated by a 30 m long embankment.

The road alignment at the bridge site is on a 280 m horizontal curve and 3320 m vertical curve for the first section and 3174 m for the second.

The bridge is 199 m long overall with spans of 18, 26, 17, 22 and 11 m for the first section and 12, 26, 26 and 11 m for the following section. Varying spans are required to accommodate the number and spacing of the rail tracks.

The abutments consist RC headstock on bored piles with spill through embankments.

The piers consist of RC headstocks on blade columns, pile caps and bored piles, or pad footings where appropriate.

The superstructure consists of 1100 deep deck units, with a minimum 180mm deck slab.

Barriers are nominated as 1100 mm high, with extension to 2000 above the rail tracks.

The 30m long embankment between the 2 bridges could be replaced with a bridge structure, with a 30m long span or smaller spans should future clearances be required. If Abutments B and C are designed and constructed as retaining wall piers instead of spillthrough abutments, it will be possible to construct the future span under traffic as a top down construction.

Drawing SK C 071 refers.

Rail Yard Access Road Bridge

The Rail Yard Access Road Bridge provides access over the new bypass tracks to the yards. The new bypass tracks run through a deep cutting. The bridge will be located at the minimum clearance to the bypass tracks, spanning across the cutting. The current road cross section is 2 x 3.5m lanes with 1.5m shoulders.

The bridge will have 2 spans of 28 m.

The geotechnical conditions at the site are extremely variable and consist of approximately 3m of stiff clays, overlying volcanic and sedimentary rock. The abutment foundations will consist of RC headstock on bored piles, drilled through the rock to found near the base of the cutting excavation level.

The embankment is proposed to be cut at an angle of 1:1 for the first 5m, then 4V:1H for the remainder of the excavation. The embankment will require stabilisation by rock bolts or soil nails, depending on the strata.

The pier will consist of RC headstock on a blade column, with a pad footing on the high strength rock. A blade column is required to resist the rail impact loads. Rock anchors may be required for stability and will need to be investigated during detail design.

The superstructure consists of 1500 deep super T girders, with a minimum 180mm deck slab. Barriers are nominated as 1100 mm high, with extension to 2000 above road level..

Drawing SK C 072 refers.

NCL & Tramway Bridges

The bridges over the tramway and the North Coast Line (NCL) are complicated due to the very high skew the tracks are to the tramway and NCL.

The complexity of the alignment has resulted in 4 independent bridges, with spans that vary from 10m to 25m.

The current scheme has RC headstocks on bored piles for the abutments. The piers will consist of RC headstocks on a skewed alignment of the blade wall crash walls. The crash walls/piers will have pile caps and bored pile foundations.

The superstructure will consist of standard QR T girders for the longer spans and QR deck slabs for the smaller spans (<= 15m).

Each bridge will have a maintenance access walkway the full length of the bridge.

Possible design developments will be to reduce the length of the bridge and utilise RSS walled embankments.

Drawing SK C 073 refers.

Oonooie Road Bridge

The Oonooie Road bridge carries the realigned Oonooie Road across the North Coast Line (NCL), the tramway tracks, the existing coal tracks and the proposed bypass tracks. The current road cross section is 2 x 3.5m lanes with 1.5m shoulders.

The assumed vertical clearance is 6.4m. The bridge alignment has been set to accommodate maintenance access tracks and cess drains on the outer limits of the tracks.

The bridge is 76m long, with spans of 18, 26, 19, 13 m. The spans are varied to accommodate the varied spacing of the rail tracks.

Abutments will be RC headstocks on bored piles, through the road embankment and founding in the lower level rock.

The piers will have RC headstocks on blade walls to resist the rail impact loads. Foundations are expected to be bored piles.

The super structure will consist of 1100 deep deck units, with a 180 min deck slab. Parapets will be 1100 high, extended to 2000 for anti throw requirements.

Drawing SK C 074 refers.

8.5 Preliminary Pavement Design

This section outlines the method used and results of the preliminary pavement design for the roads associated with Jilalan Station Bypass. Preliminary designs have been carried out for sealed and unsealed pavements for various roads. These include:

- Oonooie Road (Sealed)
- Gurnetts Road (Sealed and Unsealed)
- Smyths Road (Unsealed)
- Internal Access Road (Sealed)

It should be noted that these are solely for the purpose of a preliminary design and require further analysis during detailed design.

8.5.1 Assumptions

Design Traffic

The assumptions used in determining the design traffic for this preliminary pavement design included:

- 2008 year of opening
- 2018 flows adopted for 2008 opening as traffic is expected to double in the first 1 to 2 years and then remain constant
- 0% growth rate
- An F1 factor of 2 for smaller delivery vehicles (ie not b-doubles)
- A design life of 20 years for sealed pavements and 10 years for unsealed pavements
- Reliability factor of 4

Subgrade CBRs

The assumptions used in determining the subgrade CBRs for this preliminary pavement design included:

- Sections of fill greater than 1m deep will have a CBR of the imported fill. This depends on the available fill and for this preliminary design a CBR of 5 has been assumed
- CBR 5 for sections of shallow cut
- CBR 10 for sections of deep cut

8.5.2 Design Traffic

The design traffic used for this preliminary pavement design was determined in accordance with the Queensland Transport Pavement Design Manual. The input data was obtained from the Jilalan Traffic Assessment Report and using the assumptions outlined previously. The input data used is shown in Table 8-1 below.

Table 8-1 Input data for design traffic

	% CV (C)	ADT	T	Growth (%)
Oonooie Road	77.4	584	292	0
Gurnetts Road	6.4	707	354	0
Smyths Road	21.9	94	47	0
Internal Access Road	5	234	117	0

The 2008 present number of ESA's for subgrade distress (NPS) was then calculated using an F1 factor of 2 for each road. Following this the traffic growth factor (g) and cumulative growth factor (f) were determined from tables 7.7 and 7.8 of the Queensland Transport Pavement Design Manual. Using these factors, reliability factor (r) of 4, a lane distribution factor (B) of 1 and the NPS, the design traffic (NES) was calculated for each road. This information is shown in Table 8-2.

Table 8-2 Calculation of design traffic

	F1	N_{PS}	g	f 20y	f 10y	r	B	Sealed N_{ES}	Unsealed N_{ES}
Oonooie Road	2	452	1	20	-	4	1	1.32×10^7	-
Gurnetts Road	2	45	1	20	10	4	1	1.31×10^6	6.57×10^5
Smyths Road	2	21	1	20	10	4	1	6.13×10^5	3.07×10^5
Internal Access Road	2	12	1	20	-	4	1	3.5×10^5	-

8.5.3 Subgrade CBRs

The subgrade CBRs adopted for this preliminary pavement design were obtained from the Preliminary Geotechnical Investigation Report. The CBRs were calculated from boreholes in the area where the road was being built at grade, assumed a CBR 5 for areas of fill greater than 1m deep and CBR 5 for areas of shallow cut and CBR10 for sections of deep cut.

The subgrade CBRs adopted for the various sections of road are shown in Table 8-3 below.

Table 8-3

Road	Chainage	CBR
Smyths Road	0 – 2150	5
Gurnetts Road	2150 – 2550	5
	2550 – 2800	10
	5200 - 5550	5
Oonooie Road	5550 – 7450	5
Internal Access Road	Entire Length	3

8.5.4 Pavement Design

The preliminary pavement designs required for this project involve both sealed and unsealed pavements. The type of pavement required for each section of road is shown in Table 8-4 below.

Table 8-4 Type of pavement required

Road	Type of Pavement
Smyths Road	Unsealed
Smyths Road Alternative Option	Sealed
Gurnetts Road (Ch2150 – 2800)	Sealed
Gurnetts Road (Ch5200 – 5550)	Unsealed
Gurnetts Road (Ch5200 – 5550) Alternative Option	Sealed
Oonooie Road	Sealed
Internal Access Road	Sealed

Unsealed Pavement Design

The unsealed preliminary pavement design has been undertaken in accordance with Chapter 3 of the Unsealed Roads Manual (2000). The unsealed roads will consist of a base course and a wearing course. The base course thickness has been determined using Figure 3.1 of the guidelines, the design traffic from Section 8.5.2 and design CBRs from Section 8.5.3. This gives the following base thicknesses for Gurnetts Road (Ch1700 – 2100) and Smyths Road (Table 8-5).

Due to the higher design traffic for Gurnetts Road, slight interpolation of the table was required to provide the pavement thicknesses. More detailed design needs to be done to obtain exact thicknesses.

Table 8-5 Base thicknesses for unsealed pavements

Road	Design Traffic	CBR	Base Thickness (mm)
Smyths Road (Ch0 – 2150)	3.07×10^5	5	250
Gurnetts Road (Ch5200 – 5550)	6.57×10^5	5	280

The wearing course for the unsealed roads (Gurnetts Road Ch5200 – 5550, and Smyths Road) is to comply with the grading limits of table 3.2 from Chapter 3 of the Unsealed Roads Manual (2000) and be thick enough to provide:

- Skid resistance
- Smooth riding characteristics
- Cohesive properties
- Resistance to ravelling and scouring
- Wet and dry stability
- Low permeability
- Load spreading ability

8.6 Sealed Pavement Design

The sealed pavement design has been undertaken in accordance with Chart 1 of the Queensland Transport Pavement Design Manual. The pavement consists of:

- Seal
- Base
- Subbase
- Subgrade Replacement

Using Chart 1, design traffic and design CBRs the preliminary designs for the sealed roads are obtained in Table 8-6 below.

Table 8-6 Preliminary sealed pavement thicknesses

	Oonooie Rd (Ch5550 – 7450)	Gurnetts Rd (Ch2150 – 2550) (Ch5200 – 5500)	Gurnetts Rd (Ch2550 – 2800)	Smyths Rd Alternative Option	Internal Access Rd
Design Traffic	1.32×10^7	1.31×10^6	1.31×10^6	6.13×10^5	3.5×10^5
Design CBR	5	5	10	5	3
Seal	Yes	Yes	Yes	Yes	Yes
Base (mm)	125	125	125	125	125
Upper Subbase (mm)	125	125	125	125	125
Lower Subbase (mm)	160	-	-	-	-
Subgrade Replacement (mm)	240	210	90	140	185

It should be noted that these designs are for the purpose of a preliminary design and require further analysis during detailed design.

9. Land Acquisition

Land to be acquired for the proposed wagon maintenance and provisioning facilities and the bypass lines has been based on the preliminary designs developed by Connell Hatch, as described in this report.

The land parcels affected by the proposed works are identified in Table 9-1. The location of these properties is identified on drawings SK C 096 to SK C 099. The drawings indicate the total extent of property required and also show the approximate road reserve boundary, where land is required for public roads.

Table 9-1 Properties affected by the proposed Jilalan expansion

LOT	PLAN	ORIGINALLY DRAWN AS	DEVELOPMENT AREA	OBSERVED LAND USE
100	USL39250		North of Smyths Road Underpass	Vegetated tidal zone
1	RP725966		North of Smyths Road Underpass	Vegetated tidal zone / Agricultural cropping
4	RP725063		South of Smyths Road Underpass	Natural vegetation / grazing / residential
2	RP747769		Smyths Rd Realignment near residence	Agricultural cropping
18	RP736235		Smyths Rd Realignment	Agricultural cropping
1	RP728847		Smyths Rd Realignment	Residential
2	RP728847		Smyths Rd Realignment	Residential
3	RP728847		Smyths Rd Realignment	Residential
4	RP728847		Smyths Rd Realignment	Residential
A	AP3638	Lot A on AP3638	Gurnetts Road Realignment & Rail Yard	Permit for grazing - reserve, road, or stock route
1	RP723998		Gurnetts Road Realignment & Rail Yard	Natural vegetation / grazing / agricultural cropping
4	SP168447	Lot 2 on RP746879	Jilalan Rail Yard	Natural vegetation / grazing / residential
6	RP746880		Jilalan Rail Yard	Agricultural cropping
8	RP741153		Jilalan Rail Yard	Agricultural cropping / vegetated water course
10	RP741154		Jilalan Rail Yard	Agricultural cropping / vegetated water course
7	RP725329		Rail Turning Angle	Agricultural cropping / vegetated water course
13	RP806561		Jilalan Rail Yard	Agricultural cropping / vegetated water course
14	RP806561	Partially as Lot 18 on RP806561	Oonooie Rd Realignment	Agricultural cropping / vegetated water course
161	SP129945		Oonooie Rd Realignment	QR Corridor
11	RP748341		Oonooie Rd Realignment	Agricultural cropping / vegetated water course

A review was undertaken to confirm the currency of the property descriptions provided in the previous Connell Hatch Report. The Natural Resources and Water - Resource and Tenure Map database was used for this purpose. This database is located at the following World Wide Web address:

- http://www.nrw.qld.gov.au/science/geoscience/tenure_maps.html

Two discrepancies were found as a result of this search:

- The property, previously identified as Lot 2 on RP746879 was referred to by NRW as Lot 4 on SP168447
- The property, previously identified in part as Lot 18 on RP806561 was referred to by NRW as Lot 14 on RP806561

It is recommended that all property descriptions be verified with the Titles Office prior to commencing acquisitions.

The following should be noted in regard to the property acquisition drawings:

- The extent of proposed QR property was assessed in accordance with QR Standard Drawings 2567 to 2572, ie nominally the maximum of:
  - 20m nominally from the centreline of the outermost track; and
  - 15m nominally from the edge of the cut or fill batter (10m absolute minimum)
- Road reserves were assessed as being a minimum of 20m wide and of sufficient width to accommodate the proposed earthworks batters. This is in accordance with advice from Andrew Gibbs of Sarina Shire Council.
- The recommended road reserve boundaries are slightly wider than required for the preliminary designs. This is to allow for alignment flexibility in the detailed design phase.
- The large excavation batter for the bypass lines has been designed to eliminate the need to relocate the Gurnetts Road road reserve.
- The tie in at the southern end requires additional survey. It should be understood that the extent of proposed property acquisition may vary in this location.
- No recommendation has been made regarding the redundant section of Oonooie Road. It is understood that if the Oonooie Road level crossing is closed, this section of road will only provide access to properties owned by QR and could theoretically be closed to the general public. Access would still be required to QR's Oonooie substation.
- During CSR's involvement in the Traffic Assessment Working Group, they indicated their willingness to support the proposed Oonooie Road realignment east of the rail line, although they have requested input during the detailed design. It is possible that negotiations with CSR could result in amendments to the proposed alignment, which may involve changes to the required property acquisitions.

10. Environmental

Works undertaken as part of the Stage 1 commission consisted of the identification of noise issues, review and update of environmental issues and the preparation of both an Impact Assessment Statement (IAS) and draft Terms of Reference (TOR)

Connell Hatch assisted QR with initial environmental studies relating to the upgrade of the existing Jilalan Rail Yard. Specific tasks have included:

- Initial Advice Statement (IAS)
- Terms of Reference (TOR) for the EIS
- Preliminary ecological field and desktop investigations

The draft IAS and TOR have been submitted to QR for comment, comments have been addressed by Connell Hatch and final draft is currently been reviewed by Coordinator General for 'significant project' status. If the Jilalan Rail Yard Upgrade project is declared "significant project' under Section 26 of the *Queensland State Development and Public Works Organisation Act 1971*, an Environmental Impact Statement (EIS) will be required.

While the proposed works are unlikely to have a significant impact on any matters of national environmental significance, a consideration will be given to the need for submitting an EPBC Referral to the Commonwealth Department of Environment and Heritage to confirm controlled status for the project.

In addition to undertaking a comprehensive environmental impact assessment process, a number of other planning and environmental approvals will need to be secured prior to construction and operation of the JYRUP. These may include:

- Community Infrastructure Designation under IPA
- Material Change of Use for an Environmentally Relevant Activity (ERA) under the *Environmental Protection Act 1994* and IPA
- Amended Registration Certification for ERA's under the *Environmental Protection Act 1994*
- Cultural Heritage Management Plan under the *Aboriginal Cultural Heritage Act 2003*
- RE Vegetation Clearing under the VM Act and IPA
- Marine Plant Removal Permit under the *Fisheries Act 1994* and IPA
- Building of Raising Water Barrier Works Permit under the *Fisheries Act 1994* and IPA
- Tidal Works Permit under the *Coastal Protection and Management Act 1995*
- Riverine Protection Permit (RPP) under the *Water Act 2000*

Appendix A

Survey Control Data

SURVEY CONTROL STATIONS

POINT	EASTINGS	NORTHINGS	RL	DESCRIPTION
148377	32487.197	629095.898	12.758	Permanent Survey Mark
53152	32440.290	629030.182	12.423	Permanent Survey Mark
148381	32353.584	628829.998	12.615	Permanent Survey Mark
116035	30790.989	630567.574	11.596	Permanent Survey Mark
86576	32779.728	631111.882	16.786	Permanent Survey Mark
149382	32353.583	628830.005	12.614	Permanent Survey Mark
124484	32269.871	628301.021	15.374	Permanent Survey Mark
124458	31760.215	627279.625	21.606	Permanent Survey Mark
124483	31624.725	626632.384	18.353	Permanent Survey Mark
124482	31612.213	626321.613	16.854	Permanent Survey Mark
124456	31540.579	626981.258	20.153	Permanent Survey Mark
124486	31624.387	625561.702	14.655	Permanent Survey Mark
124470	31600.828	626037.664	15.490	Permanent Survey Mark
124459	31710.745	627024.814	26.892	Permanent Survey Mark
124466	31522.955	627150.277	20.479	Permanent Survey Mark
124455	31652.134	627345.246	26.381	Permanent Survey Mark
124485	31865.012	627431.31	20.654	Permanent Survey Mark
124468	31977.421	627560.422	20.148	Permanent Survey Mark
124454	32078.444	627689.758	19.846	Permanent Survey Mark
124469	32231.477	627982.714	24.705	Permanent Survey Mark
124424	32316.209	628540.076	11.703	Permanent Survey Mark

COORDINATE TRANSFORMATION PARAMETERS

MGA (55) TO PROJECT GRID

Translation x	*-699936.6724670*	*m*
Translation y	*-6997835.1635724*	*m*
Clockwise Roatation	*1.2746914429*	*sec*
Scale Factor	*0.999693148255070*	

PROJECT GRID TO MGA 55

Translation x	*700108.2561259*	*m*
Translation y	*6999987.4473925*	*m*
Clockwise Roatation	*-1.2746914429*	*sec*
Scale Factor	*1.000306945824440*	

Parameters determined using 12D Helmert Transformation

PROJECT TO MGA 55 TRANSFORMATION RESIDUALS

MGA COORDS		PROJECT COORDS		RESIDUALS	
EASTINGS	NORTHINGS	EASTINGS	NORTHINGS	EASTINGS	NORTHINGS
732345.729	7628163.102	32231.477	627982.714	0.01539	0.01530
732091.612	7627740.700	31977.421	627560.422	0.00102	-0.00589
730904.798	7630748.766	30790.989	630567.574	0.00026	-0.00419
731979.187	7627611.547	31865.012	627431.310	-0.01668	-0.00522

MGA 55 TO PROJECT TRANSFORMATION RESIDUALS

MGA COORDS		PROJECT COORDS		RESIDUALS	
EASTINGS	NORTHINGS	EASTINGS	NORTHINGS	EASTINGS	NORTHINGS
32231.477	627982.714	732345.729	7628163.102	-0.01539	-0.01530
31977.421	627560.422	732091.612	7627740.700	-0.00102	0.00589
30790.989	630567.574	730904.798	7630748.766	-0.00026	0.00419
31865.012	627431.310	731979.187	7627611.547	0.01668	0.00521

QUEENSLAND GOVERNMENT

QUEENSLAND - DEPARTMENT OF NATURAL RESOURCES

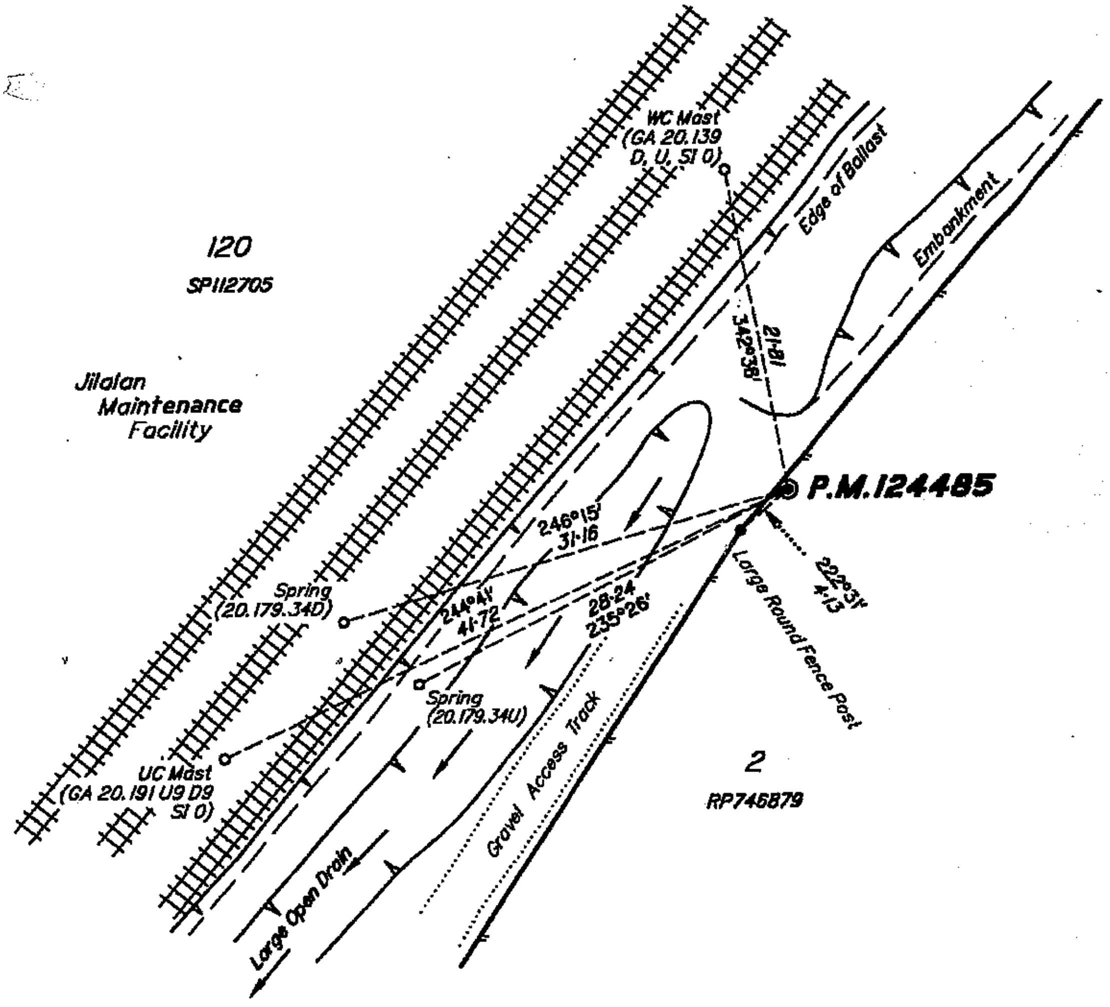
PERMANENT MARK SKETCH PLAN

REGD NO. 124485

NATURAL RESOURCES

Bearings are Magnetic **(Magnetic, AMG) Distances are metres**

Sketch plan to be completed in accordance with the Department's QA document; "Completion of Permanent Mark Sketch Plans"



Not to Scale

Suited to GPS	
Yes/No	No
Date	

SCDB DETAILS ON REVERSE ARE TO BE COMPLETED

I certify that the permanent mark sketch has been prepared in accordance with the "The Survey Co-ordination Act of 1952-1989".

Date 10/11/1999

Signature

15/04/96

Queensland Government
Natural Resources and Mines

Survey Search Detail Report

Details of Registered Number: 124485

Current Information

Administrative

Alternate Name(s)	
Parish	SARINA
Town	
Local Authority	SARINA
Locality Description	JILALAN
Related Information	

Mark Details

Mark Type	S/PIC	**Mark Condition**	GOOD
Installed By	WS GROUP	**Installed Date**	01/01/1999
Last Visited	31/03/2004	**Sketch Available**	YES
Connection(s)	SP168447		

Horizontal

Datum	GDA94		
Latitude	21°26' 20.3169" S	**Longitude**	149°14' 17.8363" E
Easting	731979.187	**Northing**	7627611.547
Zone	55		
Order	NO ORDER	**Class**	CLASS D
Adjustment Name	GDA - TRANSFORMED QLD_0900 GRID	**Fixed By**	TRIG
Prominent Feature	NO		

Vertical

Height	20.654	**Datum**	AHD D
Order	NO ORDER	**Class**	Class D
Fixed By	SPIRIT LEVELLING	**Origin**	124459
Geoid/Ellipsoid Separation(N)	0.000		
Model			

QUEENSLAND GOVERNMENT

. QUEENSLAND - DEPARTMENT OF NATURAL RESOURCES

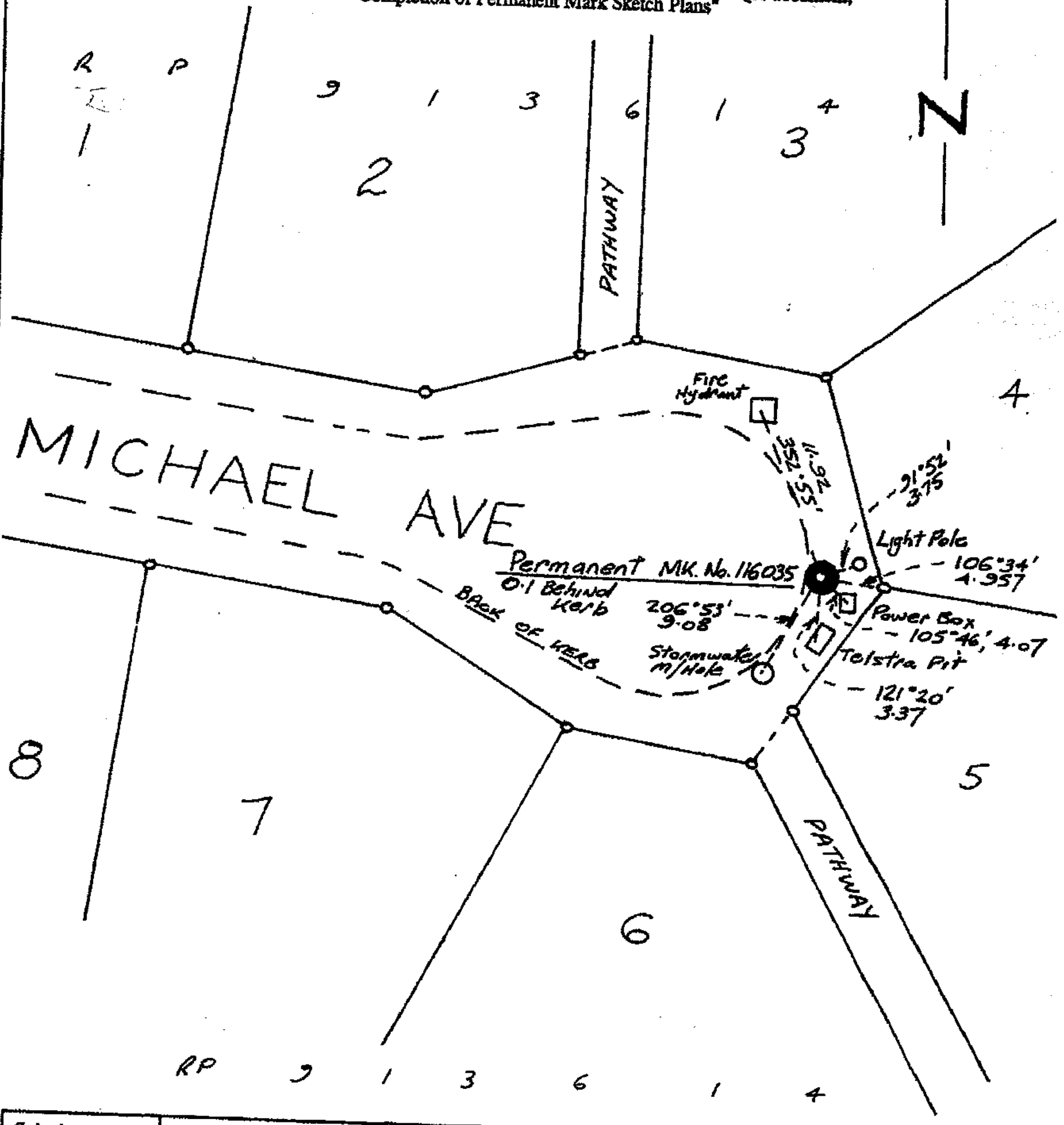
PERMANENT MARK SKETCH PLAN

REGD NO. 116035

NATUR RESOUR

Bearings are AMG (Magnetic, AMG) Distances are metres

Sketch plan to be completed in accordance with the Department's QA document; "Completion of Permanent Mark Sketch Plans"



Suited to GPS
[✓ Yes]/No YES

SCDB DETAILS ON REVERSE ARE TO BE COMPLETED

I certify that the permanent mark sketch has been prepared in accordance with the "The Survey Co-ordination Act of 1952-1989"

Queensland Government
Natural Resources and Mines

Survey Search Detail Report

Details of Registered Number: 116035

Current Information

Administrative

Alternate Name(s)	
Parish	HECTOR
Town	SARINA
Local Authority	SARINA
Locality Description	MICHAEL AVENUE
Related Information	FIELD INSPECTED BY NRM 01/04/2002 BURIED 0.05 DEEP GPS - GOOD

Mark Details

Mark Type	STAND	**Mark Condition**	BURIED
Installed By	KANE & LEGGE	**Installed Date**	30/05/1997
Last Visited	16/09/2004	**Sketch Available**	YES
Connection(s)	RP913614		

Horizontal

Datum	GDA94		
Latitude	21°24' 38.8487" S	**Longitude**	149°13' 38.9912" E
Easting	730904.798	**Northing**	7630748.766
Zone	55		
Order	1st ORDER	**Class**	CLASS A
Adjustment Name	MACKAY REGIONAL CONTROL UPDATE 2004	**Fixed By**	GPS
Prominent Feature	NO		

Vertical

Height	11.609	**Datum**	AHD
Order	4th ORDER	**Class**	Class D
Fixed By	GPS	**Origin**	MACKAY REGIO
Geoid/Ellipsoid Separation(N)	54.849		
Model	AUSGEOID98 INTERPOLATED		

FOR LOCATION PURPOSES ONLY -
Refer to Survey Search Details for current Survey Control Information

Form 6
Survey and Mapping Infrastructure Act 2003
DEPARTMENT OF NATURAL RESOURCES & MINES

Queensland Government
Natural Resources and Mines

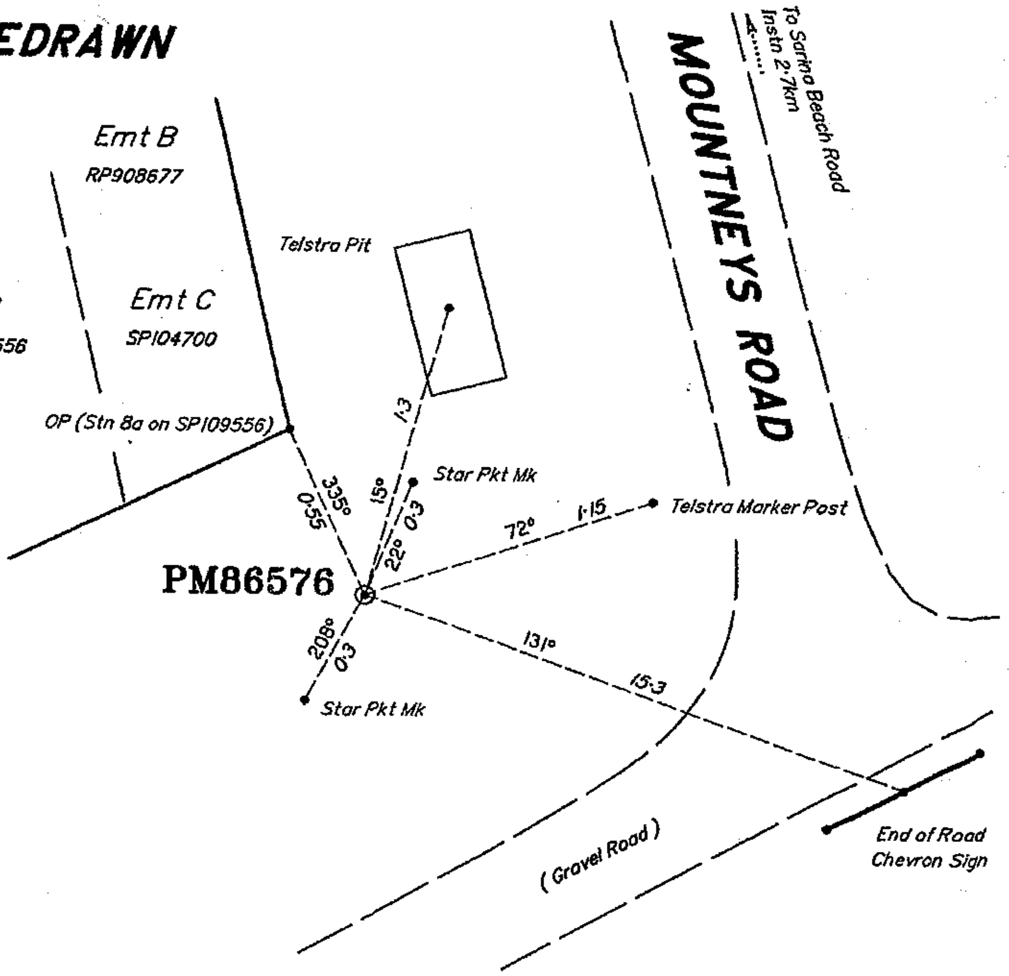
PERMANENT MARK SKETCH PLAN

REGD NO. 86576

Bearings are Magnetic (Magnetic, MGA) Distances are metres

Sketch plan to be completed in accordance with the Department's QA document; "Completion of Permanent Mark Sketch Plans"

REDRAWN



Details completed by T.NEY, Cadastral Surveyor, 18/03/2005

Mark Type Star Picket in Conc. Collar

Scale Not to Scale

Suited to GPS
Yes/No Yes
Date 07/02/1997

SCDB DETAILS ON REVERSE ARE TO BE COMPLETED

I certify that the permanent mark sketch has been prepared in accordance with the "Survey and Mapping Infrastructure Act 2003".

Date 18/3/05 Signature

31/08/2004

Queensland Government
Natural Resources and Mines

Survey Search Detail Report
Details of Registered Number: 86576

Current Information

Administrative

Alternate Name(s)	
Parish	HECTOR
Town	
Local Authority	SARINA
Locality Description	MOUNTNEYS ROAD
Related Information	FIELD INSPECTED BY NRM-MACKAY 22/04/2002

Mark Details

Mark Type	S/PIC	**Mark Condition**	GOOD
Installed By	DNR	**Installed Date**	07/02/1997
Last Visited	16/09/2004	**Sketch Available**	YES
Connection(s)	SP131424 SP109556 SP104700		

Horizontal

Datum	GDA94		
Latitude	21°24' 20.2301" S	**Longitude**	149°14' 47.7650" E
Easting	732894.070	**Northing**	7631293.249
Zone	55		
Order	1st ORDER	**Class**	CLASS A
Adjustment Name	MACKAY REGIONAL CONTROL	**Fixed By**	GPS
Prominent Feature	NO		

Vertical

Height	16.842	**Datum**	AHD
Order	4th ORDER	**Class**	Class D
Fixed By	GPS	**Origin**	MACKAY REGIO
Geoid/Ellipsoid Separation(N)	54.816		
Model	AUSGEOID98 INTERPOLATED		

22 November, 2005

FOR LOCATION PURPOSES ONLY -
Refer to Survey Search Details for current Survey Control Information

QUEENSLAND GOVERNMENT

QUEENSLAND - DEPARTMENT OF NATURAL RESOURCES

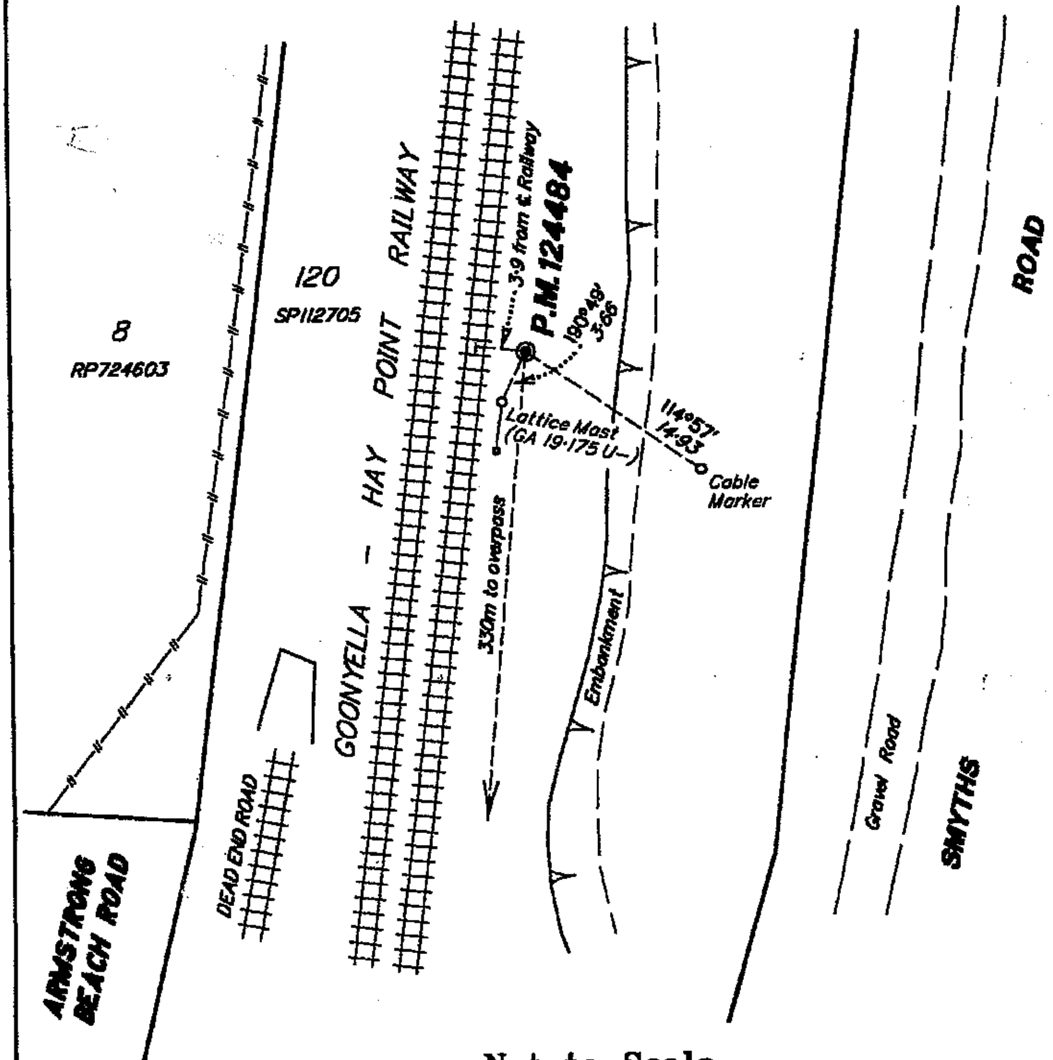
PERMANENT MARK SKETCH PLAN

REGD NO. 124484

NATURAL RESOURCES

Bearings are Magnetic **(Magnetic, AMG) Distances are metres**

Sketch plan to be completed in accordance with the Department's QA document; "Completion of Permanent Mark Sketch Plans"



Not to Scale

Suited to GPS	
Yes/No	No
Date	Aug 99

SCDB DETAILS ON REVERSE ARE TO BE COMPLETED

I certify that the permanent mark sketch has been prepared in accordance with the "The Survey Co-ordination Act of 1952-1969".

Date 10/11/1999

Signature

15/04/98

Queensland Government
Natural Resources and Mines

Survey Search Detail Report
Details of Registered Number: 124484

Current Information

Administrative

Alternate Name(s)	
Parish	SARINA
Town	
Local Authority	SARINA
Locality Description	SMYTHS RD
Related Information	

Mark Details

Mark Type	S/PIC	**Mark Condition**	GOOD
Installed By	WS GROUP	**Installed Date**	01/01/1999
Last Visited	12/09/2005	**Sketch Available**	YES
Connection(s)	SP184898		

Horizontal

Datum	GDA94		
Latitude	21°25' 51.8541" S	**Longitude**	149°14' 31.4616" E
Easting	732384.127	**Northing**	7628481.491
Zone	55		
Order	NO ORDER	**Class**	CLASS D
Adjustment Name	GDA - TRANSFORMED QLD_0900 GRID	**Fixed By**	TRIG
Prominent Feature	NO		

Vertical

Height	15.374	**Datum**	AHD D
Order	NO ORDER	**Class**	Class D
Fixed By	SPIRIT LEVELLING	**Origin**	124459
Geoid/Ellipsoid Separation(N)	0.000		
Model			

SP184898

SP 108534 ✓

22 November, 2005

QUEENSLAND GOVERNMENT

QUEENSLAND - DEPARTMENT OF NATURAL RESOURCES

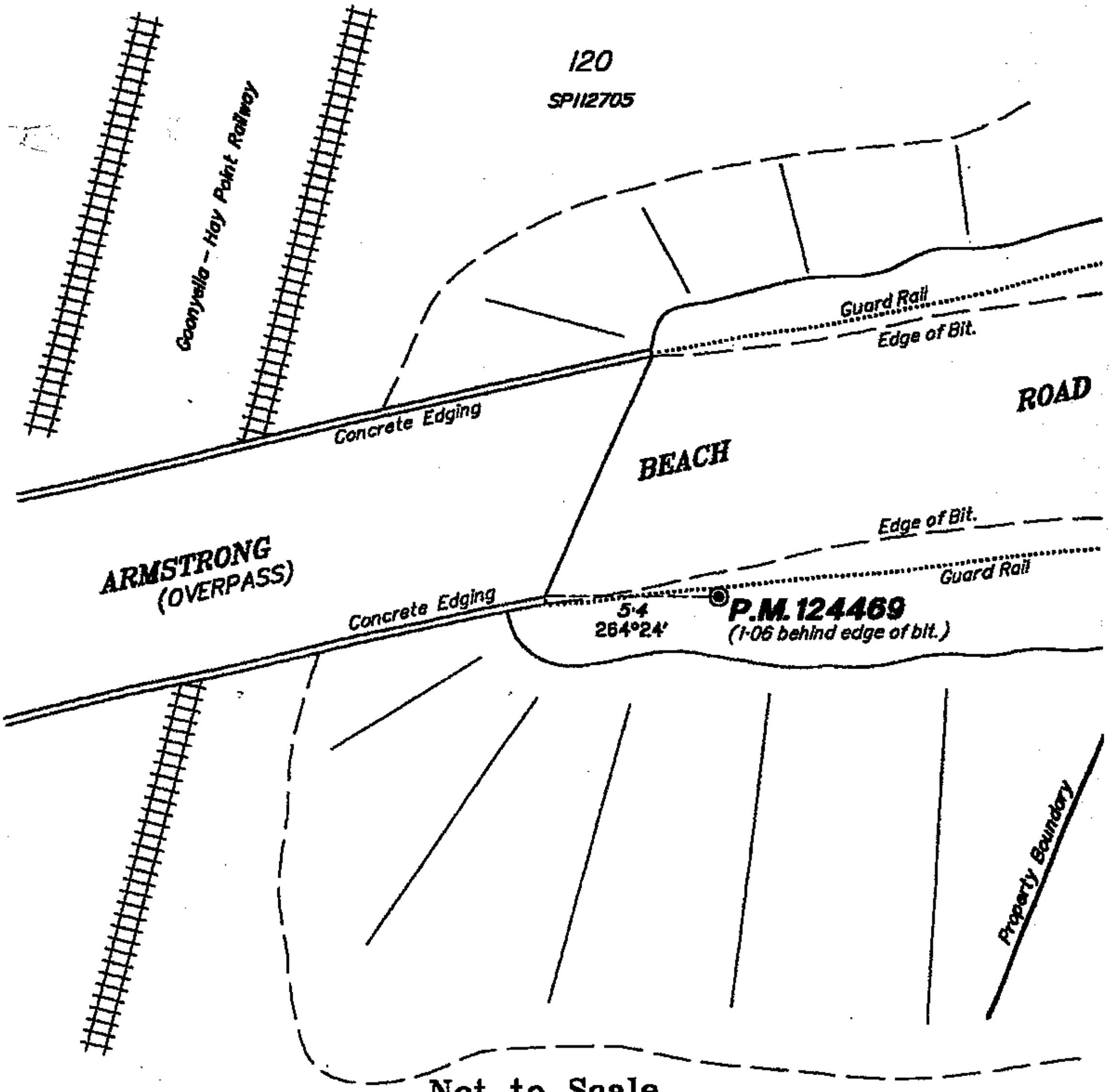
PERMANENT MARK SKETCH PLAN

REGD NO. 124469

NATURAL RESOURCES

Bearings are Magnetic (Magnetic, AMG) Distances are metres

Sketch plan to be completed in accordance with the Department's QA document; "Completion of Permanent Mark Sketch Plans"



Not to Scale

Suited to GPS	
Yes/No	Yes
Date	Aug 1999

SCDB DETAILS ON REVERSE ARE TO BE COMPLETED

I certify that the permanent mark sketch has been prepared in accordance with the "The Survey Co-ordination Act of 1952-1989".

Date 10/11/1999

Signature

15/04/96

Queensland Government
Natural Resources and Mines

Survey Search Detail Report

Details of Registered Number: 124469

Current Information

Administrative

Alternate Name(s)	
Parish	SARINA
Town	
Local Authority	SARINA
Locality Description	ARMSTRONG BEACH RD OVERPASS
Related Information	

Mark Details

Mark Type	S/PIC	**Mark Condition**	GOOD
Installed By	WS GROUP	**Installed Date**	01/01/1999
Last Visited	12/09/2005	**Sketch Available**	YES
Connection(s)	SP184898		

Horizontal

Datum	GDA94		
Latitude	21°26' 2.2201" S	**Longitude**	149°14' 30.2868" E
Easting	732345.729	**Northing**	7628163.102
Zone	55		
Order	NO ORDER	**Class**	CLASS D
Adjustment Name	GDA - TRANSFORMED QLD_0900 GRID	**Fixed By**	GPS
Prominent Feature	NO		

Vertical

Height	24.705	**Datum**	AHD D
Order	NO ORDER	**Class**	Class D
Fixed By	GPS	**Origin**	29203
Geoid/Ellipsoid Separation(N)	54.533		
Model	AUSGEOID98		

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22 November, 2005

QUEENSLAND GOVERNMENT

QUEENSLAND - DEPARTMENT OF NATURAL RESOURCES

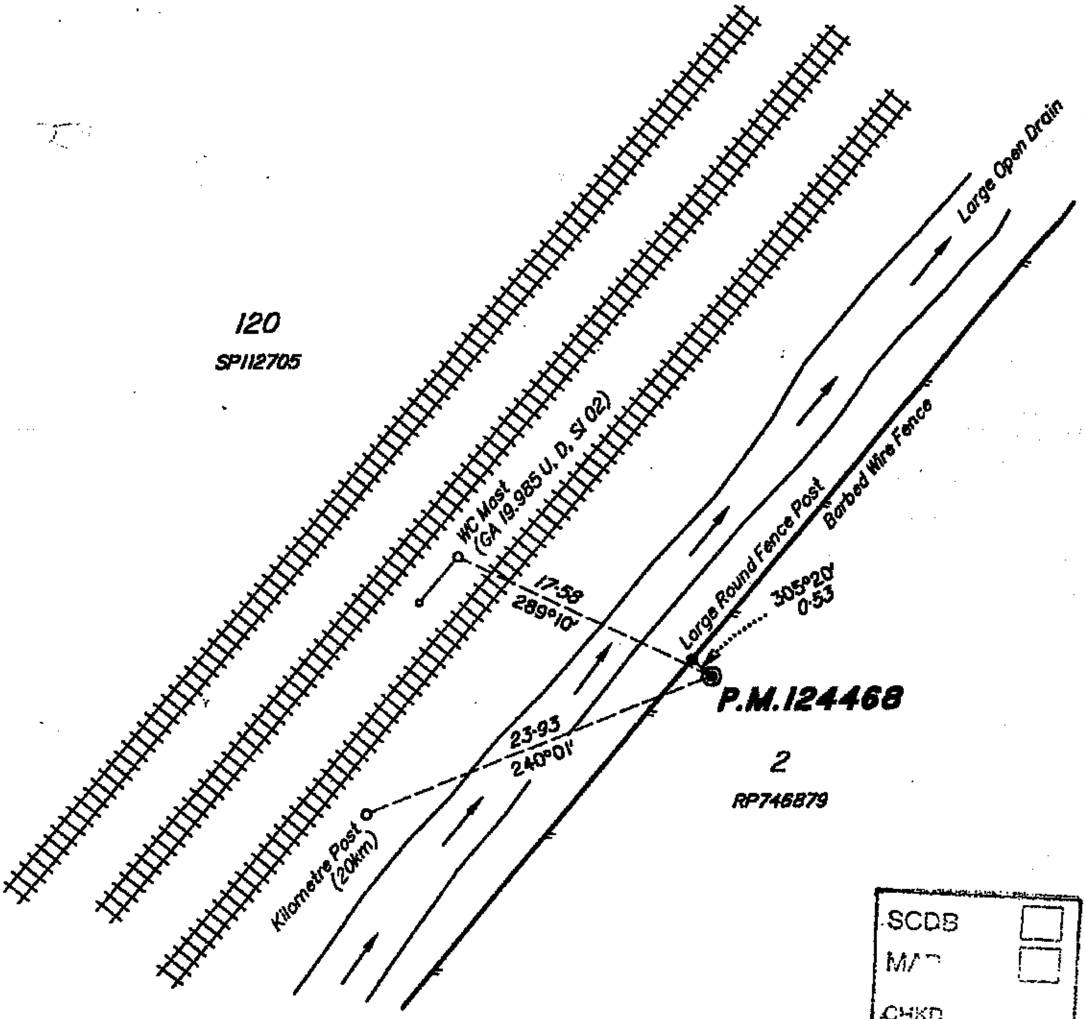
PERMANENT MARK SKETCH PLAN

REGD NO. 124468

NATURAL RESOURCES

Bearings are Magnetic (Magnetic, AMG) Distances are metres

Sketch plan to be completed in accordance with the Department's QA document; "Completion of Permanent Mark Sketch Plans"



SCDB ☐
MAP ☐
CHKD ....
DATE ....

Not to Scale

Suited to GPS	
Yes/No	No
Date	

SCDB DETAILS ON REVERSE ARE TO BE COMPLETED

I certify that the permanent mark sketch has been prepared in accordance with the "The Survey Co-ordination Act of 1952-1989"

Date 10/11/1999

Signature

15/04/96

Queensland Government
Natural Resources and Mines

Survey Search Detail Report

Details of Registered Number: 124468

Current Information

Administrative

Alternate Name(s)	
Parish	SARINA
Town	
Local Authority	SARINA
Locality Description	JILALAN
Related Information	

Mark Details

Mark Type	S/PIC	**Mark Condition**	GOOD
Installed By	WS GROUP	**Installed Date**	01/01/1999
Last Visited	31/03/2004	**Sketch Available**	YES
Connection(s)	SP168447		

Horizontal

Datum	GDA94		
Latitude	21°26' 16.0670" S	**Longitude**	149°14' 21.6750" E
Easting	732091.612	**Northing**	7627740.700
Zone	55		
Order	NO ORDER	**Class**	CLASS D
Adjustment Name	GDA - TRANSFORMED QLD_0900 GRID	**Fixed By**	TRIG
Prominent Feature	NO		

Vertical

Height	20.148	**Datum**	AHD D
Order	NO ORDER	**Class**	Class D
Fixed By	SPIRIT LEVELLING	**Origin**	124459
Geoid/Ellipsoid Separation(N)	0.000		
Model			

22 November, 2005

Queensland Government
Natural Resources and Mines

Survey Search Detail Report

Details of Registered Number: 53152

Current Information

Administrative

Alternate Name(s)	
Parish	SARINA
Town	
Local Authority	SARINA
Locality Description	SMYTHS RD
Related Information	

Mark Details

Mark Type	STAND	**Mark Condition**	GOOD
Installed By	DARELL BLACK	**Installed Date**	01/06/1988
Last Visited	16/03/1992	**Sketch Available**	YES
Connection(s)	RP747769 CI4430		

Horizontal

Datum	GDA94		
Latitude	21°25' 28.0698" S	**Longitude**	149°14' 37.1964" E
Easting	732559.770	**Northing**	7629210.763
Zone	55		
Order	NO ORDER	**Class**	NO CLASS
Adjustment Name	GDA - TRANSFORMED QLD_0900 GRID	**Fixed By**	SCALED
Prominent Feature	NO		

Vertical

Height	0.000	**Datum**	
Order		**Class**	
Fixed By		**Origin**	
Geoid/Ellipsoid Separation(N) Model	0.000		

The Survey Co-ordination Act of 1952-1981
(Regulation 16)
FORM 6

QUEENSLAND

REGD. No. 53152

PERMANENT MARK SKETCH PLAN

Other Ref. No.

Description of Mark STANDARD D.M.S. District MACKAY

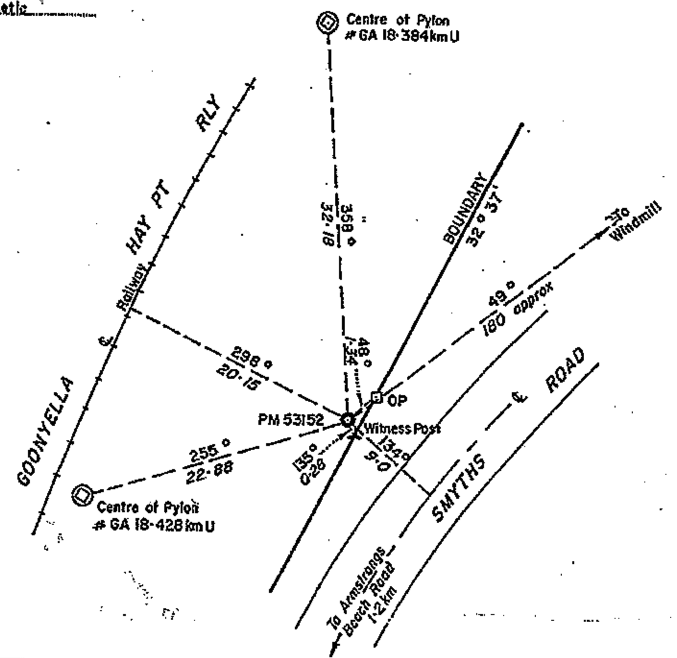
Parish of SARINA City or Town of

Local Authority SARINA SHIRE Map 8755-32

PLEASE LEAVE THIS MARGIN VACANT

PERMANENT SURVEY MARK INSTALLATION DETAILS

Measurements are in Metres (Not necessarily to scale)
Bearings are Magnetic



Field Checked

Installed by DARELL BLACKWELL & ASSOC Date 10 / 6 / 88
Placed in Connection with (Type of survey/project) CADASTRAL survey Plan and/or Field Bk. Ref. CI 4430 K2/88507
Connd. on Cadastral Plan No CI 4430

VERTICAL DATA

AUSTRALIAN HEIGHT DATUM (This section to be completed by D.M.S. when Official Lin-adj. Values are available)
Adj. Height Analysis Ref. L. Book No.
Origin Secn. Secn. Nos Book No.

OTHER DATUMS (Relevant information columns to be completed in full)
Reduced Level (i) A.H.D.(der.) (ii) Datum Adopted (i) A.H.D. (ii) L. Book No. (i) (ii)
Levelled by (i) (ii) Date (i) (ii)
Origin Mark (i) (ii) Origin R.L. (i) (ii)

HOR DATA

A.M.G. CO-ORDINATES E N Zone Date
Origin Stns. for Co-ordinates with values adopted (i) E N (ii) (iii)
Local Co-ords. available on Plan Ref. Estab. by

Amended

I certify that the permanent mark shown in this sketch has been placed on the ground in accordance with the regulations under "The Survey Co-ordination Act of 1952-1981".

Date 15th June 1988. Signature

Licensed Surveyor

53152

SCS053152

Queensland Government
Natural Resources and Mines

Survey Search Detail Report

Details of Registered Number: 124455

Current Information

Administrative

Alternate Name(s)	
Parish	SARINA
Town	
Local Authority	SARINA
Locality Description	JILALAN
Related Information	

Mark Details

Mark Type	S/PIC	**Mark Condition**	GOOD
Installed By	WS GROUP	**Installed Date**	01/01/1999
Last Visited	01/04/1999	**Sketch Available**	YES
Connection(s)			

Horizontal

Datum	GDA94		
Latitude	21°26' 23.2132" S	**Longitude**	149°14' 10.4866" E
Easting	731766.245	**Northing**	7627525.475
Zone	55		
Order	NO ORDER	**Class**	CLASS D
Adjustment Name	GDA - TRANSFORMED QLD_0900 GRID	**Fixed By**	GPS
Prominent Feature	NO		

Vertical

Height	26.377	**Datum**	AHD D
Order	NO ORDER	**Class**	Class D
Fixed By	GPS	**Origin**	29203
Geoid/Ellipsoid Separation(N)	54.230		
Model	AUSGEOID98		

QUEENSLAND GOVERNMENT

QUEENSLAND - DEPARTMENT OF NATURAL RESOURCES

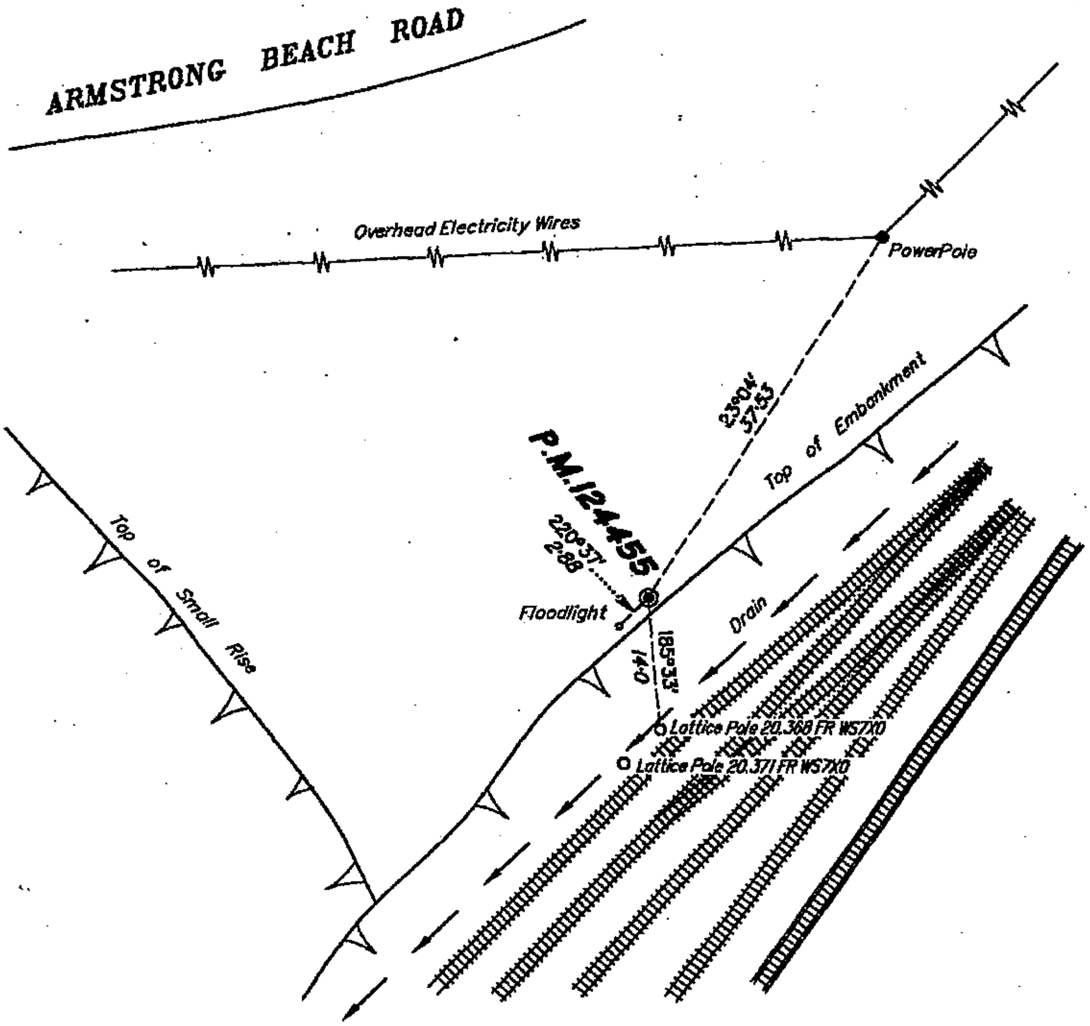
PERMANENT MARK SKETCH PLAN

REGD NO. 124455

NATURAL RESOURCES

Bearings are Magnetic **(Magnetic, AMG) Distances are metres**

Sketch plan to be completed in accordance with the Department's QA document; "Completion of Permanent Mark Sketch Plans"



Not to Scale

Suited to GPS
Yes/No No
Date

SCDB DETAILS ON REVERSE ARE TO BE COMPLETED

I certify that the permanent mark sketch has been prepared in accordance with the "The Survey Co-ordination Act of 1952-1989".

Date 03.08.99

Signature

15/04/96

Appendix B

Intensity Frequency Duration (IFD) – Sarina, Qld

Rainfall Intensity for Sarina, Qld

Duration	Average Recurrence Interval						
	1 Year (mm/hr)	2 Year (mm/hr)	5 Year (mm/hr)	10 Year (mm/hr)	20 Year (mm/hr)	50 Year (mm/hr)	100 Year (mm/hr)
5.0 m	117	152	198	226	263	313	353
5.5 m	114	148	192	219	255	304	342
6.0 m	110	143	186	213	248	295	332
6.5 m	108	140	181	207	241	287	323
7.0 m	105	136	177	202	235	280	315
7.5 m	102	133	172	197	229	273	308
8.0 m	100	130	168	192	224	267	301
8.5 m	98	127	165	188	219	261	294
9.0 m	96	124	161	184	214	255	288
9.5 m	94	122	158	180	210	250	282
10 m	92	119	155	177	206	245	276
11 m	89	115	149	170	198	236	266
12 m	86	111	144	165	192	228	257
13 m	83	107	140	159	186	221	249
14 m	80	104	135	154	180	214	241
15 m	78	101	131	150	175	208	234
16 m	76	98	128	146	170	202	228
17 m	74	96	125	142	166	197	222
18 m	72	94	121	139	161	192	216
19 m	70	91	119	135	158	188	211
20 m	69	89	116	132	154	183	206
21 m	67	87	113	129	151	179	202
22 m	66	85	111	127	147	176	198
23 m	65	84	109	124	144	172	194
24 m	63	82	107	122	142	169	190
25 m	62	81	105	119	139	165	186
26 m	61	79	103	117	136	162	183
27 m	60	78	101	115	134	159	179
28 m	59	76	99	113	132	157	176
29 m	58	75	97	111	129	154	173
30 m	57	74	96	109	127	152	171
32 m	55	72	93	106	123	147	165
34 m	54	69	90	103	120	142	160
36 m	52	68	88	100	116	138	156
38 m	51	66	85	97	113	135	152
40 m	49.4	64	83	95	110	131	148
45 m	46.5	60	78	89	104	124	139
50 m	44.1	57	74	85	98	117	132
55 m	41.9	54	71	80	94	111	125
60 m	40.1	52	67	77	89	106	120
75 m	35.4	46.0	60	69	80	96	108
90 m	32.0	41.6	55	63	73	88	99
105 m	29.3	38.2	50	58	68	81	92
120 m	27.1	35.4	46.8	54	63	76	86
135 m	25.4	33.1	43.9	51	60	72	81
150 m	23.9	31.2	41.5	48.0	56	68	77
165 m	22.6	29.6	39.4	45.6	54	65	74
180 m	21.5	28.2	37.6	43.6	51	62	71
195 m	20.5	26.9	36.0	41.8	49.4	60	68
210 m	19.6	25.8	34.6	40.2	47.5	58	66
225 m	18.9	24.8	33.3	38.8	45.9	56	63
240 m	18.2	23.9	32.2	37.5	44.4	54	61
270 m	17.0	22.4	30.2	35.2	41.8	51	58
300 m	16.0	21.1	28.5	33.3	39.6	48.2	55
6 h	14.4	19.0	25.9	30.3	36.0	44.0	50
7 h	13.2	17.4	23.8	27.9	33.3	40.8	46.8
8 h	12.2	16.1	22.2	26.1	31.1	38.2	43.8
9 h	11.4	15.1	20.8	24.5	29.3	36.0	41.4
10 h	10.7	14.2	19.7	23.2	27.8	34.2	39.3
11 h	10.1	13.5	18.7	22.1	26.5	32.6	37.5
12 h	9.65	12.8	17.8	21.1	25.3	31.2	36.0
14 h	8.80	11.7	16.4	19.4	23.4	28.9	33.4
16 h	8.12	10.8	15.2	18.1	21.8	27.0	31.2
18 h	7.57	10.1	14.2	17.0	20.5	25.4	29.5
20 h	7.10	9.51	13.4	16.0	19.4	24.1	28.0
22 h	6.70	8.98	12.7	15.2	18.4	23.0	26.7
24 h	6.35	8.53	12.1	14.5	17.6	22.0	25.5
30 h	5.54	7.45	10.7	12.8	15.6	19.6	22.8
36 h	4.93	6.65	9.58	11.6	14.1	17.8	20.7
42 h	4.46	6.03	8.74	10.6	12.9	16.3	19.1
48 h	4.09	5.53	8.05	9.77	12.0	15.2	17.8
54 h	3.77	5.12	7.48	9.10	11.2	14.2	16.6
60 h	3.51	4.76	6.99	8.52	10.5	13.3	15.7
66 h	3.28	4.46	6.56	8.02	9.89	12.6	14.8
72 h	3.08	4.19	6.19	7.58	9.36	11.9	14.1

The rainfall intensities shown above are calculated in accordance with Chapter 2, Australian Rainfall and Runoff - 1987 Edition.

Sarina, Qld; 21.25 South 149.15 East

AUS-IFD
Ver 2.0, 1999

27 February,2007

Appendix C

Plane Creek Flood Study

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Hydraulic Assessment Report
Jilalan Station Yard Upgrade
Queensland Rail

24 October 2006
Reference HI88
Revision 4

Document Control

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Rev No	Date	Revision Details	Typist	Author	Verifier	Approver
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3	11 September 2006	Draft Report	CD	YR	DL/TG	
4	24 October 2006	Final Report	NJE	MO.	CAR	CAR.

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Abbreviations

AHD	Australian Height Datum
ARI	Average Recurrence Interval
CD	Chart Datum
CW	Connell Wagner
DNRM	Department of Natural Resources and Mines
HAT	Highest Astronomical Tide
IFD	Intensity – Frequency - Duration
LAT	Lowest Astronomical Tide
MHWN	Mean High Water Neaps
MLWN	Mean Low Water Neaps
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
QR	Queensland Rail

1. Introduction

Connell Wagner was commissioned by Queensland Rail to undertake a concept design of the proposed Jilalan Station Yard upgrade at Jilalan, Sarina. The concept design proposes realignment of Smythes Road, north of Jilalan Rail Yard and includes a railway underpass. This study investigates existing flooding patterns in the area and their interaction with the proposed underpass.

The study area encompasses Plane Creek east of the Bruce Highway to its discharge point at Sarina Outlet. The subject reach of Plane Creek is tidal. This study focused on investigations to determine Plane Creek peak flood levels in the subject area resulting from a range of scenarios including:

- Highest Astronomical Tide (HAT);
- Mean High Water Springs (MHWS); and
- Flooding events with Average Recurrence Intervals (ARI) of 1, 2, 5, 10, 20, 50, 100 and 500 years.

Specific requirements of this investigation include estimation of:

- Peak flood levels in the immediate area of the proposed underpass off Smyths Road; and
- Flood immunity of the proposed underpass.

This report documents the analysis undertaken and presents the outcomes of the investigation.

2. Study Data

A range of data was available or sourced for this project including:

- Contour Maps – 1m contour data in digital format at 1:5,000 scale for the catchment and study area were sourced from the Queensland Department of Natural Resources and Mines (DNRM). Approximately 5% of the catchment area was not available in this format;
- Topographic Maps – Topographic maps of the catchment area at a scale of 1:100,000 with 20m contour interval were sourced from the map shop 'Map World';
- Aerial Photos – Aerial photography of Jilalan Station Yard and Plane Creek in digital format was sourced from map shop 'Webmap';
- Survey Data – Site specific survey of the proposed development site was captured by Connell Wagner and provided in digital format. This data included cross-sections of Plane Creek at the railway bridge and a minor causeway;
- Tide Tables – Tide data was sourced from *The Official Tide Tables & Boating Safety Guide* (Queensland Transport, 2006); and
- Hydrologic Data – Rainfall Intensity-Frequency-Duration (IFD) characteristics for the Plane Creek catchment were derived in accordance with Australian Rainfall & Runoff (AR&R, 1987).

3. Methodology

The methodology adopted for this investigation is summarised below:

- Delineation of the Plane Creek catchment and sub-catchments using available mapping;
- Formulation of a RAFTS hydrologic model and simulation of 1, 2, 5, 10, 20, 50, 100 and 500 year ARI storm events to derive respective design storm discharge hydrographs for the creek system;

- Preparation of a MIKE 11 hydraulic model of Plane Creek extending from east of the Bruce Highway to the creek's point of discharge into Sarina Inlet;
- Simulation of the tidal HAT and MHWS events, and the 1, 2, 5, 10, 20, 50, 100 and 500 year ARI storm events to derive peak flood levels in Plane Creek; and
- Assessment of the peak flood levels adjacent to the proposed underpass.

4. Hydrologic Modelling

4.1 RAFTS Model

A RAFTS model was formulated to derive discharge hydrographs for the Plane Creek catchment resulting from design rainfall events with ARI between 1 and 500 years.

4.2 Catchment

The Plane Creek catchment was delineated using the available topographic data as presented in Figure 4.1 and was estimated to have an area of 14,130ha. The catchment was further divided into 9 sub-catchments, also included in Figure 4.1, for hydrologic investigation. The township of Sarina falls within sub catchment 8. Sub catchment areas have been presented in Table 4.1.

4.2.1 Pervious/Impervious Areas

The Plane Creek catchment is generally undeveloped. The extent of impervious area within each sub catchment was estimated with available aerial photography.

All sub-catchments were allocated an impervious fraction of 5% with the exception of sub catchment 8 (which includes Sarina township), which was allocated an impervious fraction of 10%.

4.2.2 Manning's Roughness 'n'

Manning's roughness values were adopted based on available aerial photography and site investigation.

Sub catchment 8 was considered to be rural residential and given a Manning's roughness value of 0.04. All other sub-catchments were treated as open space with a Manning's roughness value of 0.07.

4.2.3 Sub-Catchment Slope

Sub-catchment slopes were determined with the equal area method based on the available 1m contour interval topographic data.

The adopted RAFTS model parameters for each sub-catchment in its existing state have been summarised in Table 4.1.

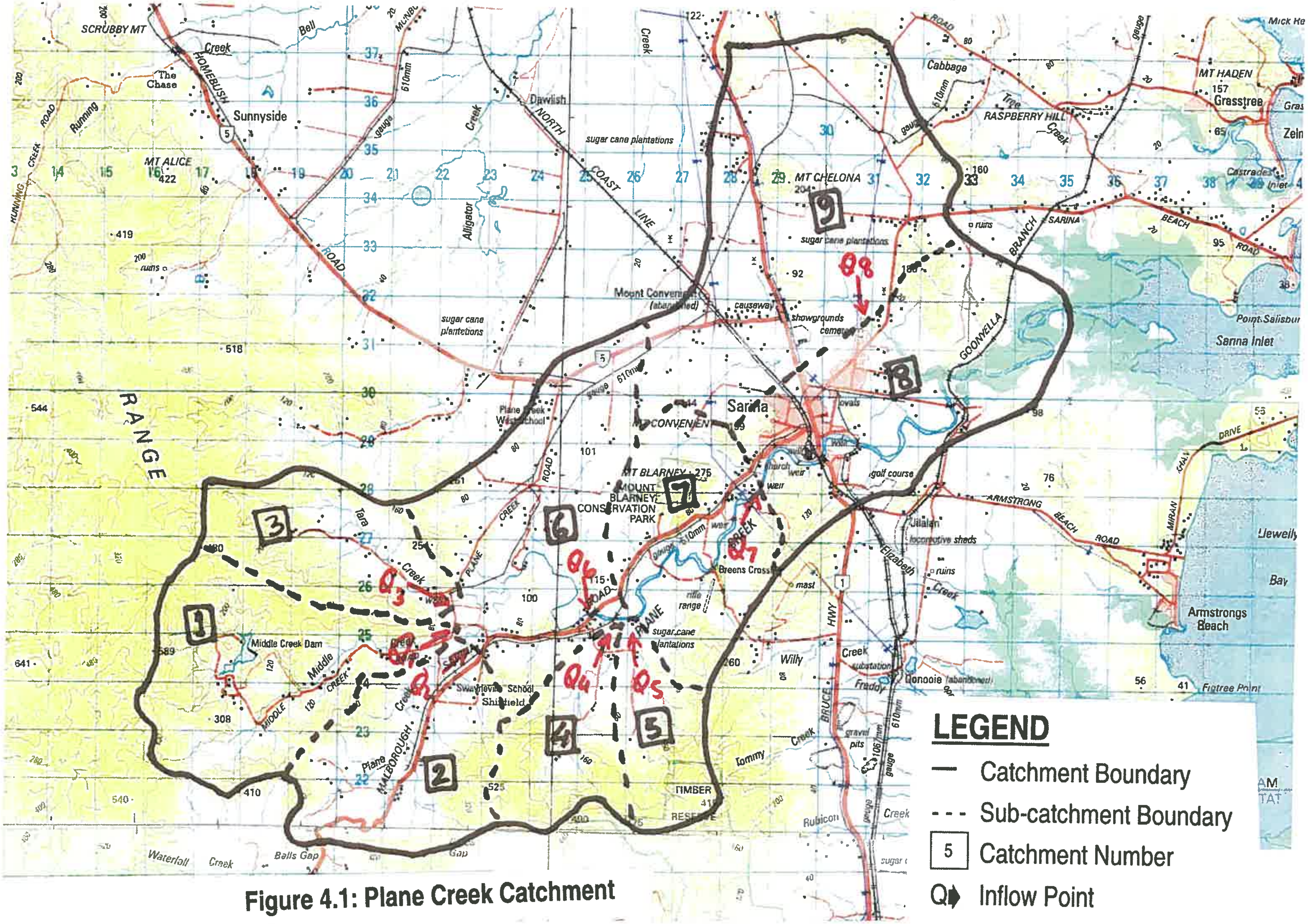


Figure 4.1: Plane Creek Catchment

Table 4.1 Rafts Model Parameters

Sub-Catchment	Land Use	Area (ha)	Sub-Catchment Slope (%)	Impervious (%)	Roughness
1	Open space	1,677	2.53	5	0.07
2	Open space	1,574	2.01	5	0.07
3	Open space	1,184	1.67	5	0.07
4	Open space	573	2.70	5	0.07
5	Open space	784	2.13	5	0.07
6	Open space	1,832	0.46	5	0.07
7	Open space	1,298	1.03	5	0.07
8	Open space & Rural residential	1,914	0.21	10	0.04
9	Open space	3,295	0.59	5	0.07

4.3 Design Rainfall Data

Design rainfall for the subject catchment was derived in accordance with ARR (1987) for Sarina. IFD data for Sarina has been included in Appendix A.

4.4 Rainfall Losses

The catchment was considered to be a in a wet condition at the start of rainfall event. Rainfall losses of 0mm/hr and 2.5mm/hr for initial and continuing losses respectively were applied.

4.5 Critical Duration Event

To determine the critical duration event for the catchment, total design rainfall depths for durations between 2 and 30 hours for a 100 year ARI event were simulated with the RAFTS model. Resultant peak discharges at the catchment outlet have been presented in Table 4.2.

Table 4.2 Critical Duration Determination

Duration (hrs)	Design Rainfall Intensity (mm/hr)	Peak Discharge (m^3/s)
2	86	1220
3	70	1450
4.5	58	1600
6	50	1730
9	41.4	1490
12	36	1810
18	29.5	1300
24	25.6	1970
30	22.8	1530

Key points to note from Table 4.2 include:

- The critical duration event for the Plane Creek catchment is 24 hours; and
- The peak discharge for this event for the 100 year ARI is 1,970m^3/s.

4.6 Design Hydrographs

The RAFTS model was used to generate discharge hydrographs for the 24 hour duration, 1, 2, 5, 10, 20, 50, 100 and 500 year ARI design events.

Discharge hydrographs were required from sub-catchments 8 and 9 for application to the hydraulic model (described in Section 5). Hydrographs derived for sub-catchment 8 represent the discharge generated from the majority of the Plane Creek catchment while the inflow from sub-catchment 9 represents a lateral inflow. Critical duration peak discharges from sub-catchments 8 and 9 have been listed in Table 4.3 for the range of design events considered. The discharge hydrographs are presented in Figures 4.2 and 4.3.

Table 4.3 Critical Duration Peak Discharges

Return Period (year)	Peak Discharge (m^3/s)	
	Sub-Catchment 8	Sub-Catchment 9
1	290	48
2	441	76
5	711	130
10	892	167
20	1142	219
50	1365	274
100	1644	336
500	2408	509

The discharge hydrographs derived for sub-catchment 8 represent the total discharge of the catchment to that point while the discharge from sub-catchment flow of the catchment would be applied to the upstream boundary of the

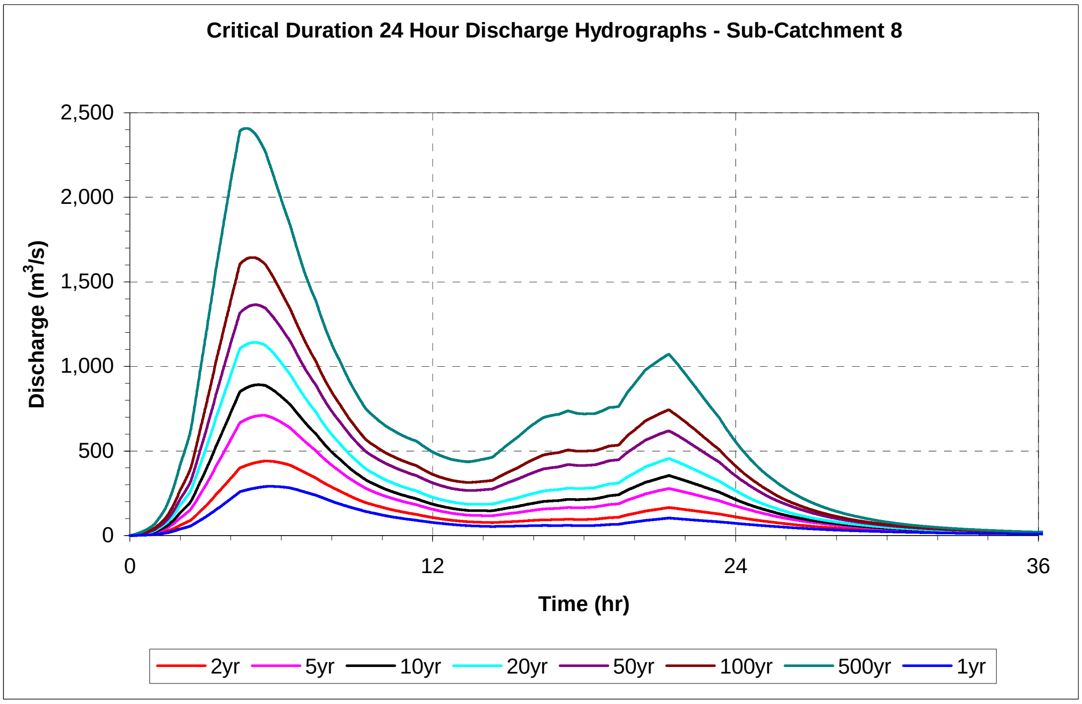


Figure 4.2 Critical Duration Discharge Hydrographs for Sub-Catchment 8

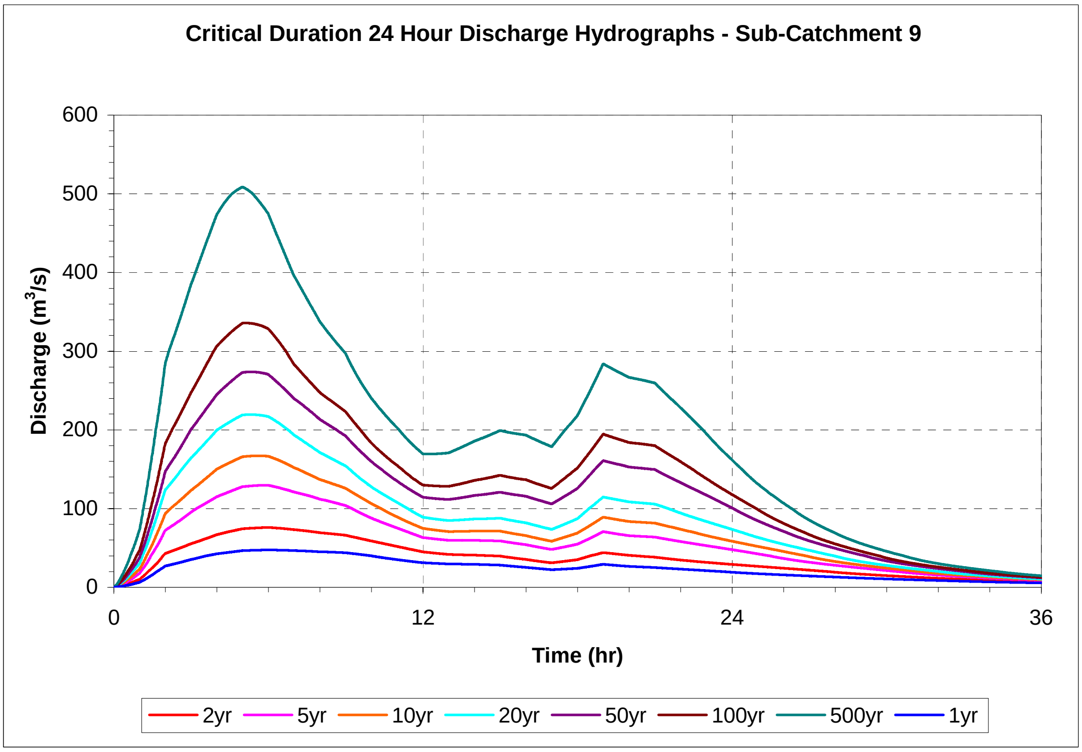


Figure 4.3 Critical Duration Discharge Hydrographs for Sub-Catchment 9

4.7 Verification of Estimated Discharges

A gauging station was located on Plane Creek between 1974 and 1988 and recorded 15 years of stream flow data. Unfortunately, the stream flow record is insufficient to be useful for flood frequency analysis and hydrologic model calibration. Additionally, the maximum peak discharge recorded was 663m^3/s (1978), exceeding the next greatest peak discharge of 431m^3/s (1974) by 232m^3/s. It can be noted that the magnitude of the largest recorded event (663m^3/s) was less than that estimated by the hydrologic model for an event with an ARI of 5 years, thus confirming the recorded data's unsuitability for calibration purposes.

Typically, the Rational Method is employed to verify hydrologic model peak discharge estimations in ungauged catchments. The Rational Method has inherent limitations including constraints on catchment area. Plane Creek catchment at 14,900ha or 149km^2 was considered to exceed the area for which Rational Method estimated discharges might be confidently adopted. A formal verification with the Rational Method was therefore excluded from analysis.

Another runoff and stream flow model, RORB (Laurenson & Mein, 1987), was formulated with the same base data used in the RAFTS model to verify RAFTS discharge estimations. Details of RORB will not be discussed herein beyond the point that a kc value of 12.04 was adopted.

Peak discharges at the catchment for RAFTS and RORB have been presented in Table 4.4.

Table 4.4 Comparison of Peak Discharges between RAFTS and RORB

Parameter	RAFTS	RORB
Critical Duration (hrs)	24	24
Peak Discharge (m^3/s)	1973	1801

It can be concluded from Table 4.4 that:

- The critical duration for each hydrologic model is 24 hours;
- Peak discharges vary between the models by less than 10%, and
- The RAFTS peak discharge exceeds that from RORB.

The 10% variation between models was considered acceptable and the RAFTS model was deemed appropriate for use in subsequent hydraulic analysis.

5. *Hydraulic Modelling*

5.1 MIKE 11 Model

A MIKE 11 unsteady state hydrodynamic model was formulated for hydraulic analysis of Plane Creek. Approximately 9km of Plane Creek was represented from just downstream of the weir, near the Bruce Highway, to the discharge point into Sarina Inlet.

A MIKE 11 model was setup for the existing scenario, that is to represent the study area in its current condition prior to implementation of the works proposed for the Smythes Road underpass.

The model was amended to represent the post developed situation, the scenario that would include the Smythes Road underpass, to determine any variations to flooding patterns or peak flood levels that could be attributed the proposed works.

The MIKE 11 layout has been presented in Figure 5.1.

5.1.1 Branches

Three branches were included in the hydraulic model to represent the existing case. The main branch was Plane Creek and extended for approximately 9km.

Aerial photography and topographic data indicated two areas where Plane Creek would break its banks during large flooding events and would be conveyed across cultivation as overland flow. Each overland flow path was included within the MIKE 11 model.

In the post developed scenario an additional branch was included to represent the flow path that would be created between the western and eastern sides of the railway embankment.

5.1.2 Cross-Sections

Topography of Plane Creek and surrounds was represented in the hydraulic model by a series of 37 cross-sections. An additional six cross-section were included in the “developed” case to represent a potential flow path resulting from the proposed underpass. Cross section locations can be noted on Figure 5.1.

5.1.3 Structures

Several structures were include in the hydraulic model:

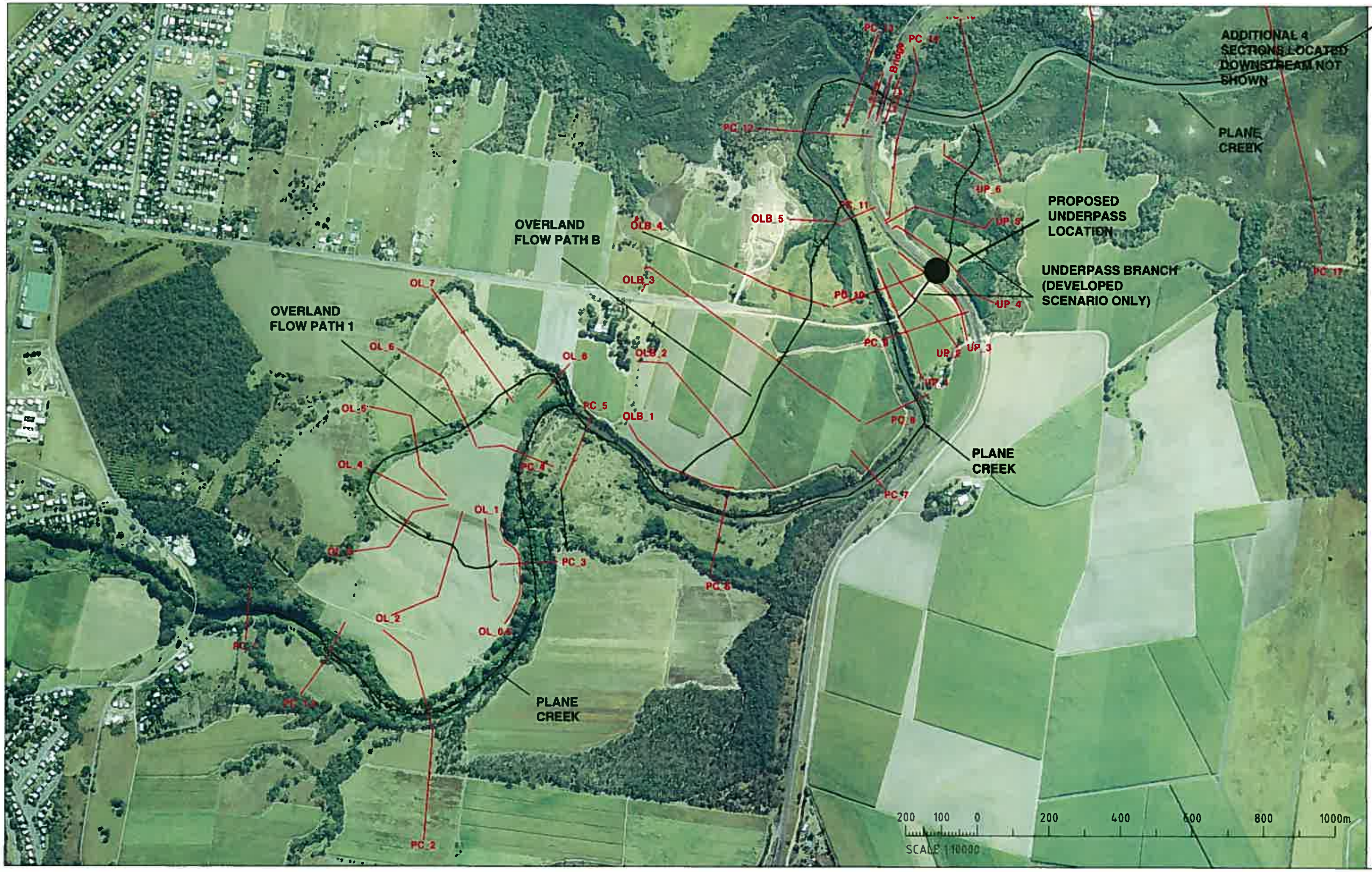
- The Goonyella railway bridge (Railway Ch: 16.95km) at Plane Creek, details sourced from QR Drawing, C9524 (15/11/82);
- The proposed underpass structure was included as a culvert in the post developed scenario with dimensions 4.8m x 11.4m and road invert level at 0.8mAHD; and
- Two weirs representing bunds proposed to provide flood immunity to the underpass for frequent events (ie 1 year ARI).

5.1.4 Manning’s Roughness

Manning’s roughness, ‘n’, were adopted based on aerial photography, site investigation reports and recommendations by Chow, 1957.

The upper reaches of Plane Creek within the study area were noted to be heavily vegetated with trees, grasses and weeds. Further downstream, the channel cleared and consisted of shorter grasses and few trees.

Plane Creek’s floodplain and overland flow paths pass through cultivation where the predominant crop is sugar cane although some areas appear to be utilised for grazing.



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1	24/10/06	For information only	TRW	

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Client
QUEENSLAND RAIL

Project
JILALAN STATION
YARD UPGRADE

Drawn TRW
Signed
Date 24/10/06
Surveyed
Signed
Date
Verified
Signed
Date
Approved
Signed
Date

Drawing Title
FIGURE 5.1
MIKE11 LAYOUT

Project No. HI88
Scale 1:10000
Sheet Size A3
Drawing No. Figure 5.1
Rev 1

20 10 0 10 20 30 40 50mm

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Adopted Manning's roughness values have been listed in Table 5.1.

Table 5.1 Manning's Roughness Values

Branch	Creek Chainage (m)	Manning's "n" Channel	Manning's "n" Floodplain
Plane Creek	0 – 1485	0.1	0.15
	1485 – 2688	0.05	0.04
	2688 – 3511	0.15	0.04
	3511 – 4209	0.05	0.04
	4209 – 9046	0.1	0.04
Overland Flow Path 1	0 – 1160	N/A	0.15
Overland Flow Path B	0 – 900	N/A	0.15
Underpass	0 – 217	N/A	0.15
	217 – 615	N/A	0.1

5.1.5 Upstream Boundary Conditions

Discharge hydrographs derived from the RAFTS model for sub-catchments 8 and 9 were applied to their corresponding locations along Plane Creek in the MIKE 11 model. Sub-Catchment 8 discharges were applied to the upper extremity of Plane Creek (Chainage 0m) and sub-catchment 9 discharges were applied at Plane Creek Chainage 3961m.

5.1.6 Downstream Boundary Conditions

The lower reach of Plane Creek discharges to the estuarine environment of Sarina Inlet and is tidal. As such, the downstream boundary of the MIKE 11 model, Creek Chainage 9046m, was set to represent the various tidal occurrences listed in Table 5.2.

Tide levels included in Table 5.2 were taken from *The Official Tide Tables & Boating Safety Guide* (Queensland Transport, 2006). The closest available tidal data to Sarina Inlet was Hay Point, approximately 15km north of Sarina Inlet which was subsequently adopted as the downstream boundary of the hydraulic model.

Table 5.2 Predicted Tide Levels for Hay Point Adopted for Sarina Inlet

Tidal Condition	Relative to Chart Datum (m)	m AHD
Highest Astronomical Tide (HAT)	7.14	3.8
Mean High Water Springs (MHWS)	5.78	2.44
Mean High Water Neaps (MHWN)	4.46	1.12
Mean Low Water Neaps (MLWN)	2.22	-1.12
Mean Low Water Springs (MLWS)	0.9	-2.44
Lowest Astronomical Tide (LAT)	0.0	-3.34

5.2 Modelling Scenarios

Scenarios simulated in this investigation have been listed in Table 5.3.

Table 5.3 Hydraulic Modelling Scenarios

Scenario	Boundary Conditions
HAT	No upstream inflow (dry condition) HAT tidal cycle at outlet
MHWS	No upstream inflow (dry condition) MHWS tidal cycle at outlet
1 year ARI	1 year ARI upstream inflow Constant MHWS level (2.94m) at outlet
2 year ARI	2 year ARI upstream inflow Constant MHWS level (2.94m) at outlet
5 year ARI	5 year ARI upstream inflow Constant MHWS level (2.94m) at outlet
10 year ARI	10 year ARI upstream inflow Constant MHWS level (2.94m) at outlet
20 year ARI	20 year ARI upstream inflow Constant MHWS level (2.94m) at outlet
50 year ARI	50 year ARI upstream inflow Constant MHWS level (2.94m) at outlet
100 year ARI	100 year ARI upstream inflow Constant MHWS level (2.94m) at outlet
500 year ARI	500 year ARI upstream inflow Constant MHWS level (2.94m) at outlet

5.2.1 Existing Scenario

All of the scenarios listed in Table 5.3 were simulated for the study area, as it exists in its current state, to determine existing peak flood levels.

5.2.2 Developed Scenario

The Jilalan Station Yard Upgrade includes a proposal to realign Smythes Road and requires that the Smythes Road level crossing be replaced with an underpass structure. The underpass structure would be located around 230m north of the level crossing, where Smythes Road approaching from the west, would intersect the railway.

The existing case hydraulic model was amended to include the proposed underpass structure by inclusion of:

- An additional branch allowing conveyance of flow from the western side of the railway to the east;
- A culvert structure (11.4m wide and 4.8m vertical clearance and invert level of 0.8mAHD) to represent the underpass; and
- Bunds adjacent to the underpass with crest elevations of 5.4mAHD and 6.0mAHD for the east and western sides respectively, to provide flood immunity to the underpass during more frequent flooding events.

The amended model representing the study area, following construction of the proposed Smythes Road, was simulated for all of the scenarios listed in Table 5.3.

6. Results of Analysis

Peak flood levels estimated in this hydraulic analysis for the areas immediately upstream and downstream of the proposed underpass have been provided in Table 6.1 for all scenarios simulated.

Table 6.1 Summary of Peak Water Levels for Various Scenarios

Scenario	Peak Flood Levels (m AHD)			
	West of Proposed Underpass		East of Proposed Underpass	
	Existing (Ch:3293)	Developed (UP138)	Existing (Ch:4426)	Developed (UP217)
HAT	3.69	3.69	3.69	3.69
MHWS	2.43	2.43	2.43	2.43
1 year ARI	5.38	5.35	4.65	4.55
2 year ARI	6.17	6.10	5.29	5.17
5 year ARI	7.39	6.99	6.17	6.11
10 year ARI	8.11	7.61	6.65	6.56
20 year ARI	8.99	8.43	7.21	7.08
50 year ARI	9.73	9.15	7.72	7.50
100 year ARI	9.95	9.77	8.36	8.03
500 year ARI	11.01	10.64	9.60	9.17

It can be concluded from Table 6.1 that construction of the proposed underpass would not result in an increase in peak flood levels in the area.

Bunds have been proposed immediately west and east of the proposed underpass to provide flood immunity. Preliminary crest elevations of the bunds adopted were 6.0mAHD and 5.4mAHD for the western (upstream) and eastern (downstream) bunds respectively.

From Table 6.1 it can be determined that the proposed bunds:

- Provide underpass flood immunity for flooding events with ARI up to 1 year;
- Provide 2 year ARI flood immunity for the eastern side of the underpass;
- Would provide full immunity from the 2 year ARI event if the western bund was raised an additional 200mm to 6.2mAHD; and
- Provide flood immunity for the underpass for HAT and MHWS;
- Events with recurrence intervals greater than 2 year will overtop the bunds and flood the underpass.

Peak discharges and velocities through the underpass for all events simulated have been included in Table 6.2.

Table 6.2 Peak Discharges and Velocities Through the Underpass

Scenario	Peak Discharge (m^3/s)	Peak Average Velocity (m/s)
1 year ARI	0	0
2 year ARI	11	0.2
5 year ARI	138	2.5
10 year ARI	181	3.3
20 year ARI	219	4.0
50 year ARI	248	4.5
100 year ARI	286	5.2
500 year ARI	299	5.2

Key points to note from Table 6.2 include:

- Significant flows are conveyed through the underpass during all events greater than 1 year ARI;
- Velocities are high for all events with ARI of 5 years or more; and
- Flow through the underpass is hazardous to pedestrian and vehicular traffic for all events with ARI of 5 years or more.

7. Conclusions

This hydraulic analysis has investigated the flooding behaviour of Plane Creek between the Bruce Highway near Sarina to its discharge point at Sarina Inlet. The hydrologic model, RAFTS and hydraulic model, MIKE 11 were formulated with available data to undertake the study.

Several underpass arrangements were discussed, however at the time of this analysis, no decision had been made as to the preferred method. This analysis has considered the jack box arrangement for which details were sourced from Connell Hatch conceptual drawing SK-RD-005A. Dimensions for the jack box arrangement allow for a vertical clearance of 4.8m and width of 11.4m. The underpass road or bed elevation of 0.8mAHD was also taken from conceptual reporting. The jack box dimensions are similar to other options considered.

Hydraulic analysis was undertaken for the standard range of ARI rainfall events between 1 and 100 years and a 500 year event was also included.

No suitable data were available for calibration of the hydrologic and hydraulic models. A separate hydrologic model was formulated to verify that the adopted hydrology was reasonable.

Queensland Rail drawing C9524 (15/11/1982) of the railway bridge over Plane Creek indicated a peak flood level of 9.55mAHD at the bridge. The peak flood level for the same point determined in this analysis was 9.6mAHD suggesting that the hydraulic model could be used confidently.

This analysis has concluded:

- Peak flood levels in the area will not be increased due to construction of the underpass;
- The underpass would be flooded frequently without bunds to provide flood immunity;
- The underpass would be flooded by all events greater than 2 year ARI if bunds are constructed to 6.2mAHD for the west and 5.4mAHD for the east;
- For flood immunity against greater events bund heights would be excessive, eg 2.5m (for ARI 5 years);
- The peak flood level of the 100 year ARI event upstream of the proposed underpass would be 9.77mAHD (underpass constructed scenario), approximately 5.5m above natural surface level at that point;
- HAT and MWHS levels approach the natural surface level in the area of the proposed underpass;
- The underpass will function as a culvert during flooding events, hydraulic control is dependant on the event magnitude;
- Flows through the underpass would be conveyed at high velocity for events with ARI greater than 5 years;
- A flowrate of 286m^3/s would be expected through the underpass for a 100 year ARI event and conveyed at a maximum average velocity of 5.2m/s;
- During flooding the underpass would be hazardous to pedestrian and vehicular traffic;
- Velocities return to reasonable levels a short distance from the underpass; and
- Depending on the final arrangement, it is likely that anti-scouring measures would need to be employed immediately upstream and downstream of the underpass.

Appendix A

Design Rainfall Intensity Frequency Duration Data for Sarina

Rainfall Intensity for Sarina, Qld

Duration	Average Recurrence Interval						
	1 Year (mm/hr)	2 Year (mm/hr)	5 Year (mm/hr)	10 Year (mm/hr)	20 Year (mm/hr)	50 Year (mm/hr)	100 Year (mm/hr)
5.0 m	117	152	198	226	263	313	353
5.5 m	114	148	192	219	255	304	342
6.0 m	110	143	186	213	248	295	332
6.5 m	108	140	181	207	241	287	323
7.0 m	105	136	177	202	235	280	315
7.5 m	102	133	172	197	229	273	308
8.0 m	100	130	168	192	224	267	301
8.5 m	98	127	165	188	219	261	294
9.0 m	96	124	161	184	214	255	288
9.5 m	94	122	158	180	210	250	282
10 m	92	119	155	177	206	245	276
11 m	89	115	149	170	198	236	266
12 m	86	111	144	165	192	228	257
13 m	83	107	140	159	186	221	249
14 m	80	104	135	154	180	214	241
15 m	78	101	131	150	175	208	234
16 m	76	98	128	146	170	202	228
17 m	74	96	125	142	166	197	222
18 m	72	94	121	139	161	192	216
19 m	70	91	119	135	158	188	211
20 m	69	89	116	132	154	183	206
21 m	67	87	113	129	151	179	202
22 m	66	85	111	127	147	176	198
23 m	65	84	109	124	144	172	194
24 m	63	82	107	122	142	169	190
25 m	62	81	105	119	139	165	186
26 m	61	79	103	117	136	162	183
27 m	60	78	101	115	134	159	179
28 m	59	76	99	113	132	157	176
29 m	58	75	97	111	129	154	173
30 m	57	74	96	109	127	152	171
32 m	55	72	93	106	123	147	165
34 m	54	69	90	103	120	142	160
36 m	52	68	88	100	116	138	156
38 m	51	66	85	97	113	135	152
40 m	49.4	64	83	95	110	131	148
45 m	46.5	60	78	89	104	124	139
50 m	44.1	57	74	85	98	117	132
55 m	41.9	54	71	80	94	111	125
60 m	40.1	52	67	77	89	106	120
75 m	35.4	46.0	60	69	80	96	108
90 m	32.0	41.6	55	63	73	88	99
105 m	29.3	38.2	50	58	68	81	92
120 m	27.1	35.4	46.8	54	63	76	86
135 m	25.4	33.1	43.9	51	60	72	81
150 m	23.9	31.2	41.5	48.0	56	68	77
165 m	22.6	29.6	39.4	45.6	54	65	74
180 m	21.5	28.2	37.6	43.6	51	62	71
195 m	20.5	26.9	36.0	41.8	49.4	60	68
210 m	19.6	25.8	34.6	40.2	47.5	58	66
225 m	18.9	24.8	33.3	38.8	45.9	56	63
240 m	18.2	23.9	32.2	37.5	44.4	54	61
270 m	17.0	22.4	30.2	35.2	41.8	51	58
300 m	16.0	21.1	28.5	33.3	39.6	48.2	55
6 h	14.4	19.0	25.9	30.3	36.0	44.0	50
7 h	13.2	17.4	23.8	27.9	33.3	40.8	46.8
8 h	12.2	16.1	22.2	26.1	31.1	38.2	43.8
9 h	11.4	15.1	20.8	24.5	29.3	36.0	41.4
10 h	10.7	14.2	19.7	23.2	27.8	34.2	39.3
11 h	10.1	13.5	18.7	22.1	26.5	32.6	37.5
12 h	9.65	12.8	17.8	21.1	25.3	31.2	36.0
14 h	8.80	11.7	16.4	19.4	23.4	28.9	33.4
16 h	8.12	10.8	15.2	18.1	21.8	27.0	31.2
18 h	7.57	10.1	14.2	17.0	20.5	25.4	29.5
20 h	7.10	9.51	13.4	16.0	19.4	24.1	28.0
22 h	6.70	8.98	12.7	15.2	18.4	23.0	26.7
24 h	6.35	8.53	12.1	14.5	17.6	22.0	25.5
30 h	5.54	7.45	10.7	12.8	15.6	19.6	22.8
36 h	4.93	6.65	9.58	11.6	14.1	17.8	20.7
42 h	4.46	6.03	8.74	10.6	12.9	16.3	19.1
48 h	4.09	5.53	8.05	9.77	12.0	15.2	17.8
54 h	3.77	5.12	7.48	9.10	11.2	14.2	16.6
60 h	3.51	4.76	6.99	8.52	10.5	13.3	15.7
66 h	3.28	4.46	6.56	8.02	9.89	12.6	14.8
72 h	3.08	4.19	6.19	7.58	9.36	11.9	14.1

The rainfall intensities shown above are calculated in accordance with Chapter 2, Australian Rainfall and Runoff - 1987 Edition.

Sarina, Qld; 21.25 South 149.15 East

27 February,2007

AUS-IFD
Ver 2.0, 1999

Appendix D

Preliminary Geotechnical Investigation

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Preliminary Geotechnical Investigation
Jilalan Station Bypass
Queensland Rail

21 February 2007
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Rev No	Date	Revision Details	Typist	Author	Verifier	Approver
0	21 February 2007	Final				

Contents

1. Introduction

This report represents the results of the preliminary geotechnical investigation carried out by Connell Hatch for the preliminary design of a bypass line and rail yard upgrade of Jilalan Station. It is understood that the proposed works at the site will comprise fill embankments up to 7m in height and cuttings up to 17m in depth.

The geotechnical investigation was carried out to supplement the findings obtained from the previous studies to provide additional information to identify likely subsurface conditions, subsurface material properties and groundwater conditions for assessment and recommendations regarding earthworks, preliminary foundation design, excavatability and further investigation requirements.

2. Site Description and Regional Geology

2.1 Site Description

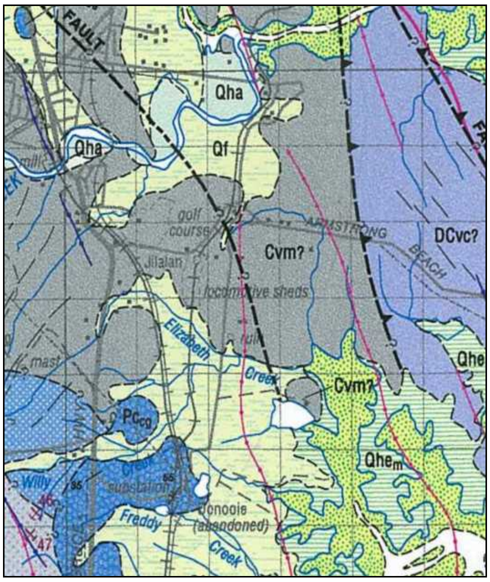
The site under investigation is an area to the East of the existing rail line in Jilalan. The site extends approximately 5.3km North-South and ranges from 50 to 400m in width East-West. The site is bounded by Smyths Road to the East and the existing rail line to the West, the Smyths Road level crossing to the North and the Oonoonie Road level crossing to the South.

The region is currently utilised for sugar cane farming with some natural bush areas. At least 3 minor creek watercourses are evident along the conceptual alignment. The creeks are generally deep cut, steep walled channels up to 4m deep, flanked by native bushland. Existing roadways currently overly the conceptual alignment as well as the crossing of the North Coast Railway at the southern end of the region.

2.2 Regional Geology

Reference to the Queensland Government Natural Resources and Mines1:100,000 Geological Series map indicates the site is underlain by the Mountain View Volcanics which comprise a heterogenous assemblage of andesitic to rhyolitic lava flows and volcaniclastic rocks (including ignimbrite, breccia, conglomerate and sandstone), the Carmilla Beds which comprise volcanolithic conglomerate and minor sandstone and Quaternary Alluvium which comprises clay, sand, silt and gravel. Review of the geological map also indicates that the Sarina Fault cuts across the site in the vicinity of Armstrong Beach Roads intersection with the rail line.

Figure 1 – Regional Geology



Legend Qha & Qf - Quaternary Alluvium
PCcg - Carmilla Beds
Cvm - Mountain View Volcanics
Map Scale is each box represents 1km x 1km

3. Site Investigation

3.1 Field Investigation

Subsurface conditions were investigated by excavation and sampling seven test pits with a Volvo BL71 Backhoe and the drilling and sampling of sixteen additional boreholes, using a Jacro 200, to depths between 1.3 and 9.0m. Dynamic Cone Penetrometer (DCP) tests were also conducted at each of the borehole positions. The previous investigations undertaken at the site comprised 14 boreholes and Spectral Analysis of Surface Waves (SASW) at 20 locations. The Spectral Analysis of Surface Waves (SASW) testing previously carried out across the site was reassessed to provide additional information on the excavatability of the materials on the site.

The soil classification descriptions and field tests were carried out in general accordance with Australian Standards:

AS1726-1993	Geotechnical Site Investigation
AS1289	Methods of Testing Soils for Engineering Purposes

The test pit, DCP and SASW records are attached to this report. A site plan detailing the investigation locations has also been attached.

3.2 Subsurface Profile

A summary of the subsurface profile intersected during the existing and previous investigations is presented in Table 3.1. The ground condition investigated generally shows the following succession

- Fill
- Alluvial Soil
- Residual Soil
- Weathered Rock

Table 3.1 Subsurface Profile at Test Locations

Test Location	Stratigraphy Encountered					
	Fill Topsoil* (m)	Alluvial Soil (m)	Residual Soil (m)	Weathered Basalt – Meta-Volcanics (m)	Weathered Siltstone/ Sandstone – Meta-Sedimentary (m)	Termination Depth (m)
BH-01 / 01A	-	0.0-5.4	5.4-TD	-	-	5.8
BH-02	0.0-0.3	0.3-5.6	5.6-TD	-	-	6.45
BH1	0.0-0.8	-	0.8-4.15	-	4.15-TD	4.5
BH2	0.0-1.4	-	1.4-4.1	-	4.1-TD	6.0
BH3	0.0-0.2	0.2-0.45	-	0.45-TD	-	0.8
BH4	N/A	N/A	N/A	N/A	N/A	N/A
BH5	0.0-3.0	-	-	3.0-TD	-	3.2
BH6	-	0.0-1.35	1.35-1.8	-	1.8-TD	2.0
BH7	-	0.0-0.4	0.4-2.2	-	2.2-TD	3.7
BH8	0.0-0.3	-	0.3-0.75	-	0.75-TD	0.8
BH9	0.0-0.4	0.4-5.7	5.7-TD	-	-	6.0
BH10	0.0-0.3	0.3-0.7	0.7-0.9	-	0.9-TD	1.3
BH11	0.0-0.35	-	-	-	0.35-TD	1.2
BH11a	-	0.0-0.95	-	-	0.95-TD	3.1
BH12	-	-	0.0-2.1	-	2.1-TD	2.85
TP1	0.0-1.3	-	-	-	1.3-TD	2.3
TP2	0.0-0.5	-	-	0.5-TD	-	2.5
TP3	0.0-0.5	-	0.5-TD	-	-	3.3
TP4	-	-	0.0-1.1	-	1.1-TD	1.3
TP5	0.0-0.20	-	0.2-1.8	1.8-TD	-	2.2
TP6	-	-	0.3-TD	-	-	2.8
TP7	0.0-0.2	-	0.2-3.6	3.6-TD	-	3.8
TP8	-	-	-	0.0-2.0	2.0-TD	4.0
CW13	0.0-2.7	2.7-TD	-	-	-	9.0
CW14	-	0.0-TD	-	-	-	6.0
CW15	-	0.0-TD	-	-	-	6.0
CW16	-	-	0.0-0.8	0.8-TD	-	1.45
CW17	0.0-1.8-	-	1.8-2.4	2.4-TD	-	2.7
CW18	-	-	0.0-1.9	-	1.9-TD	2.1
CW19	0.0-0.2	-	-	-	0.2-TD	1.4
CW20	-	-	0.0-TD?	-	-	5.0
CW21	-	-	0.0-TD?	-	-	6.0
CW22	-	-	0.0-TD?-	-	-	4.2
CW23	-	0.0-3.2	3.2-4.5	-	4.5-TD	4.6
CW24	-	-	0.0-TD?	-	-	6.0
CW25	-	-	0.0-TD?	-	-	6.0
CW26	-	-	0.0-0.5	-	0.5-TD	1.7
CW27	0.0-0.3*		0.3-TD			6.0
CW28	-	-	0.0-1.1	-	1.1-TD	2.4

Notes: ? = Indicates probable residual soils.

Due to the large extent of the site some variation is evident over the test locations. General description of the subsurface profile has been provided below.

Fill

The fill material encountered varied from dense, coarse gravel and cobbles (Ballast) to uncontrolled, soft to firm sandy clay with some organic components. Apart from BH5 where up to 3.0m of uncontrolled fill appears to have been used to cover an old excavation, and CW13 where 2.7m of fill was recorded which appears to be part of the filling associated with existing rail embankment, the fill encountered on-site did not extend below 1.4m and was often either significantly shallower or not present at all.

Alluvial Soils

The alluvial soils encountered on-site were often found to extend to a minimal depth above a residual profile and in these locations depths were generally less than 1.35m. Significant depths of alluvium were encountered at a number of locations on the site, including the northern end of the site adjacent to Plane Creek or on its floodplain and close to the creeks elsewhere on the site the depths generally encountered were between 5.4m and greater than 9.0m. The strength of the alluvium ranged from soft to hard.

Residual Soils

The residual soils encountered on-site were in general residual products of weathered Siltstone/Sandstone/Conglomerate or Volcanics. The residual soils encountered were generally clayey gravels, sandy gravels, silty clays, clayey silts, sandy clays. The depths where the soils ranged from surficial depths overlying rock to beyond 6.0m depth.

Weathered Rock (Siltstone/Sandstone/Conglomerate Volcanics (Basalt))

Siltstone, Sandstone or Conglomerate was encountered at 17 of the test locations and Volcanics were encountered at eight locations. The depths over which rock was encountered ranged from 0.45 to 4.5m depth. Where rock was encountered within the boreholes Tungsten Carbide Bit refusal occurred at a number of locations, this generally denotes a low to medium strength rock. The depth at which this material is encountered varied over the site from 0.35 to over 6.0m.

3.3 Groundwater

Groundwater was recorded in two boreholes undertaken during the current investigation. Groundwater was recorded in CW13 at a depth of 3.3m and CW22 at a depth of 1.1m in November 2006.

Groundwater was encountered in only BH6 at 0.7m depth, during site investigations undertaken in February 2006. BH6 was positioned beside an existing sugar cane field, the fast inflow of water into the borehole and the steady water level at 0.7m inside the hole may indicate the effect of irrigation rather than the natural groundwater level.

In the previous investigation undertaken at the northern end of the site for a proposed underpass in December 2005, groundwater was encountered between 2.8 and 3.3m depth. It is anticipated that in the vicinity of these boreholes and CW13 (November 2006) that local groundwater levels could be expected to fluctuate on a dampened tidal cycle due to the close proximity to the tidal estuary of Plane Creek.

A summary of the groundwater encountered during site investigations is presented in Table 3.2.

Table 3.2 Groundwater Summary

Borehole Number	Date Drilled	Groundwater Depth (m bgl)
BH01 / 01A	13/12/2005	3.3
BH02	13/12/2005	2.8
BH6	16/02/2006	0.7*
CW13	28/11/2006	3.3
CW22	28/11/2006	1.1

* Surface water from an irrigation canal

3.4 Site Observations

A significant cutting is evident on the western side of the existing rail line beneath the Armstrong Beach Road overpass. The cutting inclination was approximately 0.5H:1V. The exposed face showed a weathered grade from extremely weathered increasing in strength to moderately to slightly weathered at the exposed base. The face was composed of dark grey Basalt with a weathered interface at 30 degrees from horizontal to a highly weathered, light brown Siltstone.

3.5 Spectral Analysis of Surface Waves (SASW)

SASW (Spectral Analysis of Surface Waves) tests were carried out at short borehole and intermediate locations along the alignment, during the investigation in February 2006. During this investigation boreholes were drilled adjacent to the majority of the intermediate SASW locations. The SASW testing was used in addition to traditional Dynamic Cone Penetration (DCP) tests to determine subgrade modulus values for the proposed alignment. In addition the SASW results were assessed to provide information on the potential excavatability of the subsurface materials on the site.

SASW is a non-invasive, non-destructive seismic method for determining shear wave velocities. Once the shear wave velocity profiles are determined, shear and elastic moduli of the materials can be calculated through the use of simple mathematical equations. Seismic techniques can be used for investigation of hard strata effectively and reliably.

SASW utilises the single impulse (generally a hammer blow) or traditional energy sources to measure the seismic wave velocity. This works in the frequency ranges of 3Hz to 200 Hz, which could be generated by a range of hammers of different mass or different dropping heights. These waves are recorded by geophones positioned at 1m intervals along a straight line and the energy source placed at 2m from the geophones.

Primarily in this investigation the SASW has been used to determine:

- The ground profile between the investigation borehole sites; and,
- Profiling of soil and rock shear stiffness and modulus.

The SASW testing has been analysed using methods outlined in Schneider et al. (1999), Mayne and Schneider (2000), Massarch (1984) and Menzies (2000). These papers provide relationships relating the seismic shear wave velocity to the saturated density, static shear and elastic modulii as shown below:

Saturated Density, p_t – Schneider et al. (1999)

$$p_t = 1 + \frac{1}{0.614 + \frac{58.7 \times (\log(z) + 1.095)}{V_s}}$$

Where: Vs = Shear Wave Velocity (m/s) and
z = depth below surface (m)

Shear Modulus, G_{MAX}

$$G_{MAX} = p_t \times V_s$$

Where: p_t = Saturated Density (t/m^3)
V_s = Shear Wave Velocity (m/s)

Small Strain Elastic Modulus, E_{MAX}

$$E_{MAX} = G_{MAX} \times (2 \times (1 + \nu))$$

Where: ν = Poisson's Ratio

Working Elastic Modulus, $E_{WORKING}$

$$E_{WORKING} = E_{MAX} \times R$$

Where: R = Reduction Factor (shown in Table 3.3)

The Elastic Modulus, or soil stiffness, is dependent on the strain level. The initial shear and elastic moduli calculated by the SASW provide a measure of the upper bound for stiffness, the maximum modulus value that occurs at strains close to zero, ie less than 0.001%. "Real" strains that are associated with soil-structure interaction problems are less than 0.1%. Hence a reduction (or degradation) factor is required which takes into account the strain-softening effect of soils. A literature review has been carried out to determine the likely range of reduction factors and these are summarised in Table 3.3.

Table 3.3 Elastic Modulus Reduction Factors

Material	Reduction Factor, R*	Reference
Gravel	0.20	Massarch (1984)
Sandy Gravel	0.19	Massarch (1984)
Loose Sand	0.18	Massarch (1984)
Medium Dense Sand	0.15	Massarch (1984)
Dense Sand	0.12	Massarch (1984)
Intact Chalk	0.42	Menzies (2000)
London Clay	0.35 – 0.58	Menzies (2000)
Bothkennar Clay	0.36 – 0.55	Menzies (2000)
Mobilised Stress Level (q/q_u)	0.187	Mayne and Schneider (2000)

Note: * - Reduction factors are applicable for the 0.1% strain level

Using the above formulae and reduction factors an interpreted summary of the SASW modulus results is presented in Table 3.4. The full results for each test are attached to this report (See Appendix E).

Table 3.4 SASW Results Summary

SASW ID	Location	Depth (m) to E (MPa)				Termination	
		100	200	500	1000	Depth (m)	Modulus (MPa)
sasw15021909_1	BH1	1.4	3.4	-	-	4.6	375
sasw15022024_1	BH2	0.7	1.9	-	-	5.3	350
sasw16021754_1	BH3	0.8	1.5	3.5	-	6.2	925
sasw15022123_1	BH5	0.9	1.4	4.9	-	5.2	850
sasw15022211_1	BH6	0.8	1.5	3.0	4.2	5.6	1400
sasw16021856_1	BH7	1.4	2.5	-	-	5.4	480
sasw16021935_1	BH8	0.8	1	1.6	-	4.4	925
sasw16020027_1	BH9	2.0	2.3	7	-	7.5	980
sasw16020123_1	BH10	0.5	0.9	2.5	-	6	820
sasw15020230_1	BH11	1.3	1.4	2.4	-	5	850
sasw16022011_1	SASW13	3	4.3	5.2	-	5.4	580
sasw16022047_1	SASW14	1	3.5	-	-	4.5	400
sasw16022109_1	SASW15	2.0	2.2	-	-	3.9	325
sasw16022110_1	SASW16	1.3	1.5	-	-	2.4	340
sasw16022145_1	SASW17	1	1	1.5	2.2	7.8	3600
sasw16022203_1	SASW18	1.6	1.8	2.5	3.7	4.4	1360
sasw16022222_1	SASW19	1.2	1.9	2.1	-	3	980
sasw16022244_1	SASW20	1.9	2.5	-	-	3	300
sasw16022314_1	SASW21	0.5	1.9	3.1	-	5	950

4. Laboratory Testing

4.1 Test Schedule

In addition to the ground investigation program, laboratory testing was carried out at a NATA registered laboratory on selected samples obtained from the site investigation. The laboratory testing aimed at assessing the classification and strength of the subsurface profile. The laboratory testing program was conducted under supervision of an experienced engineering geologist and in accordance with A.S. 1289 “Methods of Testing Soils for Engineering Purposes”. The laboratory test results are included in Appendix C.

The soil testing program included:

- Particle size distribution of the subgrade materials for classification purposes;
- Atterberg limits testing of the subgrade material for classification purposes;
- Californian Bearing Ratio (CBR) tests to determine subgrade strength;
- Emerson Class tests to determine dispersive characteristics in water;
- Unconfined Undrained Compression testing to determine the undrained soil strength; and
- Shrink – Swell index testing to determine the soil expansion/contraction potential.

The number of samples tested by the various methods are shown in the Table 4.1.

Table 4.1 Laboratory Tests

Test	Number of Samples Tested
Particle Size Distribution	23
Atterberg Limits Test	25
Soaked CBR	18
Emerson Class	18
Unconfined Undrained Compression Test	6
Shrink – Swell Index Test	2

4.2 Test Results

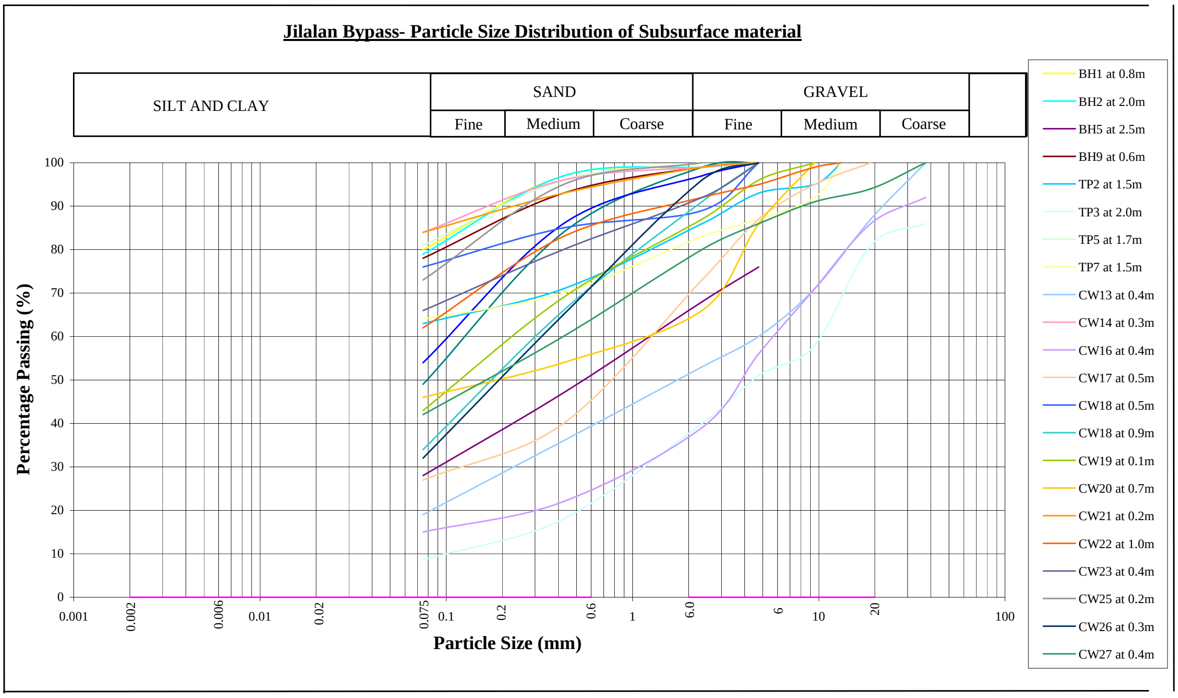
Particle size distribution tests are used to assist in classification of cohesive and non cohesive materials. The classification strata and behaviour has been used to assist in the generation of the geotechnical model of the site, the determining of appropriate excavation and construction methods and parameter estimation for preliminary foundation assessment.

The results of the particle size distribution tests are tabulated in Table 4.3 and a graphical representation of the results is presented in Figure 2.

Table 4.2 Particle Size Distribution: Test Method AS1289 3.6.1

Test Location	Depth (m)	% Passing Sieve				MC (%)	Classification (USC Symbol)
		4.75	2.36	0.425	0.075		
BH1	0.8	100	99	97	80	16.2	CH
BH2	2.0	100	99	97	79	19.2	CH
BH5	2.5	76	68	47	28	11.2	CL
BH9	0.6	100	99	93	78	13.6	CH
BH11a	0.6	100	99	84	49	14.7	CI
TP2	1.5	93	86	71	63	N/A	CH
TP3	2.0	51	40	18	8.6	N/A	GW
TP5	1.7	100	100	96	81	N/A	CI
TP7	1.5	87	83	70	64	N/A	CL
CW13	0.4	60	53	36	19	N/A	CL
CW14	0.3	100	99	96	84	N/A	CH
CW15	0.15	100	97	86	56	N/A	CI
CW16	0.4	56	39	22	15	N/A	GC
CW17	0.5	87	73	40	27	N/A	CL
CW18	0.5	100	89	85	76	N/A	CH
CW18	0.9	100	91	66	34	N/A	ML
CW19	0.1	96	87	69	43	N/A	CL
CW20	0.7	86	66	54	46	N/A	CI
CW21	0.2	100	99	93	84	N/A	CI
CW22	1.0	95	92	83	62	N/A	CI
CW23	0.4	100	92	80	66	N/A	CI
CW25	0.2	100	100	95	73	N/A	CL
CW26	0.3	100	96	65	32	N/A	CL
CW27	0.4	86	80	60	42	N/A	CL

Figure 2 Particle Size Distribution Test Results



4.2.1 Atterberg Limits

Atterberg limit tests are used to assist in classification of cohesive (silt and clay) materials. The classification strata and behaviour has been used to assist in the generation of the geotechnical model of the site, the determining of appropriate excavation and construction methods and parameter estimation for preliminary foundation assessment.

The results of the Atterberg Limits tests are tabulated in Table 4.3 and a graphical representation of the results is presented in Figure 3.

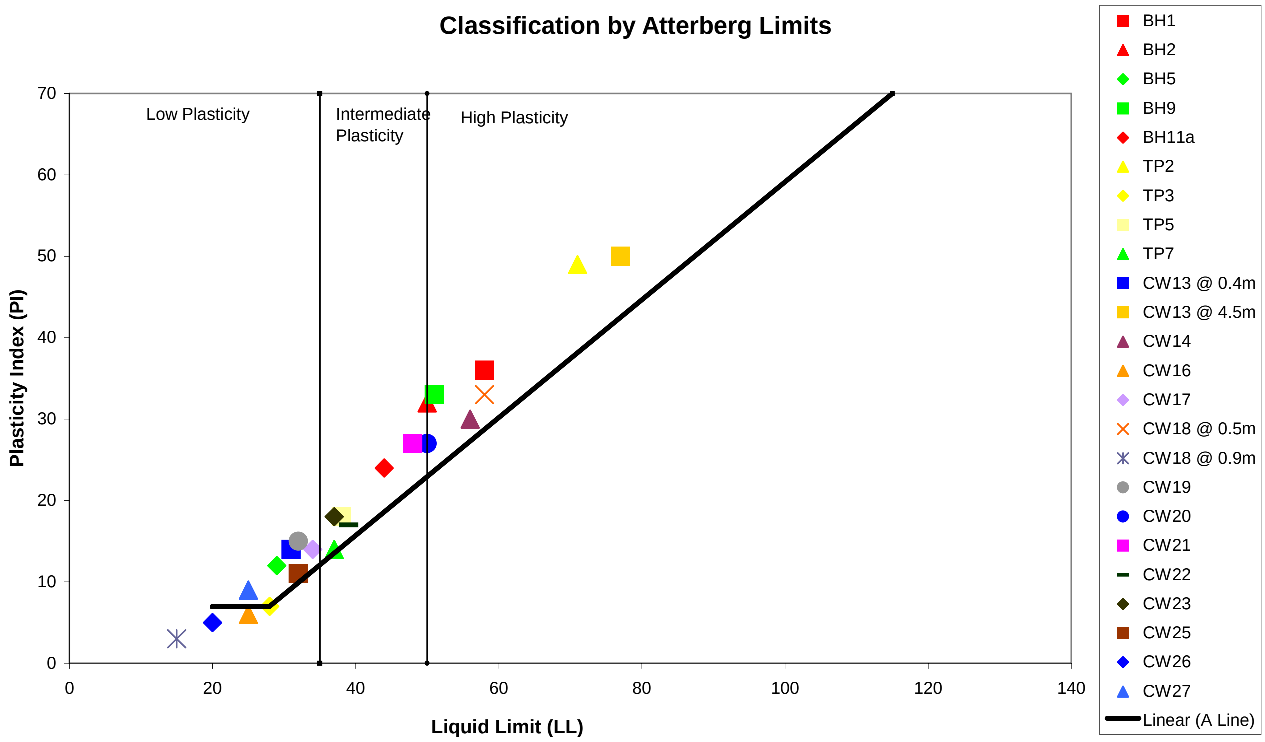
Table 4.3 Atterberg Limits Test

Location	Depth (m)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	Field Moisture Content (%)
BH1	0.8	58	22	36	9.5*	16.2
BH2	2.0	50	18	32	13.0*+	19.2
BH5	2.5	29	17	12	#	11.2
BH9	0.6	51	18	33	8.0	13.6
BH11a	0.6	44	20	24	12.0*	14.7
TP2	1.5	71	22	49	24.5	NA
TP3	2.0	28	21	7	4.5	NA
TP5	1.7	38	20	18	12.0	NA
TP7	1.5	37	23	14	7.0	NA
CW13	0.4	31	17	14	7.0	NA
CW13	4.5	77	27	50	17.0	NA
CW14	0.3	56	26	30	12.0	NA
CW15	0.15	41	21	20	10.0	NA

Location	Depth (m)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	Field Moisture Content (%)
CW16	0.4	25	19	6	4.0	NA
CW17	0.5	34	20	14	8.0	NA
CW18	0.5	58	25	33	16.5	NA
CW18	0.9	15	12	3	2.5	NA
CW19	0.1	32	16	15	11.0	NA
CW20	0.7	50	23	27	11.0	NA
CW21	0.2	48	21	27	13.5	NA
CW22	1.0	39	22	17	11.0	NA
CW23	0.4	37	19	18	12.0	NA
CW24	0.5					NA
CW25	0.2	32	21	11	7.0	NA
CW26	0.3	20	15	5	3.5	NA
CW27	0.4	25	16	9	6.0	NA

*Crumbling occurs +Curling occurs # Insufficient material
NA = Not available

Figure 3 Atterberg Limits Test Results



4.2.2 Californian Bearing Ratio

Californian Bearing Ratio tests have been conducted for preliminary estimation of pavement subgrade design and the results of the testing are tabulated in Table 4.4.

Table 4.4 Californian Bearing Ratio: Test Method AS1289 5.1.1, 6.1.1

Location	Depth (m)	Optimum Moisture Content (%)	Sample Moisture (%)	Swell (%)	Compaction (Modified %)	Laboratory CBR (%)
TP2	1.5	16.5	26.0	4.5	95	2
TP3	2.0	12.5	13.6	-0.3	95	4
TP5	1.7	19.5	23.2	1.9	95	3
TP7	1.5	13.0	17.0	2.0	95	2.5
CW13	0.4	10.0	13.0	0.2	95	15
CW14	0.3	18.0	24.6	2.0	95	5
CW15	0.15	16.0	22.2	4.2	95	2.5
CW16	0.4	9.5	12.4	0.2	95	80
CW17	0.5	13.0	19.0	0.2	96	40
CW18	0.9	8.5	8.8	0.6	95	11
CW19	0.1	16.5	21.9	5.6	95	3
CW20	0.7	10.5	23.8	5.5	95	1
CW21	0.2	16.0	22.6	2.2	95	4.5
CW22	1.0	15.5	20.4	2.9	95	3.5
CW23	0.4	15.0	19.8	2.1	95	4.5
CW25	0.2	13.5	21.8	4.7	95	1.5
CW26	0.3	13.0	14.7	0.6	95	19
CW27	0.4	10.5	13.1	1.0	95	12

4.2.3 Emerson Class Number

The Emerson Class tests categorise the potential for a soil to undergo dispersion. The test gives an indication of the potential for erosion of a material during excavation and construction and the potential for this material to pollute waterways through suspended solids. The results of the Emerson Class Number tests are presented below in Table 4.5.

Table 4.5 Emerson Class Number: Test Method AS1289 3.8.1

Location	Depth (m)	Material Description	Emerson Class Number	Potential Risk of Dispersion
TP2	1.5	Sandy Clay with Gravel	1	Very high
TP3	2.0	Sandy Gravel	4	Medium
TP5	1.7	Clay with Sand	1	Very high
TP7	1.5	Sandy Clay with Gravel	1	Very high
CW13	0.4	Sandy Gravel with Clay	4	Medium
CW14	0.3	Sandy Clay	4	Medium
CW16	0.4	Sandy Gravel with Clay	1	Very high
CW17	0.5	Gravelly Clayey Sand	1	Very high
CW18	0.5	Sandy Clay	1	Very high

Location	Depth (m)	Material Description	Emerson Class Number	Potential Risk of Dispersion
CW18	0.9	Clayey Sand	1	Very high
CW19	0.1	Clayey Sand with Gravel	2	High
CW20	0.7	Clayey Sandy Gravel	1	Very high
CW21	0.2	Sandy Clay	1	Very high
CW22	1.0	Sandy Clay	1	Very high
CW23	0.4	Sandy Clay	2	High
CW25	0.2	Sandy Clay	1	Very high
CW26	0.3	Clayey Sand	2	High
CW27	0.4	Clayey Gravelly Sand	2	High

The results of the Emerson Class tests indicated that the soils encountered over the proposed rail area has a very high to medium potential risk of dispersion and may disperse in low velocity or volume flows. Consequently appropriate erosion control measures should be taken where soils are to be exposed.

4.2.4 Unconfined Compressive Strength

Table 4.6 Qu – unconfined undrained compression: Test Method AS1289 6.4.1

Location	Depth (m)	Material Description	Compressive Strength (kPa)
CW17	1.2	Clayey Sand	153
CW20	1.9	Clay	370
CW21	1.3	Sandy Clay	301
CW22	1.0	Clay	402
CW23	1.0	Silty Clay	339
CW27	2.0	Silty Clay	729

4.2.5 Shrink – swell index

Table 4.7 Shrink – swell index: Test Method AS1289 7.1.1

Location	Depth (m)	Material	Shrink Swell index (%)
CW13	4.5	Clay	4.2
CW23	1.0	Silty Clay	0.2

5. Preliminary Engineering Assessment

5.1 Earthworks

5.1.1 Trafficability

At the time of the field investigation, trafficking problems were not encountered. However, it is expected following stripping of vegetation from the site that the sandy / silty clays, sandy silts, clayey gravels, clayey / silty sands, which will be exposed, may present substantial trafficking problems, particularly after periods of rainfall. It is recommended that in these potential problem areas, that after stripping, clearing and grubbing, the exposed surface should be proof rolled to improve trafficability. If the exposed surface is too soft to be successfully proof rolled, the soft material should be excavated and replaced provided the existing earthworks and structures where present are not destabilised by undercutting. Where excavation and replacement is impractical the alternative is placement of geotextile, geogrid and trafficing layer

All embankment foundation material shall be compacted to a minimum of 90% Maximum Dry Density (Modified Compaction) or to a minimum of 95% Maximum Dry Density (Modified Compaction) if the total height of the bank is less than 600mmm above foundation level.

5.1.2 General

All cut and fill procedures should be carried out in accordance with QR Civil Engineering Standard Specification Part No. 6 Earthworks Revision C and AS 3798-1996 “Guidelines on Earthworks for Commercial and Residential Developments” where applicable.

- Clearing, stripping and grubbing should be carried out in areas subject to earthworks. Also all soils containing organic matter should be stripped from the construction area. This material is not considered suitable for use as structural (including pavements) fill.

- Areas to be covered by fill will require stripping of soils made unstable by water before placement of fill can commence. This applies only to fills that carry structural loads and other surface facilities susceptible to movement such as pavements.

- Depressions formed by the removal of vegetation, underground elements, etc, should have all disturbed, weakened soil cleaned out and be backfilled with compacted select material.

- For all structural fill, it is recommended that compaction to a minimum of 90% Maximum Dry Density (Modified Compaction) for all the embankment except for the top 600mm

- The top 600mm below formation level will be compacted to a minimum of 95% Maximum Dry Density (Modified Compaction).

- Field density testing should be carried out to check the standard of compaction achieved and the placement moisture content. The frequency and extent of testing should be as per guidelines in QR Civil Engineering Standard Specification Part No. 6 Earthworks Revision C.

- Rock with any one dimension greater than 150mm shall not be placed within 1m of formation level, within a 2m radius of mast locations or within 10 m of rail bridge abutments.

- The material excavated on the project may be reused as bulk filling on the project, provided that the residual silty clay material potential reactivity is considered. The clay material will require special treatment as outlined in section 5.2 to ensure potential shrink swell movements are reduced.

- Backfilling for service trenches, etc, should use good quality material free of organic matter, either select fill won from the site or imported fill. The backfill should be placed in uniform layers over the full width of the excavations with the layers not exceeding 200mm thickness, loosely placed. The backfill material should be compacted to a minimum of 90% Maximum Dry Density (Modified Compaction).
- Any imported fill, should meet the fill criteria for embankment fill, outer verge material and top course material (Top 600 Material) depending on the requirement, as detailed in with QR Civil Engineering Standard Specification Part No. 6 Earthworks Revision C.
- All proposed filling should be benched into the existing fill embankments.
- The proposed embankment edges should be overfilled and trimmed back to ensure batters are cut within appropriately compacted fill material.
- Following earthworks all potentially erosive soils should be suitably protected to prevent scour and erosion

It is recommended that all proposed earthworks for the project should be supervised and certified by appropriately experienced geotechnical personnel, to ensure that they are constructed in accordance with the designers' intentions.

5.1.3 Fill Assessment of Onsite Material

From the boreholes undertaken previously and the test pits and boreholes undertaken during this investigation a number of samples were collected and tested to assess the onsite materials suitability, for reuse as fill on the project. The results of the testing undertaken during the current investigation and the previous investigation indicate that all the soils tested excluding two samples (CW13 0.4m & TP2 2.0m), would be suitable for reuse as bulk embankment fill. However, only eight of the samples tested would be suitable for use as outer verge material, in accordance with QR Civil Engineering Standard Specification Part No. 6 Earthworks Revision C. None of the samples tested to date would be suitable for reuse as top course (600mm) material.

5.2 Subgrade assessment

The proposed earthworks for the project will result in three subgrade scenarios distributed along the railway route at grade, in cut and in fill. The subgrade of the proposed fill sections will be determined by the imported fill quality and the cut sections will largely have residual soil or weathered rock subgrades.

It should be noted that the laboratory testing undertaken on the insitu material sampled has produced varying results depending on the material tested. With CBRs ranging from 1 to 80 and CBR swells ranging from -0.3% to 5.6%. The low CBR < 3 were generally clays that also had very high swell characteristics in excess of 3%. The high swell nature of these materials requires an embankment and pavement design, which specifically suppresses the aggressive swell potential of this material. This is achieved through an embankment or pavement thickness of specifically chosen non-expansive material. The thickness of this material is detailed below for the two possible conditions of the expansive clays, undisturbed insitu and disturbed fill material. Table 5.1 details the non-expansive material thickness required to overlie the expansive clays found in Zones 1, 2 and 4.

Table 5.1 Embankment and Pavement Design over Expansive Clays

Material	Condition of Material	Depth of Non-Expansive Material and Pavement
Residual Clay	Undisturbed	1.0 m
	Disturbed Compacted Fill	1.5 m

This non-expansive material thickness is specifically to attenuate the effect of large volume change within the underlying expansive clays from damaging the pavement and wearing surface. In addition to the depth of material over the expansive clays where embankments are required, a width of 2.0m of non reactive material is required laterally in addition to the central core of expansive material. This width of non-expansive material assists in preventing water ingress into the expansive materials within the embankment, further reducing the risk of damage to the pavement. Where no embankment is required and sufficient depth of non-expansive material is achieved over the expansive clays, care must still be exercised to prevent excessive water ingress into the expansive clay layer. Trenches or surface drains, which may become water filled, should not be constructed in the vicinity of these pavements.

5.2.1 Settlement

Where compressible soils are loaded, some degree of settlement should be expected. The amount of settlement is variable and depends on factors including the load imposed, type of settlement and material properties of the foundation soil. In granular material, predominantly elastic settlement will occur, while consolidation settlement occurs in cohesive material. Settlement consists of three main components:

a) Initial or elastic settlement,
b) Primary consolidation as a results of excess pore water pressure dissipation,
c) Secondary consolidation as a result of realignment of soil particles.

Potentially compressible soils where encountered at a number of locations on the site associated with alluvium deposited in former creek bed channels. It is anticipated based on the results of the field investigations undertaken to date and the proposed design. The area where the maximum settlement is likely to be experienced is in the vicinity of BH01/BH01A, where 4m of very soft to soft compressible soils were encountered and a 7m high embankment is proposed. Although no detailed settlement analysis has been undertaken to date preliminary estimates indicate that settlements in the order of 600-800mm may be experienced in this area. However due to the inability to collect samples of this material during the drilling at BH01/BH01A and the significant variability in depths and strength of the alluvium encountered in the other nearby boreholes (BH02, CW13 and CW14) it is recommended that significant additional testing be undertaken in this area to identify the soft compressible soils distribution, strength and their consolidation characteristics for future detailed settlement analysis.

5.2.2 Embankment Stability

It is also recommended that following the additional investigations to define the extent and strength of the compressible soils. If areas of low strength soils are to have embankments constructed over them assessment of the stability of the proposed embankments will need to be undertaken to determine whether ground improvement is necessary to achieve suitable short term and long term factors of safety.

5.3 Excavatability

It is understood that excavations up to 17m in depth are proposed during the construction of the bypass. It is anticipated that excavations on the project will consist of the following:

- Bulk Excavations – for site stripping and levelling to create even grade rail-yard.
- Local Cuts – for high level footings and underground services
- Drilling – for bored pier foundations

A preliminary assessment of the excavatability of the materials intersected in the investigation has been undertaken using a combination of the seismic velocities determined from the SASW data along with strength, fracture intensity and weathering information observed in the testpits, boreholes and cuttings within the study extent.

A summary of the seismic velocities determined from the SASW, for each geological unit, is summarised in Table 5.2.

Table 5.2 Range of Seismic Velocities

Strata	Seismic Velocity Range, Vp
Residual Cohesive	50m/s to 850m/s
Residual Cohesionless	50m/s to 1000m/s
Weathered Volcanic Rock	150m/s to 1150m/s
Weathered Sedimentary Rock	150m/s to 3100m/s

Lower than expected velocities have been determined for the rock material. These low values may give an incorrect impression of the rippability in this material due to the weathering process of volcanics and sandstones. A weathering profile for volcanics and sandstones may show hard boulders (corestones) left in a soil matrix due to the onionskin or exfoliation weathering process these rocks may undergo.

The range of seismic velocities shown in Table 5.2 for the bedrock material is dependent on the degree of weathering, strength and fracture intensity. Hence the upper bound values represent a stronger, less weathered material with larger spaced defects.

A combined assessment using the Caterpillar Handbook rippability chart for a D9 dozer and the rippability rating chart (after Weaver, 1975) exists and is commonly used. The rippability rating chart uses both the seismic velocity and rock strength, weathering and discontinuity information in its derivation. The Caterpillar Handbook rippability chart is shown in Figure 4.

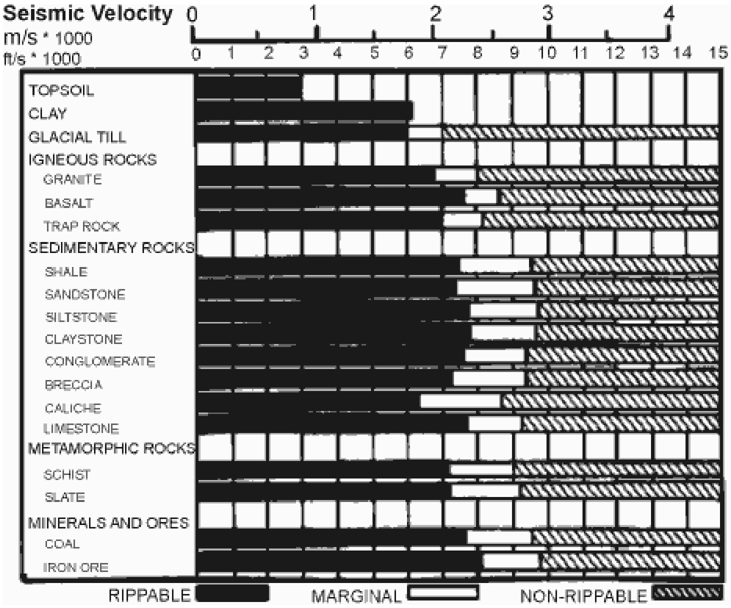


Figure 4 Caterpillar Handbook D9 rippability chart

Based on the caterpillar handbook and on the expected subsurface conditions, it is considered that excavations could likely be carried out within the upper fill / soil material using a small dozer/medium size excavator in bulk excavations or a medium size excavator in trenches. The rock encountered during the site investigation was extremely to moderately weathered and ranging from extremely low to medium to high strength. The level where refusal occurred with the tungsten carbide bit in the boreholes is a guide to where ripping was likely to become marginal or impossible. Where velocities in excess of approximately 2000m/s it is also anticipated that ripping will be marginal or impossible depending on the pattern, frequency, spacing and occurrence of fractures and discontinuities within the rock mass.

In light of the variable nature of the region’s geology it is recommended that excavation trials be carried out in various materials to confirm the type and size of equipment required.

5.4 Batter Slopes

It is understood that excavations are proposed during the site development.

Maximum batter angles for the existing site materials and any potential fill materials are outlined in Table 5.3 for unsurcharged cut and fill batters less than 3m high on the site. Where surcharges are located within H (height of batter) of the top of the batter, then some reduction in design angle will be required. Steeper batters are possible with the use of retaining structures (temporary or permanent)

Table 5.3 Batter Angles for Cuts and Fills

Material	Short Term	Long Term
Uncontrolled Fill / Alluvial Soils	1V to 2H (26º)	1V to 3H (18º)
Engineered Cohesive Fill / Residual Soils	1V to 1H (45º)	1V to 2.0H (22º)
Residual Gravelly Clays and Extremely Weathered Rock	1V to 1H (45º)	1V to 2H (26º)
Distinctly to Slightly Weathered Rock	1V to 0.6H (60º)	1V to 1H (45º)

Note:
1) The use of these batter slopes is subject to inspection by an experienced geotechnical professional as batter slopes in rock are dependent on the rock joint structure including the presence of clay seams and orientation of joints with respect to the cutting.
2) All batters should be protected to prevent scour and erosion.

5.5 Foundation Assessment

5.5.1 General

This section of the report provides the foundation options for proposed structures at the site. Based on the geotechnical conditions encountered during the investigation across the site, it is considered that a combination of high level and deep foundation systems could be adopted along the bypass route.

i) High Level Strip and Pad Footings – could be utilised where there is adequate strength material and where there are no edge effects due to existing or proposed excavations.

ii) Deep Foundations – should be adopted for all locations within the excavation edge effect zone or where uplift, lateral loads govern or where poor high level strata is present such as where soft / loose alluvium is present.

5.5.2 High Level Footings

On a preliminary basis it is recommended that all footings be founded a minimum of 500mm below the proposed surface level and a minimum 300mm into competent natural material or controlled and certified fill. Controlled fill implies fill placed under “Engineering Supervision” as described in Section 5.1 on this report.

Preliminary allowable bearing capacities assessed for the materials encountered on site are presented below in Table 5.4. However, it should be noted that additional investigations should be undertaken once the project design has been finalised to further clarify founding conditions.

Table 5.4 Preliminary Allowable Bearing Capacities

Material		Allowable Bearing Capacity (kPa)
Controlled and Certified Fill		100
Stiff Clay / Medium Dense Clayey Sand		100
Very Stiff Clay		150
Hard Clay		300
Extremely Weathered (XW) Rock	(Extremely low to very low strength)	400
Extremely to Distinctly Weathered Rock	(Very low to low strength)	600
Distinctly Weathered Rock	(Low to medium strength)	1,000
Distinctly to Slightly Weathered Rock	(Medium to high strength)	2,000
Slightly Weathered to Fresh Rock	(High to very high strength)	3,000

Additionally, all allowable bearing capacities should be confirmed by an experienced geotechnical engineer at the time of construction.

5.5.3 Deep Foundations

It is recommended that all piers are designed in accordance with AS2159-1995 Piling – Design and Installation and ASNZS5100-2004 Bridge Design. These codes use the limit state design method. In this method, the ultimate strength, serviceability and durability of the piles must be taken into account.

The design geotechnical strength (Rg*) can be calculated as the ultimate geotechnical strength multiplied by the geotechnical strength reduction factor. An assessment of the preliminary ultimate geotechnical strength parameters for the materials encountered on the site is presented in Table 5.5. However, it is recommended that once the design is finalised that additional investigations be undertaken to confirm founding conditions.

Table 5.5 Preliminary Ultimate Geotechnical Strength Parameters for Deep Foundations

Material		Ultimate Base Bearing (kPa)		Ultimate Shaft Resistance (kPa)
		L < 4D	L>4D	
Fill Material		NR	NR	NC
Silty Clays	Very Soft to Firm	NR	NR	NC
Silty Clays	Firm to Stiff	NR	NR	NC
Silty Clays	Very Stiff	450	675	25
Silty Clays	Hard	900	1,350	45
Extremely Weathered Rock	Extremely low to Very low strength	1,200	1,800	60
Extremely Weathered Rock	Very low to Low strength	1,800	2,700	90
Distinctly Weathered Rock	Low to Medium strength	3,000	4,500	150
Distinctly to Slightly Weathered	Medium to High strength	4,500	6,000	300
Slightly Weathered to Fresh Rock	High to Very High strength	6,000	9,000	300

NR – Not Recommended

NC – Not considered

Shaft Resistance figures provided are for bored piers, not driven piles.

Based on the range of values provided in AS2159-1995 and ASNZS5100-2004 it is recommended that a geotechnical strength reduction of 0.45 should be adopted for the design of the deep foundations in conjunction with the ultimate strength values provided in Table 5.5. A higher reduction factor of 0.6 may be applied if dynamic load testing is carried out.

The capacity of a pile may also be considered in terms of push, set or torque achieved.

5.5.4 Construction Considerations

Some difficulty with fall-in may occur with bored piers. It should be ensured that all loose material is removed from the base of piers prior to pouring of concrete. The use of a ‘clean-out’ bucket should be explicit in instructions to the drilling contractor. The practice of ‘using water and spinning the augers’ to remove loose material from the pier base is unacceptable.

Groundwater was encountered in some of the boreholes at the time of the investigation, and in addition seepage may occur at fill/natural, sand/clay and soil/rock interfaces following periods of rain. Therefore, should a bored pier foundation system be adopted some allowance for potential seepage may need to be made. In addition, it may be prudent to drill a “trial pier” to fully assess construction difficulties on this site.

Contractors should be made aware that boulders and corestone of hard rock may be encountered during the drilling of piers and ensure that they can suitably deal with such conditions.

5.5.5 Negative Skin Friction

It should be noted that if the soft soils are not removed as part of the preparatory earthworks where present, the fill to be placed over these compressible materials will induce settlements within the strata. Where piles are present within or adjacent to fill placed over these compressible strata, they may be subject to negative skin friction effects. Therefore in parts of the site where this is applicable these effects should be considered in the pile design.

5.5.6 Foundation Inspections

It is recommended that footing/pier inspections be undertaken by an experienced geotechnical professional following excavations to confirm the adequacy of the founding strata. Inspections should be carried out following cleaning of footing/pier bases and prior to placement of reinforcing steel and ordering of concrete. Where footings are located adjacent to underground services, the footings/piers should extend to base a minimum of 300mm below the trench base level for a distance of 1.0m out from the trench. Beyond 1.0m the footings/piers should be taken a minimum of 300mm below an imaginary line drawn up to 45° from the trench base level.

These requirements do not override minimum footing/pier base levels.

5.6 Retaining Walls

The lateral earth pressure distribution that affects the retaining walls on this site will depend on:-

- the in situ and backfill material properties,
- the design water regime at the rear of the wall,
- wall and cut geometry,
- surcharges affecting the wall,
- wall type and the structural bracing of the wall.

5.6.1 Pressure Distribution

Where walls are designed to be braced (eg. by floor slabs), a trapezoidal type distribution should be analysed. For cantilever walls or temporarily braced walls, a triangular distribution should be considered.

For cantilever walls, which allow some movement at the top (at least 0.01H in stiff clays and 0.001H in dense sand) the active case (Ka) applies, with a triangular distribution in both long term and short-term situations.

For walls which cannot tolerate as much movement, the at-rest case (Ko) applies, with a triangular distribution.

Table 5.6 Retaining Wall Design Parameters

Material	Density (kN/m^3)	*Earth Pressure Coefficient*	
		Ka	Ko
Clayey Sand	18	0.32	0.50
Clay Soft to Firm	16	0.42	0.59
Controlled Cohesive Fill & Stiff to Very Stiff Natural Silty Clay	18	0.36	0.53
XW Rock	20	0.33	0.50

5.6.2 Water Regime

Due to possible long term problems with blocking of gravel filters and drains, and short term storm conditions that could flood the fill behind retaining walls, it is recommended that all retaining walls be designed for some water pressure distribution. A suggested water pressure distribution for retaining walls on this site would be one quarter height water pressure above ground one third height water pressure below ground but above the seasonal water table and full height water pressure below this level.

5.6.3 Construction Details

With all retaining walls, it is essential that adequate drainage be provided behind the wall. All backfill should be loose granular material, which should not be heavily compacted. It is recommended that a permeable geofabric be placed between the natural soils and the loose granular backfill to prevent fine material piping out of soils and blocking the backfill.

During the installation of retaining walls, the insitu soils should be battered back to minimise fall-in. Suitable precautions to satisfy Health and Safety requirements must also be adhered to.

5.6.4 Additional Investigations

Due to the preliminary nature of this investigation and the uncertainty of the proposed earthworks and structural design, at the time the investigation was undertaken. It is recommended that further investigations be undertaken once the concept design is finalised to reduce the geotechnical risk to the project. It is recommended that as a minimum that the additional investigations should include the following;

- Investigation and assessment of the extent, strength and consolidation characteristics of soft soils on the site. To allow settlement analysis, stability assessments and ground improvement design to be undertaken.
- A minimum of one borehole per pier or abutment location and at each culvert site will be required in accordance with the Bridge Design Code ASNZS 5100- 2004 and also a suitable level of investigation will be required at all the other proposed structure sites.
- Due to the large variability of the materials in both strength and type encountered across the site in the investigations to date. Significant further investigations should be undertaken to clarify the likely excavation characterise on the site.

6. Limitations

We have prepared this report in accordance with the brief provided. The contents of the report are for the sole use of the client (Queensland Rail) and no responsibility or liability will be accepted to any third party. Data or opinions contained within the report may not be used in other contexts or for any other purposes without our prior review and agreement.

The recommendations in this report are based on data collected at specific locations and by using suitable investigation techniques. Only a finite amount of information has been collected to meet the specific financial and technical requirements of the clients brief and this report does not purport to completely describe all the site characteristics and properties.

Contractors who can make their own interpretation of the factual data provided should assess subsurface conditions relevant to construction works. They should perform any additional tests as necessary for their own purposes. It is strongly recommended that any plans and specifications prepared by others and relating to the content of this report, or any amendments to the original plans and specifications are reviewed by Connell Hatch to verify that the intent of our recommendations is properly reflected in the design. During construction we request the opportunity to review our interpretations if the exposed site conditions are significantly different from those inferred in this report.

Subsurface conditions, such as groundwater levels, can change over time. This should be borne in mind, particularly if the report is used after a protracted delay.

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Appendix A

Explanatory Notes

EXPLANATORY NOTES AND ABBREVIATIONS

The following information provides the terms and abbreviations used in Connell Hatch geotechnical borelogs and reports. Description of soil and rock are generally in accordance with the Unified Soil Classification System and Australian Standard AS1726-1993, Geotechnical Site Investigations. Soil and rock descriptions using established field techniques have been recorded independent of any laboratory test results. As far as is practicable the data contained on the log sheets is factual. Some interpretation is inevitable in the assessment of conditions between samples and of the origin of the materials. Standard colour charts have not been used.

Assessment of potential site contamination does not form part of this geotechnical report. Any reference to potential contaminants is for information only, and does not necessarily indicate the presence or absence of soil or groundwater contamination.

Soil Description

Soils are generally described in the borelog using the following sequence of terms:

[Drilling Information]; [USC Symbol]; [Soil Type, Colour, Plasticity/Particle Description, Structure]; [Moisture Condition]; [Consistency]

Unified Soil Classification Group Symbols

Typical Names	USC Symbol
Well graded gravels	GW
Poorly graded gravels	GP
Silty gravels	GM
Clayey gravels	GC
Inorganic silts of low plasticity.	ML
Inorganic silts of high plasticity	MH
Organic silts of low plasticity	OL
Organic clays of high plasticity	OH

Typical Names	USC Symbol
Well graded sands	SW
Poorly graded sands	SP
Silty sands	SM
Clayey sands	SC
Inorganic clay of low plasticity	CL
Inorganic clay of medium plasticity	CI
Inorganic clays of high plasticity	CH
Peat and other highly organic soils	Pt

Soil Type and Particle Size

Major Divisions		Symbols	Subdivision	Particle Size
Coarse Grained Soils (more than half of material is larger than 0.075mm)	Boulders			> 200 mm
	Cobbles			63 mm – 200 mm
	Gravels (more than half of coarse fraction is larger than 2.36mm)	G	Coarse	20 mm – 63 mm
			Medium	6 mm – 20 mm
			Fine	2.36 mm – 6 mm
	Sands (more than half of coarse fraction is smaller than 2.36mm)	S	Coarse	0.6 mm – 2.36 mm
			Medium	0.2 mm – 0.6 mm
			Fine	75 µm – 0.2 mm
Fine Grained Soils (more than half of material is smaller than 0.075mm)	Silts	M		< 75 µm
	Clays	C		
	Organic	O		

Soil Plasticity

Term	Symbol	Field Assessment	
Low Plasticity	L	Cannot be rolled into threads when moist	
Medium Plasticity	I ; L / H	Can be rolled into threads when moist.	Shows some shrinkage on drying
High Plasticity	H		Considerable shrinkage on drying. Greasy to touch. Cracks in dry material

Moisture Content

Term	Symbol	Field Assessment	
		Cohesive Soils	Granular Soils
Dry	D	Hard and friable or powdery	Runs freely through hands.
Moist	M	Feels cool, darkened in colour	
		Can be moulded	Tend to cohere.
Wet	W	Feels cool, darkened in colour	
		Free water forms on hands when handling	Tend to cohere

Consistency of Cohesive Soil

Term	Symbol	Field Assessment	Undrained Shear Strength (kPa)
Very Soft	VS	Exudes between fingers when squeezed.	< 12
Soft	S	Can be moulded by light finger pressure.	12 – 25
Firm	F	Can be moulded by strong finger pressure.	25 – 50
Stiff	St	Cannot be moulded by fingers. Can be indented by thumb pressure.	50 – 100
Very Stiff	VSt	Can be indented by thumb nail.	100 – 200
Hard	H	Difficult to indented by thumb nail.	> 200

Consistency of Non-cohesive Soil

Term	Symbol	Field Assessment	SPT N – Value	Density Index (%)
Very Loose	VL	Foot Imprints easily.	< 4	< 15
Loose	L	Can be excavated with spade. 50mm peg easily driven	4 – 10	15 –35
Medium Dense	MD	Shovelling difficult	10 – 30	35 – 65
Dense	D	Needs pick for excavation. 50mm peg hard to drive.	30 – 50	65 – 85
Very Dense	VD	Picking difficult	> 50	> 85
Cemented	C	Cemented, indurated or large size particles	> 50	N / A

Rock Description

Rocks are generally described in the borelog using the following sequence of terms:

[Drilling Information]; [Weathering]; [Rock Type, Colour, Structure]; [Rock Quality Designation]; [Strength]; [Defects]

Rock Weathering Classification

Term	Symbol	Field Assessment
Residual Soil	RS	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
Extremely Weathered	XW	Soil is weathered to such an extend that it has 'soil' properties ie it either disintegrates or can be remoulded, in water.
Distinctly Weathered	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by ironstaining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in spores.
Slightly Weathered	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh	FR	Rock shows no sign of decomposition or staining.

Rock Strength

Strength	Symbol	Field Assessment		Point Load Index $I_s(50)$ (MPa)
		By Hand	Hammer with Hand Held Specimen	
Extremely Low	EL	Easily remoulded to a material with soil properties.		< 0.03
Very Low	VL	Easily crumbled in 1 hand.		0.03 – 0.1
Low	L	Broken into pieces in 1 hand.		0.1 – 0.3
Medium	M	Broken with difficulty in 2 hands.	Easily broken with light blow (thud).	0.3 – 1.0
High	H		1 firm blow to break (rings).	1.0 – 3.0
Very High	VH		> 1 blow to break (rings)	3.0 – 10
Extremely High	EH		Many blows to break (rings).	> 10

Notes on rock strength

1. These items refer to the strength of the rock material and not to the strength of the rock mass which may be considerably weaker due to the effect of rock defects.
2. Anisotropy of rock material samples may affect the field assessment of strength
3. The unconfined compressive strength is typically about 20 x I_s (50), but the multiplier may vary widely for different rock types.

Rock Defects
Defects are generally described using the following sequence of terms:

[Defect Spacing]; [Depth (metres from surface), Defect Type, Defect Angle (degrees from horizontal), Surface roughness, Infill, Defect thickness (mm)]

Defect Spacing

Description	Spacing
Extremely closely spaced	< 20mm
Very closely spaced	20mm to 60mm
Closely spaced	60mm to 200mm
Medium spaced	0.2m to 0.6m
Widely spaced	0.6m to 2.0m
Very widely spaced	2.0m to 6.0m
Extremely widely spaced	> 6.0m

Defect Description

Defect Type	Surface Roughness		Coating or Infill
	Macro-surface geometry	Micro- surface geometry	
Bp – Bedding Parting	St – Stepped	Ro – Rough	cn – clean
Fp – Foliation Parting	Cu – Curved	Sm – Smooth	sn – stained
Jo – Joint	Un – Undulating	Sl – Slickensided	vn – veneer
Sh – Sheared Zone	Ir – Irregular		cg – coating
Cs – Crushed Seam	Pl – Planar		
Ds – Decomposed seam			
Is – Infilled Seam			

Water

▼	Measurement standing water level and date
∇	Water Noted
►	Water inflow
◄	Water / drilling fluid loss

Method

BH EX	Backhoe bucket (rubber tyred machine) Excavator bucket (tracked machine)
HA	Hand Auger
AV	Auger drilling with steel "V" bit
AT	Auger drilling with Tungsten Carbide (TC) bit
HOA	Hollow Auger

Support

C	Casing
M	Mud
W	Water

 RA RM RC	Rotary drilling with flushing of cuttings using - air circulation - bentonite or polymer mud circulation - water circulation
NMLC	Coring using an NMLC core barrel
RR	Tricone (Rock Roller) Bit
DB	Drag Bit

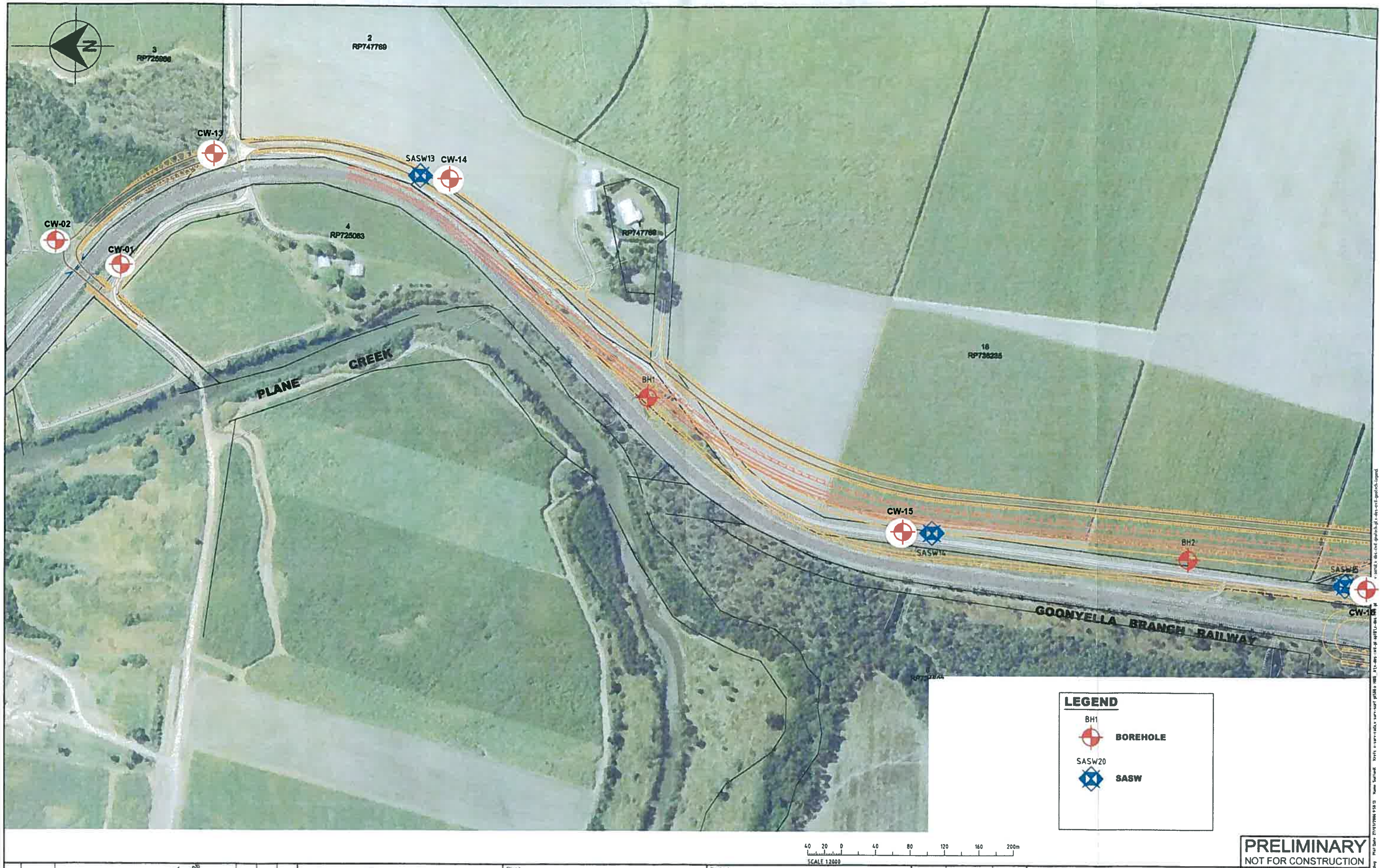
Field Sampling and Testing

Symbol	Sample or Test
W	Water Sample
D	Disturbed Sample
B	Bulk Disturbed Sample
SPT	Standard Penetration Test
- 7, 11, 12 (eg)	Example of blows per 150mm penetration
- N = 23 (eg)	Penetration Resistance (blows for 300mm penetration following 150mm seating drive), Example of 11 + 12 = 23
- 25/20mm (eg)	Partial Penetration, example of blow for the measured penetration
- N*	Inferred SPT Value

Symbol	Sample or Test
- RW	Rod Weight only causing penetration (N < l)
- HW	Hammer and rod weight only causing full penetration (N < l)
- HB	Hammer Bouncing (N* > 50)
U (50)	Undisturbed Sample (50mm diameter tube)
PP	Pocket Penetrometer Test (kPa)
FV	Field Shear Vane (kPa)
RQD	Rock Quality Designation expressed as : $\frac{\text{Sum of lengths of sound core pieces} > 100\text{mm}}{\text{Total Length of core section considered}}$
DCP	Dynamic Cone Penetrometer measured in blows / 100mm

Appendix B

Borehole and SASW Location Map



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Client
QUEENSLAND RAIL

Project
JILALAN STATION
YARD UPGRADE
STAGE 1
CONCEPT DESIGN

Drawn ST	Signed	Date
Designed SM	Signed	Date
Verified	Signed	Date
Approved	Signed	Date

Drawing Title
GEOTECHNICAL INVESTIGATION
PLAN
SHEET 1 OF 4

PRELIMINARY
NOT FOR CONSTRUCTION

Project No
HI88

Scale
1:2000

Sheet Size
A1

Drawing No
SK-GT-900

Rev
01

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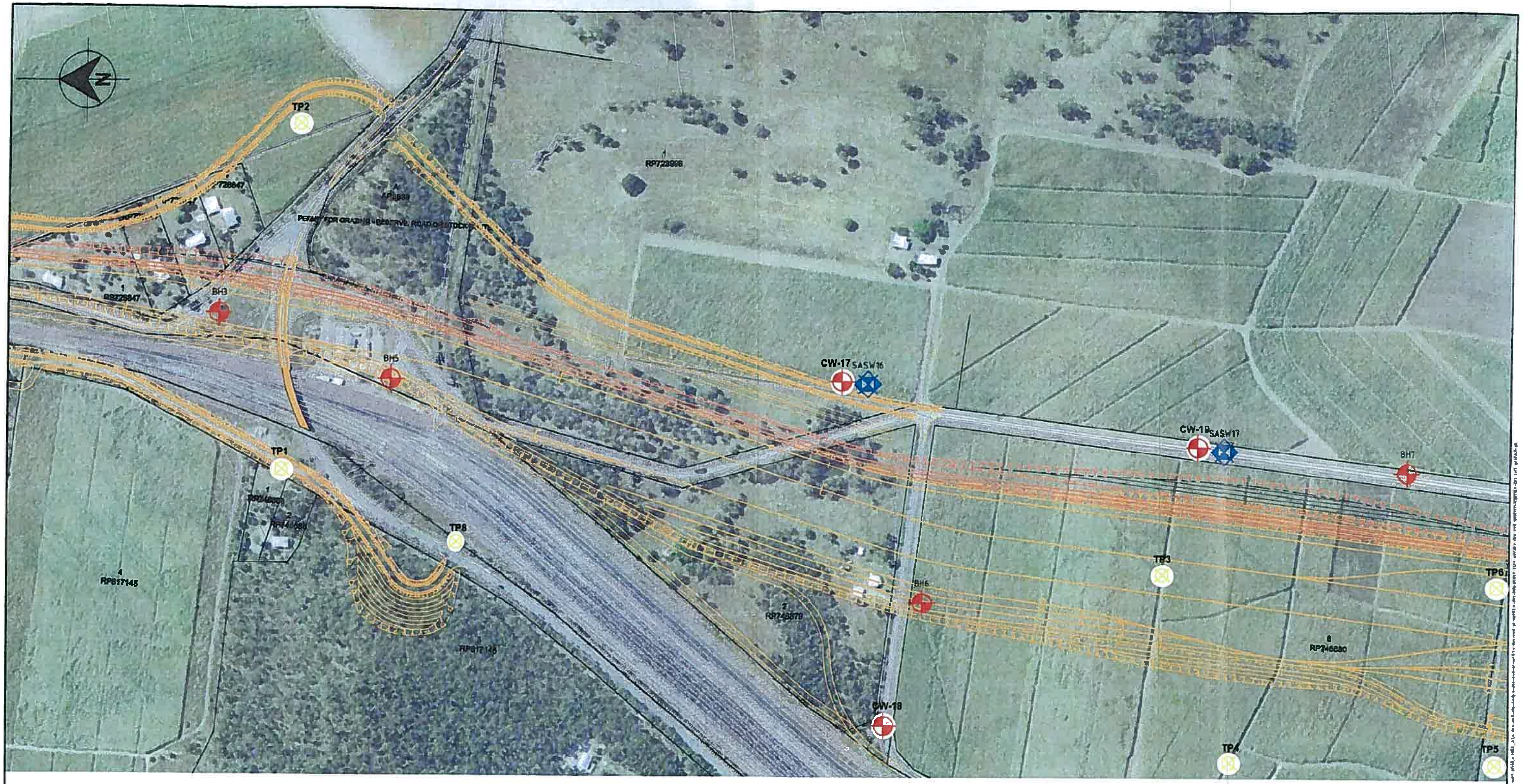

LEGEND

BH1	**BOREHOLE**
SASW20	**SASW**
	TESTPIT

40 20 0 40 80 120 160 200m
SCALE 1:2000

PRELIMINARY
NOT FOR CONSTRUCTION

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QUEENSLAND RAIL

Project:
JILALAN STATION
YARD UPGRADE
STAGE 1
CONCEPT DESIGN

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Designed SM	Signed	Date
Verified	Signed	Date
Approved	Signed	Date

Drawing Title
GEOTECHNICAL INVESTIGATION
PLAN
SHEET 2 OF 4

Project No
H188

Scale
1:2000

Sheet Size
A1

Drawing No
SK-GT-901

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01

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Client
QUEENSLAND RAIL

Project
JILALAN STATION
YARD UPGRADE
STAGE 1
CONCEPT DESIGN

Drawn	Signed	Date
ST		
Designed	Signed	Date
SM		
Verified	Signed	Date
Approved	Signed	Date

Drawing Title
GEOTECHNICAL INVESTIGATION
PLAN
SHEET 3 OF 4

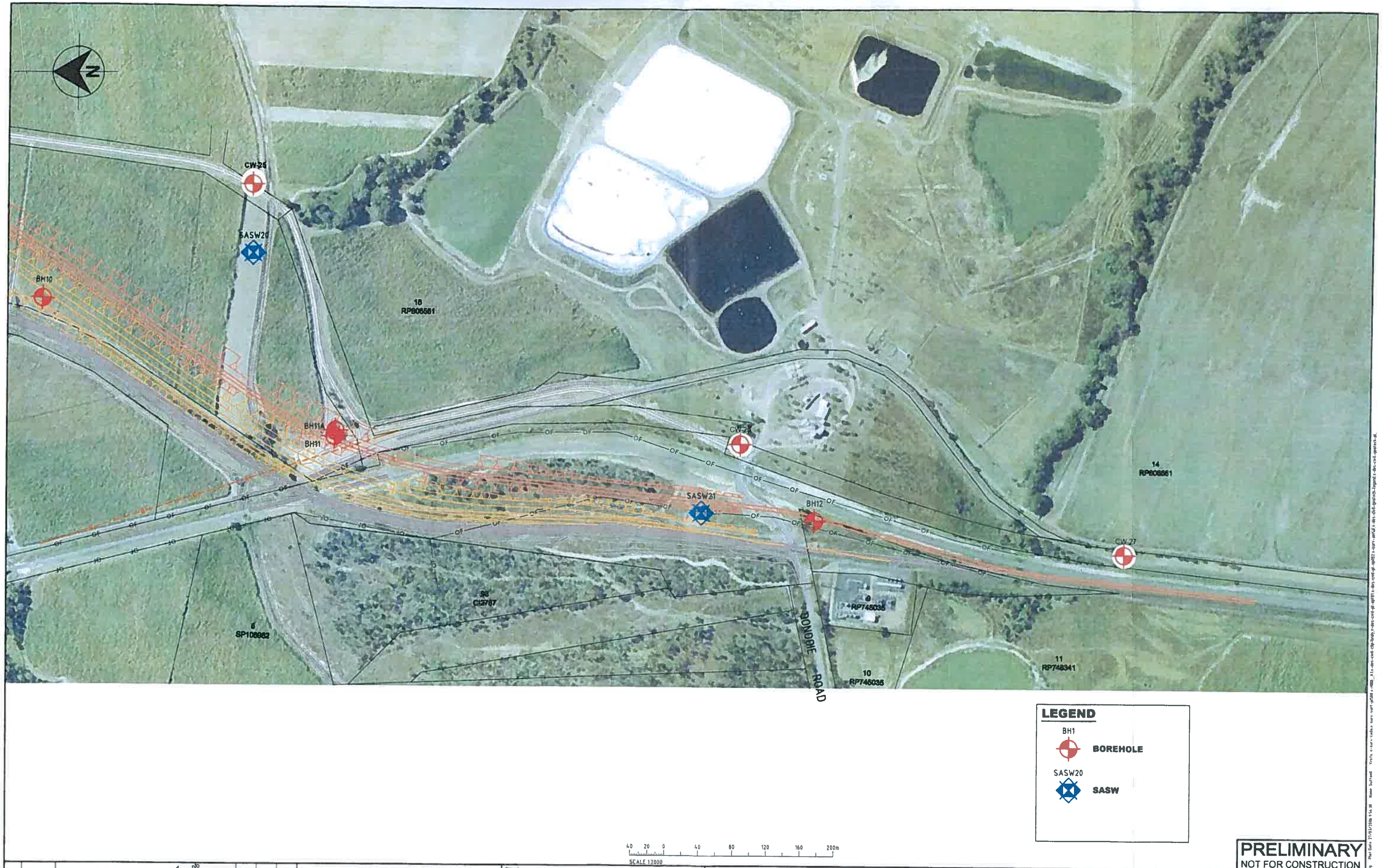
Project No
H188

Scale
1:2000

Sheet Size
A1

Drawing No
SK-GT-902

Rev
01



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2 using the drawings or other data for any purpose not agreed to in writing by Connell Wagner

Client

QUEENSLAND RAIL

Project

JILALAN STATION
YARD UPGRADE
STAGE 1
CONCEPT DESIGN

Drawn	Signed	Date
ST		
Designed SM	Signed	Date
Verified	Signed	Date
Approved	Signed	Date

Drawing Title

GEOTECHNICAL INVESTIGATION
PLAN
SHEET 4 OF 4

PRELIMINARY
NOT FOR CONSTRUCTION

Project No H188

Scale 1:2000

Sheet Size A1

Drawing No SK-GT-903

Rev 01

Appendix C

Laboratory Results

Australian Geomechanical Laboratories Pty Ltd
ABN 25 065 630 505

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Facsimile: (07) 3217 5311
Email: aglabs@bigpond.net.au

ATTERBERG LIMITS TEST REPORT

TEST METHOD: AS1289 2.1.1, 3.1.1, 3.2.1, 3.3.1, 3.4.1

Client:	Connell Wagner Pty Ltd	Report No.	602410-AL
Project:	Jilalan Station Bypass-HI8802UG	Test Date:	24/2/06 to 1/3/06
		Report Date:	2/3/06

Client ID: BH 1	Depth(m): 0.8	Sample No. 602410	
Liquid Limit (%):	58	Linear Shrinkage (%):	9.5*
Plastic Limit (%):	22	Field Moisture Content (%):	16.2
Plasticity Index (%):	36		

Client ID: BH 9	Depth(m): 0.6	Sample No. 602411	
Liquid Limit (%):	51	Linear Shrinkage (%):	8.0
Plastic Limit (%):	18	Field Moisture Content (%):	13.6
Plasticity Index (%):	33		

Client ID: BH 2	Depth(m): 2.0	Sample No. 602412	
Liquid Limit (%):	50	Linear Shrinkage (%):	13.0*+
Plastic Limit (%):	18	Field Moisture Content (%):	19.2
Plasticity Index (%):	32		

Client ID:	Depth(m):	Sample No.602413	
Liquid Limit (%):	44	Linear Shrinkage (%):	12.0*
Plastic Limit (%):	20	Field Moisture Content (%):	14.7
Plasticity Index (%):	24		

Client ID:	Depth(m):	Sample No. 602414	
Liquid Limit (%):	29	Linear Shrinkage (%):	#
Plastic Limit (%):	17	Field Moisture Content (%):	11.2
Plasticity Index (%):	12		

Remarks: The sample/s were tested oven dried, dry sieved and in a 125 – 250mm mould.
*Crumbling/ +Curling occurred. # Insufficient material

Sample/s supplied by the client

Page: 1 of 1

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The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National standards

N ATA Accredited Laboratory Number 9926

Form Number:GT004-5

Authorised Signatory

James Russell

J. Russell

Manager

Australian Geomechanical Laboratories Pty Ltd
ABN 25 063 630 505

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P.O. Box 434, Paddington, Qld. 4064
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Facsimile: (07) 3217 5311
Email: aglabs@bigpond.net.au

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS1289 3.6.1, 2.1.1

Client:	Connell Wagner Pty Ltd	Report No.	602410-G
Project:	Jilalan Station Bypass	Test Date:	27/2/06
		Report Date:	2/3/06

Sample No.	602410	602411	602412	602413	602414
Client ID:	BH 1	BH 9	BH 2	BH 11a	BH 5
Depth (m):	0.8	0.6	2.0	0.6	2.5
Moisture (%)	16.2	13.6	19.2	14.7	11.2

AS SIEVE SIZE (mm)	**PERCENT PASSING**				
26.5					
19					100
9.5					83
4.75	100	100	100	100	76
2.36	99	99	99	99	68
1.18	98	98	99	96	61
0.600	98	95	98	90	52
0.425	97	93	97	84	47
0.300	96	90	96	77	43
0.150	91	84	89	60	34
0.075	80	78	79	49	28

Sample/s supplied by the client

Page: 1 of 1

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Authorised Signatory

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Manager

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Also at: Gold Coast Hillcrest Sunshine Coast Gladstone Rockhampton Townsville Cairns Mount Isa Bendigo (Vic) and Sydney - Associated Offices in Melbourne Adelaide Perth Vietnam and Papua New Guinea

REPORT ON SOIL CLASSIFICATION

CLIENT:	**CONNELL HATCH**	*JOB NO:*	**BW/1030**
PROJECT:	**JILALAN**	*REPORT NO:*	**45**

SENDER NO:	**HP30**	*SAMPLE LOCATION:*	**BH 15**
LABORATORY REF.NO.:	**06/9804**	*SENDER NO:*	
MATERIAL:	**Sandy Clay**	*DEPTH:*	**0.15**
LOT NO:		*CH (m):*	
PREPN. METHOD (PI):	**OVEN/DRY**	*OFFSET(m):*	

SIEVE SIZE (mm)	*SAMPLE % PASS*	CLASSIFICATION AS 1289.3.6.1-1997	
152.4	-		COBBLES
75.0			
53.0			
37.5		coarse:	
26.5			
19.0		medium:	GRAVEL
13.2			
9.5			
6.7		fine :	
4.75	**100**		
2.36	**97**		
1.18		coarse:	
0.600			SAND
0.425	**86**	medium:	
0.300		fine :	
0.150			
0.075	**54.0**		CLAY OR SILT

	RESULTS
LIQUID LIMIT (%)	**41**
PLASTIC LIMIT (%)	**21**
PLASTICITY INDEX (%)	**20**
LINEAR SHRINKAGE (%)	**10.0**
EMERSON CLASS No.	**2**
CURLING/CRUMBLING	**Slight**

TEST METHODS **AS1289 3.6.1, 2.1.1,3.1.2,3.2.1,3.3.1,3.4.1,3.8.1**
TESTED BY: *J.A* *DATE:* *05/12/2006*
REPORTED BY: *M.D* *DATE:* *12/12/2006*
CHECKED BY: *M.D* *Approved Signatory:*
M. Dumigan

NATA Accredited Laboratory
Number: 5683

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REPORT ON SOIL CLASSIFICATION

CLIENT:	**CONNELL HATCH**	*JOB NO:*	**BW/1030**
PROJECT:	**JILALAN**	*REPORT NO:*	**50**

SENDER NO:	**HP30**	*SAMPLE LOCATION:*	**BH 22**
LABORATORY REF.NO.:	**06/9808**	*SENDER NO:*	
MATERIAL:	**Sandy Gravel with Clay**	*DEPTH:*	**1.00-1.20**
LOT NO:		*CH (m):*	
PREPN. METHOD (PI):	**OVEN/DRY**	*OFFSET(m):*	

SIEVE SIZE (mm)	*SAMPLE % PASS*	CLASSIFICATION AS 1289.3.6.1-1997	
152.4	-	COBBLES	
75.0	**100**		
53.0			
37.5	**93**	coarse:	
26.5			
19.0	**82**		GRAVEL
13.2		medium:	
9.5	**72**		
6.7		fine :	
4.75	**62**		
2.36	**54**		
1.18		coarse:	
0.600			SAND
0.425	**27**	medium:	
0.300			
0.150		fine :	
0.075	**14.0**	CLAY OR SILT	

	RESULTS
LIQUID LIMIT (%)	**28**
PLASTIC LIMIT (%)	**19**
PLASTICITY INDEX (%)	**11**
LINEAR SHRINKAGE (%)	**7.5**
EMERSON CLASS No.	**2**
CURLING/CRUMBLING	**Slight**

TEST METHODS	**AS1289 3.6.1, 2.1.1,3.1.2,3.2.1,3.3.1,3.4.1,3.8.1**		
TESTED BY:	*J.A*	*DATE:*	*05/12/2006*
REPORTED BY:	*M.D*	*DATE:*	*12/12/2006*
CHECKED BY:	*M.D*	*Approved Signatory:*	M. Dumigan

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REPORT ON SOIL CLASSIFICATION

CLIENT:	**CONNELL HATCH**	*JOB NO:*	**BW/1030**
PROJECT:	**JILALAN**	*REPORT NO:*	**35**

SENDER NO:	**HP30**	*SAMPLE LOCATION:*	**TP 2**
LABORATORY REF.NO.:	**06/9796**	*SENDER NO:*	
MATERIAL:	**Sandy Clay with Gravel**	*DEPTH:*	**1.50**
LOT NO:		*CH (m):*	
PREPN. METHOD (PI):	**OVEN/DRY**	*OFFSET(m):*	

SIEVE SIZE (mm)	*SAMPLE % PASS*	CLASSIFICATION AS 1289.3.6.1-1997	
152.4	-		COBBLES
75.0			
53.0			
37.5		coarse:	
26.5			
19.0		medium:	GRAVEL
13.2	**100**		
9.5	**95**		
6.7		fine :	
4.75	**93**		
2.36	**86**		
1.18		coarse:	
0.600			SAND
0.425	**71**	medium:	
0.300		fine :	
0.150			
0.075	**63**	CLAY OR SILT	

	RESULTS
LIQUID LIMIT (%)	**71**
PLASTIC LIMIT (%)	**22**
PLASTICITY INDEX (%)	**49**
LINEAR SHRINKAGE (%)	**24.5**
EMERSON CLASS No.	**1**
CURLING/CRUMBLING	**Major**

TEST METHODS	**AS1289 3.6.1, 2.1.1,3.1.2,3.2.1,3.3.1,3.4.1,3.8.1**		
TESTED BY:	*J.A*	*DATE:*	*05/12/2006*
REPORTED BY:	*M.D*	*DATE:*	*12/12/2006*
CHECKED BY:	*M.D*	*Approved Signatory:*	M. Dumigan

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REPORT ON SOIL CLASSIFICATION

CLIENT:	**CONNELL HATCH**	*JOB NO:*	**BW/1030**
PROJECT:	**JILALAN**	*REPORT NO:*	**37**
SENDER NO:	**HP30**	*SAMPLE LOCATION:*	**TP 3**
LABORATORY REF.NO.:	**06/9798**	*SENDER NO:*	
MATERIAL:	**Sandy Gravel**	*DEPTH:*	**2.00**
LOT NO:		*CH (m):*	
PREPN. METHOD (PI):	**OVEN/DRY**	*OFFSET(m):*	

SIEVE SIZE (mm)	*SAMPLE % PASS*	CLASSIFICATION AS 1289.3.6.1-1997	
152.4	-	COBBLES	
75.0	**100**		
53.0			
37.5	**86**	coarse:	
26.5			
19.0	**81**		GRAVEL
13.2		medium:	
9.5	**58**		
6.7		fine :	
4.75	**51**		
2.36	**40**		
1.18		coarse:	
0.600			SAND
0.425	**18**	medium:	
0.300		fine :	
0.150			
0.075	**8.6**	CLAY OR SILT	

	RESULTS
LIQUID LIMIT (%)	**28**
PLASTIC LIMIT (%)	**21**
PLASTICITY INDEX (%)	**7**
LINEAR SHRINKAGE (%)	**4.5**
EMERSON CLASS No.	**4**
CURLING/CRUMBLING	**N/A**

TEST METHODS	**AS1289 3.6.1, 2.1.1,3.1.2,3.2.1,3.3.1,3.4.1,3.8.1**		
TESTED BY:	*J.A*	*DATE:*	*05/12/2006*
REPORTED BY:	*M.D*	*DATE:*	*12/12/2006*
CHECKED BY:	*M.D*	*Approved Signatory:*	M. Dumigan

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Number: 5683

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REPORT ON SOIL CLASSIFICATION

CLIENT:	**CONNELL HATCH**	*JOB NO:*	**BW/1030**
PROJECT:	**JILALAN**	*REPORT NO:*	**52**

SENDER NO:	**HP30**	*SAMPLE LOCATION:*	**TP 5**
LABORATORY REF.NO.:	**06/9810**	*SENDER NO:*	
MATERIAL:	**Clay with Sand**	*DEPTH:*	**1.70-2.00**
LOT NO:		*CH (m):*	
PREPN. METHOD (PI):	**OVEN/DRY**	*OFFSET(m):*	

SIEVE SIZE (mm)	*SAMPLE % PASS*	CLASSIFICATION AS 1289.3.6.1-1997	
152.4	-	COBBLES	
75.0			
53.0			
37.5		coarse:	GRAVEL
26.5			
19.0		medium:	
13.2			
9.5			
6.7		fine :	
4.75			
2.36	**100**		
1.18		coarse:	SAND
0.600			
0.425	**96**	medium:	
0.300		fine :	
0.150			
0.075	**81.0**	CLAY OR SILT	

	RESULTS
LIQUID LIMIT (%)	**38**
PLASTIC LIMIT (%)	**20**
PLASTICITY INDEX (%)	**18**
LINEAR SHRINKAGE (%)	**12.0**
EMERSON CLASS No.	**1**
CURLING/CRUMBLING	**Slight**

TEST METHODS **AS1289 3.6.1, 2.1.1,3.1.2,3.2.1,3.3.1,3.4.1,3.8.1**

TESTED BY:	*J.A*	*DATE:*	*05/12/2006*
REPORTED BY:	*M.D*	*DATE:*	*12/12/2006*
CHECKED BY:	*M.D*	*Approved Signatory:*	M. Dumigan

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REPORT ON SOIL CLASSIFICATION

CLIENT: **CONNELL HATCH**
JOB NO: **BW/1030**
PROJECT: **JILALAN**
REPORT NO: **48**

SENDER NO: **HP30**
SAMPLE LOCATION: **TP 7**
LABORATORY REF.NO.: **06/9806**
SENDER NO:
MATERIAL: **Sandy Clay with Gravel**
DEPTH: **1.50**
LOT NO:
CH (m):
PREPN. METHOD (PI): **OVEN/DRY**
OFFSET(m):

SIEVE SIZE (mm)	*SAMPLE % PASS*	CLASSIFICATION AS 1289.3.6.1-1997	
152.4	-		COBBLES
75.0			
53.0			
37.5		coarse:	
26.5			
19.0			GRAVEL
13.2	**100**	medium:	
9.5	**92**		
6.7		fine :	
4.75	**87**		
2.36	**83**	coarse:	
1.18			
0.600			SAND
0.425	**70**	medium:	
0.300		fine :	
0.150			
0.075	**64.0**	CLAY OR SILT	

	RESULTS
LIQUID LIMIT (%)	**37**
PLASTIC LIMIT (%)	**23**
PLASTICITY INDEX (%)	**14**
LINEAR SHRINKAGE (%)	**7.0**
EMERSON CLASS No.	**1**
CURLING/CRUMBLING	**N/A**

TEST METHODS **AS1289 3.6.1, 2.1.1,3.1.2,3.2.1,3.3.1,3.4.1,3.8.1**
TESTED BY: *J.A* *DATE:* *05/12/2006*
REPORTED BY: *M.D* *DATE:* *12/12/2006*
CHECKED BY: *M.D* *Approved Signatory:*
M. Dumigan

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REPORT ON SOIL CLASSIFICATION

CLIENT:	**CONNELL HATCH**	*JOB NO:*	**BW/1030**
PROJECT:	**JILALAN**	*REPORT NO:*	**47**
SENDER NO:	**HP30**	*SAMPLE LOCATION:*	**CW 13**
LABORATORY REF.NO.:	**06/9805**	*SENDER NO:*	
MATERIAL:	**Sandy Gravel with Clay**	*DEPTH:*	**0.40-0.70**
LOT NO:		*CH (m):*	
PREPN. METHOD (PI):	**OVEN/DRY**	*OFFSET(m):*	

SIEVE SIZE (mm)	*SAMPLE % PASS*	CLASSIFICATION AS 1289.3.6.1-1997	
152.4	-		COBBLES
75.0			
53.0			
37.5	**100**	coarse:	GRAVEL
26.5			
19.0	**87**	medium:	
13.2			
9.5	**71**		
6.7		fine :	
4.75	**60**		
2.36	**53**		
1.18		coarse:	SAND
0.600			
0.425	**36**	medium:	
0.300		fine :	
0.150			
0.075	**19.0**		CLAY OR SILT

	RESULTS
LIQUID LIMIT (%)	**31**
PLASTIC LIMIT (%)	**17**
PLASTICITY INDEX (%)	**14**
LINEAR SHRINKAGE (%)	**7.0**
EMERSON CLASS No.	**4**
CURLING/CRUMBLING	**N/A**

TEST METHODS **AS1289 3.6.1, 2.1.1,3.1.2,3.2.1,3.3.1,3.4.1,3.8.1**
TESTED BY: *J.A* *DATE:* *05/12/2006*
REPORTED BY: *M.D* *DATE:* *12/12/2006*
CHECKED BY: *M.D* *Approved Signatory:*
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REPORT ON SOIL CLASSIFICATION

CLIENT:	**CONNELL HATCH**	*JOB NO:*	**BW/1030**
PROJECT:	**JILALAN**	*REPORT NO:*	**39**
SENDER NO:	**HP30**	*SAMPLE LOCATION:*	**CW 14**
LABORATORY REF.NO.:	**06/9800**	*SENDER NO:*	
MATERIAL:	**Sandy Clay**	*DEPTH:*	**0.30-0.80**
LOT NO:		*CH (m):*	
PREPN. METHOD (PI):	**OVEN/DRY**	*OFFSET(m):*	

SIEVE SIZE (mm)	*SAMPLE % PASS*	CLASSIFICATION AS 1289.3.6.1-1997	
152.4	-	COBBLES	
75.0			
53.0			
37.5		coarse:	
26.5			
19.0			GRAVEL
13.2		medium:	
9.5			
6.7		fine :	
4.75	**100**		
2.36	**99**		
1.18		coarse:	
0.600			SAND
0.425	**96**	medium:	
0.300			
0.150		fine :	
0.075	**84.0**	CLAY OR SILT	

	RESULTS
LIQUID LIMIT (%)	**56**
PLASTIC LIMIT (%)	**26**
PLASTICITY INDEX (%)	**30**
LINEAR SHRINKAGE (%)	**12.0**
EMERSON CLASS No.	**4**
CURLING/CRUMBLING	**Slight**

TEST METHODS **AS1289 3.6.1, 2.1.1,3.1.2,3.2.1,3.3.1,3.4.1,3.8.1**

TESTED BY:	*J.A*	*DATE:*	*05/12/2006*
REPORTED BY:	*M.D*	*DATE:*	*12/12/2006*
CHECKED BY:	*M.D*	*Approved Signatory:*	M. Dumigan

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REPORT ON SOIL CLASSIFICATION

CLIENT:	**CONNELL HATCH**	*JOB NO:*	**BW/1030**
PROJECT:	**JILALAN**	*REPORT NO:*	**42**
SENDER NO:	**HP30**	*SAMPLE LOCATION:*	**CW 16**
LABORATORY REF.NO.:	**06/9802**	*SENDER NO:*	
MATERIAL:	**Sandy Gravel with Clay**	*DEPTH:*	**0.40-0.90**
LOT NO:		*CH (m):*	
PREPN. METHOD (PI):	**OVEN/DRY**	*OFFSET(m):*	

SIEVE SIZE (mm)	*SAMPLE % PASS*	CLASSIFICATION AS 1289.3.6.1-1997	
152.4	-		COBBLES
75.0	**100**		
53.0			
37.5	**92**	coarse:	
26.5			
19.0	**86**		GRAVEL
13.2		medium:	
9.5	**71**		
6.7		fine :	
4.75	**56**		
2.36	**39**		
1.18		coarse:	
0.600			SAND
0.425	**22**	medium:	
0.300			
0.150		fine :	
0.075	**15.0**	CLAY OR SILT	

	RESULTS
LIQUID LIMIT (%)	**25**
PLASTIC LIMIT (%)	**19**
PLASTICITY INDEX (%)	**6**
LINEAR SHRINKAGE (%)	**4.0**
EMERSON CLASS No.	**1**
CURLING/CRUMBLING	**N/A**

TEST METHODS	**AS1289 3.6.1, 2.1.1,3.1.2,3.2.1,3.3.1,3.4.1,3.8.1**		
TESTED BY:	*J.A*	*DATE:*	*05/12/2006*
REPORTED BY:	*M.D*	*DATE:*	*12/12/2006*
CHECKED BY:	*M.D*	*Approved Signatory:*	M. Dumigan

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REPORT ON SOIL CLASSIFICATION

CLIENT:	**CONNELL HATCH**	*JOB NO:*	**BW/1030**
PROJECT:	**JILALAN**	*REPORT NO:*	**36**

SENDER NO:	**HP30**	*SAMPLE LOCATION:*	**CW 17**
LABORATORY REF.NO.:	**06/9797**	*SENDER NO:*	
MATERIAL:	**Gravelly Clayey Sand**	*DEPTH:*	**0.50**
LOT NO:		*CH (m):*	
PREPN. METHOD (PI):	**OVEN/DRY**	*OFFSET(m):*	

SIEVE SIZE (mm)	*SAMPLE % PASS*	CLASSIFICATION AS 1289.3.6.1-1997	
152.4	-	COBBLES	
75.0			
53.0			
37.5		coarse:	
26.5			
19.0	**100**		GRAVEL
13.2		medium:	
9.5	**95**		
6.7		fine :	
4.75	**87**		
2.36	**73**		
1.18		coarse:	
0.600			SAND
0.425	**40**	medium:	
0.300			
0.150		fine :	
0.075	**27**	CLAY OR SILT	

	RESULTS
LIQUID LIMIT (%)	**34**
PLASTIC LIMIT (%)	**20**
PLASTICITY INDEX (%)	**14**
LINEAR SHRINKAGE (%)	**8.0**
EMERSON CLASS No.	**1**
CURLING/CRUMBLING	**N/A**

TEST METHODS	**AS1289 3.6.1, 2.1.1,3.1.2,3.2.1,3.3.1,3.4.1,3.8.1**		
TESTED BY:	*J.A*	*DATE:*	*05/12/2006*
REPORTED BY:	*M.D*	*DATE:*	*12/12/2006*
CHECKED BY:	*M.D*	*Approved Signatory:*	M. Dumigan

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REPORT ON SOIL CLASSIFICATION

CLIENT:	**CONNELL HATCH**	*JOB NO:*	**BW/1030**
PROJECT:	**JILALAN**	*REPORT NO:*	**29**
SENDER NO:	**HP30**	*SAMPLE LOCATION:*	**CW 18**
LABORATORY REF.NO.:	**06/9793**	*SENDER NO:*	
MATERIAL:	**Sandy Clay**	*DEPTH:*	**0.50-1.00**
LOT NO:		*CH (m):*	
PREPN. METHOD (PI):	**OVEN/DRY**	*OFFSET(m):*	

SIEVE SIZE (mm)	*SAMPLE % PASS*	CLASSIFICATION AS 1289.3.6.1-1997	
152.4	-		COBBLES
75.0			
53.0			
37.5		coarse:	
26.5			
19.0		medium:	GRAVEL
13.2			
9.5			
6.7		fine :	
4.75	**100**		
2.36	**89**		
1.18		coarse:	
0.600			SAND
0.425	**85**	medium:	
0.300			
0.150		fine :	
0.075	**76**	CLAY OR SILT	

	RESULTS
LIQUID LIMIT (%)	**58**
PLASTIC LIMIT (%)	**25**
PLASTICITY INDEX (%)	**33**
LINEAR SHRINKAGE (%)	**16.5**
EMERSON CLASS No.	**1**
CURLING/CRUMBLING	**N/A**

TEST METHODS	**AS1289 3.6.1, 2.1.1,3.1.2,3.2.1,3.3.1,3.4.1,3.8.1**		
TESTED BY:	*J.A*	*DATE:*	*05/12/2006*
REPORTED BY:	*M.D*	*DATE:*	*12/12/2006*
CHECKED BY:	*M.D*	*Approved Signatory:*	M. Dumigan

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REPORT ON SOIL CLASSIFICATION

CLIENT:	**CONNELL HATCH**	*JOB NO:*	**BW/1030**
PROJECT:	**JILALAN**	*REPORT NO:*	**28**
SENDER NO:	**HP30**	*SAMPLE LOCATION:*	**CW 18**
LABORATORY REF.NO.:	**06/9792**	*SENDER NO:*	
MATERIAL:	**Clayey Sand**	*DEPTH:*	**0.90**
LOT NO:		*CH (m):*	
PREPN. METHOD (PI):	**OVEN/DRY**	*OFFSET(m):*	

SIEVE SIZE (mm)	*SAMPLE % PASS*	CLASSIFICATION AS 1289.3.6.1-1997	
152.4	-	COBBLES	
75.0			
53.0			
37.5		coarse:	
26.5			
19.0			GRAVEL
13.2		medium:	
9.5			
6.7		fine :	
4.75	**100**		
2.36	**91**		
1.18		coarse:	
0.600			SAND
0.425	**66**	medium:	
0.300			
0.150		fine :	
0.075	**34**	CLAY OR SILT	

	RESULTS
LIQUID LIMIT (%)	**15**
PLASTIC LIMIT (%)	**12**
PLASTICITY INDEX (%)	**3**
LINEAR SHRINKAGE (%)	**2.5**
EMERSON CLASS No.	**1**
CURLING/CRUMBLING	**N/A**

TEST METHODS	**AS1289 3.6.1, 2.1.1,3.1.2,3.2.1,3.3.1,3.4.1,3.8.1**		
TESTED BY:	*J.A*	*DATE:*	*05/12/2006*
REPORTED BY:	*M.D*	*DATE:*	*12/12/2006*
CHECKED BY:	*M.D*	*Approved Signatory:*	M. Dumigan

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REPORT ON SOIL CLASSIFICATION

CLIENT:	**CONNELL HATCH**	*JOB NO:*	**BW/1030**
PROJECT:	**JILALAN**	*REPORT NO:*	**43**
SENDER NO:	**HP30**	*SAMPLE LOCATION:*	**CW 19**
LABORATORY REF.NO.:	**06/9803**	*SENDER NO:*	
MATERIAL:	**Clayey Sand with Gravel**	*DEPTH:*	**0.10-0.70**
LOT NO:		*CH (m):*	
PREPN. METHOD (PI):	**OVEN/DRY**	*OFFSET(m):*	

SIEVE SIZE (mm)	*SAMPLE % PASS*	CLASSIFICATION AS 1289.3.6.1-1997	
152.4	**-**	COBBLES	
75.0			
53.0			
37.5		coarse:	
26.5			
19.0			GRAVEL
13.2		medium:	
9.5	**100**		
6.7		fine :	
4.75	**96**		
2.36	**87**		
1.18		coarse:	
0.600			SAND
0.425	**69**	medium:	
0.300			
0.150		fine :	
0.075	**43.0**	CLAY OR SILT	

	RESULTS
LIQUID LIMIT (%)	**32**
PLASTIC LIMIT (%)	**16**
PLASTICITY INDEX (%)	**15**
LINEAR SHRINKAGE (%)	**11.0**
EMERSON CLASS No.	**2**
CURLING/CRUMBLING	**Slight**

TEST METHODS **AS1289 3.6.1, 2.1.1,3.1.2,3.2.1,3.3.1,3.4.1,3.8.1**

TESTED BY:	*J.A*	*DATE:*	*05/12/2006*
REPORTED BY:	*M.D*	*DATE:*	*12/12/2006*
CHECKED BY:	*M.D*	*Approved Signatory:*	M. Dumigan

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REPORT ON SOIL CLASSIFICATION

CLIENT: **CONNELL HATCH** *JOB NO:* **BW/1030**
PROJECT: **JILALAN** *REPORT NO:* **51**

SENDER NO: **HP30** *SAMPLE LOCATION:* **CW 20**
LABORATORY REF.NO.: **06/9809** *SENDER NO:*
MATERIAL: **Clayey Sandy Gravel** *DEPTH:* **0.70**
LOT NO: *CH (m):*
PREPN. METHOD (PI): **OVEN/DRY** *OFFSET(m):*

SIEVE SIZE (mm)	*SAMPLE % PASS*	CLASSIFICATION AS 1289.3.6.1-1997	
152.4	-	COBBLES	
75.0			
53.0			
37.5		coarse:	
26.5			
19.0			GRAVEL
13.2		medium:	
9.5	**100**		
6.7		fine :	
4.75	**86**		
2.36	**66**		
1.18		coarse:	
0.600			SAND
0.425	**54**	medium:	
0.300			
0.150		fine :	
0.075	**46.0**	CLAY OR SILT	

	RESULTS
LIQUID LIMIT (%)	**50**
PLASTIC LIMIT (%)	**23**
PLASTICITY INDEX (%)	**27**
LINEAR SHRINKAGE (%)	**11.0**
EMERSON CLASS No.	**1**
CURLING/CRUMBLING	**Slight**

TEST METHODS **AS1289 3.6.1, 2.1.1,3.1.2,3.2.1,3.3.1,3.4.1,3.8.1**
TESTED BY: *J.A* *DATE:* *05/12/2006*
REPORTED BY: *M.D* *DATE:* *12/12/2006*
CHECKED BY: *M.D* *Approved Signatory:*
M. Dumigan

NATA Accredited Laboratory
Number: 5683

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REPORT ON SOIL CLASSIFICATION

CLIENT:	**CONNELL HATCH**	*JOB NO:*	**BW/1030**
PROJECT:	**JILALAN**	*REPORT NO:*	**31**

SENDER NO:	**HP30**	*SAMPLE LOCATION:*	**CW 21**
LABORATORY REF.NO.:	**06/9794**	*SENDER NO:*	
MATERIAL:	**Sandy Clay**	*DEPTH:*	**0.20-0.50**
LOT NO:		*CH (m):*	
PREPN. METHOD (PI):	**OVEN/DRY**	*OFFSET(m):*	

SIEVE SIZE (mm)	*SAMPLE % PASS*	CLASSIFICATION AS 1289.3.6.1-1997	
152.4	-		COBBLES
75.0			
53.0		coarse:	GRAVEL
37.5			
26.5			
19.0		medium:	
13.2			
9.5			
6.7		fine :	
4.75	**100**		
2.36	**99**	coarse:	SAND
1.18			
0.600		medium:	
0.425	**93**		
0.300			
0.150		fine :	
0.075	**84**		CLAY OR SILT

	RESULTS
LIQUID LIMIT (%)	**48**
PLASTIC LIMIT (%)	**21**
PLASTICITY INDEX (%)	**27**
LINEAR SHRINKAGE (%)	**13.5**
EMERSON CLASS No.	**1**
CURLING/CRUMBLING	**N/A**

TEST METHODS	**AS1289 3.6.1, 2.1.1,3.1.2,3.2.1,3.3.1,3.4.1,3.8.1**		
TESTED BY:	*J.A*	*DATE:*	*05/12/2006*
REPORTED BY:	*M.D*	*DATE:*	*12/12/2006*
CHECKED BY:	*M.D*	*Approved Signatory:*	M. Dumigan

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REPORT ON SOIL CLASSIFICATION

CLIENT:	**CONNELL HATCH**	*JOB NO:*	**BW/1030**
PROJECT:	**JILALAN**	*REPORT NO:*	**49**
SENDER NO:	**HP30**	*SAMPLE LOCATION:*	**CW 22**
LABORATORY REF.NO.:	**06/9807**	*SENDER NO:*	
MATERIAL:	**Sandy Clay**	*DEPTH:*	**1.00-1.20**
LOT NO:		*CH (m):*	
PREPN. METHOD (PI):	**OVEN/DRY**	*OFFSET(m):*	

SIEVE SIZE (mm)	*SAMPLE % PASS*	CLASSIFICATION AS 1289.3.6.1-1997	
152.4	**-**	COBBLES	
75.0			
53.0		coarse:	GRAVEL
37.5			
26.5			
19.0		medium:	
13.2	**100**		
9.5	**99**		
6.7		fine :	
4.75	**95**		
2.36	**92**	coarse:	SAND
1.18			
0.600		medium:	
0.425	**83**		
0.300			
0.150		fine :	
0.075	**62.0**	CLAY OR SILT	

	RESULTS
LIQUID LIMIT (%)	**39**
PLASTIC LIMIT (%)	**22**
PLASTICITY INDEX (%)	**17**
LINEAR SHRINKAGE (%)	**11.0**
EMERSON CLASS No.	**1**
CURLING/CRUMBLING	**Slight**

TEST METHODS	**AS1289 3.6.1, 2.1.1,3.1.2,3.2.1,3.3.1,3.4.1,3.8.1**		
TESTED BY:	*J.A*	*DATE:*	*05/12/2006*
REPORTED BY:	*M.D*	*DATE:*	*12/12/2006*
CHECKED BY:	*M.D*	*Approved Signatory:*	M. Dumigan

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REPORT ON SOIL CLASSIFICATION

CLIENT:	**CONNELL HATCH**	*JOB NO:*	**BW/1030**
PROJECT:	**JILALAN**	*REPORT NO:*	**33**
SENDER NO:	**HP30**	*SAMPLE LOCATION:*	**CW 23**
LABORATORY REF.NO.:	**06/9795**	*SENDER NO:*	
MATERIAL:	**Sandy Clay**	*DEPTH:*	**0.40-0.70**
LOT NO:		*CH (m):*	
PREPN. METHOD (PI):	**OVEN/DRY**	*OFFSET(m):*	

SIEVE SIZE (mm)	*SAMPLE % PASS*	CLASSIFICATION AS 1289.3.6.1-1997	
152.4	-	COBBLES	
75.0			
53.0			
37.5		coarse:	
26.5			
19.0			GRAVEL
13.2		medium:	
9.5			
6.7		fine :	
4.75	100		
2.36	92		
1.18		coarse:	
0.600			SAND
0.425	80	medium:	
0.300			
0.150		fine :	
0.075	66	CLAY OR SILT	

	RESULTS
LIQUID LIMIT (%)	37
PLASTIC LIMIT (%)	19
PLASTICITY INDEX (%)	18
LINEAR SHRINKAGE (%)	12.0
EMERSON CLASS No.	2
CURLING/CRUMBLING	N/A

TEST METHODS	**AS1289 3.6.1, 2.1.1,3.1.2,3.2.1,3.3.1,3.4.1,3.8.1**		
TESTED BY:	*J.A*	*DATE:*	*05/12/2006*
REPORTED BY:	*M.D*	*DATE:*	*12/12/2006*
CHECKED BY:	*M.D*	*Approved Signatory:*	M. Dumigan

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REPORT ON SOIL CLASSIFICATION

CLIENT:	**CONNELL HATCH**	*JOB NO:*	**BW/1030**
PROJECT:	**JILALAN**	*REPORT NO:*	**26**
SENDER NO:	**HP30**	*SAMPLE LOCATION:*	**CW 25**
LABORATORY REF.NO.:	**06/9791**	*SENDER NO:*	
MATERIAL:	**Sandy Clay**	*DEPTH:*	**0.20-0.50**
LOT NO:		*CH (m):*	
PREPN. METHOD (PI):	**OVEN/DRY**	*OFFSET(m):*	

SIEVE SIZE (mm)	*SAMPLE % PASS*	CLASSIFICATION AS 1289.3.6.1-1997	
152.4	-		COBBLES
75.0			
53.0			
37.5		coarse:	
26.5			
19.0			GRAVEL
13.2		medium:	
9.5			
6.7		fine :	
4.75			
2.36	**100**		
1.18		coarse:	
0.600			SAND
0.425	**95**	medium:	
0.300			
0.150		fine :	
0.075	**73**	CLAY OR SILT	

	RESULTS
LIQUID LIMIT (%)	**32**
PLASTIC LIMIT (%)	**21**
PLASTICITY INDEX (%)	**11**
LINEAR SHRINKAGE (%)	**7.0**
EMERSON CLASS No.	**1**
CURLING/CRUMBLING	**N/A**

TEST METHODS **AS1289 3.6.1, 2.1.1,3.1.2,3.2.1,3.3.1,3.4.1,3.8.1**

TESTED BY:	*J.A*	*DATE:*	*05/12/2006*
REPORTED BY:	*M.D*	*DATE:*	*12/12/2006*
CHECKED BY:	*M.D*	*Approved Signatory:*	M. Dumigan

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REPORT ON SOIL CLASSIFICATION

CLIENT:	**CONNELL HATCH**	*JOB NO:*	**BW/1030**
PROJECT:	**JILALAN**	*REPORT NO:*	**38**

SENDER NO:	**HP30**	*SAMPLE LOCATION:*	**CW 26**
LABORATORY REF.NO.:	**06/9799**	*SENDER NO:*	
MATERIAL:	**Clayey Sand**	*DEPTH:*	
LOT NO:		*CH (m):*	
PREPN. METHOD (PI):	**OVEN/DRY**	*OFFSET(m):*	

SIEVE SIZE (mm)	*SAMPLE % PASS*	CLASSIFICATION AS 1289.3.6.1-1997	
152.4	-		COBBLES
75.0			
53.0			
37.5		coarse:	
26.5			
19.0			GRAVEL
13.2		medium:	
9.5			
6.7		fine :	
4.75	**100**		
2.36	**96**		
1.18		coarse:	
0.600			SAND
0.425	**65**	medium:	
0.300			
0.150		fine :	
0.075	**32.0**	CLAY OR SILT	

	RESULTS
LIQUID LIMIT (%)	**20**
PLASTIC LIMIT (%)	**15**
PLASTICITY INDEX (%)	**5**
LINEAR SHRINKAGE (%)	**3.5**
EMERSON CLASS No.	**2**
CURLING/CRUMBLING	**N/A**

TEST METHODS	**AS1289 3.6.1, 2.1.1,3.1.2,3.2.1,3.3.1,3.4.1,3.8.1**		
TESTED BY:	*J.A*	*DATE:*	*05/12/2006*
REPORTED BY:	*M.D*	*DATE:*	*12/12/2006*
CHECKED BY:	*M.D*	*Approved Signatory:*	M. Dumigan

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REPORT ON SOIL CLASSIFICATION

CLIENT:	**CONNELL HATCH**	*JOB NO:*	**BW/1030**
PROJECT:	**JILALAN**	*REPORT NO:*	**40**

SENDER NO:	**HP30**	*SAMPLE LOCATION:*	**CW 27**
LABORATORY REF.NO.:	**06/9801**	*SENDER NO:*	
MATERIAL:	**Clayey Gravelly Sand**	*DEPTH:*	**0.40**
LOT NO:		*CH (m):*	
PREPN. METHOD (PI):	**OVEN/DRY**	*OFFSET(m):*	

SIEVE SIZE (mm)	*SAMPLE % PASS*	CLASSIFICATION AS 1289.3.6.1-1997	
152.4	-	COBBLES	
75.0			
53.0			
37.5	**100**	coarse:	
26.5			
19.0	**94**		GRAVEL
		medium:	
13.2			
9.5	**91**		
6.7		fine :	
4.75	**86**		
2.36	**80**		
		coarse:	
1.18			
0.600			SAND
0.425	**60**	medium:	
0.300			
		fine :	
0.150			
0.075	**42.0**	CLAY OR SILT	

	RESULTS
LIQUID LIMIT (%)	**25**
PLASTIC LIMIT (%)	**16**
PLASTICITY INDEX (%)	**9**
LINEAR SHRINKAGE (%)	**6.0**
EMERSON CLASS No.	**2**
CURLING/CRUMBLING	**N/A**

TEST METHODS	**AS1289 3.6.1, 2.1.1,3.1.2,3.2.1,3.3.1,3.4.1,3.8.1**		
TESTED BY:	*J.A*	*DATE:*	*05/12/2006*
REPORTED BY:	*M.D*	*DATE:*	*12/12/2006*
CHECKED BY:	*M.D*	*Approved Signatory:*	M. Dumigan

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SHRINK SWELL INDEX TEST REPORT

Test Method: AS1289 7.1.1

Client:	Connell Wagner Pty Ltd	Report No.	612175-ISS
Project:	Jilalan Bypass	Test Date:	08/12/06
		Report Date:	13/12/06

Client I.D: CW13 Depth (m): 4.5

SWELL SPECIMEN		**SHRINKAGE SPECIMEN**	
Wet Density (t/m^3):	2.10	Extent of Crumbling:	Nil
Initial Moisture (%):	14.3	Extent of Cracking:	Low
Final Moisture (%):	22.6	Moisture (%):	14.6
Swell (%):	**10.6**	**Shrinkage (%):**	**2.2**

SHRINK SWELL INDEX (Iss%): 4.2

Description: (CH) CLAY – grey brown.

Remarks: Shrinkage measured using steel pins inserted into the side of the specimen. Inert inclusions as estimated in the visual classification.

Sample/s supplied by the client

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Authorised Signatory

James Russell

J. Russell

Manager

N ATA Accredited Laboratory Number 9926

Form Number: GT012-5

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SHRINK SWELL INDEX TEST REPORT

Test Method: AS1289 7.1.1

Client:	Connell Wagner Pty Ltd	Report No.	612180-ISS
Project:	Jilalan Bypass	Test Date:	08/12/06
		Report Date:	13/12/06

Client I.D: CW23 Depth (m): 1.0

SWELL SPECIMEN		**SHRINKAGE SPECIMEN**	
Wet Density (t/m^3):	1.70	Extent of Crumbling:	Nil
Initial Moisture (%):	14.7	Extent of Cracking:	Nil
Final Moisture (%):	17.2	Moisture (%):	15.2
Swell (%):	**0.3**	**Shrinkage (%):**	**0.1**

SHRINK SWELL INDEX (Iss%): 0.2

Description: (CI) SILTY CLAY – grey.

Remarks: Shrinkage measured using steel pins inserted into the side of the specimen. Inert inclusions as estimated in the visual classification.

Sample/s supplied by the client

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Form Number: GT012-5

Authorised Signatory

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Manager

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UNCONFINED COMPRESSIVE STRENGTH (Qu) TEST REPORT

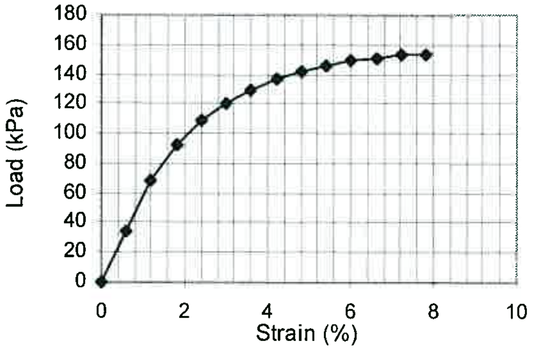
Test Method: AS 1289 6.4.1

Client:	Connell Wagner Pty Ltd	Report No.	612176-QU
Project:	Jilalan Bypass	Test Date:	08/12/06
		Report Date:	13/12/06

Client ID: CW17
Depth (m): 1.2

Description: (SC) CLAYEY SAND – brown and orange.

Sample No.:	612176
Rate of Strain (mm/min):	1.0
Strain at Failure (%):	7.8
Mode of Failure:	Plastic
Specimen Dimensions: Length (mm): Diameter (mm):	 83.1 46.6
Sample Type:	Undisturbed
Wet Density (t/m3):	2.25
Dry Density (t/m3):	1.85
Moisture Content (%):	21.5
Compressive Strength (kPa):	**153**



Remarks:

Sample/s supplied by the client

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Form Number: GT017-5

Authorised Signatory

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UNCONFINED COMPRESSIVE STRENGTH (Qu) TEST REPORT

Test Method: AS 1289 6.4.1

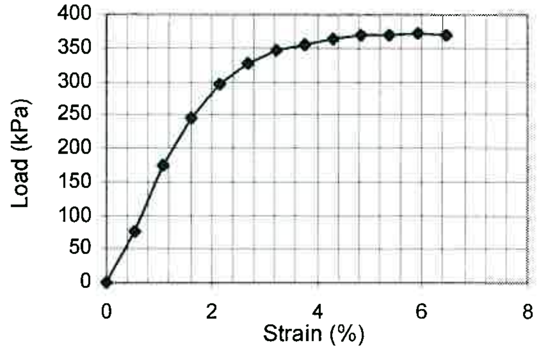
Client: Connell Wagner Pty Ltd
Report No. 612177-QU

Project: Jilalan Bypass
Test Date: 08/12/06
Report Date: 13/12/06

Client ID: CW20
Depth (m): 1.9

Description: (CH) CLAY – orange and red.

Sample No.:	612177
Rate of Strain (mm/min):	1.0
Strain at Failure (%):	6.4
Mode of Failure:	Shear
Specimen Dimensions: Length (mm): Diameter (mm):	 93.1 47.4
Sample Type:	Undisturbed
Wet Density (t/m3):	2.04
Dry Density (t/m3):	1.69
Moisture Content (%):	21.0
Compressive Strength (kPa):	**370**



Remarks:

Sample/s supplied by the client

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UNCONFINED COMPRESSIVE STRENGTH (Qu) TEST REPORT

Test Method: AS 1289 6.4.1

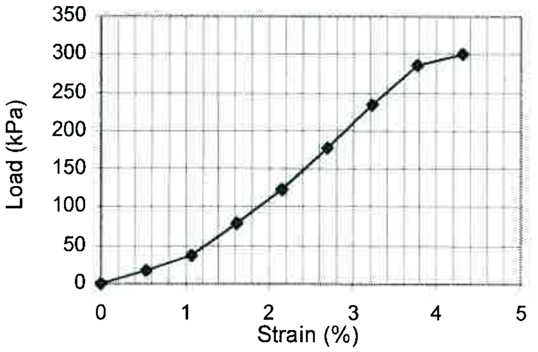
Client: Connell Wagner Pty Ltd
Report No. 612178-QU

Project: Jilalan Bypass
Test Date: 08/12/06
Report Date: 13/12/06

Client ID: CW21
Depth (m): 1.3

Description: (CI) SANDY CLAY – grey.

Sample No.:	612178
Rate of Strain (mm/min):	1.0
Strain at Failure (%):	4.3
Mode of Failure:	Axial
Specimen Dimensions: Length (mm): Diameter (mm):	 93.0 42.8
Sample Type:	Undisturbed
Wet Density (t/m3):	2.63
Dry Density (t/m3):	2.25
Moisture Content (%):	16.7
Compressive Strength (kPa):	**301**



Remarks:

Sample/s supplied by the client

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N ATA Accredited Laboratory Number 9926
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UNCONFINED COMPRESSIVE STRENGTH (Qu) TEST REPORT

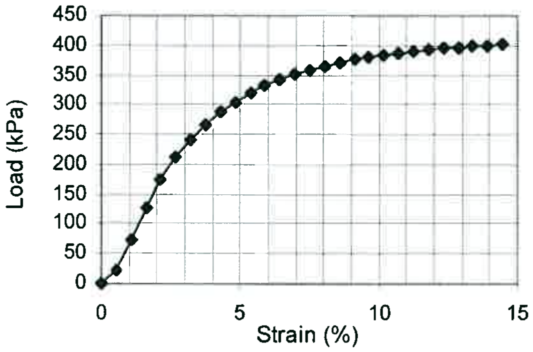
Test Method: AS 1289 6.4.1

Client:	Connell Wagner Pty Ltd	Report No.	612179-QU
Project:	Jilalan Bypass	Test Date:	08/12/06
		Report Date:	13/12/06

Client ID: CW22
Depth (m): 1.0

Description: (CH) CLAY – yellow brown.

Sample No.:	612179
Rate of Strain (mm/min):	1.0
Strain at Failure (%):	14.5
Mode of Failure:	Shear
Specimen Dimensions: Length (mm): Diameter (mm):	 93.3 47.1
Sample Type:	Undisturbed
Wet Density (t/m3):	2.17
Dry Density (t/m3):	1.86
Moisture Content (%):	16.4
Compressive Strength (kPa):	**402**



Remarks:

Sample/s supplied by the client

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Form Number: GT017-5

Authorised Signatory

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J. Russell

Manager

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UNCONFINED COMPRESSIVE STRENGTH (Qu) TEST REPORT

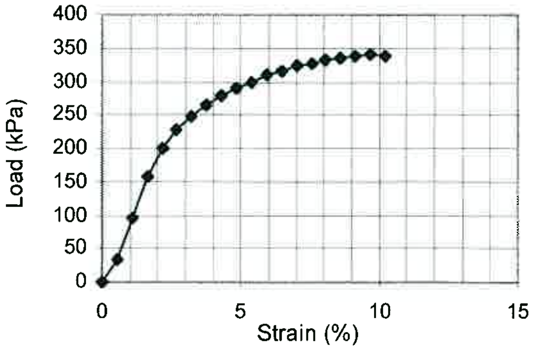
Test Method: AS 1289 6.4.1

Client:	Connell Wagner Pty Ltd	Report No.	612180-QU
Project:	Jilalan Bypass	Test Date:	08/12/06
		Report Date:	13/12/06

Client ID: CW23
Depth (m): 1.0

Description: (CH) SILTY CLAY - grey

Sample No.:	612180
Rate of Strain (mm/min):	1.0
Strain at Failure (%):	10.2
Mode of Failure:	Shear
Specimen Dimensions: Length (mm): Diameter (mm):	 92.9 47.3
Sample Type:	Undisturbed
Wet Density (t/m3):	2.15
Dry Density (t/m3):	1.86
Moisture Content (%):	16.0
Compressive Strength (kPa):	**339**



Remarks:

Sample/s supplied by the client

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UNCONFINED COMPRESSIVE STRENGTH (Qu) TEST REPORT

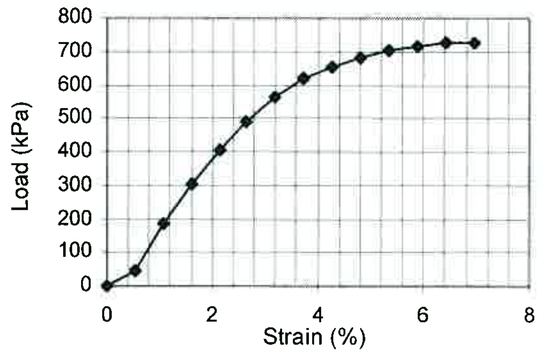
Test Method: AS 1289 6.4.1

Client:	Connell Wagner Pty Ltd	Report No.	612181-QU
Project:	Jilalan Bypass	Test Date:	08/12/06
		Report Date:	13/12/06

Client ID: CW27
Depth (m): 2.0

Description: (CI) SILTY CLAY - grey

Sample No.:	612181
Rate of Strain (mm/min):	1.0
Strain at Failure (%):	6.9
Mode of Failure:	Shear
Specimen Dimensions:	
Length (mm):	93.6
Diameter (mm):	47.5
Sample Type:	Undisturbed
Wet Density (t/m3):	2.18
Dry Density (t/m3):	1.91
Moisture Content (%):	14.0
Compressive Strength (kPa):	**729**



Remarks:

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ATTERBERG LIMITS TEST REPORT

TEST METHOD: AS1289 2.1.1, 3.1.1, 3.2.1, 3.3.1, 3.4.1

Client:	Connell Wagner Pty Ltd	Report No.	612174-AL
Project:	Jilalan Bypass	Test Date:	08/12/06
		Report Date:	12/12/06

Client ID: CW13	Depth(m): 4.5	Sample No. 612174	
Liquid Limit (%):	77	Linear Shrinkage (%):	17.0
Plastic Limit (%):	27	Field Moisture Content (%):	54.8
Plasticity Index (%):	50		

Remarks: The sample/s were tested in a natural state, wet sieved and in a 125 – 250mm mould.
*Crumbling occurred.
+Curling occurred.

Sample/s supplied by the client

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CALIFORNIA BEARING RATIO REPORT SHEET

CLIENT:	CONNELL HATCH	*JOB No.:*	BW/1030
PROJECT:	JILALAN	*REPORT No.:*	46

SENDER NO:		*CHAINAGE:*	
DEPTH:	0.15m	*OFFSET:*	
SAMPLE LOCATION:	BH 15	*SAMPLE No.:*	06/9804

SOIL DESCRIPTION & COMMENTS: Existing
-
-

MAXIMUM DRY DENSITY (t/m3): 1.86
OPTIMUM MOISTURE CONTENT (%): 16.0

TEST CONDITIONS

CONDITION OF SPECIMEN	SOAKED (4 DAYS)
SURCHARGE (g)	4500
PERCENTAGE RETAINED 19mm *(Not Included in Sample)*	0
MOISTURE CONTENT OF TOP 30mm (%)	22.2
SWELL/CONSOLIDATION (%)	4.2
LABORATORY MOISTURE RATIO %	101
LABORATORY DENSITY RATIO:	95
CBR VALUE 5.0mm (%)	2.5

TESTED BY:	D.S	*DATE:*	05/12/2006
REPORTED BY:	M.D	*DATE:*	12/12/2006
TEST PROCEDURES:	AS 1289 6.1.1 & .5.2.1 (MODIFIED)		

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CLIENT:	CONNELL HATCH	*JOB No.:*	BW/1030
PROJECT:	JILALAN	*REPORT No.:*	55

SENDER NO:		*CHAINAGE:*	
DEPTH:	1.50m	*OFFSET:*	
SAMPLE LOCATION:	TP 2	*SAMPLE No.:*	06/9796

SOIL DESCRIPTION & COMMENTS: Existing		*MAXIMUM DRY DENSITY (t/m3):*	1.85
-		*OPTIMUM MOISTURE CONTENT (%):*	16.5
-			

TEST CONDITIONS

CONDITION OF SPECIMEN	SOAKED (4 DAYS)
SURCHARGE (g)	4500
PERCENTAGE RETAINED 19mm *(Not Included in Sample)*	0
MOISTURE CONTENT OF TOP 30mm (%)	26.0
SWELL/CONSOLIDATION (%)	4.5
LABORATORY MOISTURE RATIO %	101
LABORATORY DENSITY RATIO:	95
CBR VALUE 5.0mm (%)	2

TESTED BY:	C.G	*DATE:*	08/12/2006
REPORTED BY:	M.D	*DATE:*	13/12/2006
TEST PROCEDURES:	AS 1289 6.1.1 & .5.2.1 (MODIFIED)		

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CLIENT: CONNELL HATCH
PROJECT: JILALAN
JOB No.: BW/1030
REPORT No.: 20

SENDER NO:
DEPTH: 2.00m
SAMPLE LOCATION: TP3
CHAINAGE:
OFFSET:
SAMPLE No.: 06/9798

SOIL DESCRIPTION & COMMENTS: Existing
-
-

MAXIMUM DRY DENSITY (t/m3): 2.10
OPTIMUM MOISTURE CONTENT (%): 12.5

TEST CONDITIONS

CONDITION OF SPECIMEN	SOAKED (4 DAYS)
SURCHARGE (g)	4500
PERCENTAGE RETAINED 19mm *(Not Included in Sample)*	0
MOISTURE CONTENT OF TOP 30mm (%)	13.6
SWELL/CONSOLIDATION (%)	-0.3
LABORATORY MOISTURE RATIO %	101
LABORATORY DENSITY RATIO:	95
CBR VALUE 5.0mm (%)	4

TESTED BY: D.S
REPORTED BY: L.C
TEST PROCEDURES: AS 1289 6.1.1 & .5.2.1 (MODIFIED)
DATE: 04/12/2006
DATE: 07/12/2006

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CLIENT:	CONNELL HATCH	*JOB No.:*	BW/1030
PROJECT:	JILALAN	*REPORT No.:*	53

SENDER NO:		*CHAINAGE:*	
DEPTH:	1.70-2.00m	*OFFSET:*	
SAMPLE LOCATION:	TP 5	*SAMPLE No.:*	06/9810

SOIL DESCRIPTION & COMMENTS: Existing
-
-

MAXIMUM DRY DENSITY (t/m3): 1.75
OPTIMUM MOISTURE CONTENT (%): 19.5

TEST CONDITIONS

CONDITION OF SPECIMEN	SOAKED (4 DAYS)
SURCHARGE (g)	4500
PERCENTAGE RETAINED 19mm *(Not Included in Sample)*	0
MOISTURE CONTENT OF TOP 30mm (%)	23.2
SWELL/CONSOLIDATION (%)	1.9
LABORATORY MOISTURE RATIO %	99
LABORATORY DENSITY RATIO:	95
CBR VALUE 5.0mm (%)	3

TESTED BY:	D.S	*DATE:*	04/12/2006
REPORTED BY:	M.D	*DATE:*	12/12/2006
TEST PROCEDURES:	AS 1289 6.1.1 & .5.2.1 (MODIFIED)		

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CLIENT:	**CONNELL HATCH**	*JOB No.:*	**BW/1030**
PROJECT:	**JILALAN**	*REPORT No.:*	**23**

SENDER NO:		*CHAINAGE:*	
DEPTH:	**1.50m**	*OFFSET:*	
SAMPLE LOCATION:	**TP7**	*SAMPLE No.:*	**06/9806**

SOIL DESCRIPTION & COMMENTS: **Existing**
-
-

MAXIMUM DRY DENSITY (t/m3):	**1.99**
OPTIMUM MOISTURE CONTENT (%):	**13.0**

TEST CONDITIONS

CONDITION OF SPECIMEN	**SOAKED (4 DAYS)**
SURCHARGE (g)	**4500**
PERCENTAGE RETAINED 19mm ***(Not Included in Sample)***	**0**
MOISTURE CONTENT OF TOP 30mm (%)	**17.0**
SWELL/CONSOLIDATION (%)	**2.0**
LABORATORY MOISTURE RATIO %	**100**
LABORATORY DENSITY RATIO:	**95**
CBR VALUE 2.5mm (%)	**2.5**

TESTED BY:	*D.S*	*DATE:*	05/12/2006
REPORTED BY:	*L.C*	*DATE:*	07/12/2006
TEST PROCEDURES:	**AS 1289 6.1.1 & .5.2.1 (MODIFIED)**		

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CLIENT:	CONNELL HATCH	*JOB No.:*	BW/1030
PROJECT:	JILALAN	*REPORT No.:*	22

SENDER NO:		*CHAINAGE:*	
DEPTH:	0.40-0.70m	*OFFSET:*	
SAMPLE LOCATION:	CW13	*SAMPLE No.:*	06/9805

SOIL DESCRIPTION & COMMENTS: Existing
-
-

MAXIMUM DRY DENSITY (t/m3): 2.10
OPTIMUM MOISTURE CONTENT (%): 10.0

TEST CONDITIONS

CONDITION OF SPECIMEN	SOAKED (4 DAYS)
SURCHARGE (g)	4500
PERCENTAGE RETAINED 19mm *(Not Included in Sample)*	0
MOISTURE CONTENT OF TOP 30mm (%)	13.0
SWELL/CONSOLIDATION (%)	0.2
LABORATORY MOISTURE RATIO %	97
LABORATORY DENSITY RATIO:	95
CBR VALUE 5.0mm (%)	15

TESTED BY:	D.S	*DATE:*	04/12/2006
REPORTED BY:	L.C	*DATE:*	07/12/2006
TEST PROCEDURES:	AS 1289 6.1.1 & .5.2.1 (MODIFIED)		

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CLIENT:	**CONNELL HATCH**	*JOB No.:*	**BW/1030**
PROJECT:	**JILALAN**	*REPORT No.:*	**58**

SENDER NO:		*CHAINAGE:*	
DEPTH:	**0.30-0.80m**	*OFFSET:*	
SAMPLE LOCATION:	**CW 14**	*SAMPLE No.:*	**06/9800**

SOIL DESCRIPTION & COMMENTS: Existing
-
-

MAXIMUM DRY DENSITY (t/m3): **1.83**
OPTIMUM MOISTURE CONTENT (%): **18.0**

TEST CONDITIONS

CONDITION OF SPECIMEN	**SOAKED (4 DAYS)**
SURCHARGE (g)	**4500**
PERCENTAGE RETAINED 19mm *(Not Included in Sample)*	**0**
MOISTURE CONTENT OF TOP 30mm (%)	**24.6**
SWELL/CONSOLIDATION (%)	**2.0**
LABORATORY MOISTURE RATIO %	**101**
LABORATORY DENSITY RATIO:	**95**
CBR VALUE 2.5mm (%)	**5**

TESTED BY:	C.G	*DATE:*	15/12/2006
REPORTED BY:	L.C	*DATE:*	19/12/2006
TEST PROCEDURES:	**AS 1289 6.1.1 & .5.2.1 (MODIFIED)**		

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CLIENT:	CONNELL HATCH	*JOB No.:*	BW/1030
PROJECT:	JILALAN	*REPORT No.:*	21

SENDER NO:		*CHAINAGE:*	
DEPTH:	0.40-0.90m	*OFFSET:*	
SAMPLE LOCATION:	CW16	*SAMPLE No.:*	06/9802

SOIL DESCRIPTION & COMMENTS: Existing
-
-

MAXIMUM DRY DENSITY (t/m3): 2.20
OPTIMUM MOISTURE CONTENT (%): 9.5

TEST CONDITIONS

CONDITION OF SPECIMEN	SOAKED (4 DAYS)
SURCHARGE (g)	4500
PERCENTAGE RETAINED 19mm *(Not Included in Sample)*	0
MOISTURE CONTENT OF TOP 30mm (%)	12.4
SWELL/CONSOLIDATION (%)	0.2
LABORATORY MOISTURE RATIO %	100
LABORATORY DENSITY RATIO:	95
CBR VALUE 5.0mm (%)	80

TESTED BY:	D.S	*DATE:*	04/12/2006
REPORTED BY:	L.C	*DATE:*	07/12/2006
TEST PROCEDURES:	AS 1289 6.1.1 & .5.2.1 (MODIFIED)		

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CLIENT:	CONNELL HATCH	*JOB No.:*	BW/1030
PROJECT:	JILALAN	*REPORT No.:*	19

SENDER NO:		*CHAINAGE:*	
DEPTH:	0.50m	*OFFSET:*	
SAMPLE LOCATION:	CW17	*SAMPLE No.:*	06/9797

SOIL DESCRIPTION & COMMENTS: Existing		*MAXIMUM DRY DENSITY (t/m3):*	1.98
-		*OPTIMUM MOISTURE CONTENT (%):*	13.0
-			

TEST CONDITIONS

CONDITION OF SPECIMEN	**SOAKED (4 DAYS)**
SURCHARGE (g)	**4500**
PERCENTAGE RETAINED 19mm ***(Not Included in Sample)***	**0**
MOISTURE CONTENT OF TOP 30mm (%)	**19.0**
SWELL/CONSOLIDATION (%)	**0.2**
LABORATORY MOISTURE RATIO %	**102**
LABORATORY DENSITY RATIO:	**96**
CBR VALUE 5.0mm (%)	**40**

TESTED BY:	*D.S*	*DATE:*	04/12/2006
REPORTED BY:	*L.C*	*DATE:*	07/12/2006
TEST PROCEDURES:	**AS 1289 6.1.1 & .5.2.1 (MODIFIED)**		

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CLIENT:	CONNELL HATCH	*JOB No.:*	BW/1030
PROJECT:	JILALAN	*REPORT No.:*	54
SENDER NO:		*CHAINAGE:*	
DEPTH:	0.9m	*OFFSET:*	
SAMPLE LOCATION:	CW 18	*SAMPLE No.:*	06/9792

SOIL DESCRIPTION & COMMENTS: Existing
-
-

MAXIMUM DRY DENSITY (t/m3): 2.19
OPTIMUM MOISTURE CONTENT (%): 8.5

TEST CONDITIONS

CONDITION OF SPECIMEN	SOAKED (4 DAYS)
SURCHARGE (g)	4500
PERCENTAGE RETAINED 19mm ***(Not Included in Sample)***	0
MOISTURE CONTENT OF TOP 30mm (%)	8.8
SWELL/CONSOLIDATION (%)	0.6
LABORATORY MOISTURE RATIO %	100
LABORATORY DENSITY RATIO:	95
CBR VALUE 5.0mm (%)	11

TESTED BY: C.G *DATE:* 08/12/2006
REPORTED BY: M.D *DATE:* 13/12/2006
TEST PROCEDURES: AS 1289 6.1.1 & .5.2.1 (MODIFIED)

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CALIFORNIA BEARING RATIO REPORT SHEET

CLIENT:	CONNELL HATCH	*JOB No.:*	BW/1030
PROJECT:	JILALAN	*REPORT No.:*	44

SENDER NO:		*CHAINAGE:*	
DEPTH:	0.10-0.70m	*OFFSET:*	
SAMPLE LOCATION:	CW 19	*SAMPLE No.:*	06/9803

SOIL DESCRIPTION & COMMENTS: Existing
-
-

MAXIMUM DRY DENSITY (t/m3): 1.94
OPTIMUM MOISTURE CONTENT (%): 16.5

TEST CONDITIONS

CONDITION OF SPECIMEN	SOAKED (4 DAYS)
SURCHARGE (g)	4500
PERCENTAGE RETAINED 19mm ***(Not Included in Sample)***	0
MOISTURE CONTENT OF TOP 30mm (%)	21.9
SWELL/CONSOLIDATION (%)	5.6
LABORATORY MOISTURE RATIO %	99
LABORATORY DENSITY RATIO:	95
CBR VALUE 5.0mm (%)	3

TESTED BY:	*M.D*	*DATE:*	05/12/2006
REPORTED BY:	*M.D*	*DATE:*	12/12/2006
TEST PROCEDURES:	AS 1289 6.1.1 & .5.2.1 (MODIFIED)		

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Soils Laboratory Services

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Offices also at
Gold Coast, Geebung, Sunshine Coast, Browns Plains, Gladstone, Rockhampton, Townsville, Cairns, Mt Isa, Darwin, Vietnam, PNG.

CALIFORNIA BEARING RATIO REPORT SHEET

CLIENT:	CONNELL HATCH	*JOB No.:*	BW/1030
PROJECT:	JILALAN	*REPORT No.:*	56

SENDER NO:		*CHAINAGE:*	
DEPTH:	0.70m	*OFFSET:*	
SAMPLE LOCATION:	CW 20	*SAMPLE No.:*	06/9809

SOIL DESCRIPTION & COMMENTS: Existing		*MAXIMUM DRY DENSITY (t/m3):*	1.87
-		*OPTIMUM MOISTURE CONTENT (%):*	10.5
-			

TEST CONDITIONS

CONDITION OF SPECIMEN	SOAKED (4 DAYS)
SURCHARGE (g)	4500
PERCENTAGE RETAINED 19mm *(Not Included in Sample)*	0
MOISTURE CONTENT OF TOP 30mm (%)	23.8
SWELL/CONSOLIDATION (%)	5.5
LABORATORY MOISTURE RATIO %	100
LABORATORY DENSITY RATIO:	95
CBR VALUE 5.0mm (%)	1

TESTED BY:	*C.G*	*DATE:*	08/12/2006
REPORTED BY:	*M.D*	*DATE:*	13/12/2006
TEST PROCEDURES:	AS 1289 6.1.1 & .5.2.1 (MODIFIED)		

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Approved Signatory:
M. Dumigan

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CALIFORNIA BEARING RATIO REPORT SHEET

CLIENT:	CONNELL HATCH	*JOB No.:*	BW/1030
PROJECT:	JILALAN	*REPORT No.:*	32
SENDER NO:		*CHAINAGE:*	
DEPTH:	0.20-0.50m	*OFFSET:*	
SAMPLE LOCATION:	CW 21	*SAMPLE No.:*	06/9794
SOIL DESCRIPTION & COMMENTS:	Existing - -	*MAXIMUM DRY DENSITY (t/m3):*	1.89
		OPTIMUM MOISTURE CONTENT (%):	16.0

TEST CONDITIONS

CONDITION OF SPECIMEN	SOAKED (4 DAYS)
SURCHARGE (g)	4500
PERCENTAGE RETAINED 19mm *(Not Included in Sample)*	0
MOISTURE CONTENT OF TOP 30mm (%)	22.6
SWELL/CONSOLIDATION (%)	2.2
LABORATORY MOISTURE RATIO %	99
LABORATORY DENSITY RATIO:	95
CBR VALUE 5.0mm (%)	4.5

TESTED BY:	*D.S*	*DATE:*	05/12/2006
REPORTED BY:	*M.D*	*DATE:*	12/12/2006
TEST PROCEDURES:	AS 1289 6.1.1 & .5.2.1 (MODIFIED)		

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CALIFORNIA BEARING RATIO REPORT SHEET

CLIENT: CONNELL HATCH
PROJECT: JILALAN
JOB No.: BW/1030
REPORT No.: 24

SENDER NO:
DEPTH: 1.00-1.20m
SAMPLE LOCATION: CW22
CHAINAGE:
OFFSET:
SAMPLE No.: 06/9807

SOIL DESCRIPTION & COMMENTS: Existing
-
-

MAXIMUM DRY DENSITY (t/m3): 1.82
OPTIMUM MOISTURE CONTENT (%): 15.5

TEST CONDITIONS

CONDITION OF SPECIMEN	SOAKED (4 DAYS)
SURCHARGE (g)	4500
PERCENTAGE RETAINED 19mm *(Not Included in Sample)*	0
MOISTURE CONTENT OF TOP 30mm (%)	20.4
SWELL/CONSOLIDATION (%)	2.9
LABORATORY MOISTURE RATIO %	103
LABORATORY DENSITY RATIO:	95
CBR VALUE 2.5mm (%)	3.5

TESTED BY: D.S
DATE: 05/12/2006
REPORTED BY: L.C
DATE: 07/12/2006
TEST PROCEDURES: AS 1289 6.1.1 & .5.2.1 (MODIFIED)

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Approved Signatory
G. Russell

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CALIFORNIA BEARING RATIO REPORT SHEET

CLIENT:	CONNELL HATCH	*JOB No.:*	BW/1030
PROJECT:	JILALAN	*REPORT No.:*	34

SENDER NO:		*CHAINAGE:*	
DEPTH:	0.40-0.70m	*OFFSET:*	
SAMPLE LOCATION:	CW 23	*SAMPLE No.:*	06/9795

SOIL DESCRIPTION & COMMENTS: Existing
-
-

MAXIMUM DRY DENSITY (t/m3): 1.90
OPTIMUM MOISTURE CONTENT (%): 15.0

TEST CONDITIONS

CONDITION OF SPECIMEN	SOAKED (4 DAYS)
SURCHARGE (g)	4500
PERCENTAGE RETAINED 19mm *(Not Included in Sample)*	0
MOISTURE CONTENT OF TOP 30mm (%)	19.8
SWELL/CONSOLIDATION (%)	2.1
LABORATORY MOISTURE RATIO %	101
LABORATORY DENSITY RATIO:	95
CBR VALUE 5.0mm (%)	4.5

TESTED BY:	M.D	*DATE:*	05/12/2006
REPORTED BY:	M.D	*DATE:*	12/12/2006
TEST PROCEDURES:	AS 1289 6.1.1 & .5.2.1 (MODIFIED)		

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CALIFORNIA BEARING RATIO REPORT SHEET

CLIENT: **CONNELL HATCH**
PROJECT: **JILALAN**
JOB No.: **BW/1030**
REPORT No.: **30**

SENDER NO:
DEPTH: **0.50-1.00m**
SAMPLE LOCATION: **CW 24**
CHAINAGE:
OFFSET:
SAMPLE No.: **06/9793**

SOIL DESCRIPTION & COMMENTS: **Existing**
-
-

MAXIMUM DRY DENSITY (t/m3): **1.81**
OPTIMUM MOISTURE CONTENT (%): **18.0**

TEST CONDITIONS

CONDITION OF SPECIMEN	**SOAKED (4 DAYS)**
SURCHARGE (g)	**4500**
PERCENTAGE RETAINED 19mm *(Not Included in Sample)*	**0**
MOISTURE CONTENT OF TOP 30mm (%)	**23.7**
SWELL/CONSOLIDATION (%)	**2.3**
LABORATORY MOISTURE RATIO %	**100**
LABORATORY DENSITY RATIO:	**95**
CBR VALUE 5.0mm (%)	**6**

TESTED BY: M.D
DATE: 05/12/2006
REPORTED BY: M.D
DATE: 12/12/2006
TEST PROCEDURES: **AS 1289 6.1.1 & .5.2.1 (MODIFIED)**

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CALIFORNIA BEARING RATIO REPORT SHEET

CLIENT:	CONNELL HATCH	*JOB No.:*	BW/1030
PROJECT:	JILALAN	*REPORT No.:*	27

SENDER NO:		*CHAINAGE:*	
DEPTH:	0.20-0.50m	*OFFSET:*	
SAMPLE LOCATION:	CW 25	*SAMPLE No.:*	06/9791

SOIL DESCRIPTION & COMMENTS: Existing
-
-

MAXIMUM DRY DENSITY (t/m3): 1.85
OPTIMUM MOISTURE CONTENT (%): 13.5

TEST CONDITIONS

CONDITION OF SPECIMEN	SOAKED (4 DAYS)
SURCHARGE (g)	4500
PERCENTAGE RETAINED 19mm *(Not Included in Sample)*	0
MOISTURE CONTENT OF TOP 30mm (%)	21.8
SWELL/CONSOLIDATION (%)	4.7
LABORATORY MOISTURE RATIO %	98
LABORATORY DENSITY RATIO:	95
CBR VALUE 5.0mm (%)	1.5

TESTED BY:	D.S	*DATE:*	05/12/2006
REPORTED BY:	M.D	*DATE:*	12/12/2006
TEST PROCEDURES:	AS 1289 6.1.1 & .5.2.1 (MODIFIED)		

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CALIFORNIA BEARING RATIO REPORT SHEET

CLIENT:	CONNELL HATCH	*JOB No.:*	BW/1030
PROJECT:	JILALAN	*REPORT No.:*	57

SENDER NO:		*CHAINAGE:*	
DEPTH:		*OFFSET:*	
SAMPLE LOCATION:	CW 26	*SAMPLE No.:*	06/9799

SOIL DESCRIPTION & COMMENTS: Existing
-
-

MAXIMUM DRY DENSITY (t/m3): 1.97
OPTIMUM MOISTURE CONTENT (%): 13.0

TEST CONDITIONS

CONDITION OF SPECIMEN	SOAKED (4 DAYS)
SURCHARGE (g)	4500
PERCENTAGE RETAINED 19mm ***(Not Included in Sample)***	0
MOISTURE CONTENT OF TOP 30mm (%)	14.7
SWELL/CONSOLIDATION (%)	0.6
LABORATORY MOISTURE RATIO %	100
LABORATORY DENSITY RATIO:	95
CBR VALUE 5.0mm (%)	19

TESTED BY:	C.G	*DATE:*	15/12/2006
REPORTED BY:	M.D	*DATE:*	19/12/2006
TEST PROCEDURES:	AS 1289 6.1.1 & .5.2.1 (MODIFIED)		

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CALIFORNIA BEARING RATIO REPORT SHEET

CLIENT:	**CONNELL HATCH**	*JOB No.:*	**BW/1030**
PROJECT:	**JILALAN**	*REPORT No.:*	**41**
SENDER NO:		*CHAINAGE:*	
DEPTH:	**0.40m**	*OFFSET:*	
SAMPLE LOCATION:	**CW 27**	*SAMPLE No.:*	**06/9801**

SOIL DESCRIPTION & COMMENTS: **Existing**
-
-

MAXIMUM DRY DENSITY (t/m3): **2.09**
OPTIMUM MOISTURE CONTENT (%): **10.5**

TEST CONDITIONS

CONDITION OF SPECIMEN	**SOAKED (4 DAYS)**
SURCHARGE (g)	**4500**
PERCENTAGE RETAINED 19mm ***(Not Included in Sample)***	**0**
MOISTURE CONTENT OF TOP 30mm (%)	**13.1**
SWELL/CONSOLIDATION (%)	**1.0**
LABORATORY MOISTURE RATIO %	**98**
LABORATORY DENSITY RATIO:	**95**
CBR VALUE 5.0mm (%)	**12**

TESTED BY:	*M.D*	*DATE:*	05/12/2006
REPORTED BY:	*M.D*	*DATE:*	12/12/2006
TEST PROCEDURES:	**AS 1289 6.1.1 & .5.2.1 (MODIFIED)**		

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Appendix D

Borehole Logs

Connell HATCH
Infrastructure for Industry

Borehole Number: BH-01

Client: Queensland Rail
Project: Jilalan Bypass
Project Number: HI8801CR
File Name: P:\WP\HI8801

Commenced: 13/12/05
Completed: 13/12/05
Location: Sarina
Easting: -
Northing: -
Elevation: -
Inclination: 90°

Sheet: 1 of 1

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency/ Relative Density VS S F St VSt H VL L MD D VD H	Comments/ Test Results/ Origin	SPT Values	Graphic Log	Elevation (m)	Depth (m)
	AV			ML	**Sandy SILT** Brown, low plasticity, fine grained sands, trace clay, firm to stiff	M						
		SPT							SPT@0.5m (2,3,5) N=8			
			1.0								-1.0	1.0
				CL	**Sandy CLAY** Grey to brown to bluish grey, low plasticity, fine grained sand, soft	M-W						
		U53	2.0						U50@2.0m 300mm penetration		-2.0	2.0
					With some gravel			Gravels encountered @2.3m, push tube damaged, tube blocked by gravel, no P.P, no recovery				
			3.0		Some gravel encountered	W					-3.0	3.0
WT @ 3.3m								Water table @3.3m				
		SPT						SPT@3.8m due to gravels at 3.5m	SPT@3.8m (4,1,1) N=2			
			4.0		With interbedded sand & silty clay, with some coarse gravel						-4.0	4.0
					End of Borehole @4.25m Continued on BH-01A							
			5.0								-5.0	5.0

Driller: Bowler Geotechnical
Drill Type: Jacro

Remarks:
Support:

Logged By: GEI
Checked By: PK

Logged Date: 13/12/05
Checked Date: 21/12/05

Infrastructure for Industry

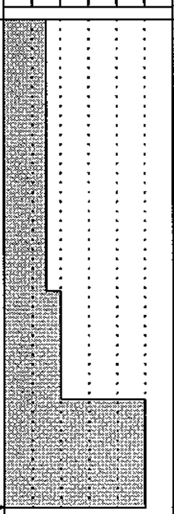
Borehole Number: BH-01A

Client: Queensland Rail
Project: Jilalan Bypass
Project Number: HI8801CR
File Name: P:\WP\HI8801

Commenced: 13/12/05
Completed: 13/12/05
Location: Sarina
Easting: -
Northing: -
Elevation: -
Inclination: 90°

Sheet: 1 of 1

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency/ Relative Density VS S F St VSt H VL L MD D VD H	Comments/ Test Results/ Origin	SPT Values	Graphic Log	Elevation (m)	Depth (m)
				CL	**Sandy CLAY** Grey, low plasticity, medium grained sands, coarse gravels, very soft to soft	W		(For sampling @ 0.00m to 4.25m refer to Log BH-01)				
			5.0		Becoming light brown, soft			Coarse gravels encountered @5.0m			-5.0	5.0
		SPT		SC	**Clayey SAND** Reddish brown, coarse rounded grains, with coarse rounded gravels, 20-50mm thick, very dense			Becoming Residual Soil @5.4m	SPT@5.5m ((17,18/130) N*=148			
					End of Borehole @5.8m							
			6.0								-6.0	6.0
			7.0								-7.0	7.0
			8.0								-8.0	8.0
			9.0								-9.0	9.0



Driller: Bowler Geotechnical
Drill Type: Jacro
Remarks:
Support:
Logged By: GEI
Checked By: PK
Logged Date: 13/12/05
Checked Date: 20/12/05

Connell HATCH
Infrastructure for Industry

Borehole Number: BH-02

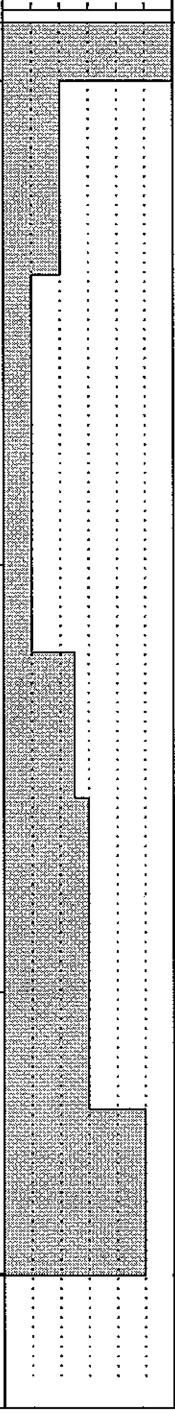
Client: Queensland Rail
Project: Jilalan Bypass
Project Number: HI8801CR
File Name: P:\WP\HI8801

Commenced: 13/12/05
Completed: 13/12/05
Location: Sarina
Easting: -
Northing: -
Elevation: -
Inclination: 90°

Sheet: 1 of 1

Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Comments/ Test Results/ Origin	SPT Values	Elevation (m)	Depth (m)
	AV			GP	**Sandy GRAVEL (FILL)** Grey, coarse angular gravel, coarse sands, very dense	0				
			1.0	SP	**Silty SAND** Reddish brown, fine to medium grained	M			-1.0	1.0
		SPT	2.0		Becomes clayey, very loose			SPT@1.5m (2,1,1) N=2	-2.0	2.0
W.T @2.8m				SC	**Clayey SAND** Reddish brown, low plasticity, fine grained sands, very loose					
		U50	3.0	CL	**Silty CLAY** Bluish grey, low plasticity, trace fine sands	W	Water table @ 2.8m Potential acid sulfate soils@3.0m, no recovery, no P.P. too sandy	U50@3.0m 450mm Penetration	-3.0	3.0
				SW	**SAND** Light grey, coarse grained with fine angular gravel & clay, loose to medium dense					
		SPT	4.0 5.0	GL	**Clayey GRAVEL** Grey, coarse gravel angular clasts with medium plasticity clay & coarse sands, medium dense	M		SPT@4.5m (9,9,9) N=18	-4.0 -5.0	4.0 5.0
		SPT	6.0		Becoming mottled reddish, brown & grey, increased gravel, dense		Becoming Residual Soil @5.6m	SPT@6.0m (15,18,17) N=35	-6.0	6.0
			7.0		**End of Borehole @6.45m**				-7.0	7.0

Consistency/ Relative Density



Driller: Bowler Geotechnical
Drill Type: Jacro
Remarks:
Support:
Logged By: GEI
Checked By: PK
Logged Date: 13/12/05
Checked Date: 20/12/05

Connell HATCH Infrastructure for Industry

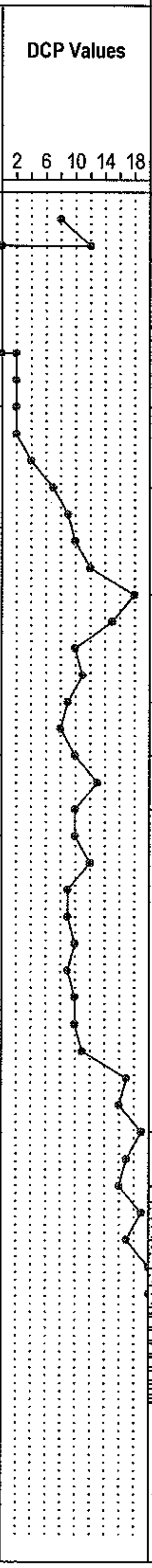
Client: QR
Project: Jilalan Preliminary Investigation
Project Number: HI88
File Name: P:\Wp\HI8801

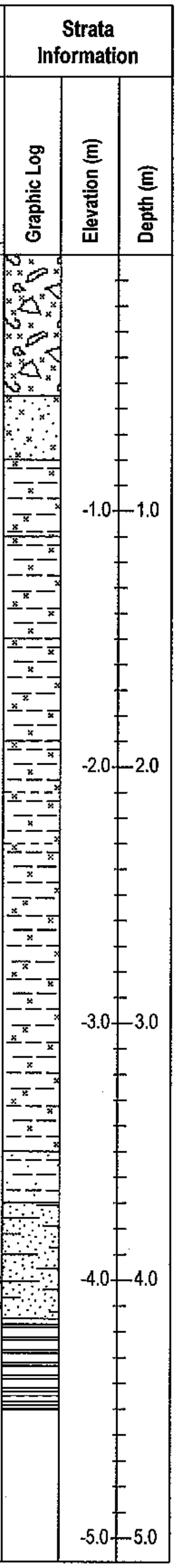
Commenced: 16/02/06
Completed: 16/02/06
Location:
Easting: 0732602
Northing: 7629283
Elevation: 0
Inclination: 90

Borehole Number: BH1

Sheet: 1 of 1

Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Comments/
*Not Encountered	AT			GP	**Silty Sandy GRAVEL (BALLAST)** Dark grey, fine to coarse gravel, fine to medium grained sand, low plasticity silt, some cobbles and small boulders, dense.	M/D	Fill 0.0 to 0.8m DCP Predrill through Ballast
				SM	**Silty SAND (FILL)** Dark brown, fine grained, medium plasticity, loose to medium dense.		
		U50	1.0	CH	**Silty CLAY** Mottled light and dark brown, high plasticity, some fine to medium grained sand, stiff to very stiff.		U50 @ 0.8m 110mm Recovery PP > 6.0 kg/cm^2
					Very stiff to hard		Residual Soil 0.8 to 4.15m
				CI	Medium plasticity		
			2.0	CH	High plasticity		
		Dist			Some small rounded gravel		Disturbed Sample @ 2.1m
			3.0	CH - CI	Interbedded medium and high plasticity		
				CH	**Sandy CLAY** Mottled light and dark brown, medium to high plasticity, fine grained sand, very stiff to hard.		
		Dist	4.0	SC	**Clayey SAND** Brown, fine grained, medium plasticity, dense to very dense.		Disturbed Sample @ 3.7m
				XW	**SILTSTONE** Light brown, extremely weathered, some fine grained Sandstone, very low strength		
					Low strength		
			5.0		**End of Borehole @ 4.5m TC Bit Refusal**		





Driller: Battison & Sons
Drill Type: Jacro 200

Remarks:
Support:

Logged By: NBR **Date Logged:** 16/02/06
Checked By: PRK **Date Checked:** 24/02/06

Connell HATCH Infrastructure for Industry

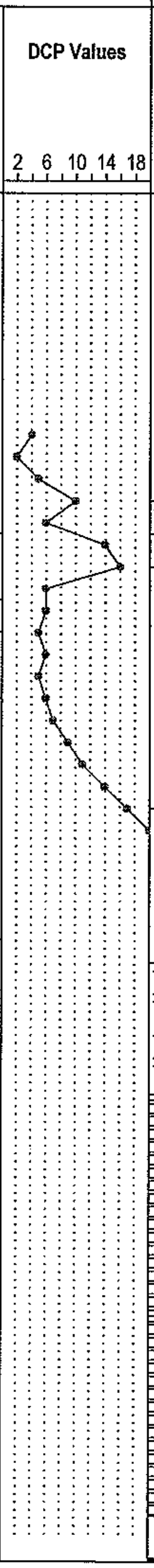
Borehole Number: BH2

Client: QR
Project: Jilalan Preliminary Investigation
Project Number: HI88
File Name: P:\Wp\HI8801

Commenced: 16/02/06
Completed: 16/02/06
Location:
Easting: 0732420
Northing: 7628702
Elevation: -
Inclination: 90

Sheet: 1 of 1

Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Comments/	Elevation (m)	Depth (m)
*Not Encountered	AT		1.0	GP	**GRAVEL and COBBLES (BALLAST)** Ballast, dark brown to black, coarse gravel and small cobbles, some coke ash and coal fragments, loose to medium dense.		Fill 0.0 to 1.4m	-1.0	1.0
		Dist		CH	**Sandy CLAY** Light brown mottled orange, fine grained, high plasticity, very stiff.	M	Disturbed Sample @ 1.55m		
				MH	**SILT** Grey, high plasticity, very stiff.				
		Dist	2.0	CH	**CLAY** Grey mottled orange, high plasticity, some fine grained sand, very stiff.		Disturbed Sample @ 2.0m Residual Soil 1.4 to 4.1m	-2.0	2.0
			3.0		Grey mottled light brown, layered very stiff and hard.			-3.0	3.0
		Dist	4.0	CI	**Sandy CLAY** Grey brown, medium plasticity, fine grained, stiff to very stiff.		Disturbed Sample @ 3.4m	-4.0	4.0
			5.0	XW	**SILSTONE** Layered extremely weathered, extremely low strength siltstone and residual very stiff clay.			-5.0	5.0
					Becoming dark grey, increased clay content, siltstone becoming highly fractured, very low to extremely low strength.				
			6.0		**End of Borehole @ 6.0m**			-6.0	6.0



Driller: Battison & Sons
Drill Type: Jackro 200
Remarks:
Support:
Logged By: NBR
Checked By: PRK
Date Logged: 16/02/06
Date Checked: 24/02/06

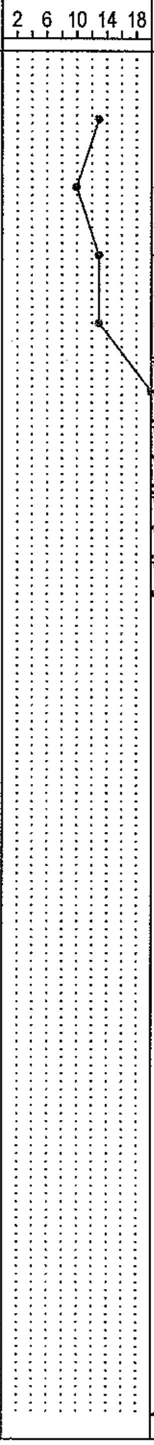
Client: QR
Project: Jilalan Preliminary Investigation
Project Number: HI88
File Name: P:\Wp\HI8801

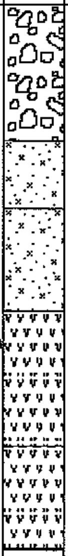
Commenced: 17/02/06
Completed: 17/02/06
Location:
Easting: 0732340
Northing: 7628187
Elevation: -
Inclination: 90

Borehole Number: BH3

Sheet: 1 of 1

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
*Not Encountered	AT			GP	**GRAVEL and COBBLES (FILL)** Grey brown, coarse gravel, small to medium size cobbles, medium dense.							
				SM	**Silty SAND** Red brown, fine grained, medium plasticity, dense.			Alluvial Deposit 0.2 to 0.45m				
					Very dense.							
				XW	**BASALT** Light brown, extremely weathered, very low strength.							
				HW	Highly weathered, dark brown grey, low strength							
					End of Borehole @ 0.8m TC Bit Refusal							
			1.0								-1.0	1.0
			2.0								-2.0	2.0





Driller: Battison & Sons
Drill Type: Jackro 200

Remarks:
Support:

Logged By: NBR
Checked By: PK

Date Logged: 17/02/06
Date Checked: 24/02/06

Connell HATCH Infrastructure for Industry

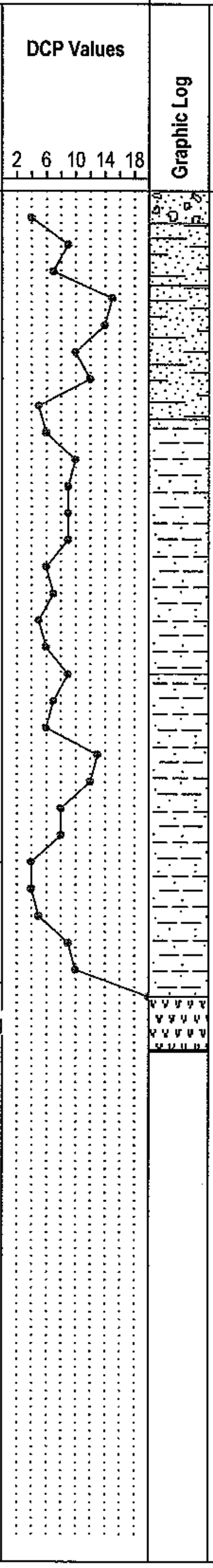
Borehole Number: BH5

Client: Queensland Rail
Project: Jilalan Preliminary Investigation
Project Number: HI88
File Name: P:\WP\HI8801

Commenced: 16/02/06
Completed: 16/02/06
Location:
Easting: 732340
Northing: 7628093
Elevation: 0
Inclination: 90

Sheet: 1 of 1

Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency (VS S F ST VSt H / VL L MD D VD C)	Comments/	Elevation (m)	Depth (m)
Not encountered	AT		0.0	SP	**Gravelly SAND** Light brown, medium dense.	D	MD	Fill 0.0 to 3.0m		
				SC	**Clayey SAND (FILL)** Brown, fine to medium grained, medium dense.	M - D	MD			
				SC	**Clayey SAND (FILL)** Grey with green bands, fine to medium grained, increased clay fines, loose.		L			
			1.0	CI - CH	**Sandy CLAY (FILL)** Grey with some green mottles, medium to high plasticity, some medium grained sand, slight odour of decaying plant matter, soft to firm.	M	S-F		-1.0	1.0
			2.0		Grey to light grey, firm to stiff with some small gravels, wet.	W	F-ST		-2.0	2.0
		U50						U50@2.5m 100mm Refusal on No PPT, too sandy.		
			3.0	MW	**BASALT** Dark blue grey, moderately weathered, highly fractured, angular, volcanic, fine crystaline structure, low strength.	M		Possible blast fracturing	-3.0	3.0
					End of Borehole at 3.2m TC Bit Refusal					
			4.0						-4.0	4.0
			5.0						-5.0	5.0



Driller: Battison & Sons
Drill Type: Jacro 200
Remarks:
Support:
Logged By: NBR
Checked By: PRK
Date Logged: 16/02/06
Date Checked: 24/02/06

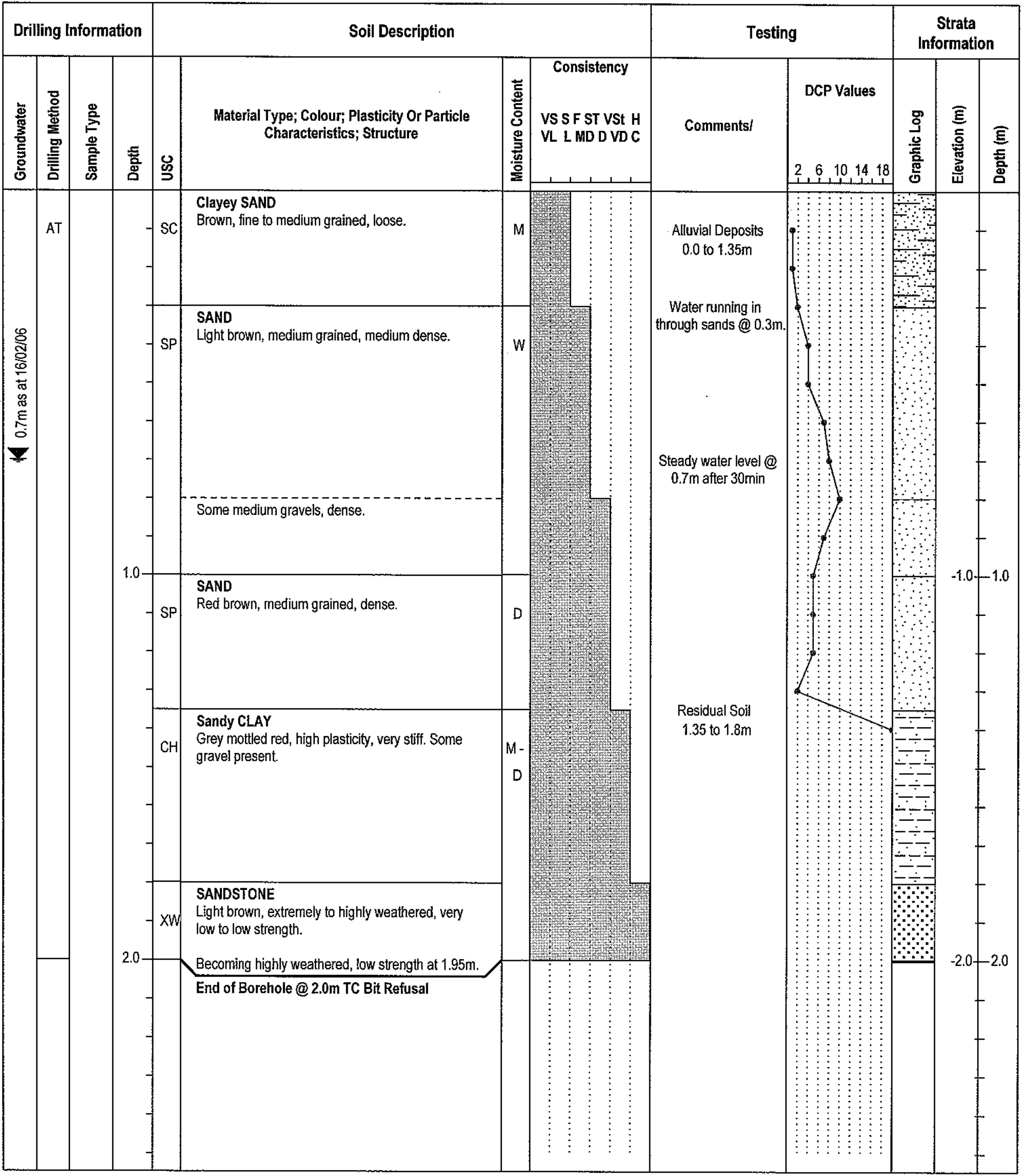
Connell HATCH Infrastructure for Industry

Client: Queensland Rail
Project: Jilalan Preliminary Investigation
Project Number: HI88
File Name: P:\WP\HI8801

Commenced: 16/02/06
Completed: 16/02/06
Location:
Easting: 732037
Northing: 7627511
Elevation: -
Inclination: 90

Borehole Number: BH6

Sheet: 1 of 1



Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Comments/	Elevation (m)	Depth (m)
0.7m as at 16/02/06	AT			SC	**Clayey SAND** Brown, fine to medium grained, loose.	M	Alluvial Deposits 0.0 to 1.35m		
				SP	**SAND** Light brown, medium grained, medium dense.	W	Water running in through sands @ 0.3m. Steady water level @ 0.7m after 30min		
					Some medium gravels, dense.				
			1.0	SP	**SAND** Red brown, medium grained, dense.	D		-1.0	1.0
				CH	**Sandy CLAY** Grey mottled red, high plasticity, very stiff. Some gravel present.	M - D	Residual Soil 1.35 to 1.8m		
				XW	**SANDSTONE** Light brown, extremely to highly weathered, very low to low strength. Becoming highly weathered, low strength at 1.95m.				
			2.0		**End of Borehole @ 2.0m TC Bit Refusal**			-2.0	2.0

Driller: Battison & Sons
Drill Type: Jacro 200

Remarks:
Support:

Logged By: NBR
Checked By: PRK

Date Logged: 16/02/06
Date Checked: 24/02/06

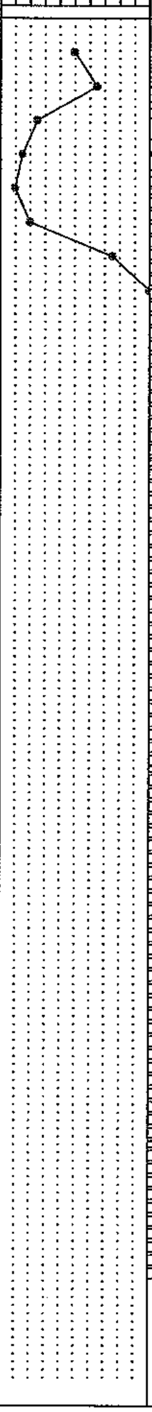
Connell HATCH
Infrastructure for Industry

Client: Queensland Rail
Project: Jilalan Preliminary Investigation
Project Number: HI88
File Name: P:\WP\HI8801

Commenced: 17/02/06
Completed: 17/02/06
Location:
Easting: 732235
Northing: 7626906
Elevation: -
Inclination: 90

Borehole Number: BH7

Sheet: 1 of 1

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
*Not encountered	AT			SM	**Silty SAND** Dark brown, topsoil with rootlet, some fine to coarse gravel, loose	D		Alluvial Deposits 0.0 to 0.4m				
				SC	**Clayey SAND** Light orange brown, some low plasticity clay, medium dense.							
				SC	**Clayey SAND** Mottled red white, fine to medium grained, some medium plasticity clay, medium dense.	D		Residual Soil + Extremely Weathered Rock 0.4 to 2.2m				
			1.0	XW	**SILTSTONE** Light brown red, extremely weathered, very low strength.						-1.0	1.0
			2.0	XW - CL	**Interbedded SILTSTONE and CLAY** SILTSTONE: Extremely weathered, extremely low to very low strength. CLAY: Low plasticity, very stiff to hard.						-2.0	2.0
			3.0	XW	**SILTSTONE** Light brown, extremely weathered, low plasticity clay infill, very low strength.						-3.0	3.0
				HW	Highly weathered, low strength.							
			4.0		**End of Borehole @ 3.7m TC Bit Refusal**						-4.0	4.0

Driller: Battison & Sons
Drill Type: Jackro 200

Remarks:
Support:

Logged By: NBR
Checked By: PRK

Date Logged: 17/02/06
Date Checked: 24/02/06

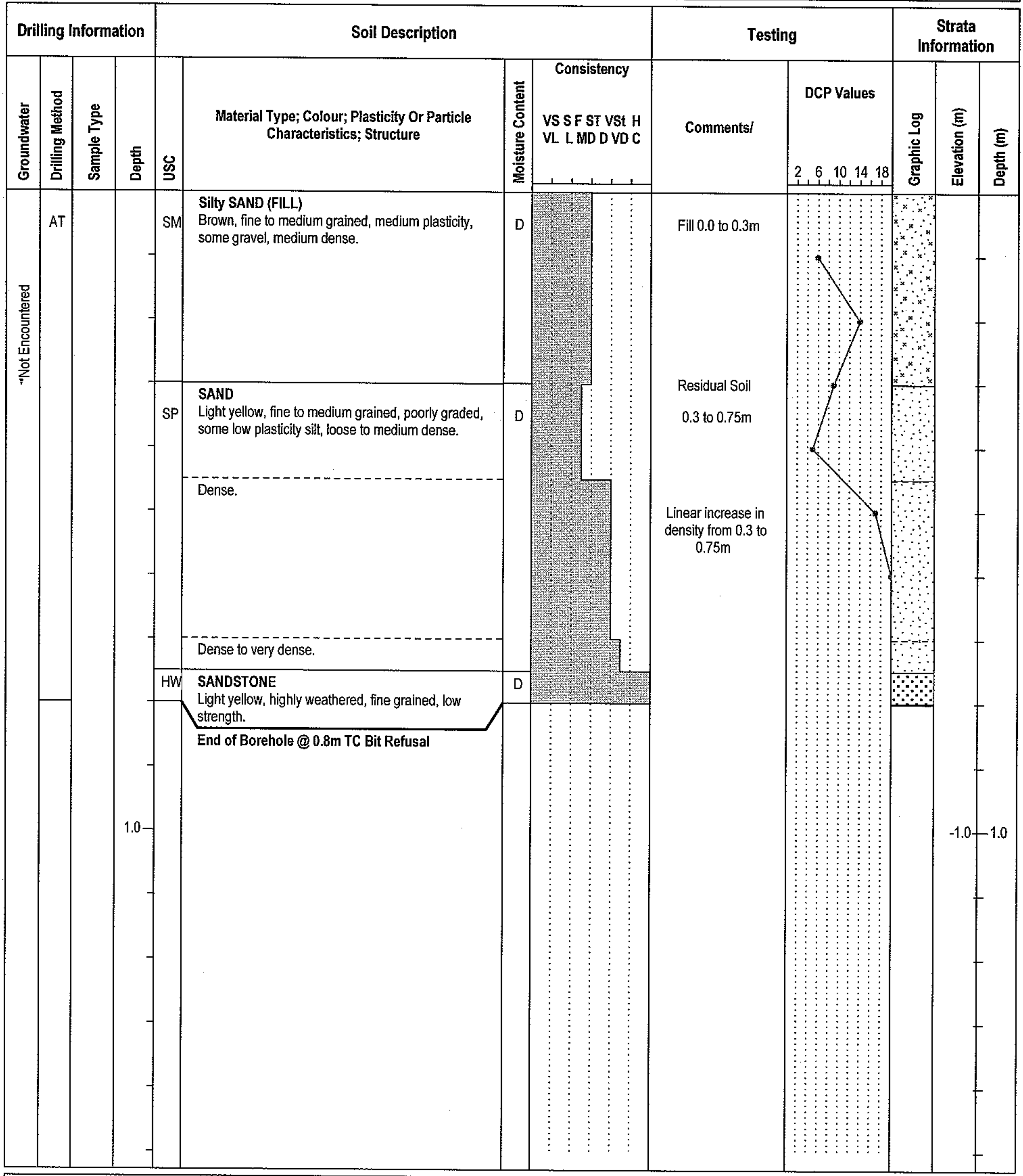
Connell HATCH Infrastructure for Industry

Borehole Number: BH8

Client: Queensland Rail
Project: Jilalan Preliminary Investigation
Project Number: HI88
File Name: P:\WP\HI8801

Commenced: 17/02/06
Completed: 17/02/06
Location:
Easting: 732136
Northing: 7626347
Elevation: -
Inclination: 90

Sheet: 1 of 1



SM **Silty SAND (FILL)** Brown, fine to medium grained, medium plasticity, some gravel, medium dense. D

SP **SAND** Light yellow, fine to medium grained, poorly graded, some low plasticity silt, loose to medium dense. D

Dense.

Dense to very dense.

HW **SANDSTONE** Light yellow, highly weathered, fine grained, low strength. D

End of Borehole @ 0.8m TC Bit Refusal

Fill 0.0 to 0.3m

Residual Soil

0.3 to 0.75m

Linear increase in density from 0.3 to 0.75m

Driller: Battison & Sons
Drill Type: Jackro 200

Remarks:
Support:

Logged By: NBR **Date Logged:** 17/02/06
Checked By: PRK **Date Checked:** 24/02/06

Connell HATCH
Infrastructure for Industry

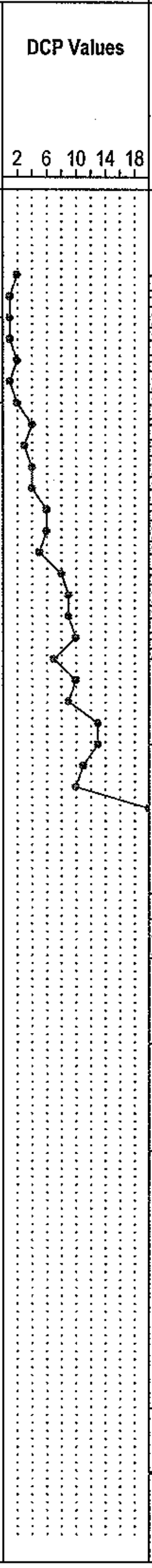
Client: Queensland Rail
Project: Jilalan Preliminary Investigation
Project Number: HI88
File Name: P:\WP\HI8801

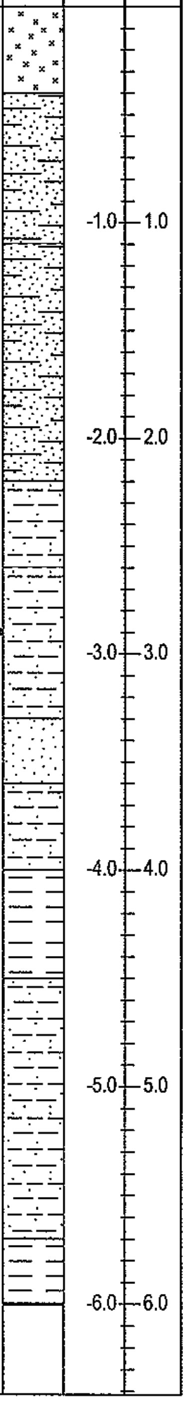
Commenced: 16/02/06
Completed: 16/02/06
Location:
Easting: 731777
Northing: 7625706
Elevation: -
Inclination: 90

Borehole Number: BH9

Sheet: 1 of 1

Groundwater	Drilling Method	Sample Type	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Comments/
*Not encountered	AT		ML	**SILT** Brown, low plasticity, some fine gravel, soft	D - M	Fill/Disturbed 0.0 to 0.4m
		U50	SC	**Clayey SAND** Light brown, fine grained, medium dense, medium to high plasticity clay, medium dense.		Alluvial Deposits 0.4 to 5.7m U50 @ 0.6m 100mm Recovery PP > 6.0 kg/cm^2
				Grey, dense.	M - D	
			CI	**Sandy CLAY** Grey, medium plasticity, fine to medium grained, very stiff to hard.		
				Becoming medium grained sand, friable and hard.	D	
			SP	**SAND** Light brown, fine to medium grained, some ironstone gravels, dense to very dense.		
			CI	**Sandy CLAY** Mottled grey brown, medium plasticity, some medium grained sand, some medium to coarse sized gravels, very stiff		
			CH	**CLAY** Light grey, medium plasticity, interbedded with rounded gravels, very stiff.		
			CH	**Sandy CLAY** Light brown, medium to high plasticity, some medium to coarse grained sand, stiff.	M	
			CI	**CLAY** Mottled orange brown, medium plasticity, very stiff. Some fine sized gravel.		Residual Soil 5.7 to TD 6.0m
				End of Borehole @ 6.0m		





Driller: Battison & Sons
Drill Type: Jackro 200

Remarks:
Support:

Logged By: NBR
Checked By: PRK

Date Logged: 16/02/06
Date Checked: 24/02/06

Connell HATCH
Infrastructure for Industry

Client: Queensland Rail
Project: Jilalan Preliminary Investigation
Project Number: HI88
File Name: P:\WP\HI8801

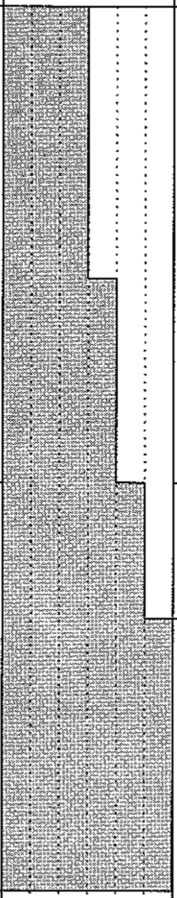
Commenced: 16/02/06
Completed: 16/02/06
Location:
Easting: 731809
Northing: 7625285
Elevation: -
Inclination: 90

Borehole Number: BH10

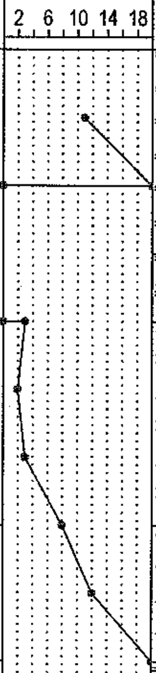
Sheet: 1 of 1

Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Comments/
*Not encountered	AT			SM	**Silty SAND** Dark grey, fine grained, low plasticity, some ballast cobbles, medium dense.		Fill/Disturbed 0.0 to 0.3m DCP Refusal on Cobble Predrill DCP to 0.4m
				SM	**Silty SAND** Light brown, fine grained, low to medium plasticity, some fine sized gravels, medium dense.		Alluvial Deposits 0.3 to 0.7m
				CI	**Sandy CLAY** Mottled light brown orange, medium plasticity, medium grained, stiff.		Residual Soil 0.7 to 0.9m
		U50		CL	**Silty CLAY** Grey, low plasticity, very stiff.	D	U50 @ 0.7m 90mm Recovery PP > 6.0 kg/cm2
			1.0	XW	**SILTSTONE** Grey brown, extremely weathered, very low strength.		Possible congolmerate layer or Basalt/Siltstone interface
				HW	Highly weathered, some basalt chips, low strength.		
					End of Borehole @ 1.3m TC Bit Refusal		
			2.0				

Consistency
VS S F ST VSt H
VL L MD D VD C



DCP Values



Strata Information

Graphic Log

Elevation (m)	Depth (m)
-1.0	1.0
-2.0	2.0

Driller: Battison & Sons
Drill Type: Jackro 200

Remarks:
Support:

Logged By: NBR
Checked By: PRK

Date Logged: 16/02/06
Date Checked: 24/02/06

Connell HATCH
Infrastructure for Industry

Borehole Number: BH11

Client: Queensland Rail
Project: Jilalan Preliminary Investigation
Project Number: HI88
File Name: P:\WP\HI8801

Commenced: 16/02/06
Completed: 16/02/06
Location:
Easting: 731646
Northing: 7624957
Elevation: -
Inclination: 90

Sheet: 1 of 1

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
*Not encountered	AT			GW	**ROADBASE** Roadbase gravel, fine to coarse, well graded, well compacted, controlled fill, very dense.			Fill 0.0 to 0.35m				
				XW	**SANDSTONE/SILTSTONE** Light brown, fine grained sandstone to coarse siltstone, some conglomerate gravels, extremely weathered, very low strength.			No DCP too hard.				
			1.0		Low strength.						-1.0	1.0
					End of Borehole @ 1.2m TC Bit Refusal							
			2.0								-2.0	2.0

Driller: Battison & Sons
Drill Type: Jackro 200

Remarks:
Support:

Logged By: NBR
Checked By: PRK

Date Logged: 16/02/06
Date Checked: 24/02/06

Connell HATCH Infrastructure for Industry

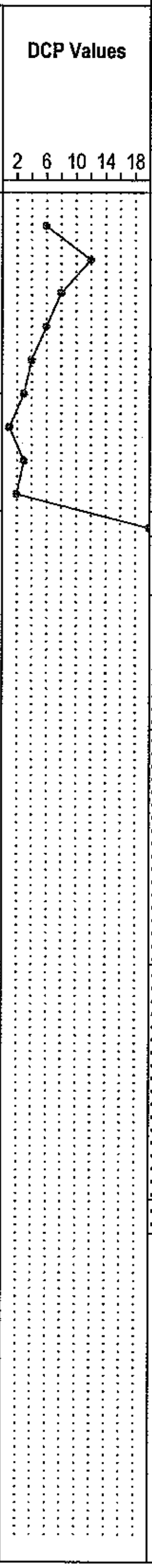
Client: Queensland Rail
Project: Jilalan Preliminary Investigation
Project Number: HI88
File Name: P:\WP\HI88-01

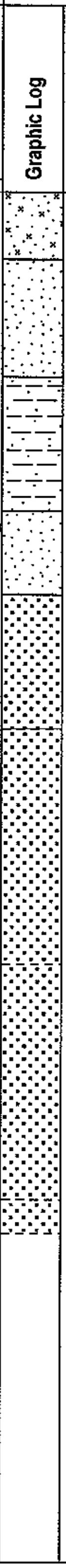
Commenced: 16/02/06
Completed: 16/02/06
Location:
Easting: 731655
Northing: 7624956
Elevation: -
Inclination: 90°

Borehole Number: BH11a

Sheet: 1 of 1

Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Comments/	Elevation (m)	Depth (m)
Not encountered	AT			SM	**Silty SAND** Dark grey, medium grained, medium dense	D	Alluvial soil 0 - 0.95m		
				SP	**SAND** Grey, medium grained, poorly graded, medium dense	M			
		U50		CI	**Sandy CLAY** Light orange, medium plasticity, some fine grained sand, stiff to very stiff		U50 @ 0.60m 130mm recovery PP= 4.00kg/cm^2		
			1.0	SW	**SAND** Grey mottled orange, fine to medium grained, dense to very dense	D	Residual soil 0.95 - 1.20m	-1.0	1.0
				XW	**SANDSTONE** Light brown, extremely weathered, very low strength, medium grained. Some clay lenses and infill, white, medium plasticity				
			2.0		- Medium to coarse grained, extremely low strength			-2.0	2.0
					- Very low strength				
			3.0		- Conglomerate gravel in sandstone matrix or differential weathering of sandstone and siltstone gravels, low strength		3.10m TC Bit Refusal	-3.0	3.0
					End of borehole at 3.10m				
			4.0					-4.0	4.0





Driller: Battison & Sons
Drill Type: Jackro 200

Remarks:
Support:

Logged By: NBR
Checked By: PRK

Date Logged: 16/02/06
Date Checked: 24/02/06

Connell HATCH Infrastructure for Industry

Borehole Number: BH12

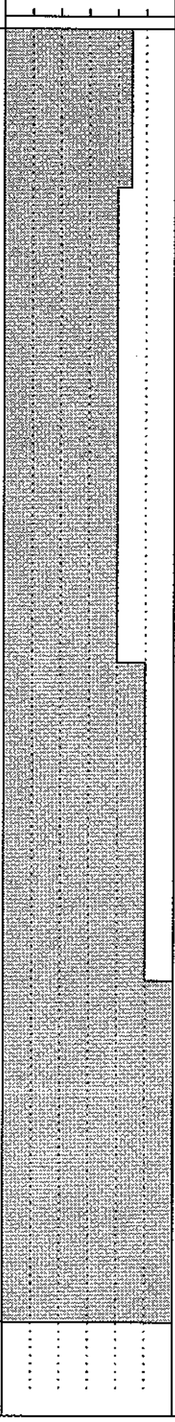
Client: Queensland Rail
Project: Jilalan Preliminary Investigation
Project Number: HI88
File Name: P:\WP\HI8801

Commenced: 16/02/06
Completed: 16/02/06
Location:
Easting: 731541
Northing: 7624357
Elevation: -
Inclination: 90

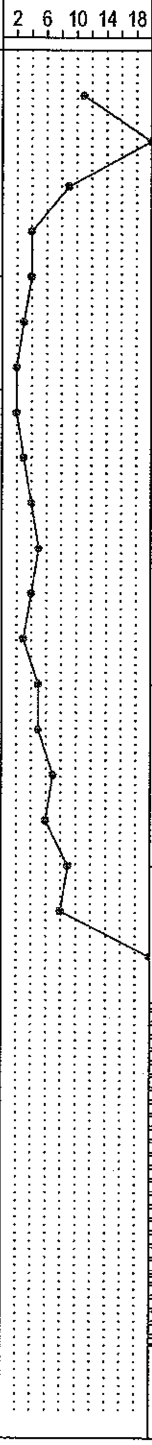
Sheet: 1 of 1

Drilling Information				Soil Description			Testing	Strata Information	
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Comments/	Elevation (m)	Depth (m)
Not encountered	AT			ML	**SILT** Light grey, low plasticity, stiff to very stiff.	D	Residual Soil 0.0 to 2.1m		
		U50		CI	**Sandy CLAY** Red brown, medium plasticity, some fine to medium grained sand, some ironstone gravel, stiff.		U50 @ 0.5m 100mm Recovery No PP. Too gravelly		
			1.0	CH	Medium to high plasticity with less ironstone.			-1.0	1.0
					Very stiff.				
			2.0	CI	**Sandy CLAY** Yellow brown, medium plasticity, fine to medium grained, very stiff to hard.			-2.0	2.0
				XW - HW	**SILTSTONE** Grey mottled light brown, extremely to highly weathered, very low strength.				
					Low strength.				
					End of Borehole @ 2.85m TC Bit Refusal				
			3.0					-3.0	3.0

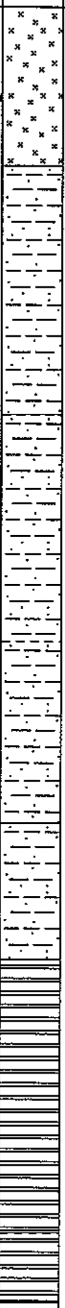
Consistency



DCP Values



Graphic Log



Driller: Battison & Sons
Drill Type: Jackro 200

Remarks:
Support:

Logged By: NBR **Date Logged:** 16/02/06
Checked By: PRK **Date Checked:** 24/02/06

Connell HATCH
Infrastructure for Industry

Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

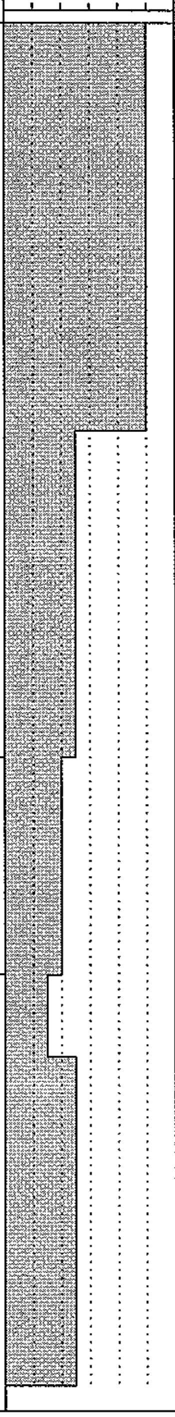
Commenced: 28/11/06
Completed: 30/11/06
Location: Smyths Rd, Sarina
Easting: 0
Northing: 0
Elevation: 0
Inclination: 90°

Borehole Number: CW-13

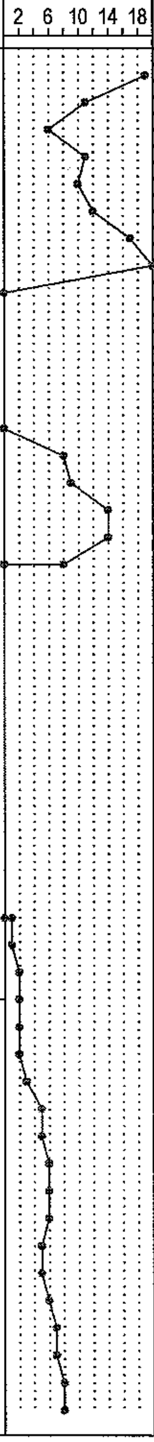
Sheet: 1 of 2

Drilling Information				Soil Description			Testing
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Comments/
	AT			GP	**SANDY GRAVEL (Fill)** Light brown to grey, coarse angular gravel and cobbles, dense to very dense	D	Fill
					- Cobbles		
			1.0				DCP refusal on obstruction
					- Becoming clayey		
					- Small boulders		
			2.0				DCP refusal on gravels
				CH-CL	**SILTY CLAY** Light grey, medium to high plasticity, trace medium grained sand, soft to very soft	M	
		U50	3.0				U50 @ 3.00m Recovery Nil Collapsing cobbles/gravel
▼					- some organics, soft to firm	W	Groundwater encountered at 3.50m
					- firm to stiff clay		
			4.0				
		U50					U50 @ 4.50m Recovery 330 PP = 50
			5.0				

Consistency
VS S F ST VSt H
VL L MD D VD C



DCP Values



Strata Information

Graphic Log

Elevation (m)	Depth (m)
-1.0	1.0
-2.0	2.0
-3.0	3.0
-4.0	4.0
-5.0	5.0

Driller: Ross Battison (RB)
Drill Type: Jacro 200

Remarks:
Support:

Logged By: RB
Checked By: PK

Date Logged: 28/11/06
Date Checked: 31/01/07

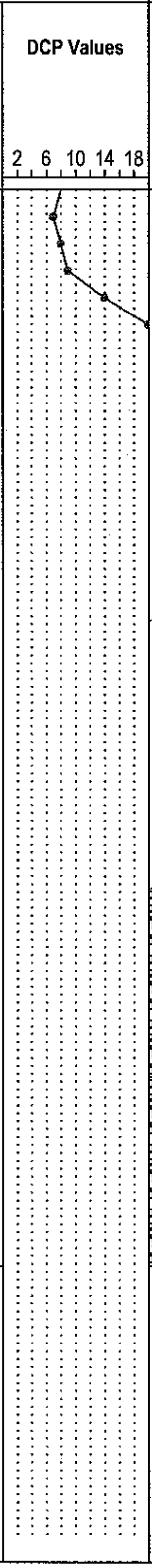
Connell HATCH Infrastructure for Industry

Commenced: 28/11/06
Completed: 30/11/06
Location: Smyths Rd, Sarina
Easting: 0
Northing: 0
Elevation: 0
Inclination: 90°

Borehole Number: CW-13

Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Sheet: 2 of 2



Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H VL L MD D VD C	Comments/	DCP Values	Graphic Log	Elevation (m)	Depth (m)
	AT			CH-CL	**SILTY CLAY cont.**	W						
			6.0								-6.0	6.0
					- gravelly, fine to medium gravel							
			7.0								-7.0	7.0
				GP	**CLAYEY/SANDY GRAVEL** Grey, low to medium plasticity clay, fine to medium sand, fine to coarse gravel.							
			8.0								-8.0	8.0
					- dense							
			9.0		**End of borehole at 9.00m**						-9.0	9.0
			10.0								-10.0	10.0

Driller: Ross Battison (RB)
Remarks:
Logged By: RB
Date Logged: 28/11/06

Drill Type: Jacro 200
Support:
Checked By: PK
Date Checked: 31/01/07

Connell HATCH
Infrastructure for Industry

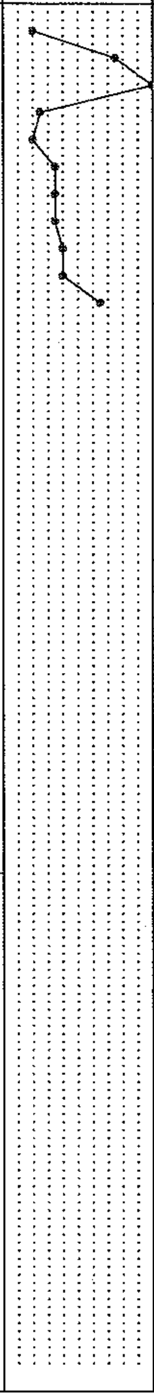
Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 28/11/06
Completed: 30/11/06
Location:
Easting: 732890
Northing: 7629555
Elevation: 0
Inclination: 90°

Borehole Number: CW-14

Sheet: 1 of 2

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
	AT			SM	**SILTY SAND** Light brown, fine sand, loose to medium dense	D						
				CL-CH	**SANDY CLAY** Light brown, low to medium plasticity, trace coarse rounded sand, hard	M		Bulk sample at 0.30 - 0.80m				
		U50						U50 @ 0.60m PP>600kPa				
			1.0								-1.0	1.0
					- Brown mottled grey, medium plasticity, becoming more sandy							
			2.0								-2.0	2.0
			3.0								-3.0	3.0
				SM	**SILTY SAND** Light reddish-brown, medium grained, trace coarse sub-rounded gravel, clay layering, medium dense to dense			Alluvial				
			4.0								-4.0	4.0
					SANDY CLAY Light grey to reddish brown, medium plasticity, medium grained sand, very stiff to hard							
			5.0								-5.0	5.0



Driller: Ross Battison (RB)
Drill Type: Jacro 200

Remarks:
Support:

Logged By: RB
Checked By: PK

Date Logged: 28/11/06
Date Checked: 31/01/07

Connell HATCH
Infrastructure for Industry

Borehole Number: CW-14

Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 28/11/06
Completed: 30/11/06
Location:
Easting: 732890
Northing: 7629555
Elevation: 0
Inclination: 90°

Sheet: 2 of 2

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
	AT				SANDY CLAY cont. - Becoming less sandy, hard	M						
					- Becoming sandy, interbedded alluvial deposits							
			6.0		End of borehole at 6.00m						-6.0	6.0
			7.0								-7.0	7.0
			8.0								-8.0	8.0
			9.0								-9.0	9.0
			10.0								-10.0	10.0

Driller: Ross Battison (RB)
Drill Type: Jacro 200
Remarks:
Support:
Logged By: RB
Checked By: PK
Date Logged: 28/11/06
Date Checked: 31/01/07

Connell HATCH
Infrastructure for Industry

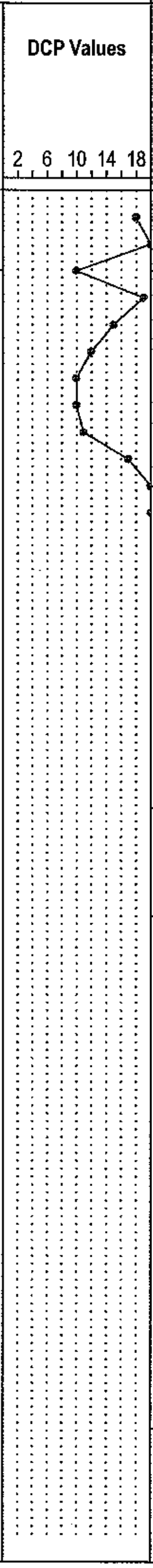
Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

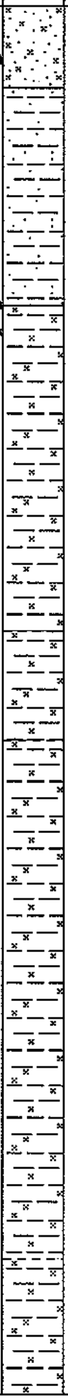
Commenced: 28/11/06
Completed: 29/11/06
Location: Smyths Rd, Sarina
Easting: 732495
Northing: 7629032
Elevation: 0
Inclination: 90°

Borehole Number: CW-15

Sheet: 1 of 2

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
	AT			SM	**SILTY SAND** Light brown to grey, fine grained, dense							
				CL	**SANDY CLAY** Light reddish-brown, mottled grey, low plasticity, fine sand, hard			Alluvium				
			1.0								-1.0	1.0
				CH	**SILTY CLAY** Brown, medium to high plasticity, trace sand, some interbedded sand layers, hard							
			2.0								-2.0	2.0
					- becoming sandy clay							
					- becoming silty clay, interbedded silty and sandy layers							
			3.0								-3.0	3.0
			4.0								-4.0	4.0
					- becoming light grey							
			5.0								-5.0	5.0





Driller: Ross Battison (RB)
Drill Type: Jacro 200

Remarks:
Support:

Logged By: RB
Checked By: PK

Date Logged: 28/11/06
Date Checked: 31/01/07

Connell HATCH
Infrastructure for Industry

Borehole Number: CW-15

Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 28/11/06
Completed: 29/11/06
Location: Smyths Rd, Sarina
Easting: 732495
Northing: 7629032
Elevation: 0
Inclination: 90°

Sheet: 2 of 2

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
	AT			CH	SILTY CLAY cont.		▨	Alluvium		▨		
			6.0		End of Borehole at 6.00m						-6.0	6.0
			7.0								-7.0	7.0
			8.0								-8.0	8.0
			9.0								-9.0	9.0
			10.0								-10.0	10.0

Driller: Ross Battison (RB)
Drill Type: Jacro 200
Remarks:
Support:
Logged By: RB
Checked By: PK
Date Logged: 28/11/06
Date Checked: 31/01/07

Connell HATCH
Infrastructure for Industry

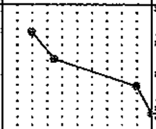
Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 28/11/06
Completed: 29/11/06
Location: Smyths Rd, Sarina
Easting: 732430
Northing: 7628486
Elevation: 0
Inclination: 90°

Borehole Number: CW-16

Sheet: 1 of 1

Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H / VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
	AT			SM	**SILTY SAND** Light brown, fine grained, trace sub-rounded gravel, dense		D					
				GP	**SANDY GRAVEL** Light grey, medium to coarse gravel, dense		D					
			1.0	RS-XW	**METAVOLCANICS** Yellowish-brown, becoming greenish-grey, residual soil to extremely weathered, fine grained, extremely low to low strength		VD	Residual soil Rock Refusal on Rock at 1.45m			-1.0	1.0
					End of borehole at 1.45m							
			2.0								-2.0	2.0
			3.0								-3.0	3.0
			4.0								-4.0	4.0
			5.0								-5.0	5.0



Driller: Ross Battison (RB)
Drill Type: Jacro 200

Remarks:
Support:

Logged By: RB
Checked By: PK

Date Logged: 28/11/06
Date Checked: 31/01/07

Connell HATCH
Infrastructure for Industry

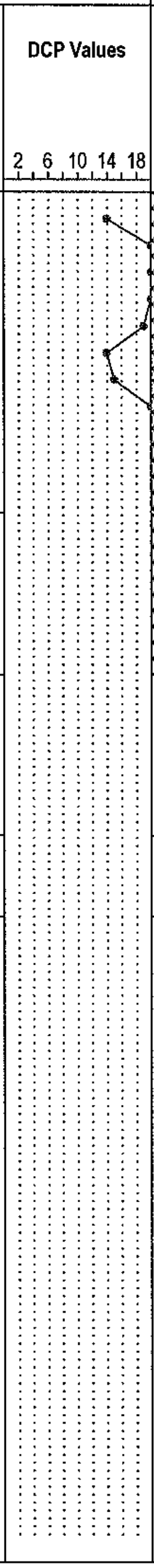
Borehole Number: CW-17

Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 28/11/06
Completed: 30/11/06
Location: Smyths Rd, Sarina
Easting: 732305
Northing: 7627547
Elevation: 0
Inclination: 90°

Sheet: 1 of 1

Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Comments/
	AT			SM	**SILTY SAND (Fill)** Brown to reddish-brown, fine grained, some fine rounded gravel, very dense	M	Bulk sample
					- increased coarse angular gravel, becoming clayey		
			1.0				
		U50		CL	**SANDY CLAY (Fill)** Light yellowish-brown, mottled grey, medium plasticity, trace coarse sand, trace fine rounded gravel, very stiff to hard		U50 @ 1.20m PP = 450kPa 130mm recovery
			2.0	RS-CL	**SANDY CLAY** Brown to dark greenish-brown, some grey mottles, low plasticity, trace medium grained angular gravel, hard		Residual soil
				XW-HW	**METAVOLCANICS** Grey to greenish grey, extremely to highly weathered, fine grained, extremely low to low strength		Rock
					End of borehole at 2.70m		
			3.0				
			4.0				
			5.0				



Elevation (m)	Depth (m)
-1.0	1.0
-2.0	2.0
-3.0	3.0
-4.0	4.0
-5.0	5.0

Driller: Ross Battison (RB)
Drill Type: Jacro 200
Remarks:
Support:
Logged By: RB
Checked By: PK
Date Logged: 28/11/06
Date Checked: 31/01/07

Connell HATCH
Infrastructure for Industry

Borehole Number: CW-18

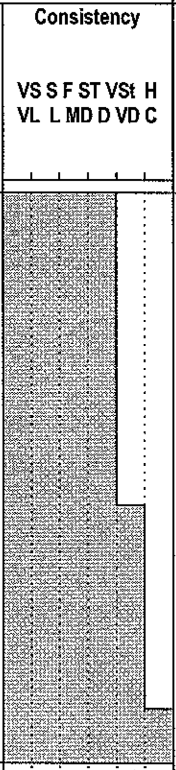
Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 28/11/06
Completed: 30/11/06
Location: Gurnetts Rd, Sarina
Easting: 731970
Northing: 7627529
Elevation: 0
Inclination: 90°

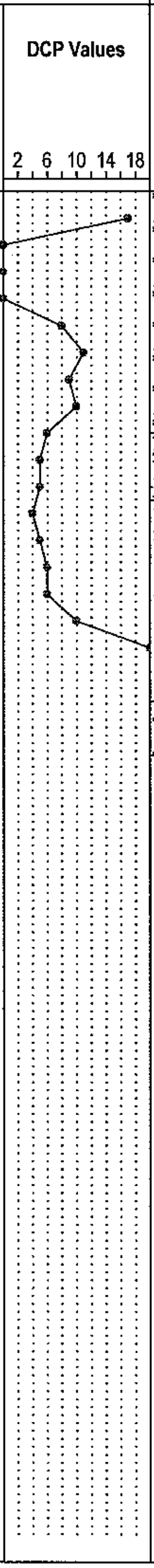
Sheet: 1 of 1

Drilling Information				Soil Description			Testing	Strata Information	
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Comments/	Elevation (m)	Depth (m)
	AT			SM	**SILTY SAND** Light grey to white, fine grained, dense	D	Bulk sample at 0.90m		
			1.0	GP	**SANDY GRAVEL** Light grey to reddish-brown, coarse to medium grained sand, sub-rounded medium gravel, dense			-1.0	1.0
				CL	**SANDY CLAY** Reddish-brown, low plasticity, medium grained sand, trace gravel, very stiff				
			2.0	XW	**CONGLOMERATE** Grey, extremely weathered, coarse grained, low strength			-2.0	2.0
					End of borehole at 2.10m				
			3.0					-3.0	3.0
			4.0					-4.0	4.0
			5.0					-5.0	5.0

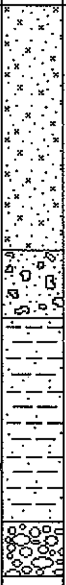
Consistency
VS S F ST VSt H
VL L MD D VD C



DCP Values



Graphic Log



Driller: Ross Battison (RB)
Drill Type: Jacro 200
Remarks:
Support:
Logged By: RB
Checked By: PK
Date Logged: 28/11/06
Date Checked: 31/01/07

Connell HATCH
Infrastructure for Industry

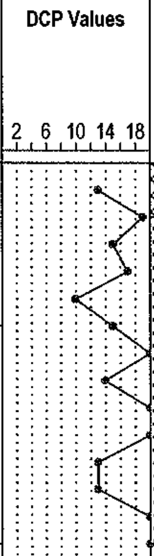
Borehole Number: CW-19

Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 28/11/06
Completed: 30/11/06
Location: Gurnetts Rd, Sarina
Easting: 732236
Northing: 7627115
Elevation: 0
Inclination: 90°

Sheet: 1 of 1

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
	AT			GP	**SANDY GRAVEL (Fill)** Greenish-grey, coarse angular gravel and cobbles, dense			Fill		▨		
					SANDSTONE Grey to greenish-grey, fine grained, extremely to moderately weathered, extremely low strength to low strength			Rock Bulk Sample 0.10 -0.70m		░		
			1.0								-1.0	1.0
					End of borehole at 1.40m							
			2.0								-2.0	2.0
			3.0								-3.0	3.0
			4.0								-4.0	4.0
			5.0								-5.0	5.0



Driller: Ross Battison (RB)
Drill Type: Jacro 200

Remarks:
Support:

Logged By: RB
Checked By: PK

Date Logged: 28/11/06
Date Checked: 31/01/07

Connell HATCH
Infrastructure for Industry

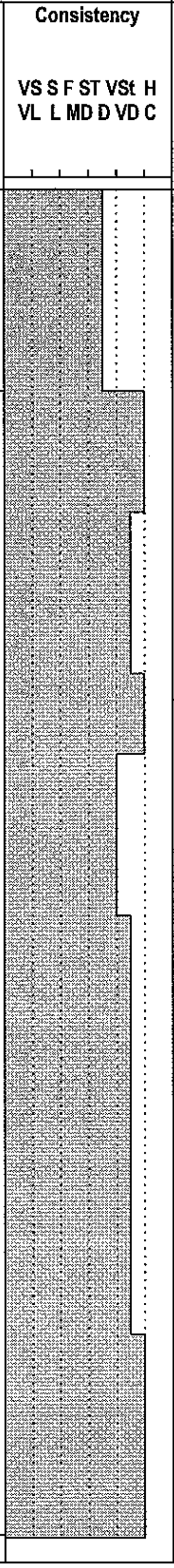
Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

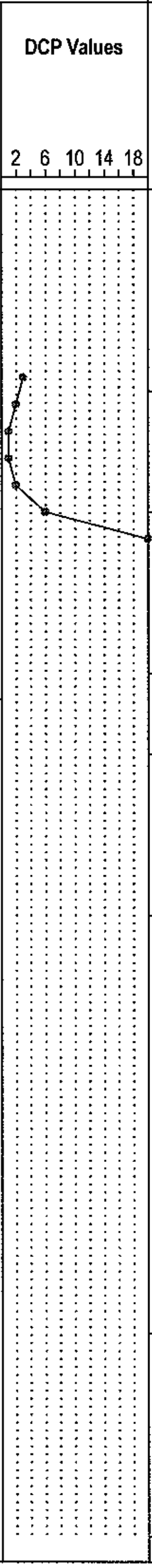
Commenced: 29/11/06
Completed: 30/11/06
Location: Gurnetts Rd, Sarina
Easting: 732195
Northing: 7626777
Elevation: 0
Inclination: 90°

Borehole Number: CW-20

Sheet: 1 of 1

Drilling Information: Groundwater	Drilling Method	Sample Type	Depth	Soil Description: USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Testing: Comments/	Strata Information: Elevation (m) / Depth (m)
	AT			GP	**SANDY GRAVEL** Reddish-brown, medium grained sand, fine rounded gravel, medium dense to dense	D	Bulk sample at 0.70m	
			1.0	CL	**SANDY CLAY** Yellowish-brown, low plasticity, medium sand, fine rounded gravel, very stiff	M		-1.0 / 1.0
				GP	**SANDY GRAVEL** Light grey, coarse angular gravel, medium grained sand, very dense to dense			
		U50	2.0	CL	**SANDY CLAY** Brown, low plasticity, medium grained sand, very stiff		U50 @ 1.90m PP = 370kPa 110mm recovery	-2.0 / 2.0
				SM	**SILTY SAND** Red to pinkish-red, medium grained, dense			
			3.0 4.0	SW	**CLAYEY SAND** Reddish-brown to pinkish-brown, medium grained, trace medium gravel sub-rounded, dense to very dense - Increased gravel, becoming cobbles, very dense			-3.0 / 3.0 -4.0 / 4.0
			5.0		**End of borehole at 5.00m**			-5.0 / 5.0





Driller: Ross Battison (RB)
Drill Type: Jacro 200
Remarks:
Support:
Logged By: GEI
Checked By: PK
Date Logged: 30/11/06
Date Checked: 31/01/07

Connell HATCH
Infrastructure for Industry

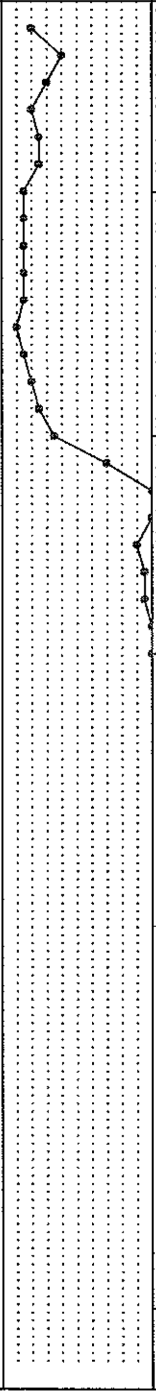
Borehole Number: CW-21

Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 29/11/06
Completed: 29/11/06
Location: Gurnetts Rd, Sarina
Easting: 731787
Northing: 7626702
Elevation: 0
Inclination: 90°

Sheet: 1 of 2

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
	AT				**SANDY CLAY** Light brown-mottled grey, medium plasticity with fine sand, very stiff	M		Bulk sample @ 0.20-0.50m				
		U50						U50 @ 0.50m PP = 270kPa 160mm recovery				
					- Becoming stiff to firm							
			1.0								-1.0	1.0
		U50						U50 @ 1.30m PP=200kPa 450mm recovery				
					- Beocming very stiff to hard							
			2.0								-2.0	2.0
					- Becoming wet	W						
			3.0								-3.0	3.0
					- Trace gravel, increased sand, becoming very stiff to hard							
			4.0								-4.0	4.0
					- Increased gravel, coarse to cobble sized							
			5.0								-5.0	5.0



Driller: Ross Battison (RB)
Drill Type: Jacro 200

Remarks:
Support:

Logged By: GEI
Checked By: PK

Date Logged: 29/11/06
Date Checked: 31/01/07

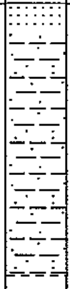
Connell HATCH
Infrastructure for Industry

Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 29/11/06
Completed: 29/11/06
Location: Gurnetts Rd, Sarina
Easting: 731787
Northing: 7626702
Elevation: 0
Inclination: 90°

Borehole Number: CW-21

Sheet: 2 of 2

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
	AT				SANDY CLAY cont.		▨					
			6.0		End of borehole at 6.00m						-6.0	6.0
			7.0								-7.0	7.0
			8.0								-8.0	8.0
			9.0								-9.0	9.0
			10.0								-10.0	10.0

Driller: Ross Battison (RB)
Drill Type: Jacro 200
Remarks:
Support:
Logged By: GEI
Checked By: PK
Date Logged: 29/11/06
Date Checked: 31/01/07

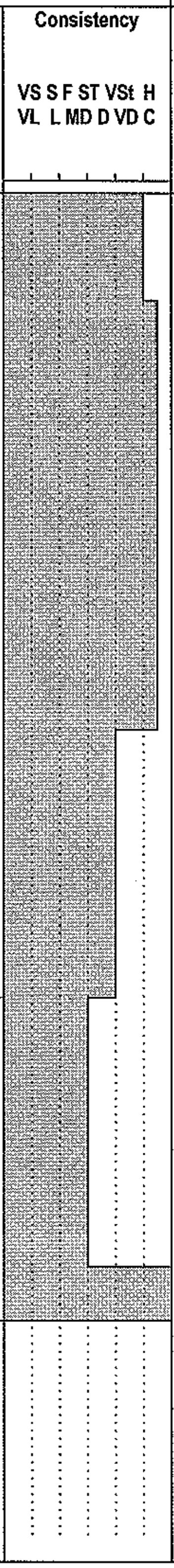
Connell HATCH Infrastructure for Industry

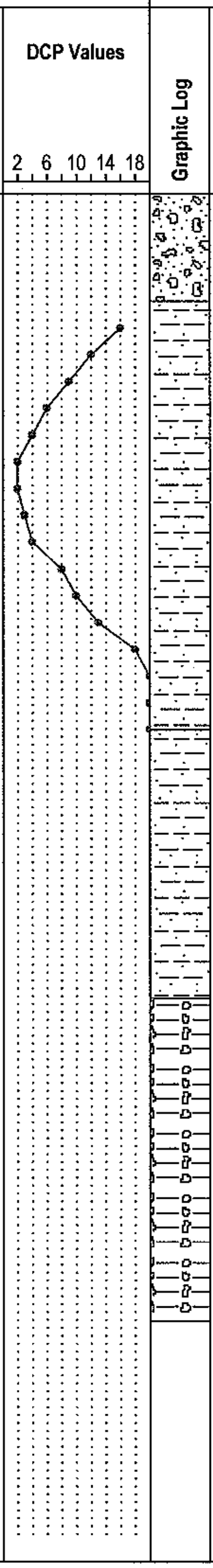
Commenced: 28/11/06	
Completed: 29/11/06	
Client: Queensland Rail	*Location:* Elizabeth Creek, Sarina
Project: Jilalan	*Easting:* 731699
Project Number: HP03-03-00-00	*Northing:* 7626855
File Name: P:\WP\HP03-03-00-00	*Elevation:* 0
	Inclination: 90°

Borehole Number: CW-22

Sheet: 1 of 1

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H / VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
	AT			GP	**SANDY GRAVEL** Light grey, fine grained sand, coarse rounded gravel and cobbles, very dense							
				CL	**SANDY CLAY** Brown-mottled grey, medium plasticity, trace fine gravel, very stiff to hard							
▼		U50	1.0					U50 @ 1.00m PP=290kPa 240mm recovery Bulk sample @ 1.00-1.20m			-1.0	1.0
			2.0		- becoming stiff						-2.0	2.0
			3.0	GR	**CLAYEY GRAVEL** Brown, coarse rounded gravel up to small cobble size, medium dense	W					-3.0	3.0
			4.0								-4.0	4.0
	AT				**End of borehole at 4.20m**							
			5.0								-5.0	5.0





Driller: Ross Battison (RB)	**Remarks:**	**Logged By:** GEI	**Date Logged:** 29/11/06
Drill Type: Jacro 200	**Support:**	**Checked By:** PK	**Date Checked:** 31/01/07

Connell HATCH
Infrastructure for Industry

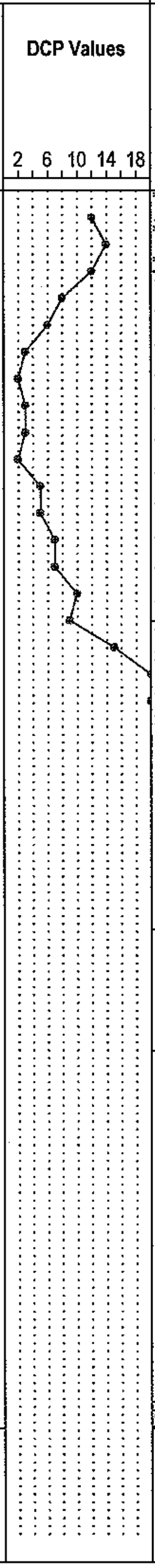
Borehole Number: CW-23

Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 28/11/06
Completed: 28/11/06
Location: Gurnetts Rd, Sarina
Easting: 732122
Northing: 7626252
Elevation: 0
Inclination: 90°

Sheet: 1 of 1

Drilling Information				Soil Description				Testing		Strata Information	
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H / VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Elevation (m)	Depth (m)
	AT			SM	**SILTY SAND** Light brown, fine grained, medium dense	M					
				CL-CH	**SILTY CLAY** Light brown to mottled grey, low to medium plasticity, trace fine sand, very stiff			Bulk sample @ 0.40-0.70m			
		U50	1.0					U50 @ 1.00m PP=320kPa 430mm recovery		-1.0	1.0
				CL	**SANDY CLAY** Brown to light brown, low plasticity, interbedded, medium to coarse sand lenses, very stiff to hard						
			2.0							-2.0	2.0
		U50						U50 @ 2.30m PP>600kPa 160mm recovery			
					- trace fine angular gravel						
			3.0							-3.0	3.0
				CH	**SILTY CLAY** Light grey to greenish grey, medium plasticity, trace sand, hard			Residual soil			
			4.0							-4.0	4.0
				XW-HW	**META VOLCANICS** Light grey, fine grained extremely weathered to highly weathered, low strength			Rock			
					End of borehole at 4.60m						
			5.0							-5.0	5.0



Driller: Ross Battison (RB)
Drill Type: Jacro 200
Remarks:
Support:
Logged By: GEI
Checked By: PK
Date Logged: 28/11/06
Date Checked: 31/01/07

Connell HATCH Infrastructure for Industry

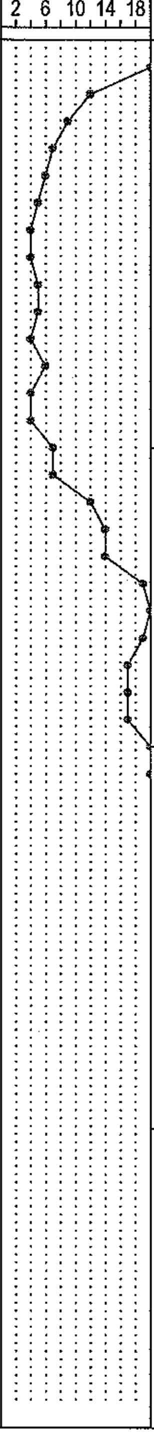
Borehole Number: CW-24

Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 30/11/06
Completed: 30/11/06
Location: Gurnetts Rd, Sarina
Easting: 731974
Northing: 7626106
Elevation: 0
Inclination: 90°

Sheet: 1 of 2

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
	AT			CH	**SILTY CLAY** Light brown - orange-brown to mottled grey, medium plasticity, trace fine sand, very stiff	M		Bulk sample at 0.50m				
			1.0								-1.0	1.0
		U50			- trace fine grained sand and gravel, hard			U50 @ 1.50m PP>600kPa 200mm recovery				
			2.0	CL							-2.0	2.0
					- becoming low plasticity							
			3.0								-3.0	3.0
			4.0		- becoming light grey - mottled orange-brown, very stiff						-4.0	4.0
			5.0								-5.0	5.0



Driller: Ross Battison (RB)
Drill Type: Jacro 200
Remarks:
Support:
Logged By: GEI
Checked By: PK
Date Logged: 30/11/06
Date Checked: 31/01/07

Connell HATCH
Infrastructure for Industry

Borehole Number: CW-24

Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 30/11/06
Completed: 30/11/06
Location: Gurnetts Rd, Sarina
Easting: 731974
Northing: 7626106
Elevation: 0
Inclination: 90°

Sheet: 2 of 2

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
				CL	SILTY CLAY cont.	M	▨					
			6.0		End of borehole at 6.00m						-6.0	6.0
			7.0								-7.0	7.0
			8.0								-8.0	8.0
			9.0								-9.0	9.0
			10.0								-10.0	10.0

Driller: Ross Battison (RB)
Drill Type: Jacro 200
Remarks:
Support:
Logged By: GEI
Checked By: PK
Date Logged: 30/11/06
Date Checked: 31/01/07

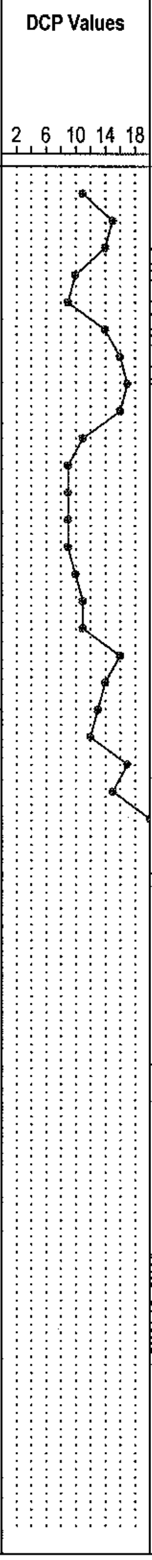
Connell HATCH
Infrastructure for Industry

Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 30/11/06
Completed: 30/11/06
Location: Gurnetts Rd, Sarina
Easting: 731944
Northing: 7625003
Elevation: 0
Inclination: 90°

Borehole Number: CW-25

Sheet: 1 of 2



Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency	Comments/	DCP Values	Graphic Log	Elevation (m)	Depth (m)
	AT			SM	**SILTY SAND** Light grey, fine grained, medium dense	D		Bulk sample 0.20 - 0.50m				
				SC	**CLAYEY SAND** Light grey to brown, fine grained, some nodules of low plasticity clay, dense							
			1.0	CL	**SANDY CLAY** Light grey, mottled reddish-brown, low plasticity, some fine to medium sand, very stiff to hard	M					-1.0	1.0
		U50	2.0					U50 @ 2.00m PP>600kPa 150mm recovery			-2.0	2.0
					- Becoming mottled reddish-brown, oxidized areas							
			3.0								-3.0	3.0
					- Medium gravel, becoming coarse with depth							
			4.0	GL	**CLAYEY GRAVEL** Light brown, coarse sub-rounded gravel, dense						-4.0	4.0
					SANDY CLAY Some trace coarse gravel, very stiff to hard							
			5.0								-5.0	5.0

Driller: Ross Battison (RB)
Drill Type: Jacro 200
Remarks:
Support:
Logged By: GEI
Checked By: PK
Date Logged: 30/11/06
Date Checked: 31/01/07

Connell HATCH
Infrastructure
for Industry

Borehole Number: CW-25

Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 30/11/06
Completed: 30/11/06
Location: Gurnetts Rd, Sarina
Easting: 731944
Northing: 7625003
Elevation: 0
Inclination: 90°

Sheet: 2 of 2

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
	AT				SANDY CLAY cont.	M	▨			▨		
			6.0		End of borehole at 6.00m						-6.0	6.0
			7.0								-7.0	7.0
			8.0								-8.0	8.0
			9.0								-9.0	9.0
			10.0								-10.0	10.0

Driller: Ross Battison (RB)
Drill Type: Jacro 200
Remarks:
Support:
Logged By: GEI
Checked By: PK
Date Logged: 30/11/06
Date Checked: 31/01/07

Connell HATCH Infrastructure for Industry

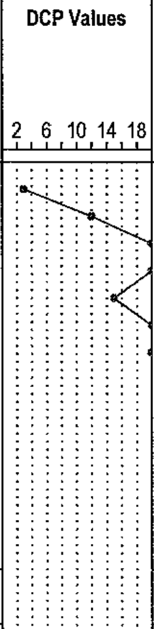
Borehole Number: CW-26

Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 29/11/06
Completed: 30/11/06
Location: Gurnetts Rd, Sarina
Easting: 731646
Northing: 7624438
Elevation: 0
Inclination: 90°

Sheet: 1 of 1

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
	AT			SM	**SILTY SAND** White, fine grained, medium dense	D		Bulk sample at 0.30m				
			1.0								-1.0	1.0
				XW	**SANDSTONE** Reddish-brown to brown, extremely weathered, coarse grained, extremely low strength to low strength			Sandstone				
			2.0		End of borehole at 1.70m						-2.0	2.0
			3.0								-3.0	3.0
			4.0								-4.0	4.0
			5.0								-5.0	5.0



Driller: Ross Battison (RB)
Drill Type: Jacro 200
Remarks:
Support:
Logged By: GEI
Checked By: PK
Date Logged: 30/11/06
Date Checked: 31/01/07

Connell HATCH
Infrastructure for Industry

Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 28/11/06
Completed: 30/11/06
Location: Gurnetts Rd, Sarina
Easting: 731516
Northing: 7624005
Elevation: 0
Inclination: 90°

Borehole Number: CW-27

Sheet: 1 of 2

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
	AT				**SANDY GRAVEL (Fill)** Reddish-brown, coarse rounded gravel and cobbles, road base, dense	D						
				SM	**SILTY SAND** White, coarse grained sand and coarse gravel, dense			Bulk sample at 0.40m				
				CL	**SANDY CLAY** Brown, low plasticity, with fine to medium grained sand, stiff							
			1.0		- becoming medium plasticity, hard						-1.0	1.0
		U50	2.0					U50 @ 2.00m PP> 600kPa 130mm recovery			-2.0	2.0
			3.0	GP	**SANDY GRAVEL** Brown, very coarse grained sand and coarse rounded gravel, some clasts of tuff and granite, dense						-3.0	3.0
			4.0					4.20m Difficult drilling			-4.0	4.0
			5.0								-5.0	5.0

Driller: Ross Battison (RB)
Drill Type: Jacro 200
Remarks:
Support:
Logged By: GEI
Checked By: PK
Date Logged: 30/11/06
Date Checked: 31/01/07

Connell HATCH
Infrastructure for Industry

Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 28/11/06
Completed: 30/11/06
Location: Gurnetts Rd, Sarina
Easting: 731516
Northing: 7624005
Elevation: 0
Inclination: 90°

Borehole Number: CW-27

Sheet: 2 of 2

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
	AT			GP	SANDY GRAVEL cont.	D	▨			▨		
			6.0		End of borehole at 6.00m						-6.0	6.0
			7.0								-7.0	7.0
			8.0								-8.0	8.0
			9.0								-9.0	9.0
			10.0								-10.0	10.0

Driller: Ross Battison (RB)
Drill Type: Jacro 200
Remarks:
Support:
Logged By: GEI
Checked By: PK
Date Logged: 30/11/06
Date Checked: 31/01/07

Connell HATCH
Infrastructure for Industry

Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 30/11/06
Completed: 30/11/06
Location: Gurnetts Rd, Sarina
Easting: 731794
Northing: 7627571
Elevation: 0
Inclination: 90°

Borehole Number: CW-28

Sheet: 1 of 1

Drilling Information				Soil Description				Testing		Strata Information	
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Elevation (m)	Depth (m)
	AT			GP	**SANDY GRAVEL** Light grey, fine sand, coarse gravel, dense						
			1.0	CL	**SANDY CLAY** Light brown, mottled grey, low plasticity, hard					-1.0	1.0
			2.0	XW	**SANDSTONE** White to light brown, extremely weathered, fine to medium grained, extremely low to low strength			2.40m Refusal on rock		-2.0	2.0
					End of borehole at 2.40m						
			3.0							-3.0	3.0
			4.0							-4.0	4.0
			5.0							-5.0	5.0

Driller: Ross Battison (RB)
Drill Type: Jacro 200
Remarks:
Support:
Logged By: GEI
Checked By: PK
Date Logged: 30/11/06
Date Checked: 31/01/07

Connell HATCH
Infrastructure for Industry

Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 28/11/06
Completed: 28/11/06
Location: Armstrong Beach Rd
Easting: 732387
Northing: 7628460
Elevation: 0
Inclination: 90°

Borehole Number: TP-1

Sheet: 1 of 1

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
				GP	**SANDY GRAVEL (Fill)** Dark grey-black, coarse angular gravel, trace cobbles and small boulders, dense to very dense			Fill		▩		
			1.0							▩	-1.0	1.0
				XW-HW	**SANDSTONE** Reddish-brown, extremely to highly weathered, medium to coarse grained, friable, heavy oxidation staining along fracture surfaces, low to medium strength			Rock, low to medium strength		░		
			2.0							░	-2.0	2.0
					End of Test Pit at 2.30m							
			3.0								-3.0	3.0
			4.0								-4.0	4.0
			5.0								-5.0	5.0

Driller:
Drill Type:
Remarks:
Support:
Logged By: GEI
Checked By: PK
Date Logged:
Date Checked:

Connell HATCH Infrastructure for Industry

Borehole Number: TP-2

Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 28/11/06
Completed: 28/11/06
Location: Armstrong Beach Rd, Sarina
Easting: 732571
Northing: 7628153
Elevation: 0
Inclination: 90°

Sheet: 1 of 1

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
				SM	**SANDY SILT (Topsoil)** Light brown, fine grained sand, very stiff	D		Topsoil				
				XW-RS	**BASALT VOLCANICS** Reddish-brown to red, residual soil to extremely weathered volcanic material, vesicles with heavy oxidation, friable, extremely low strength			Residual soil, extremely weathered rock				
			1.0								-1.0	1.0
				RS-GC	**CLAYEY GRAVEL** Greenish-grey, high plasticity clay with coarse angular gravel to cobble and small boulder size, dense to very dense			Bulk sample at 1.50m				
					- becoming highly weathered rock with depth							
			2.0								-2.0	2.0
				HW-MW	**BASALT** Greenish-grey, fine grained, highly to moderately weathered, clay infilled fractures, medium to high strength			Rock sample at 2.00m				
					End of Test Pit at 2.50m							
			3.0								-3.0	3.0
			4.0								-4.0	4.0
			5.0								-5.0	5.0

Driller:
Drill Type:
Remarks:
Support:
Logged By: GEI
Checked By: PK
Date Logged:
Date Checked:

Connell HATCH
Infrastructure for Industry

Borehole Number: TP-3

Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 28/11/06
Completed: 28/11/06
Location: Gurnetts Rd, Sarina
Easting: 732147
Northing: 7627227
Elevation: 90°
Inclination:

Sheet: 1 of 1

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
				SM	**SANDY SILT (Topsoil)** Light brown to grey, stiff	D						
				RS-GC	**CLAYEY GRAVEL** Light reddish-brown, coarse sand, coarse sub-angular gravel with trace cobbles upt o 300mm in diameter, low plasticity clay, increased angular clasts of extremely weathered, fine grained volcanic rock, very dense to cemented	M		Residual Soil				
			1.0								-1.0	1.0
			2.0		- Rounded cobbles in lightly cemented matrix, some areas of high plasticity clay			Bulk sample at 2.00m			-2.0	2.0
			3.0								-3.0	3.0
					End of Test Pit at 3.30m							
			4.0								-4.0	4.0
			5.0								-5.0	5.0

Driller:
Drill Type:

Remarks:
Support:

Logged By: GEI
Checked By: PK

Date Logged:
Date Checked:

Connell HATCH Infrastructure for Industry

Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 28/11/06
Completed: 28/11/06
Location: Gurnetts Rd, Sarina
Easting: 731990
Northing: 7627118
Elevation: 90°
Inclination:

Borehole Number: TP-4

Sheet: 1 of 1

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
				SM	**SANDY SILT** Light brown to grey, trace fine to medium grained sand, stiff	D						
				GP	**SANDY GRAVEL** Light brown, coarse rounded gravel and cobbles up to 300mm in diameter, medium grained sand, lightly cemented, very dense			Residual soil				
			1.0								-1.0	1.0
				HW	**CONGLOMERATE** Light greenish-grey, highly weathered, coarse rounded gravel and cobbles, cemented, hard to medium strength			Medium strength rock				
					End of Test Pit at 1.30m							
			2.0								-2.0	2.0
			3.0								-3.0	3.0
			4.0								-4.0	4.0
			5.0								-5.0	5.0

Driller:
Drill Type:
Remarks:
Support:
Logged By: GEI
Checked By: PK
Date Logged:
Date Checked:

Connell HATCH
Infrastructure for Industry

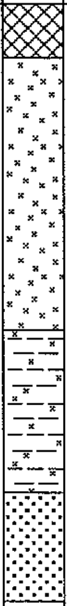
Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 28/11/06
Completed: 28/11/06
Location: Gurnetts Rd, Sarina
Easting: 731902
Northing: 7626890
Elevation: 90°
Inclination:

Borehole Number: TP-5

Sheet: 1 of 1

Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H / VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
				SM	**SANDY SILT (Topsoil)** Light brown, trace fine sand, stiff to very stiff	D						
				ML	**SILT** Light brown to grey, fine sand, hard							
			1.0								-1.0	1.0
					SILTY CLAY Riddish-brown, mottled grey, medium to high plasticity, fine rounded gravel, very stiff	M		Residual soil Bulk sample 1.70, - 2.00m				
				MW	**TUFF (Ignimbrite)** Brown, medium to coarse grained, moderately weathered, medium to high strength			Rock sandstone				
			2.0								-2.0	2.0
					End of Test Pit at 2.20m							
			3.0								-3.0	3.0
			4.0								-4.0	4.0
			5.0								-5.0	5.0



Driller:
Drill Type:
Remarks:
Support:
Logged By: GEI
Checked By: PK
Date Logged:
Date Checked:

Connell HATCH
Infrastructure for Industry

Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 28/11/06
Completed: 28/11/06
Location: Gurnetts Rd, Sarina
Easting: 732119
Northing: 7626855
Elevation: 90°
Inclination:

Borehole Number: TP-6

Sheet: 1 of 1

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
				ML	**SANDY SILT** Light reddish-brown, trace fine sand, very stiff	D						
				GP	**SANDY GRAVEL** Reddish-brown, coarse rounded gravel and cobbles, up to 300mm in diameter, some trace fines, dense to very dense	M						
			1.0								-1.0	1.0
								Bulk sample at 1.50m				
					- becoming lightly cemented with depth, very dense to cemented							
			2.0								-2.0	2.0
								2.80m Refusal on very dense gravel				
					End of Test Pit at 2.80m							
			3.0								-3.0	3.0
			4.0								-4.0	4.0
			5.0								-5.0	5.0

Driller:
Remarks:
Logged By: GEI
Date Logged:
Drill Type:
Support:
Checked By: PK
Date Checked:

Connell HATCH
Infrastructure for Industry

Client: Queensland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 28/11/06
Completed: 28/11/06
Location: Gurnetts Rd, Sarina
Easting: 732085
Northing: 7626635
Elevation: 90°
Inclination:

Borehole Number: TP-7

Sheet: 1 of 1

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
				ML	**SANDY SILT (Topsoil)** Reddish-brown, trace fine sand, stiff	D						
			1.0	CL	**SILTY CLAY** Light reddish-brown to light grey, low to medium plasticity, fine sand, stiff	M		Bulk sample at 1.50m			-1.0	1.0
			2.0		- becoming red to mottled grey, medium plasticity, stiff to very stiff						-2.0	2.0
			3.0	CH	- Light grey, mottled reddsh-brown and greenish-grey, high plasticity, very stiff to hard			Residual soil			-3.0	3.0
				XW	**ALTERED VOLCANICS** Green to grey to reddish-brown, extremely weathered, fine grained, medium to high strength							
			4.0		**End of Test Pit at 3.80m**						-4.0	4.0
			5.0								-5.0	5.0

Driller:
Drill Type:
Remarks:
Support:
Logged By: GEI
Checked By: PK
Date Logged:
Date Checked:

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Client: Queesnland Rail
Project: Jilalan
Project Number: HP03-03-00-00
File Name: P:\WP\HP03-03-00-00

Commenced: 28/11/06
Completed: 28/11/06
Location: Gurnetts Rd, Sarina
Easting: 732105
Northing: 7627939
Elevation: 0
Inclination: 90

Borehole Number: TP-8

Sheet: 1 of 1

Drilling Information				Soil Description				Testing		Strata Information		
Groundwater	Drilling Method	Sample Type	Depth	USC	Material Type; Colour; Plasticity Or Particle Characteristics; Structure	Moisture Content	Consistency VS S F ST VSt H VL L MD D VD C	Comments/	DCP Values 2 6 10 14 18	Graphic Log	Elevation (m)	Depth (m)
				HW-MW	**RHYOLITIC TUFF (Ignimbrite)** Pale pink and grey, highly to moderately weathered, medium to high strength	D						
			1.0								-1.0	1.0
			2.0	MW	**SANDSTONE** Yellow-brown, fine grained, moderately weathered, high strength						-2.0	2.0
			3.0								-3.0	3.0
			4.0		**End of Test Pit at 4.0m**						-4.0	4.0
			5.0								-5.0	5.0

Driller: Sarina Excavations
Drill Type: Volvo BL71

Remarks:
Support:

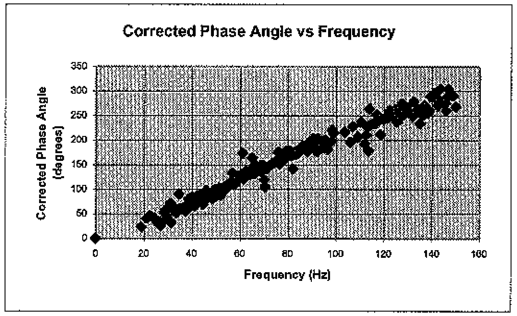
Logged By: GEI
Checked By: PK

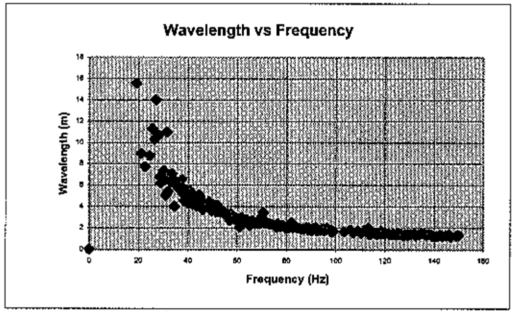
Date Logged: 28/11/06
Date Checked: 31/01/07

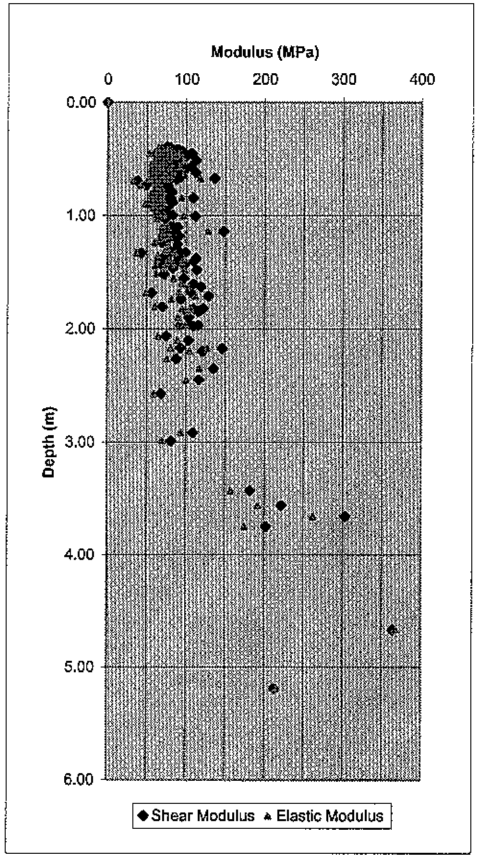
Appendix E

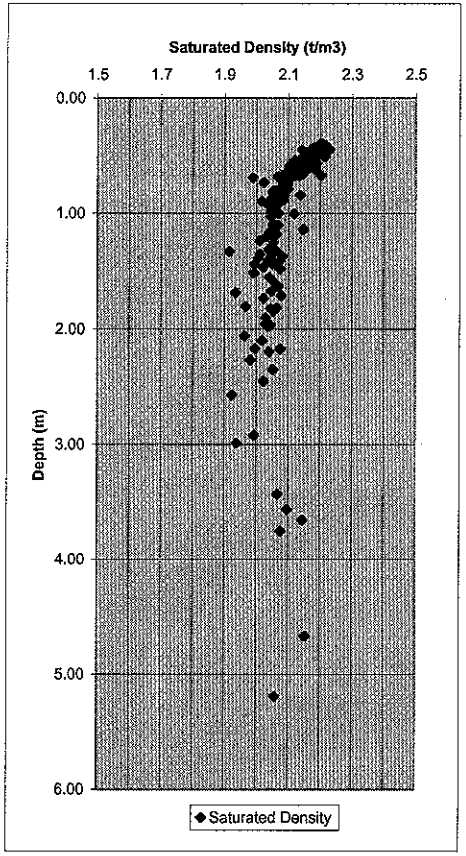
SASW Results

CLIENT:-	Queensland Rail
PROJECT:-	Queensland Rail Jilalan
PROJECT NUMBER:-	HI8802UG
LOCATION:-	BH1
FILE NAME:-	sasw15021909_1
DATE:-	16/02/2006
OPERATOR:-	Nathan Roberts


Corrected Phase Angle vs Frequency


Wavelength vs Frequency


Modulus (MPa)


Saturated Density (t/m3)

CLASSIFICATION
Fill 0.0 - 1.4m Gravel Loose to medium dense
Residual Soil Sandy Clay Very stiff 1.4 - 3.6m
Siltstone Extremely weathered very low strength 3.6 - penetration depth

Testing Notes:	Classification based on BH1 from Geotechnical Report

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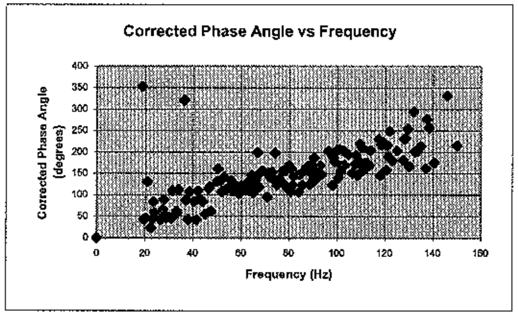
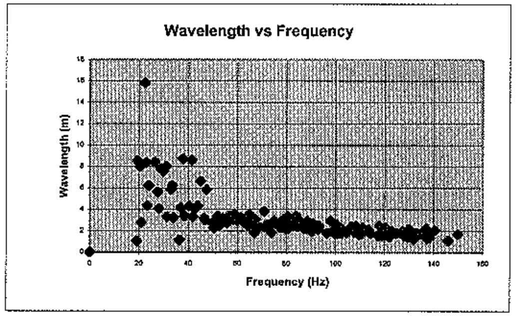
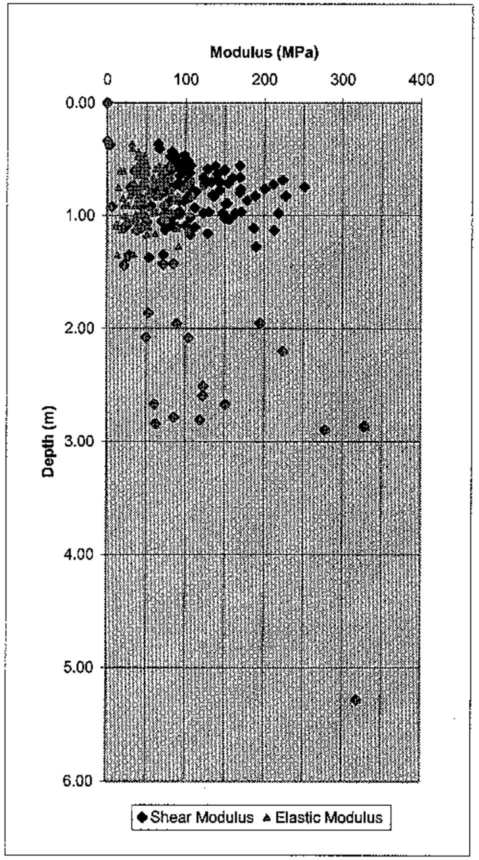
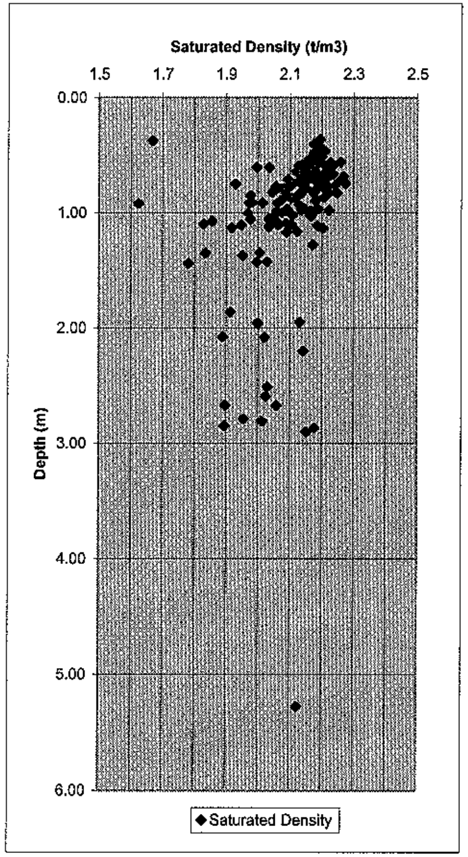
CLIENT:-	Queensland Rail
PROJECT:-	Queensland Rail Jialan
PROJECT NUMBER:-	HI8802UG
LOCATION:-	BH2
FILE NAME:-	sasw150222024_1
DATE:-	16/02/2006
OPERATOR:-	Nathan Roberts


Corrected Phase Angle vs Frequency


Wavelength vs Frequency


Modulus (MPa)


Saturated Density (t/m3)

CLASSIFICATION
Fill 0.0 - 1.4m Gravel Loose to medium dense
Residual Soil Sandy Clay Very stiff 1.4 - 4.0m
Siltstone Extremely weathered very low strength 4.0 - penetration depth

Testing Notes:	Classification based on BH2 from Geotechnical Report

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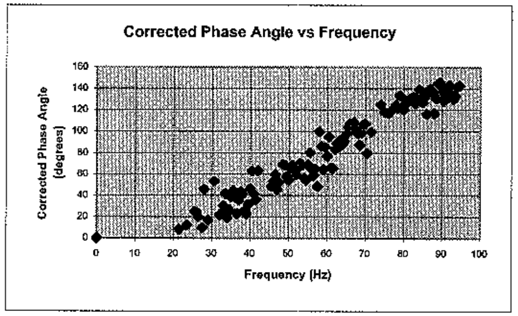
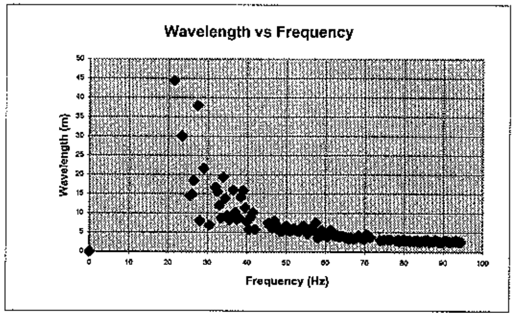
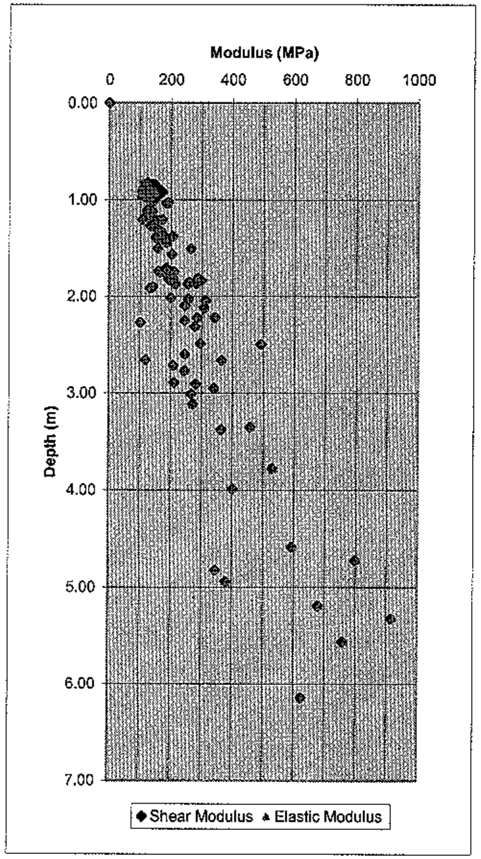
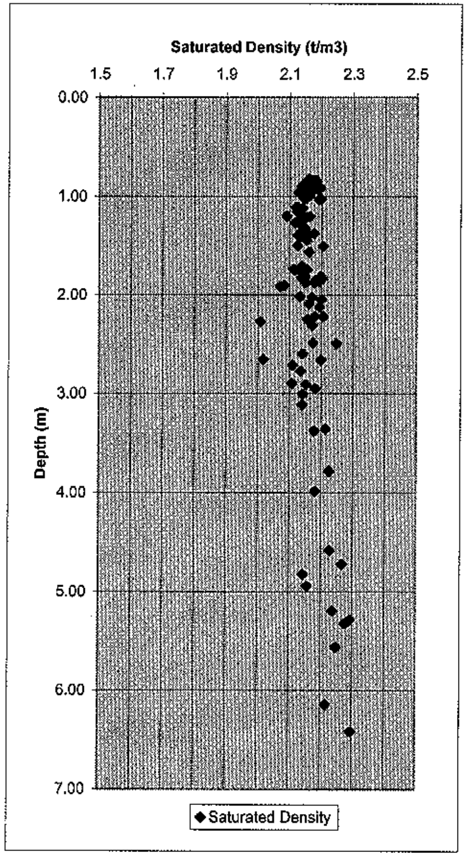
CLIENT:-	Queensland Rail
PROJECT:-	Queensland Rail Jilalan
PROJECT NUMBER:-	HI8802UG
LOCATION:-	BH3
FILE NAME:-	Sasw16021754_1
DATE:-	16/02/2006
OPERATOR:-	Nathan Roberts





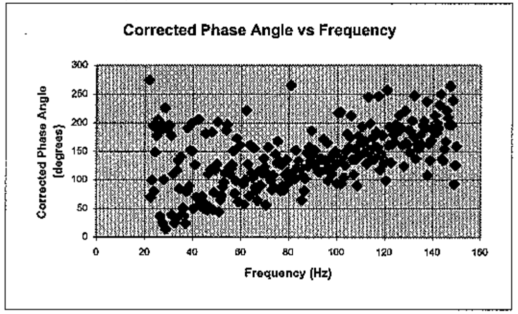


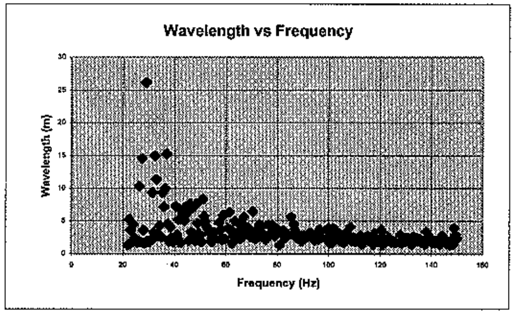


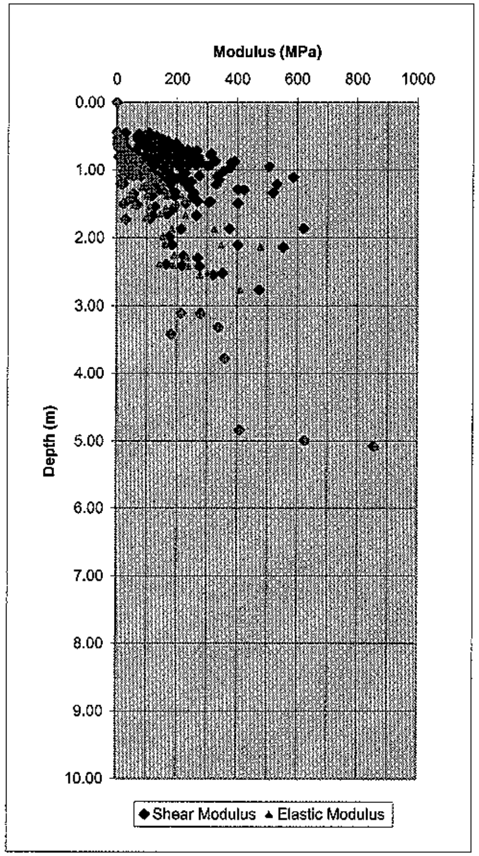
CLASSIFICATION
Fill 0.0 - 0.2
Silty Sand 0.2 - 0.5
Basalt Extremely weathered Extremely low strength 0.5 - 1.5 Extremely weathered Very low strength 1.5-4.0m Low to medium strength 4.0 - penetration depth

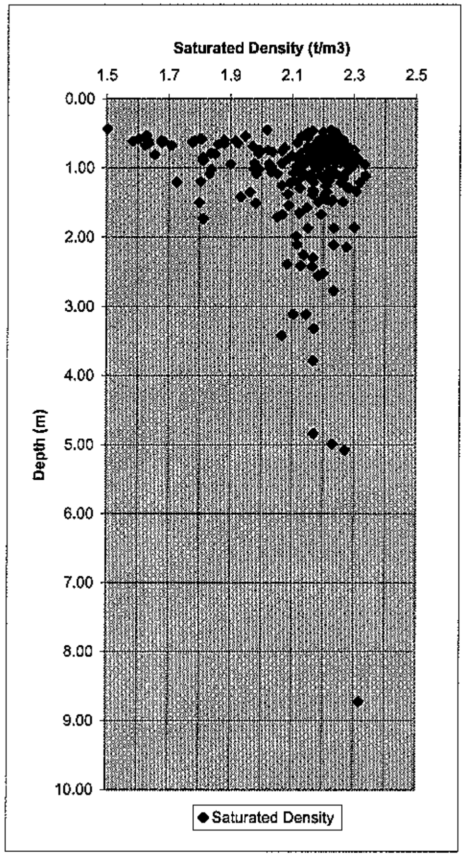
Testing Notes:	Classification based on BH3 from Geotechnical Report

CLIENT:-	Queensland Rail
PROJECT:-	Queensland Rail Jilalan
PROJECT NUMBER:-	HI8802UG
LOCATION:-	BH5
FILE NAME:-	Sasw15021910_1
DATE:-	15/02/2006
OPERATOR:-	Nathan Roberts









CLASSIFICATION
Silty CLAY Stiff to Very Stiff
Silty CLAY Very Stiff to Hard
Silty CLAY Stiff to Very Stiff
GRANITE/DIORITE Low Strength Very Low Strength Low Strength

Testing Notes:	Classification based on BH5 from Geotechnical Report

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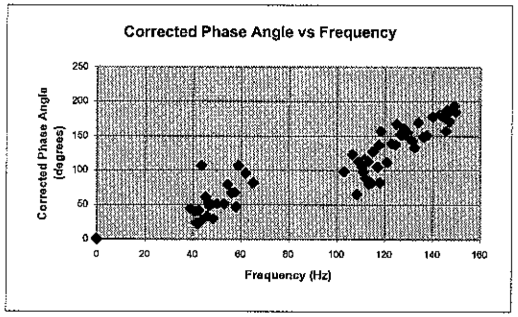
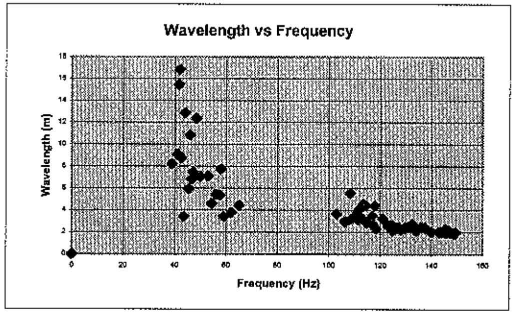
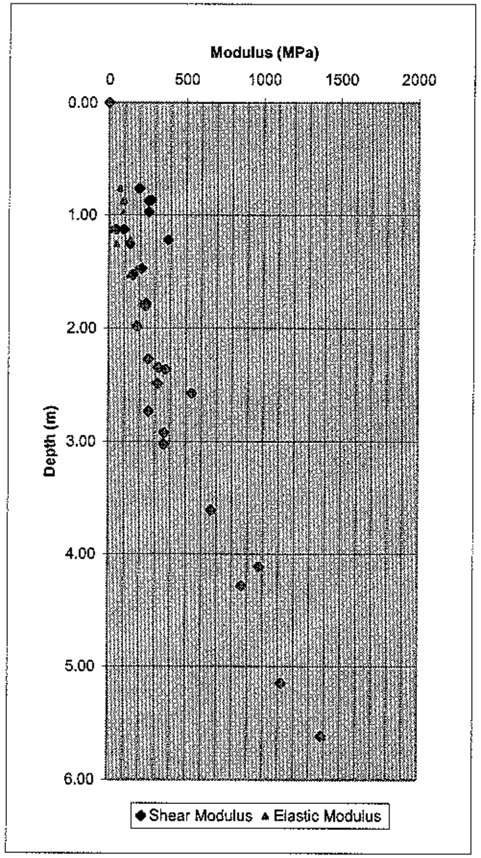
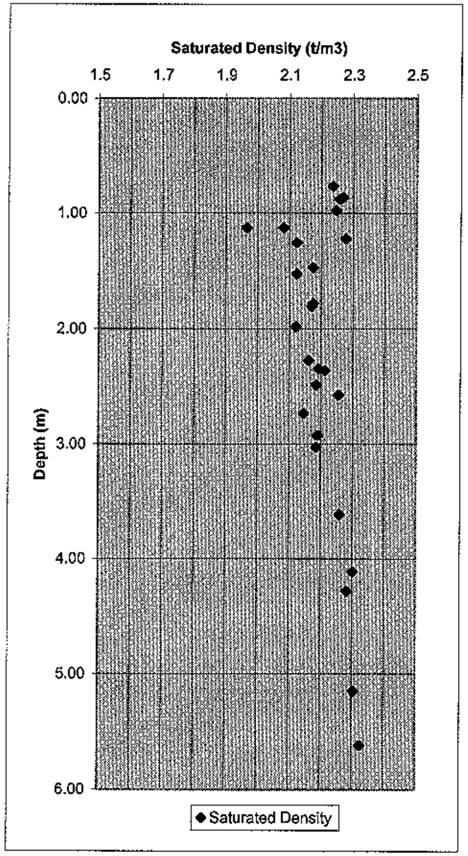
CLIENT:-	Queensland Rail
PROJECT:-	Queensland Rail Jilalan
PROJECT NUMBER:-	HI8802UG
LOCATION:-	BH6
FILE NAME:-	Sasw15021909_1
DATE:-	15/02/2006
OPERATOR:-	Nathan Roberts









CLASSIFICATION
Alluvium Clayey Sand Loose to medium dense 0.0 - 1.35m
Residual Soil Sandy Clay - Very stiff 1.35 - 1.8m
Sandstone Extremely weathered Very low strength Becoming low strength Becoming medium strength

Testing Notes:	Classification based on BH6 from Geotechnical Report

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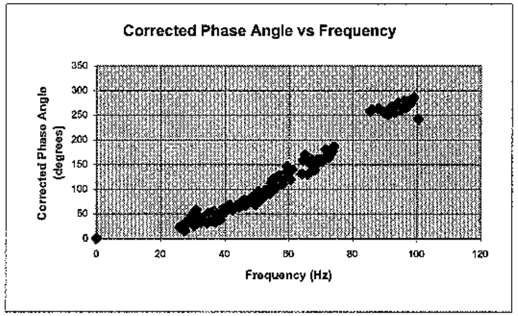
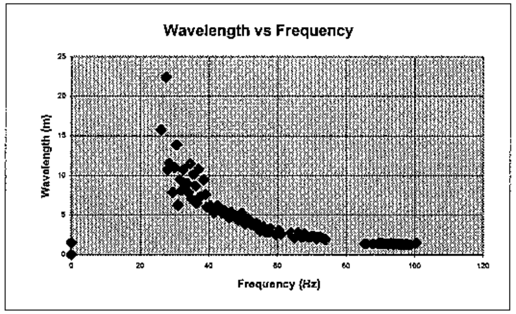
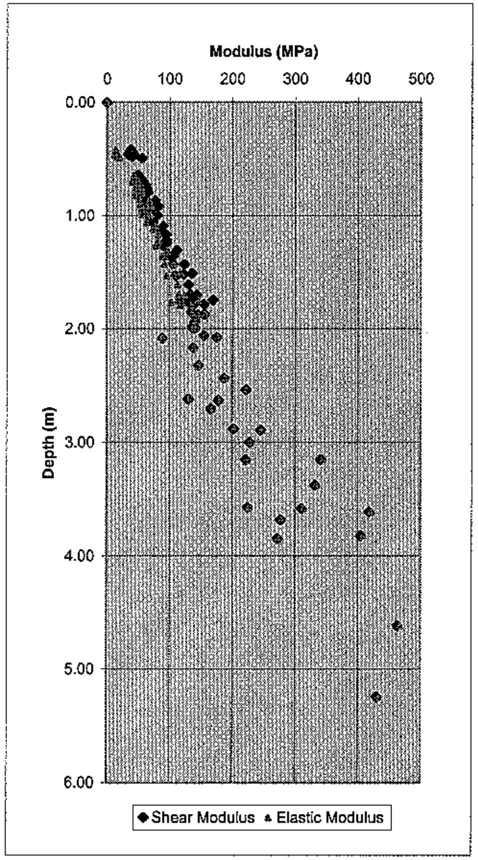
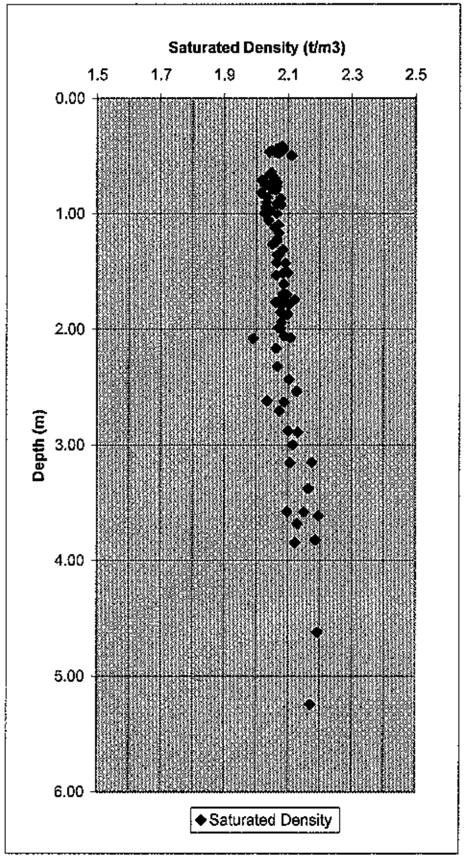
Infrastructure for Industry

CLIENT:-	Queensland Rail
PROJECT:-	Queensland Rail Jilalan
PROJECT NUMBER:-	HI8802UG
LOCATION:-	BH7
FILE NAME:-	sasw160201856_1
DATE:-	15/02/2006
OPERATOR:-	Nathan Roberts





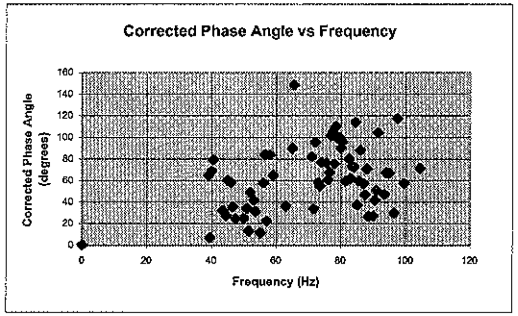


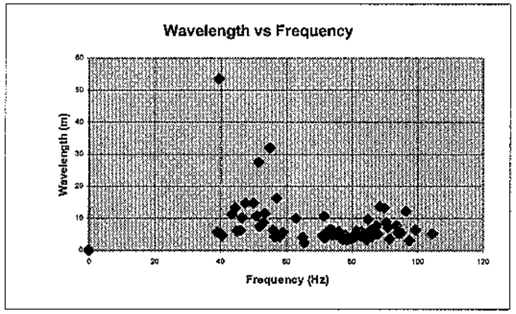


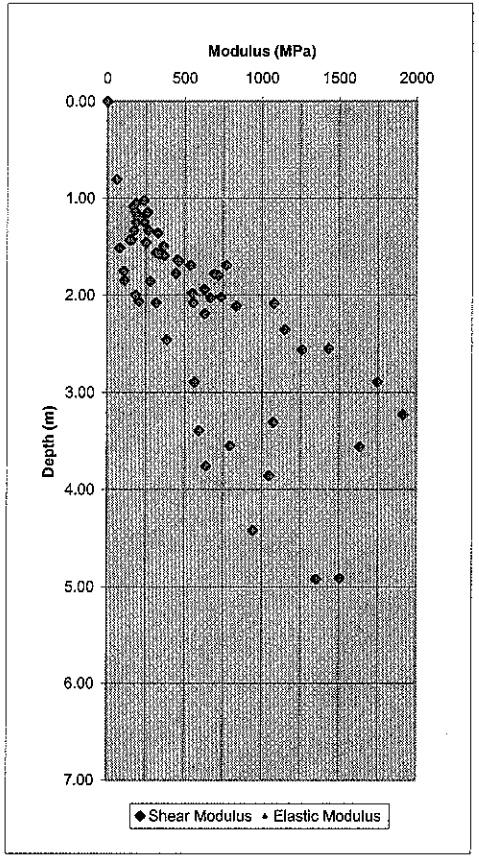
CLASSIFICATION
0.0 - 0.4m Alluvium Sand - Loose to medium dense
Residual soil and extremely weathered Siltstone layers
Siltstone Extremely weathered Very low to low strength 2.2 - penetration depth

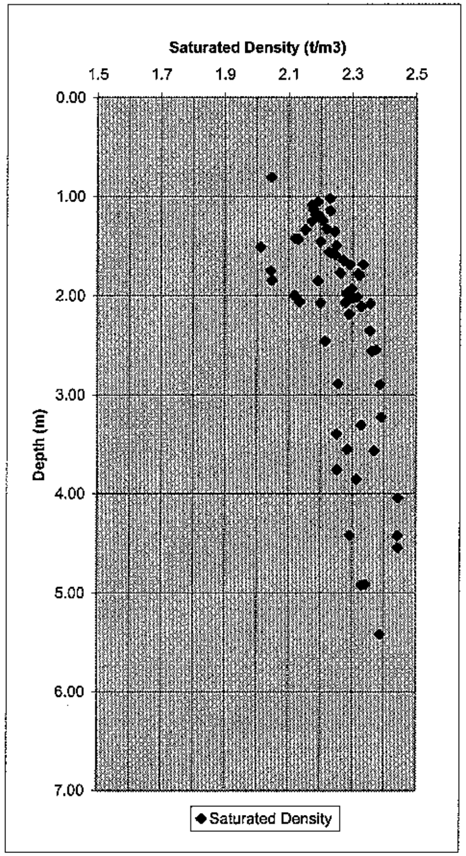
Testing Notes:	Classification based on BH7 from Geotechnical Report

CLIENT:-	Queensland Rail
PROJECT:-	Queensland Rail Jilalan
PROJECT NUMBER:-	HI8802UG
LOCATION:-	BH8
FILE NAME:-	sasw160201935_1
DATE:-	16/02/2006
OPERATOR:-	Nathan Roberts









CLASSIFICATION

Fill 0.0 - 0.3m
Residual Soil 0.3 - 0.8m
Sand - Dense

Sandstone
Highly weathered
Low strength
0.8 - penetration depth

Becoming medium strength

Testing Notes:	Classification based on BH8 from Geotechnical Report

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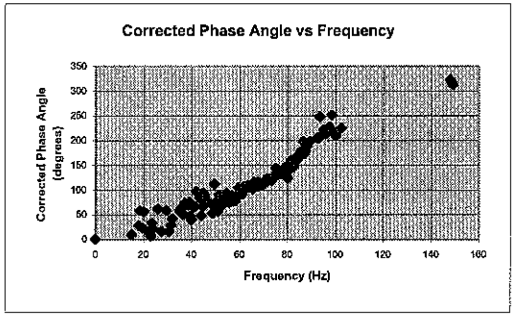
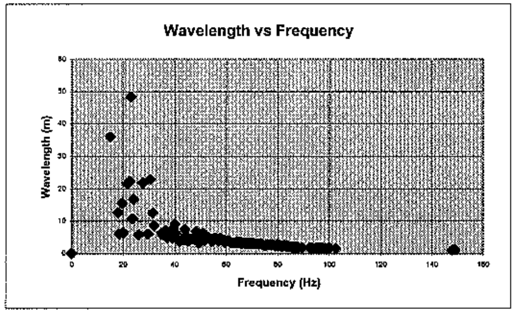
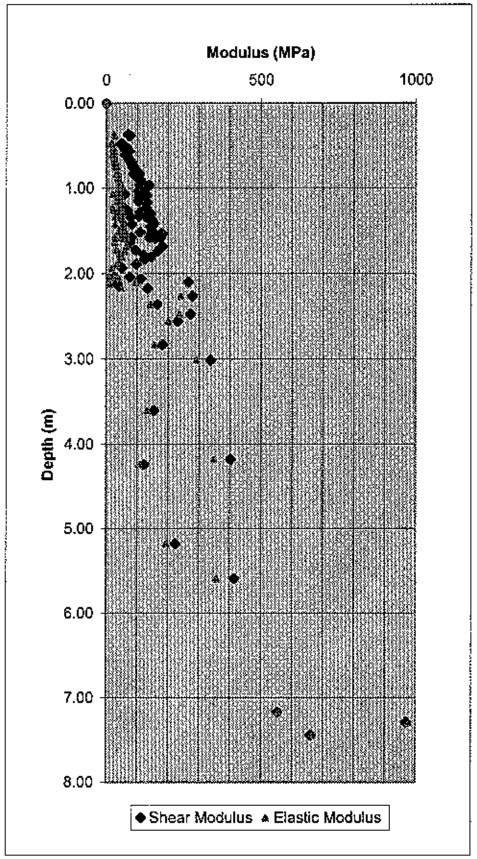
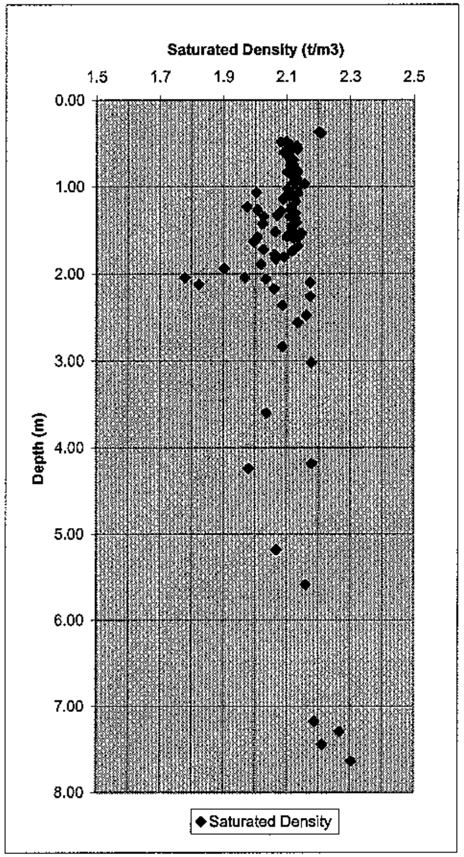
CLIENT:-	Queensland Rail
PROJECT:-	Queensland Rail Jilalan
PROJECT NUMBER:-	HI8802UG
LOCATION:-	BH9
FILE NAME:-	sasw16020027_1
DATE:-	15/02/2006
OPERATOR:-	Nathan Roberts


Corrected Phase Angle vs Frequency


Wavelength vs Frequency


Modulus (MPa)


Saturated Density (t/m3)

CLASSIFICATION
Fill 0.0 - 0.4
Alluvium 0.4 - 5.7m Clayey Sand Medium dense to dense Sandy Clay Very Stiff
Residual Soil Clay Very stiff to hard 5.7 - approx 7.0m
Siltstone/Sandstone Highly weathered

Testing Notes:	Classification based on BH9 from Geotechnical Report

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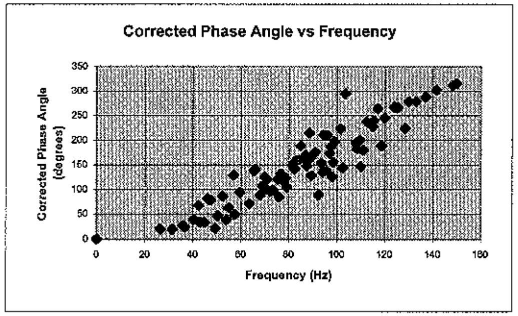
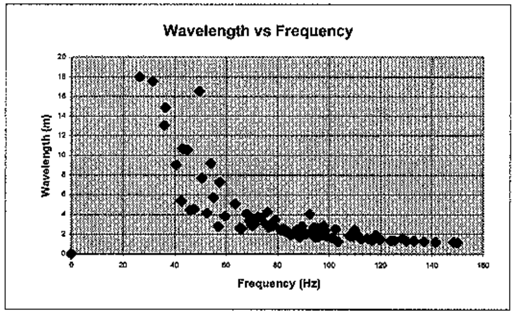
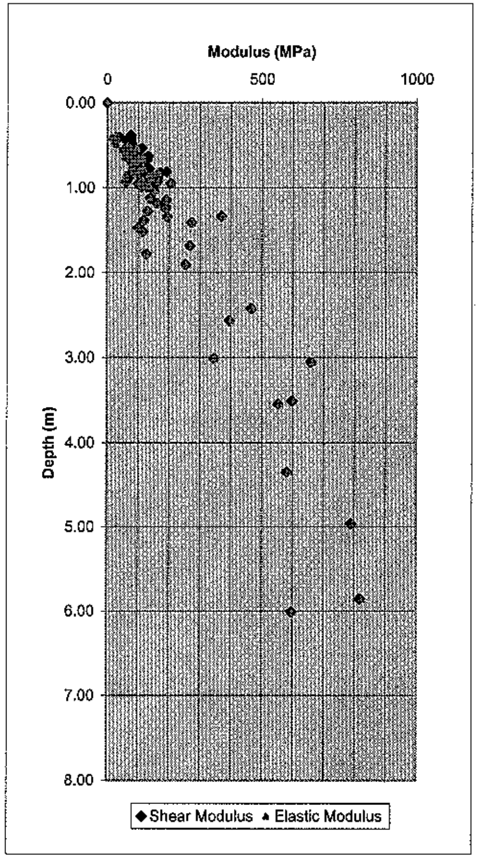
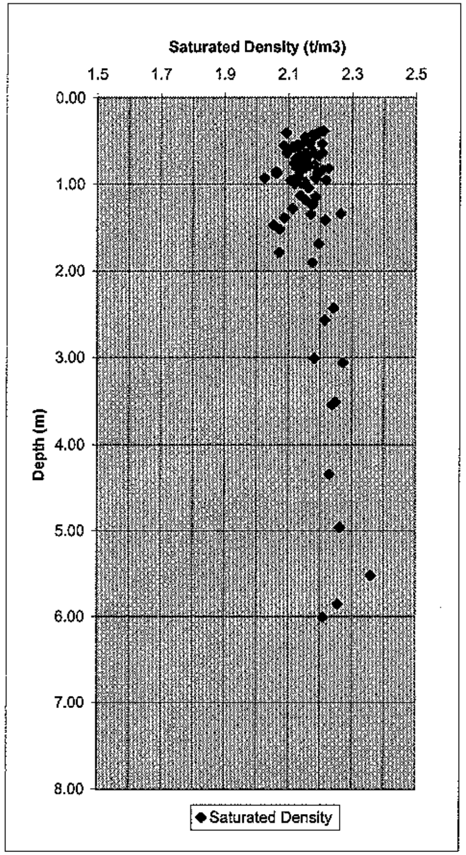
Infrastructure for industry

CLIENT:-	Queensland Rail
PROJECT:-	Queensland Rail Jilalan
PROJECT NUMBER:-	HI8802UG
LOCATION:-	BH10
FILE NAME:-	sasw16020123_1
DATE:-	15/02/2006
OPERATOR:-	Nathan Roberts









CLASSIFICATION
Fill 0.0 - 0.3m
Alluvium 0.3 - 0.7m Sandy Clay - stiff
Residual Soil 0.7 - 0.9m Clay - very stiff
Siltstone Extremely weathered 0.9 - penetration depth Very low strength Low to medium strength

Testing Notes:	Classification based on BH10 from Geotechnical Report

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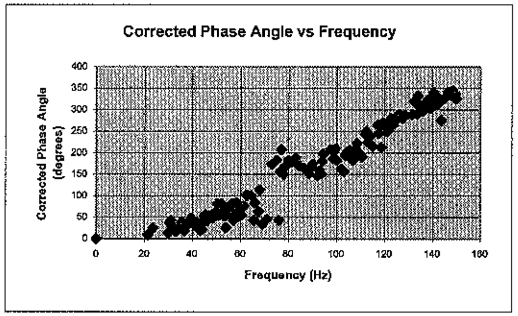
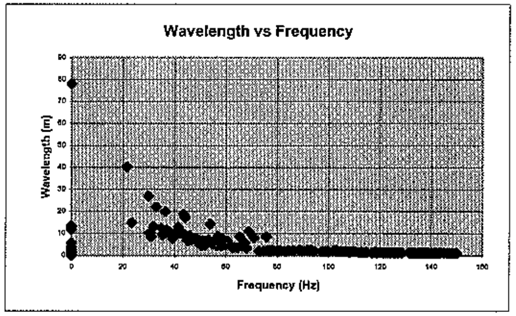
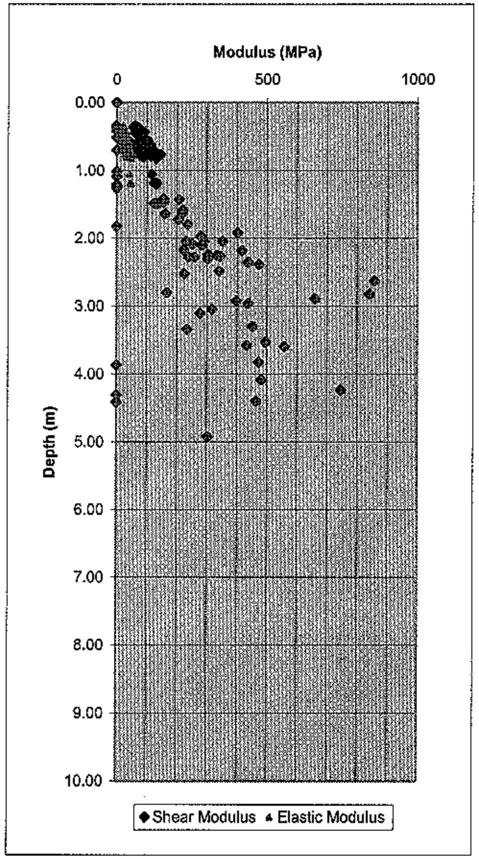
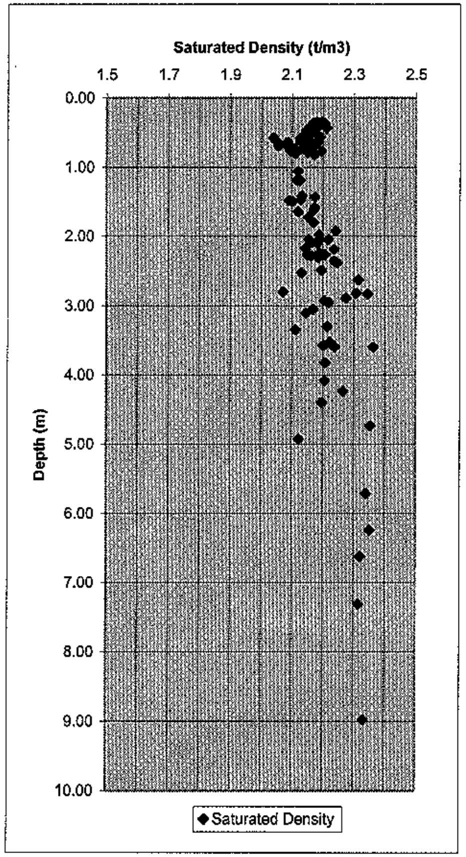
Infrastructure for Industry

CLIENT:-	Queensland Rail
PROJECT:-	Queensland Rail Jilalan
PROJECT NUMBER:-	HI8802UG
LOCATION:-	BH11
FILE NAME:-	sasw160201856_1
DATE:-	15/02/2006
OPERATOR:-	Nathan Roberts









CLASSIFICATION
Alluvium 0.0 - 0.95m Sand - Medium dense
Residual Soil - 0.95 - 1.2m Sand - Dense
Sandstone 1.2 - penetration depth Extremely weathered Very low to medium strength with depth

Testing Notes:	Classification based on BH11a from Geotechnical Report

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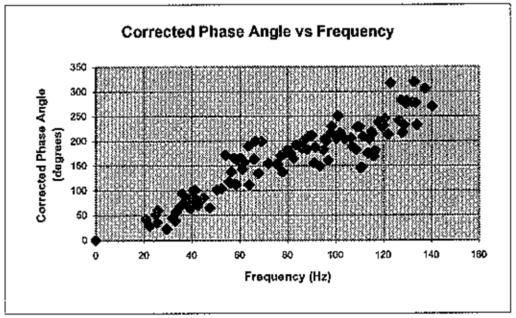
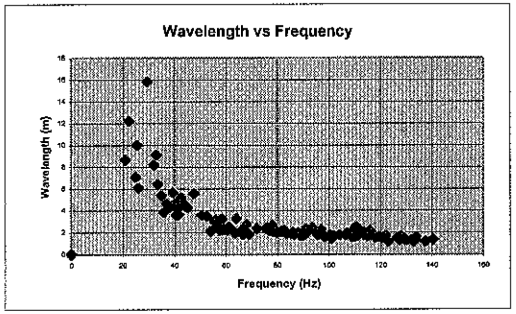
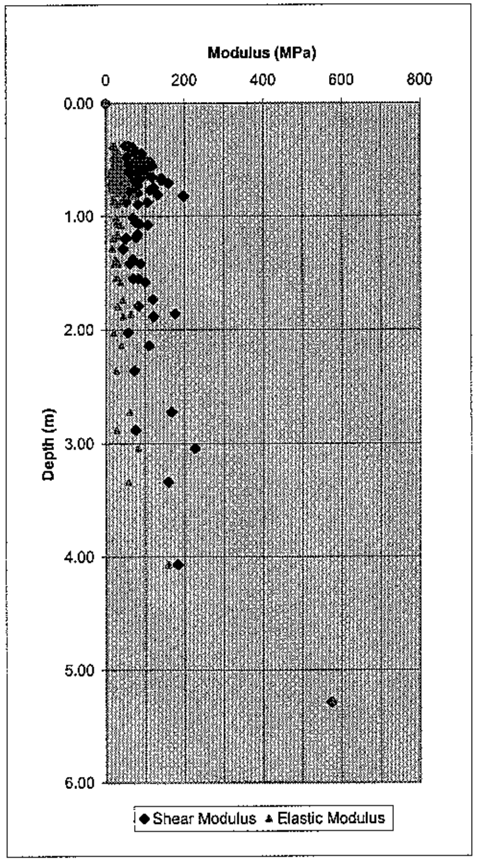
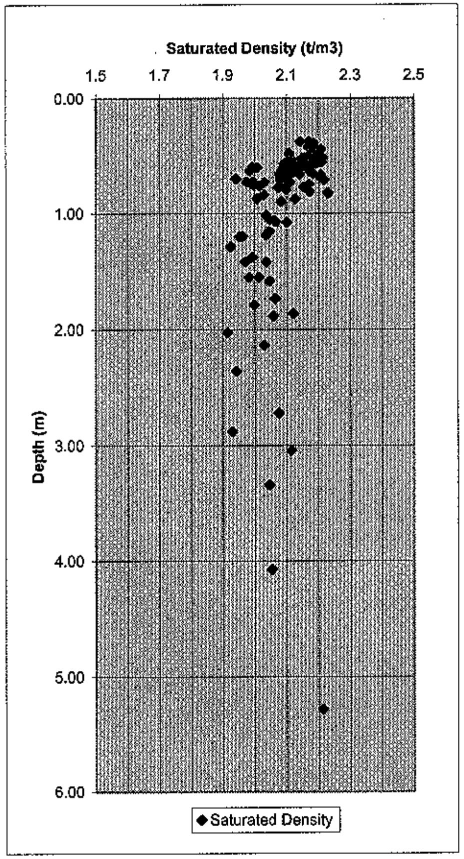
infrastructure for industry

CLIENT:-	Queensland Rail
PROJECT:-	Queensland Rail Jilalan
PROJECT NUMBER:-	HI8802UG
LOCATION:-	SASW13
FILE NAME:-	sasw160202011_1
DATE:-	16/02/2006
OPERATOR:-	Nathan Roberts


Corrected Phase Angle vs Frequency


Wavelength vs Frequency





CLASSIFICATION
Alluvium
Sandy Clay
0.0 - 6.0m

Very stiff to hard

Testing Notes:	Classification based on extrapolation between boreholes

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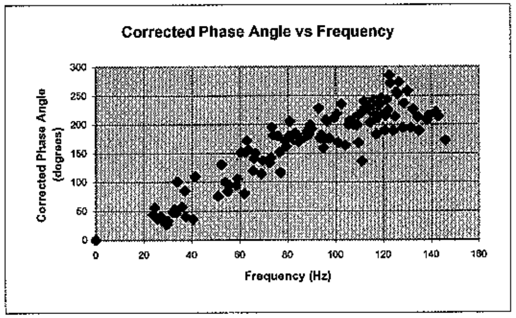
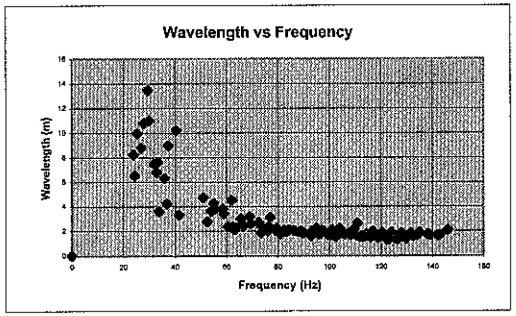
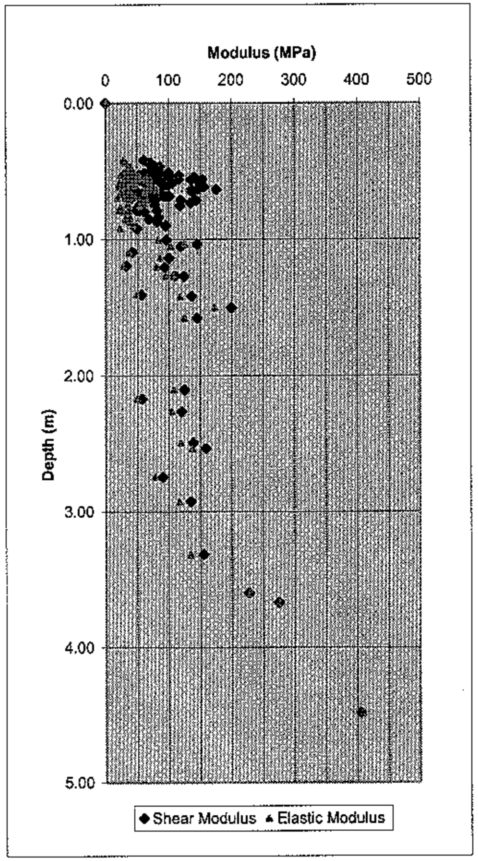
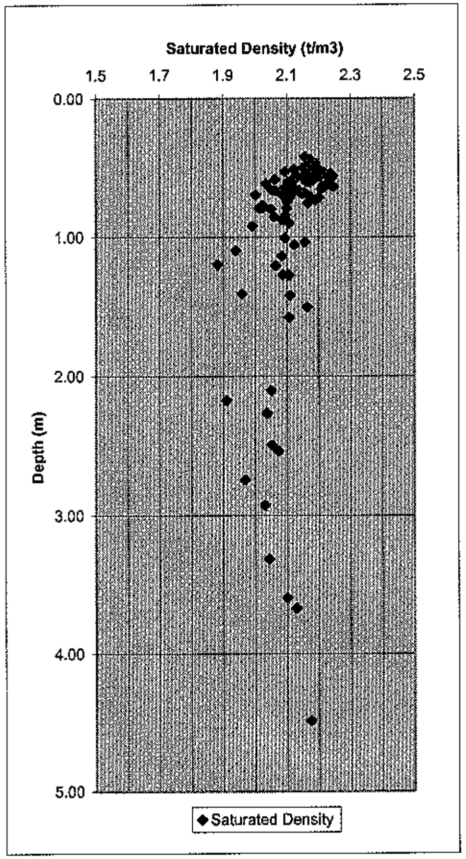
Infrastructure for Industry

CLIENT:-	Queensland Rail
PROJECT:-	Queensland Rail Jilalan
PROJECT NUMBER:-	HI8802UG
LOCATION:-	SASW14
FILE NAME:-	sasw160202047_1
DATE:-	16/02/2006
OPERATOR:-	Nathan Roberts









CLASSIFICATION
Alluvium
0.3 - 6.0m
Silty Clay - hard

Testing Notes:	Classification based on interpolation between borehole positions

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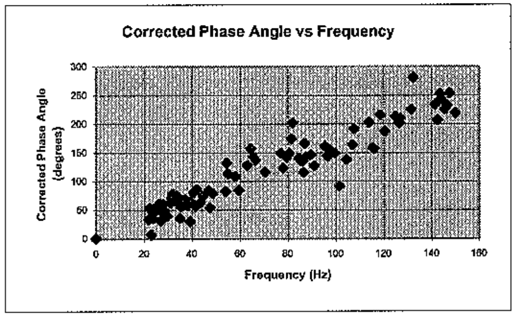
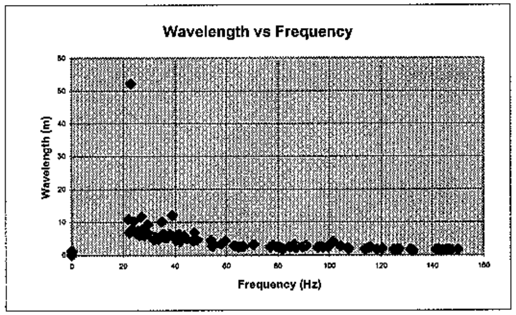
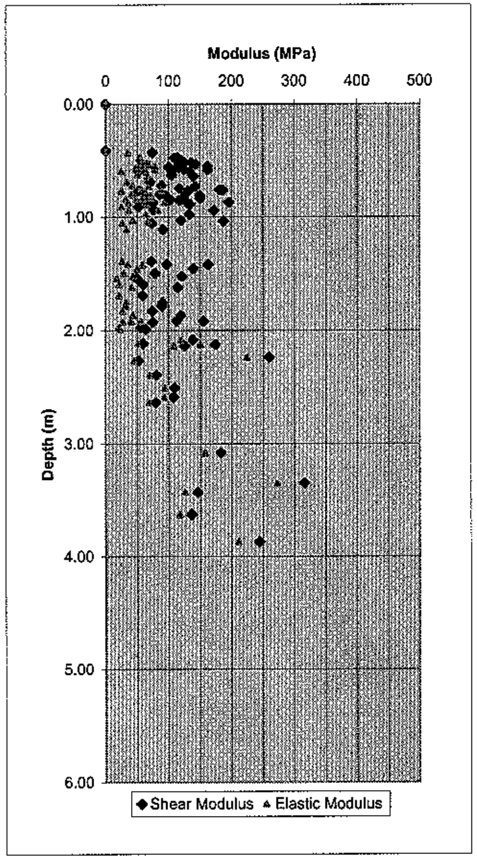
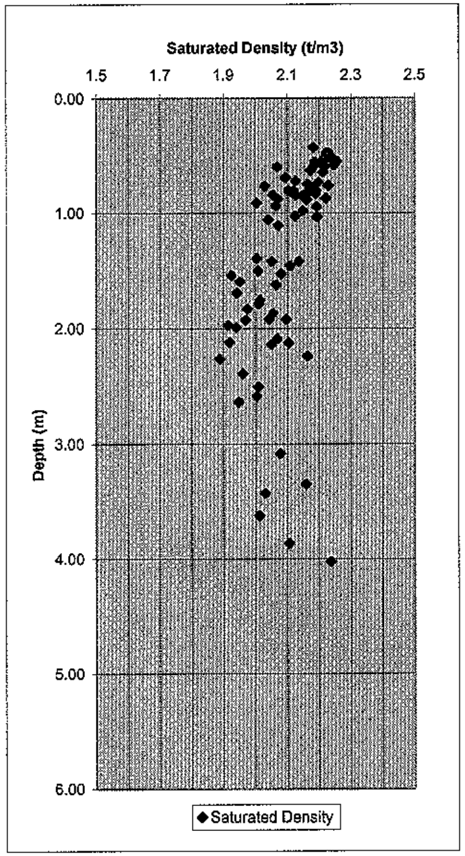
Infrastructure for Industry

CLIENT:-	Queensland Rail
PROJECT:-	Queensland Rail Jilalan
PROJECT NUMBER:-	HI8802UG
LOCATION:-	SASW15
FILE NAME:-	sasw160202109_1
DATE:-	16/02/2006
OPERATOR:-	Nathan Roberts







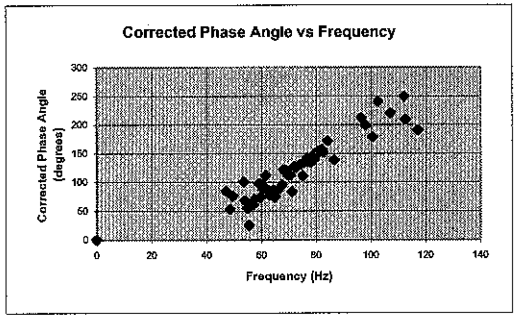


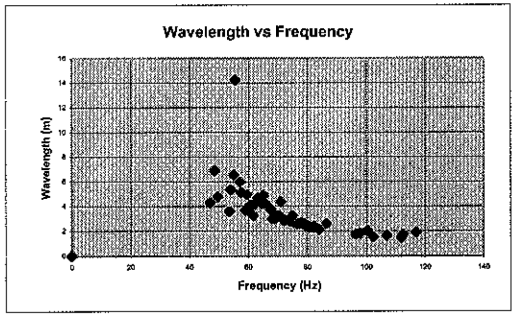
CLASSIFICATION
Fill 0.0 - 1.0m
Alluvium 1.0 - 1.5m Sandy Gravel
1.5m - penetration Meta Volcanics

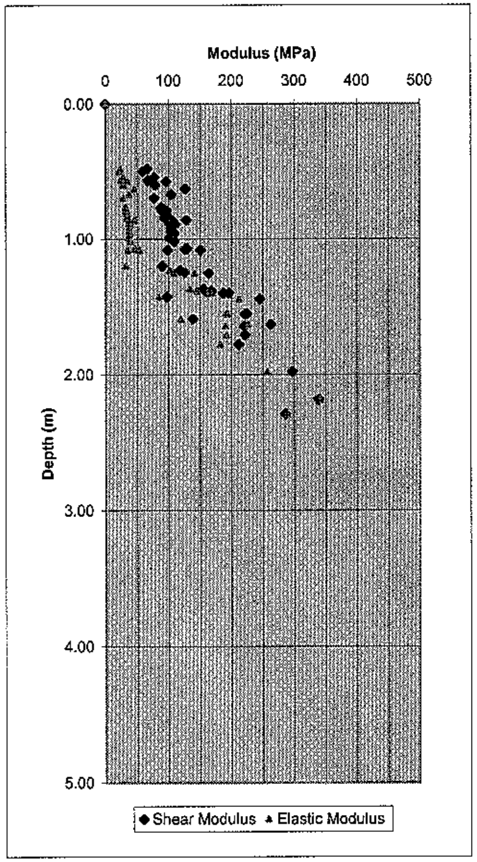
Testing Notes:	Classification based on interpolation between borehole locations

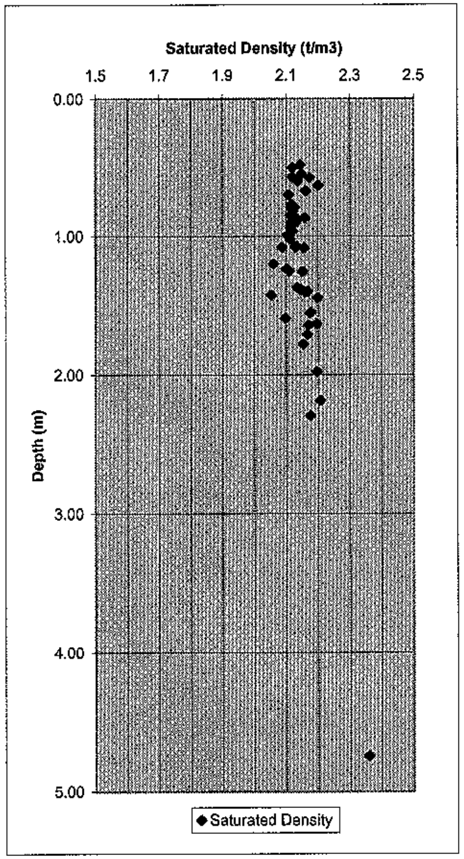
Connell HATCH
Infrastructure for industry

CLIENT:-	Queensland Rail
PROJECT:-	Queensland Rail Jilalan
PROJECT NUMBER:-	HI8802UG
LOCATION:-	SASW16
FILE NAME:-	sasw160202110_1
DATE:-	16/02/2006
OPERATOR:-	Nathan Roberts





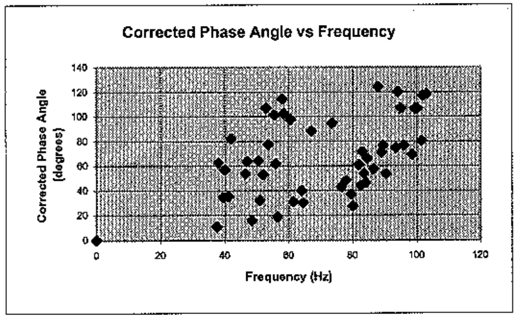


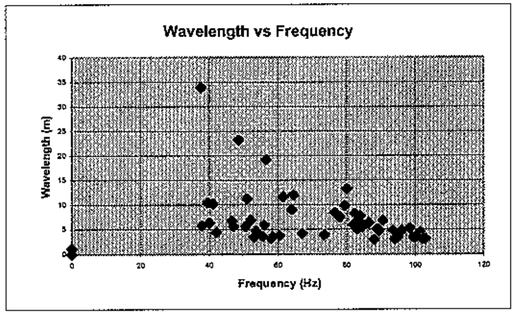


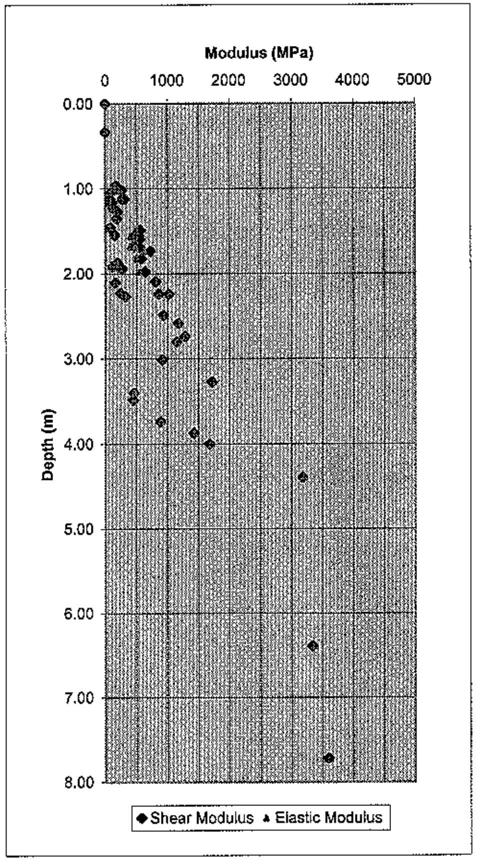
CLASSIFICATION
Alluvium 0.0 - 1.2m Sand - Medium dense
Residual Soil 1.2 - 2.0m Sandy Clay - stiff to very stiff
Metavolcanics 2.0 - penetration depth

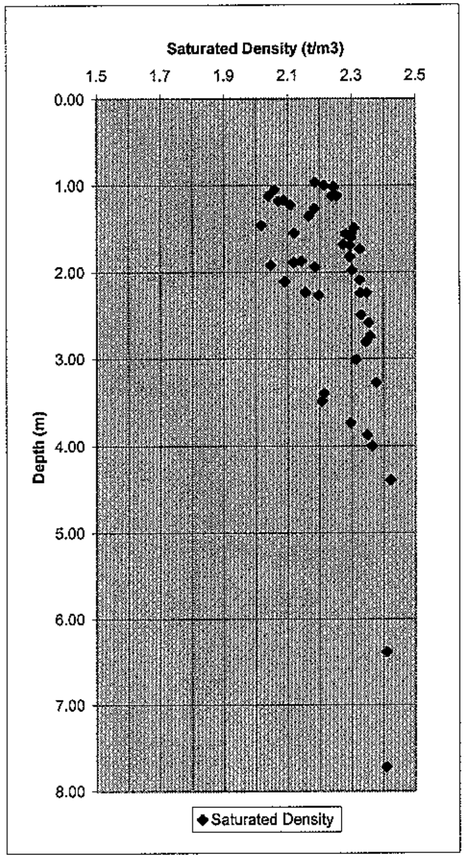
Testing Notes:	Classification based on interpolation between borehole locations

CLIENT:-	Queensland Rail
PROJECT:-	Queensland Rail Jilalan
PROJECT NUMBER:-	HI8802UG
LOCATION:-	SASW17
FILE NAME:-	sasw160202145_1
DATE:-	16/02/2006
OPERATOR:-	Nathan Roberts









CLASSIFICATION
Sandstone/Siltstone Highly weathered Very low strength 0.0 - 3.0 low to medium stength

Testing Notes:	Classification based on interpolation between borehole locations

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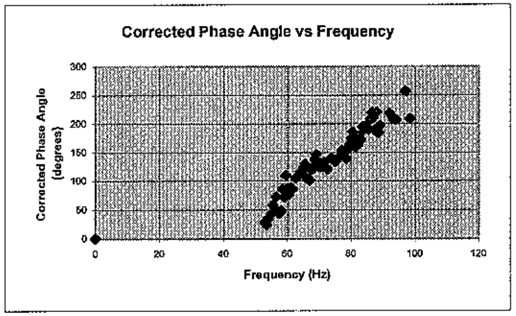
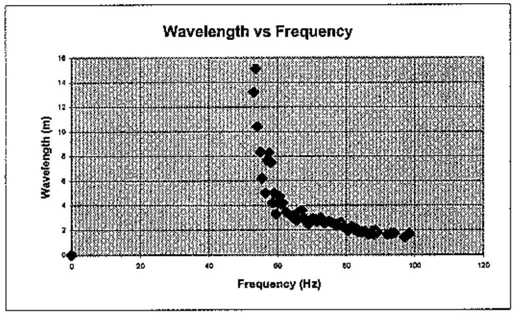
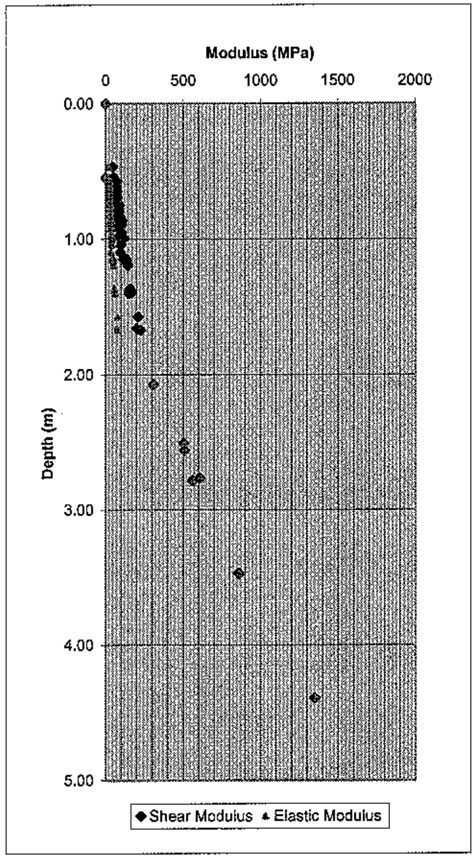
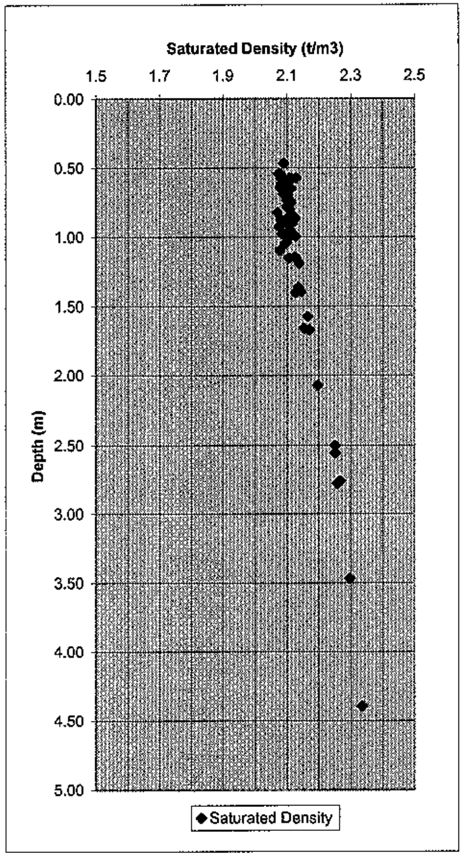
Infrastructure for Industry

CLIENT:-	Queensland Rail
PROJECT:-	Queensland Rail Jilalan
PROJECT NUMBER:-	HI8802UG
LOCATION:-	SASW18
FILE NAME:-	sasw160202203_1
DATE:-	16/02/2006
OPERATOR:-	Nathan Roberts









CLASSIFICATION
Alluvium 0.0 - 1.1m Sand Loose to medium dense
Residual Soil Clayey Sand 1.1 - 2.0m Medium dense to dense

Testing Notes:	Classification based on Interpolation between borehole locations

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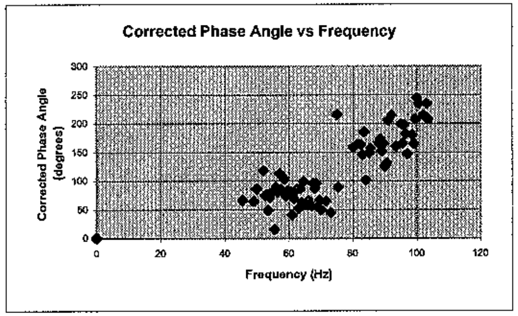
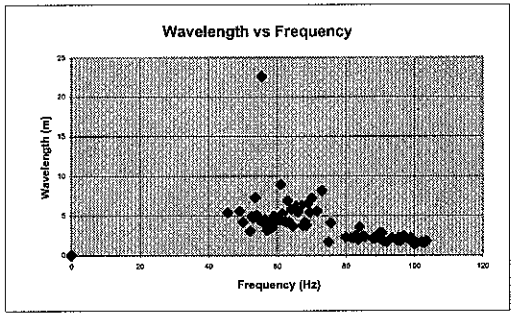
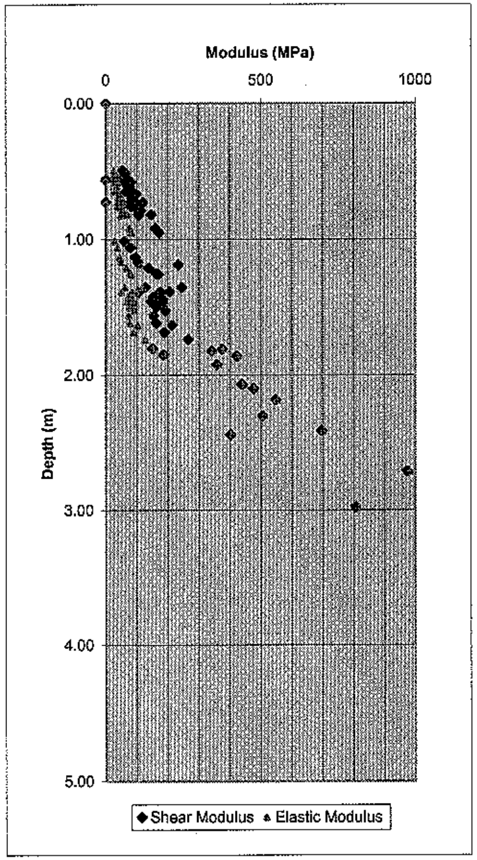
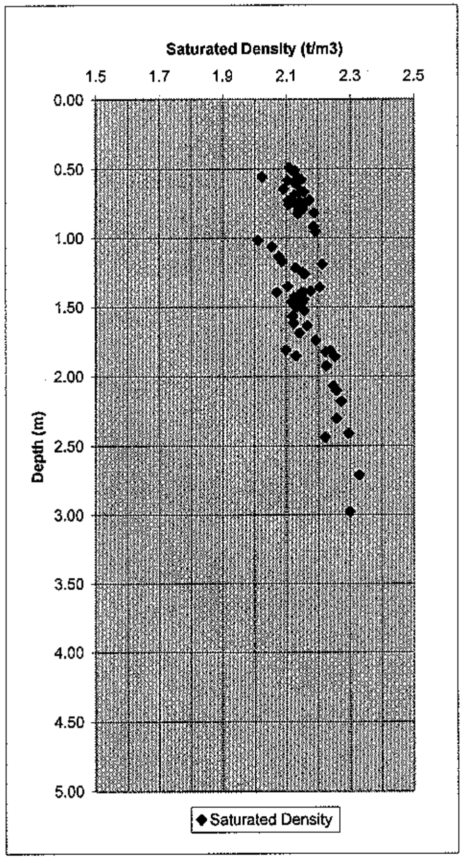
infrastructure for industry

CLIENT:-	Queensland Rail
PROJECT:-	Queensland Rail Jilalan
PROJECT NUMBER:-	HI8802UG
LOCATION:-	SASW19
FILE NAME:-	sasw160202222_1
DATE:-	16/02/2006
OPERATOR:-	Nathan Roberts









CLASSIFICATION
Alluvium 0.0 - 1.3m Silty Sand Loose to medium dense
Residual Soil 1.3 - 1.8m Silty Clay Medium dense to dense
Meta Volcanics 4.5m - penetration depth

Testing Notes:	Classification based on Interpolation between borehole locations

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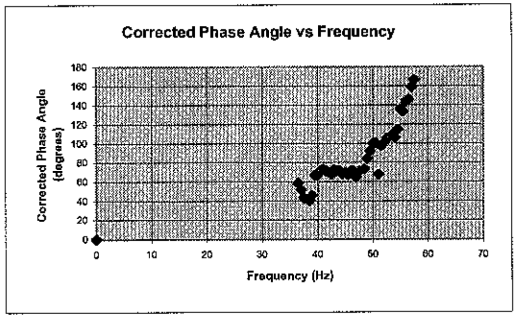
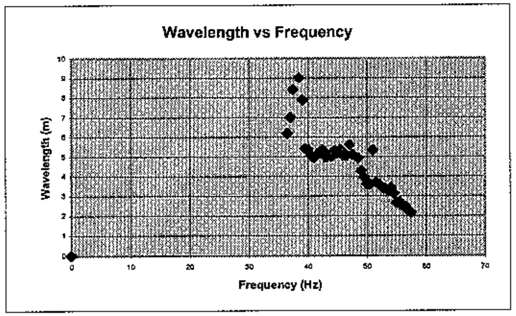
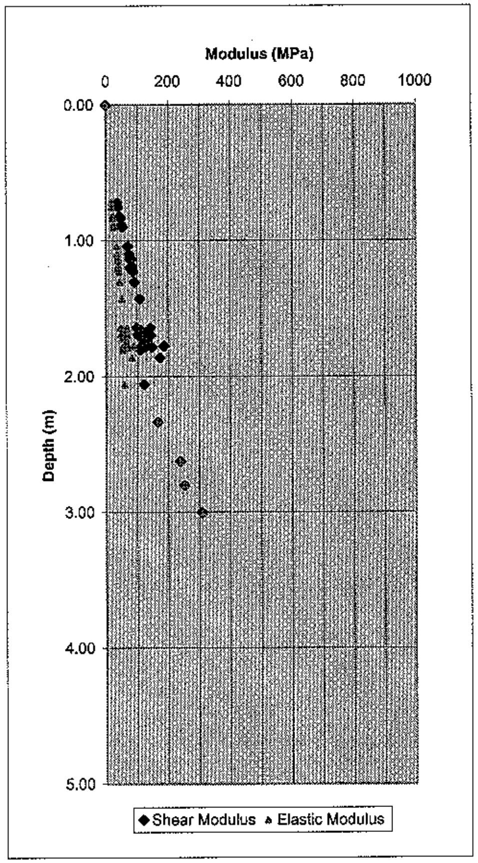
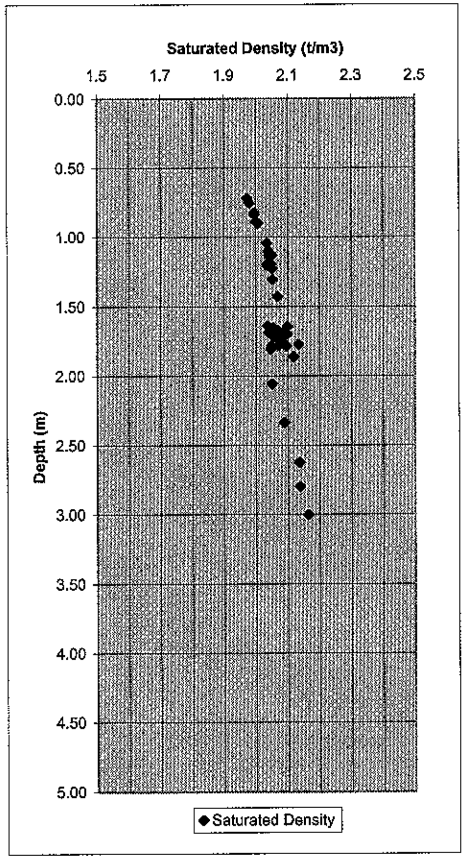
Infrastructure for Industry

CLIENT:-	Queensland Rail
PROJECT:-	Queensland Rail Jilalan
PROJECT NUMBER:-	HI8802UG
LOCATION:-	SASW20
FILE NAME:-	sasw160202244_1
DATE:-	16/02/2006
OPERATOR:-	Nathan Roberts


Corrected Phase Angle vs Frequency


Wavelength vs Frequency


Modulus (MPa)


Saturated Density (t/m3)

CLASSIFICATION
Alluvium Silty Sand 0.0 - 2.4m Loose to medium dense
Siltstone Extremely weathered 2.4 - penetration depth Extremely low to very low strength

Testing Notes:	Classification based on Interpolation between borehole locations

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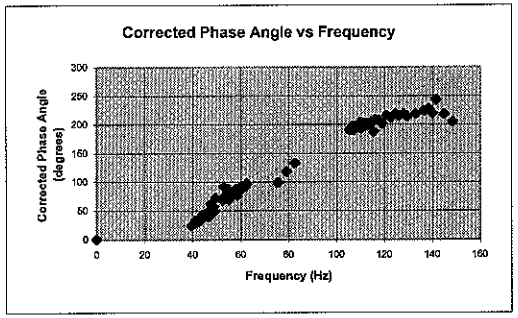
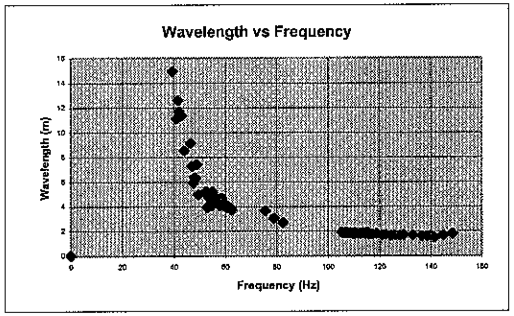
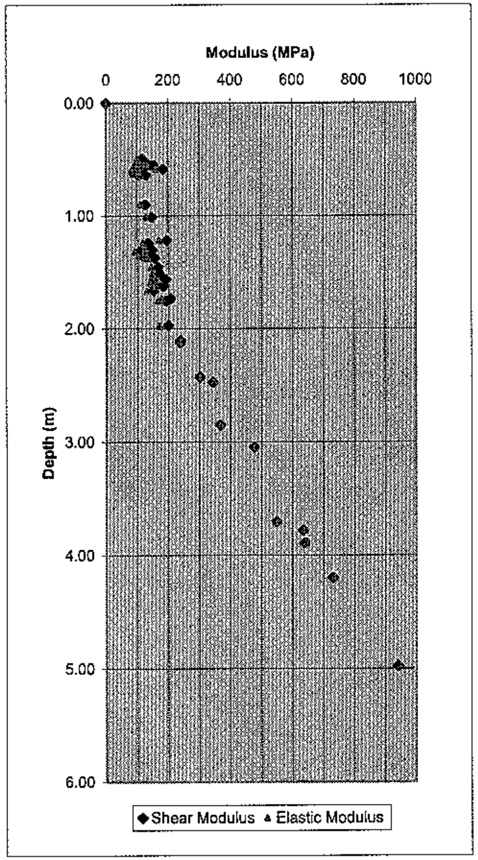
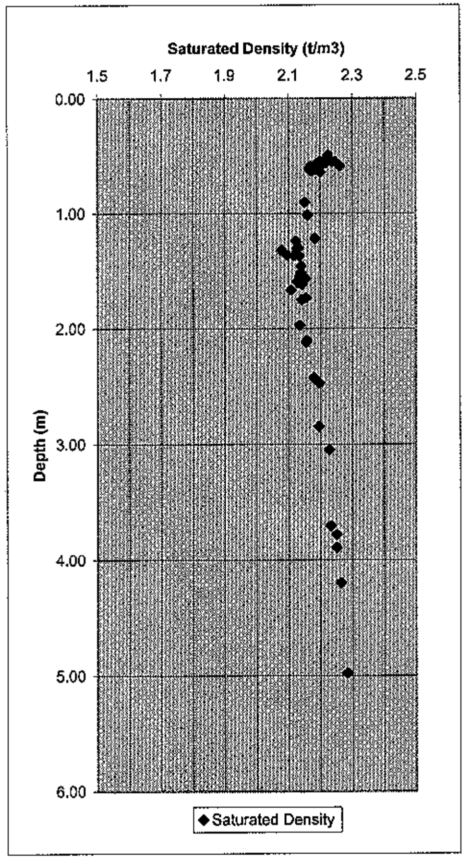
Infrastructure for Industry

CLIENT:-	Queensland Rail
PROJECT:-	Queensland Rail Jilalan
PROJECT NUMBER:-	HI8802UG
LOCATION:-	SASW21
FILE NAME:-	sasw160202314_1
DATE:-	16/02/2006
OPERATOR:-	Nathan Roberts









CLASSIFICATION
Residual Soil Sandy Clay 0.0 - 2.0m Stiff
Sandstone/Siltstone Extremely Weathered Very low strength 2.0 - penetration depth Low strength

Testing Notes:	Classification based on interpolation between borehole locations

Appendix E

Jilalan Traffic Assessment

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Jilalan
Traffic Assessment
Queensland Rail & Sarina Shire Council

21 February 2007
Reference HP03-04
Revision 4

Document Control

Connell HATCH
Infrastructure for Industry

Document ID: V:\PROJECTS\QLD_RAIL\HP0310\TRAFFIC & TRANSPORT\REPORTS\TRAFFIC ASSESSMENT REPORT (REVISION 4).DOC

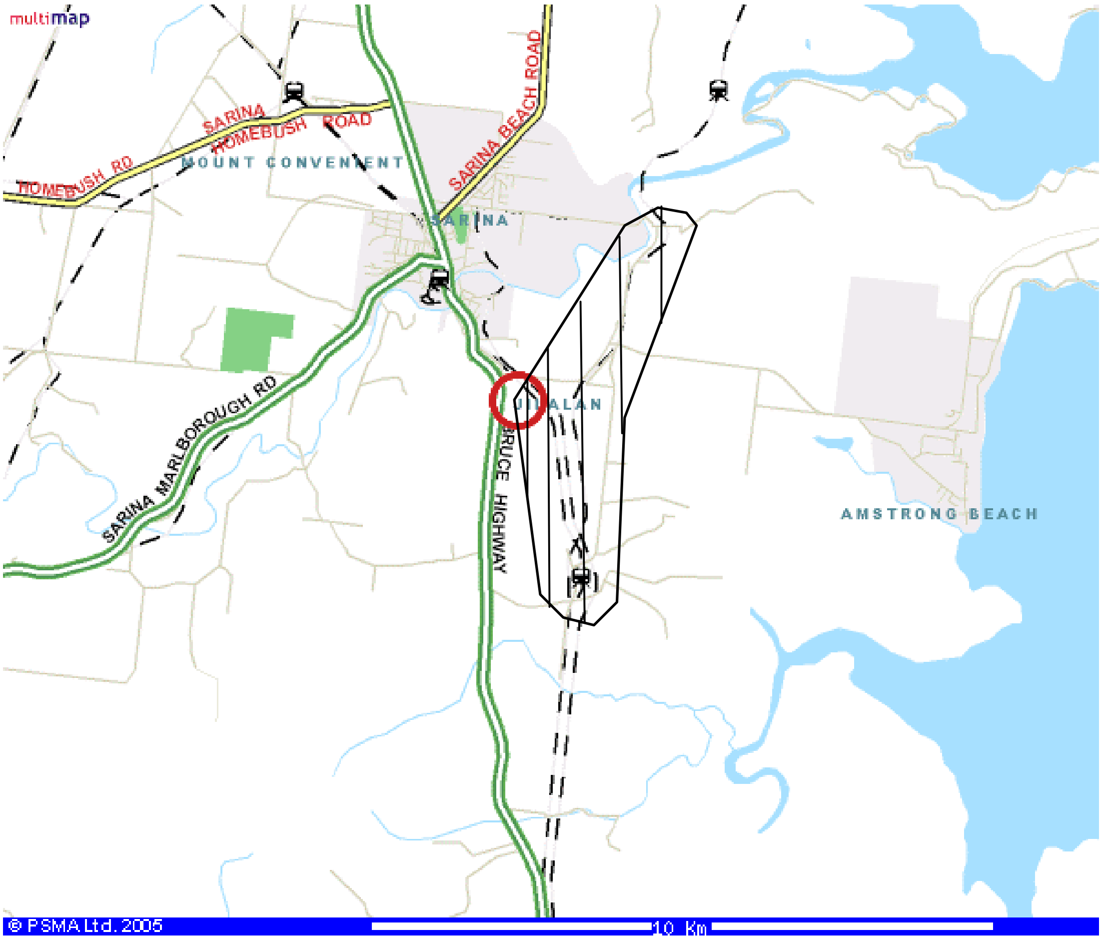
Rev No	Date	Revision Details	Typist	Author	Verifier	Approver
0	18 January 2007	Issued to Client subject to internal review	CEC	MJS	WO	
1	29 January 2007	Second Issue to Client subject to internal review	MJS	MJS	WO	
2	31 January 2007	Final Draft Issue	NJE	MJS	WO	OW
3	1 February 2007	Minor Amendments	NJE	MJS	WO	OW
4	21 February 2007	Incorporating Comments Received	NJE	MJS	WO	

Contents

1. Introduction

1.1 Introduction

This report which is being undertaken on behalf of Queensland Rail ("QR") and Sarina Shire Council assesses the implications on the local road network of the proposed upgrade and expansion of the Dalrymple Bay Coal terminal (DBCT) rail loop, Jilalan Rail Yard and By Pass Line. The location of which is shown below and in Figure 1 of Appendix A.



It has been agreed with Sarina Shire Council that a total of seventeen (17) crossings would be investigated to determine what the impact of QR's upgrade and expansion proposals would have on their operation. The crossings that have been investigated are listed in Table 1.1 and their approximate location shown in Figure 2 of Appendix A.

Table 1.1 – Level Crossing Study

ID	Km	Road Name	Type	Nearest Station
6471	0.010	-	Occupation	-
6472	0.040	-	Occupation	-
6473	0.830	-	Occupation	-
6474	1.100	-	Occupation	-
3485	6.213	Private Access Road	Occupation	Hay Point
3486	7.800	QR Maintenance Rd	QR	Dalrymple Junction
3492	17.720	Smyths Road	Public Level	Jilalan
3493	19.650	Entrance to Station	QR	Jilalan
3494	20.950		Occupation	Jilalan
3495	21.983	Access Road	Occupation	Jilalan
3496	22.530	Private Access Road	Occupation	Jilalan
954	23.530	Oonooie Road	Public Level	Oonooie
3499	27.880	The Glen Access Road	Occupation	Yukan
3500	28.840	Borgs Access Road/ QR Maintenance Rd	QR	Yukan
6688	29.191	QR Maintenance Rd	QR	Yukan
3501	31.150	Private Access Road	Occupation	Yukan
3502	32.720	Private Access Road	Occupation	Yukan
-	35.100	Farquar Road	Occupation	Yukan

However, as is outlined below, out of the seventeen (17) crossings, the biggest impact of QR's upgrade and expansion proposals will be on the Oonooie Road and Smyth Road level crossings, and on the existing road network in the vicinity of these crossings, namely the Bruce Highway, Oonooie Road, Armstrong Beach Road, Gurnetts Road and Smyths Road.

2. Scheme Proposals

2.1 Proposed QR Facilities

The works proposed to QR's facilities as part of the upgrade and expansion scheme consist of:

- The provision of up to three new bypass lines for the main rail line
- Two new provisioning lines and provisioning shed
- A Wagon maintenance facility
- Wagon storage lines

The frequency of trains passing through the area is also expected to increase from around fifty-two (52) movements per day currently, to around eighty (80) movements per day in 2010.

There are currently a total of two hundred and twelve (212) train crew members who are employed at Jilalan who operate seventy five, two crew shifts per day.

In 2010, the number of train crew members is expected to increase to approximately 263, resulting in one hundred, two crew shifts per day.

The number of staff working at the Jilalan rail yard and workshops will also increase as a result of the proposals. It is proposed to increase the number of staff working at the Jilalan Locomotive and Wagon maintenance facilities from sixty-seven (67) and twenty-nine (29) respectively, to ninety-three (93) and forty-two (42), a total increase in staff of thirty-nine (39).

In addition, there are also expected to be approximately ten (10) additional QR National/Network Access operational staff working at the QR facility.

2.2 Proposed Level Crossing Improvements

2.2.1 Smyths Road Crossing

Smyth Road provides access to the cane rail siding on the western side of the coal rail lines and is also used to access a number of farmer's fields along the road. The proposals will impact on the crossing by increasing the number of rail lines and by increasing the volume of rail traffic.

Due to the lack of alternative routes for traffic and the need for farmers to access fields either side of the rail line and the cane siding on the western side of the rail line, an underpass is proposed as part of the scheme proposals to mitigate for the impact. It is proposed to locate the underpass slightly to the north of the current level crossing as indicated in Figure 3 attached in Appendix A. However, the underpass will be further defined and developed during the subsequent design stages.

As currently occurs, the Smyth's Road crossing of Plane Creek is impassable at high tide thereby restricting vehicular movement through it. There are no plans to improve this situation as any improvements may encourage Armstrong Beach Road traffic to take this route as a short cut to Sarina.

2.2.2 Oonooie Road Crossing

Oonooie Road provides access from the Bruce Highway (located to the west of the rail line) to CSR's Fertiliser/Ethanol plant, which is located at the eastern end of Oonooie Road to the east of the rail line.

At present a number of lines operate through the crossing including the NCL and Cane rail line. All the lines operate independently but the trains travelling along them have a series of accumulative impacts on the crossing and on general road traffic. The Oonooie Road crossing is currently fitted with active protection and trains run slow through the crossing at around 15km/h due to wagon roll by inspections.

The scheme proposals will impact on the Oonooie Road crossing by increasing the number of rail lines running through the crossing and increasing the volume of rail traffic travelling along these lines. Representatives from CSR have stated that at times during peak harvesting season, the queue of traffic along Oonooie Road resulting from the temporary closure of the crossing for rail traffic to pass, sometimes stretches back from the crossing through to the nearby Bruce Highway.

The additional rail lines and the increased train frequency are only likely to add further delay to general road traffic travelling along Oonooie Road. The current situation where the crossing closes and road traffic waits for rail traffic to clear is unlikely to be acceptable in the future, particularly with the expected increase in rail traffic. As a result, two possible mitigation options have been considered:

- Provide a new overpass over the rail crossing (see Figure 4 of Appendix A)
- Close off Oonooie Road near the crossing, ie 'cul de sac' the road. Traffic would then be redirected from the Bruce Highway down Armstrong Beach Road and Gurnetts Road

The impact that these two options have on the local road network are described in Section 5 below.

2.3 Proposed Road Network Improvements

2.3.1 Armstrong Beach Road

Due to the provision of additional rail lines, the current Armstrong Beach Road bridge over the railway will need to be lengthened and re-configured as part of the scheme. Although currently only at a preliminary design stage, two options are being considered for the bridge:

- Upgrade and modify the existing bridge
- Construct a new bridge on the southern side of the existing bridge as shown in Figure 5 of Appendix A

One of the options proposed for Oonooie Road (ie its closure) will result in the redirection of traffic from Oonooie Road to Armstrong Beach Road and through to Gurnetts Road. As a result, the capability of Armstrong Beach Road to deal with the additional traffic has been examined as part of this report as detailed in Section 5 below.

Access to the rail yard and workshop is currently via Gurnetts Road which runs southwards from Armstrong Beach Road parallel to the rail line. The intersection of Armstrong Beach Road and Gurnetts Road operates under priority control with traffic travelling on Armstrong Beach Road having priority over traffic travelling along Gurnetts Road.

As part of the scheme proposals, it is proposed to re-configure the intersection of Armstrong Beach Road/Gurnetts Road and Smyth Road as shown in Figure 5 of Appendix A. A capacity assessment has also been undertaken on the proposed re-configured intersection layout, the results of which are detailed in Section 5 below.

2.3.2 Gurnetts Road

Gurnetts Road is currently an unsealed gravel road. As part of the scheme, it is proposed to seal the section of Gurnetts Road between Armstrong Beach Road and QR's new access road, which is located between Armstrong Beach Road and the CSR Fertiliser/Ethanol plant.

The option to close the Oonooie Road rail crossing to traffic will substantially increase the volume of traffic travelling along Gurnetts Road between Armstrong Beach Road and the CSR's plant. Therefore, if the option to close Oonooie Road were taken, Gurnetts Road would need to be sealed along its entire length between Armstrong Beach Road and the CSR plant.

3. Level Crossing Impact Assessment

3.1 Level Crossings Closure Times

The increased frequency of trains is likely to lead to an increase in the time when the crossings are closed. The following table 3.1 estimates the time taken for trains to travel through level crossings at a range of speeds assuming the current train frequency of fifty-two (52) trains per day in both directions, and the future proposed frequency of eighty (80) movements per day in both directions.

Table 3.1 – Crossing Closure Times

	SPEED			
	15 kph	**40 kph**	**60 kph**	**80 kph**
Time for train to Pass	8.4 min	3.2 min	2.1 min	1.6 min
Total time that crossing closed per day based on current frequency (52/day)	436.8 mins (7.3 hrs)	166.4 mins (2.8 hrs)	109.2 mins (1.8 hrs)	83.2 mins (1.4 hrs)
Total time that crossing closed per day based on current frequency (80/day)	672 mins (11.2hrs)	256 mins (4.3 hrs)	168 mins (2.8 hrs)	128 mins (2.1hrs)

NOTES:

- Based on a train length of 2.1km
- Different Speeds represent:
  - 15kph – speed through the roll through inspection
  - A range of speeds up to 80kph

The times in the above table are conservative and are considered to be extremely unlikely as they assume that all the trains travel through the crossing separately. It is more likely that some of the trains would pass through crossings at the same time, thereby reducing the total time shown in the above table.

3.2 Level Crossing Impact and Proposals

The impact of QR's proposals on the seventeen level crossings examined are shown in the following table 3.1.

Table 3.1 – Level Crossing Impact

ID	Km	Road Name	Type	Nearest Station	Impact & Proposals
6471	0.010	-	Occupation	-	QR have purchased level crossing access rights. Therefore no impact on general public
6472	0.040	-	Occupation	-	
6473	0.830	-	Occupation	-	
6474	1.100	-	Occupation	-	
3485	6.213	Private Access Road	Occupation	Hay Point	
3486	7.800	QR Maintenance Rd	QR	Dalrymple Junction	No impact on general public
3492	17.720	Smyths Road	Public Level	Jilalan	Underpass proposed. See Section 2.2
3493	19.650	Entrance to Station	QR	Jilalan	QR will purchase land in the vicinity of the crossings Therefore no impact on general public
3494	20.950		Occupation	Jilalan	
3495	21.983	Access Road	Occupation	Jilalan	
3496	22.530	Private Access Road	Occupation	Jilalan	

ID	Km	Road Name	Type	Nearest Station	Impact & Proposals
954	23.530	Oonooie Road	Public Level	Oonooie	Overpass proposed. See Section 2.2
3499	27.880	The Glen Access Road	Occupation	Yukan	Minor crossing not greatly impacted by additional rail traffic.
3500	28.840	Borgs Access Road/ QR Maintenance Rd	QR	Yukan	Crossing, which is located next to 'undersized' underpass, is locked but can be opened with 24hours notice. Therefore negligible impact
6688	29.191	QR Maintenance Rd	QR	Yukan	No impact on general public
3501	31.150	Private Access Road	Occupation	Yukan	Crossings rarely used. Therefore negligible impact
3502	32.720	Private Access Road	Occupation	Yukan	
-	35.100	Farquar Road	Occupation	Yukan	Crossings rarely used. Therefore negligible impact

In general, it is considered that the increased closure time of the occupational crossings will not impact significantly on individual property owners as the level of traffic generated by property owners is low and will not result in excessive queuing at individual crossings.

3.3 Risk Assessments

Risk assessments have previously been undertaken by QR at the following crossings using the Australian Level Crossing Assessment Model (ALCAM).

- ID 3485 - Private Access Road, Occupation crossing
- ID 3499 - The Glen Access Road, Occupation crossing
- ID 3500 - Borgs Access Road/ QR Maintenance Rd, QR crossing
- ID 3501 - Private Access Road, Occupation crossing
- ID 3502 – Private Access Road, Occupation crossing

The ALCAM assessments were undertaken assuming the current situation. Recommendations from these assessments have either been implemented or are included as part of QR's ongoing maintenance schedule.

QR have advised that the additional rail traffic is unlikely to alter the crossing configurations as it will have minimal impact on the crossing risks.

4. Road Traffic Data

4.1 Existing Road Traffic Data

Sarina Shire Council (SSC) and Queensland Department of Main Roads (DMR) were contacted to obtain traffic data for the area.

Only the following limited traffic data was readily available. Copies of the traffic data are attached as Appendix B for information.

Table 4.1 – Council Traffic Data

Road	Type	Date	Weekly Count	Daily Count	Hourly Count
Oonooie Road	Classified vehicle count	Sept 2003	✓		
Oonooie Road	Classified speed count	July 1999	✓		
Armstrong Beach Road	Vehicle and classified speed count	June/July 2004	✓	✓	✓
Smyth Road	Classified speed count	Nov 2000	✓		
Gurnetts Road	Classified speed count	April 1999	✓		
Bruce Highway	AADT Count Information	2005	✓		

NOTES:

- None of the counts are split up into direction of travel
- The count location on Oonooie Road was 285m east of the Bruce Highway
- The count location on Armstrong Beach Road was 3.512 Km east of the Bruce Highway
- The count location on Smyth Road was on the bitumen section at the south end

In addition to the above traffic information, Connell Hatch commissioned the following classified turning movement count at the intersection of Bruce Highway/Armstrong Beach Road in November 2006. Copies of the traffic data are also attached as Appendix B for information.

Table 4.2 – Commissioned Traffic Data

Road	Type	Date	Weekly Count	Daily Count	Hourly Count
Bruce Highway/ Armstrong Beach Rd	Classified turning movement count	30 Nov 2006			✓

4.2 Future Road Traffic Flows

Council have advised that there are plans to build a housing development to the east of Jilalan along Armstrong Beach Road. Apart from this development, Council advises that there are no other developments planned in the area.

Information obtained from Council related to population projections to be adopted for planning purposes suggest that the local population is expected to grow by 2% p.a. in Sarina, 3% in Northern Beach Centres, and 5%p.a. in Armstrong Beach.

From the count information available, the following traffic numbers shown in table 4.3 have been deduced. In order to provide a consistent year, the traffic flows have been growthed up to the schemes potential opening year 2008 using a growth factor of 5% per annum. However, CSR traffic flows have been assumed not to grow at a constant rate of 5% per annum but have been assumed to double by 2008. See Section 4.2.2 below.

Using a growth factor of 5% per annum is considered to represent a worst case scenario and provide a robust assessment as DMR have indicated that the current growth rate on the Bruce Highway is only around 2% per annum. However, a growth rate of 5% per annum is in line with the future population growth of Armstrong Beach as indicated above. It is also acknowledged that the traffic counts used are not current and that the use of a growth factor of 5% will provide for a conservative estimate of traffic growth in the area over the last few years.

Furthermore, to take account of the fact that the Bruce Highway/Armstrong Beach Road traffic survey was undertaken in November 2006 and not in the main harvesting season, to provide for a robust assessment, the December surveyed traffic figures have been increased by 10%.

Table 4.3 – Observed Traffic Flows

Road	Count Date	Daily Traffic Flows (Recorded)	% CV
Oonooie Road	Sept 2003	292	77.4
Armstrong Beach Road	June/July 2004	924	4.0
Smyth Road	Nov 2000	39*	21.9
Gurnetts Road	April 1999	315*	6.4
Bruce Highway	2005	3513	24.4
Bruce Highway (N) ^{T}	30 Nov 2006	420 (AM peak) 439 (PM Peak)	18.3 12.8
Armstrong Beach Road (E)^T	“	151 (AM peak) 177 (PM Peak)	3.3 6.8
Bruce Highway (S)^T	“	277 (AM peak) 286 (PM Peak)	26.0 17.5

NOTES:
All flows are 2-Way
* Only weekly traffic flows were available for Smyth Road and Gurnetts Road. To obtain daily traffic flows the weekly traffic flows were divided by 7.
^{T} Peak hour classified count – AM Peak = 08:00 – 09:00, PM Peak = 15:15-16:15

The turning count undertaken at the Bruce Highway/Armstrong Beach Road intersection also counted the number of B-Doubles travelling through the intersection. During the AM peak period there were 17 B-Doubles travelling along the Bruce Highway (2.5% of the total Bruce Highway traffic) and 11 (2.5%) during the PM peak period. No B-Doubles were observed travelling along Armstrong Beach Road during the survey.

Traffic flow diagrams showing the observed traffic flows, factored up to 2008 and 2018 can be seen in Figures 1, 2, and 3 and 4 of Appendix C.

4.2.1 QR Road Traffic Flows

As part of the scheme, it is proposed to increase the number of staff working at the Jilalan Locomotive and Wagon maintenance facilities from the existing staff numbers of sixty-seven (67) and twenty-nine (29) respectively, to ninety-three (93) and forty-two (42), a total increase in staff of thirty-nine (39).

For assessment purposes, it has been assumed that each new member of staff travels independently to and from work thereby increasing the traffic flow generated by the Locomotive and Wagon maintenance facilities by seventy-eight (78) movements (thirty-nine (39) arrivals and thirty-nine (39) departures) per day.

In addition, there will also be approximately ten (10) additional QR National/Network Access operational staff working eight (8) hour shifts. The busiest time would be at the start and finish of the day shift when staff are arriving and leaving, which is between approximately 7 to 8 am and 3 to 4 pm.

For assessment purposes it has been assumed that all the additional trips to the Locomotive and Wagon maintenance facilities, together with the additional QR National/Network Access operational staff arrive during the AM peak period, and depart during the PM peak period.

Furthermore, there are currently a total of two hundred and twelve (212) train crew who are employed at Jilalan which results in 75 two crew shifts per day. Each shift signs on approximately 40 mins apart resulting in 2 crew changes every 40 mins which results in approximately 4 crew members arriving and 4 crew members departing Jilalan every 40 mins.

In 2010, the number of crew members is expected to increase to approximately 263 resulting in 100 two crew shifts per day who sign on approximately 25 minutes apart. This will result in approximately 4 crew members arriving and 4 crew members departing Jilalan every 25 minutes, which equates to 8 crew members arriving and 8 crew members departing every hour. (For assessment purposes, to provide for a robust assessment it has been assumed that the increase in crew numbers occurs by 2008).

There will also be delivery vehicles servicing the depot such as sand, water etc. No figures are available for these movements, however, for the purpose of this assessment it has been assumed that there would be a total of 20 deliveries per day and that 5 arrivals and 5 departures would occur during the peak hours.

The trips have then been assigned to the local road network in proportion to the observed traffic flows on Armstrong Beach Road.

The resultant traffic flows are detailed in Figure 5 of Appendix C.

4.2.2 CSR Road Traffic Flows

At a meeting held at Sarina Shire Council offices on 14 November 2006, CSR's representatives indicated that there are currently around forty-two thousand (42,000) vehicles travelling down Oonooie Road to their Fertiliser/Ethanol plant a year and that around 84% of these travel to and from the north. Of these vehicles, around 30% are B-Doubles.

CSR traffic currently operates between 4:00 am and 8:00 pm six days a week with reduced numbers on a Sunday. Truck and Dog, B-Doubles, together with tandem and tri-axle semi tankers are currently used.

Traffic travelling to the Fertiliser/Ethanol plant generally travel along Oonooie Road to get to and from the plant. However, due to the delay experienced at the Oonooie Rail crossing, at times some of the traffic uses Armstrong Beach Road and Gurnetts Road as an alternative route.

Although not yet committed, CSR indicate that by 2008 they are likely to expand the Fertiliser/Ethanol plant thereby increasing the number of vehicles travelling to and from the plant to over eighty thousand (80,000) per year, nearly doubling the capacity.

To provide for a robust assessment of expected increases in CSR traffic due to planned future expansions, it has been assumed that all the traffic observed travelling along Oonooie Road and 50% of the traffic observed travelling along Gurnetts Road is generated by the CSR plant. The estimated CSR traffic flows have then been doubled to take account of the expansion.

The resultant traffic flows for 2008 and 2018 with the addition of QR traffic and the doubling of CSR traffic are shown in Figures 7 and 8 of Appendix C.

4.2.3 Road Traffic Flows with the Closure of Oonooie Road

As detailed in Section 2.2 above, one of the options being considered for the scheme is to close Oonooie Road at its crossing with the rail line. This would result in the traffic that currently travels along Oonooie Road diverting to Armstrong Beach Road and Gurnetts Road to reach the CSR's Fertiliser/Ethanol plant.

The resultant traffic flows assuming that all the traffic currently travelling along Oonooie Road diverts to Armstrong Beach Road and Gurnetts Road are shown in Figures 10 and 11. Although this is unlikely, assuming this assignment will provide a worst case scenario for the traffic analysis detailed in the following Section 5.

5. Road Impact Assessment

5.1 Introduction

As detailed above, two options are being considered along Oonooie Road:

- Provide an overpass over the Oonooie Road rail crossing; or
- To close Oonooie Road near the crossing.

5.2 Oonooie Road Overpass

5.2.1 Oonooie Road

If the overpass option was to be chosen, the overpass would be built further to the south than the current crossing as shown in Figure 4 of Appendix A. The new location is necessary to provide the minimum span to cross all rail lines (ie Coal, NCL and Cane Rail). The cane line that runs parallel to the NCL will be incorporated into the overpass arrangement and therefore will be grade separated. However, the cane line is crossed again by the realigned Oonooie Road, between the overpass and Gurnett's Road. This crossing will be at grade.

The volume of traffic travelling along Oonooie Road in this option would be unaffected by the QR proposals. This said, the level of traffic along Oonooie Road may increase with the building of an overpass as CSR traffic that currently uses Armstrong Beach Road and Gurmett's Road as a result of the delays suffered currently at Oonooie Road (See Section 4.2.2 above) may revert back to Oonooie Road. The expansion of CSR's Fertiliser/Ethonal plant in the future will also increase the volume of traffic.

However, the potential increase in traffic along Oonooie Road in the future is as a result of CSR's expansion activities and not as a result of QR's scheme. Therefore the provision of additional infrastructure to support CSR's expansion would be borne by others.

This said, even with the doubling of the current level of traffic along Oonooie Road to five hundred and eighty-four (584) vehicles per day and the addition of CSR traffic that is currently estimated to travel down Armstrong Beach Road and Gurnetts Road (estimated to be three hundred and sixteen (316) per day after expansion – See Figure 6) which results in nine hundred (900) vehicles per day or fifty-six (56) per hour, only one (1) lane in each direction would be required along the road and over the overpass.

It is possible that the provision of an overpass may attract Armstrong Beach traffic which would otherwise have elected to use the Bruce Highway/Armstrong Beach Road intersection. While this is not a desirable outcome it is expected that this trend will be minimised by leaving the major portion of Gurnetts Road unsealed.

5.2.2 Bruce Highway

The volume of traffic travelling along the Bruce Highway in this option would be unaffected by the QR proposals. This said, as with Oonooie Road, the level of traffic along Bruce Highway between Armstrong Beach Road and Oonooie Road may increase with the building of an overpass as CSR traffic that currently uses Armstrong Beach Road and Gurmetts Road as a result of the delays suffered currently at Oonooie Road may revert back to Oonooie Road. The expansion of CSR's Fertiliser/Ethanol plant in the future will also increase the volume of traffic along the Bruce Highway.

However, as above, the potential increase in traffic is a result of CSR's activities and not as a result of QR's scheme.

5.2.3 Armstrong Beach Road

The provision of an overpass on Oonooie Road is only likely to decrease the volume of traffic along Armstrong Beach Road for the reasons given above.

The traffic flows likely to be generated by the expansion to QR's activities are reasonably low, estimated to result in an additional two hundred and thirty four (234) trips per day, or seventy (70) trips during the peak hour, which will have a negligible impact on the road. Therefore no improvements to Armstrong Beach Road would be required as a result of the QR scheme.

5.2.4 Gurnetts Road

As with Armstrong Beach Road, the provision of an overpass on Oonooie Road will potentially only decrease the volume of traffic travelling along Gurnetts Road.

Again, the traffic flows likely to be generated by the expansion to QR's activities are reasonably low and will have a negligible impact on the road. However, as part of this scheme it is proposed to seal the section of Gurnetts Road between Armstrong Beach Road and QR's new access road while leaving the remaining section of Gurnetts Road unsealed.

5.3 Closure of Oonooie Road

As described above, the closure of Oonooie Road will result in traffic that currently travels along Oonooie Road diverting elsewhere.

For the purpose of this study, it has been assumed that all the traffic currently travelling along Oonooie Road would divert to Armstrong Beach Road and Gurnetts Road and also through the intersections of the Bruce Highway/Armstrong Beach Road and Armstrong Beach Road/Gurnetts Road.

The following describes the impact of the closure of Oonooie Road on the Bruce Highway, Armstrong Beach Road, and Gurnetts Road and also on the intersections of Bruce Highway/ Armstrong Beach Road and Armstrong Beach Road/ Gurnetts Road.

The operation of the intersections have been evaluated against the following criteria during the 2008 and 2018 peak periods assuming the closure of Oonooie Road:

- Degree of saturation ("DOS");
- Level of Service ("LOS"); and
- Queue length.

Degree of Saturation is an important parameter used as a target (maximum acceptable) degree of saturation for intersections. An unsignalised controlled intersection is normally said to have reached its 'Practical Capacity' when the Degree of Saturation reaches 0.8.

Austroads Part 2 – Roadway Capacity, defines the Level of Service 'as a qualitative measure describing the operational conditions within a traffic stream, and their perception by motorists and/ or passengers' in terms of 'factors such as speed and travel time, freedom to manoeuvre, traffic interruptions, comfort and convenience and safety'.

In general, there are six levels of service, ranging from A to F, with level of service A representing best operating conditions (ie free flow) and level of service F, the worst (ie forced or break-down flow). It is generally considered that a level of service of "D" represents the lower bound of acceptable intersection performance.

5.3.1 Bruce Highway

CSR indicate that around 84% of the traffic travelling to CSR's Fertiliser/Ethanol Plant travel to and from the north. The closure of Oonooie Road will therefore result in a reduction in the volume of traffic travelling along the stretch of the Bruce Highway between Armstrong Beach Road and Oonooie Road as the traffic redirects to Armstrong Beach Road. This will result in reduced flows passing through the Bruce Highway/Oonooie Road intersection.

However, the closure of Oonooie Road will result in the reassignment of turning movements at the Bruce Highway/Armstrong Road intersection. As a result, a capacity assessment has been undertaken at the intersection using the SIDRA computer software during the AM and PM peak periods. In line with normal procedure, the intersection has been assessed for a design year, ten (10) years after the opening, in this case 2018.

The results of the SIDRA assessment (attached in Appendix D) show that the existing Bruce Highway/Armstrong Beach Road intersection is expected to operate below its practical capacity in 2008 with a maximum DOS of 0.382 and LOS of C. However, in 2018 the existing intersection is expected to operate at above its practical capacity with a maximum DOS and LOS (on the Armstrong Beach Road during the AM peak period) of 0.977 and F and a queue length of over 100 on Armstrong Beach Road.

Therefore if this level of traffic was to materialise, signalisation of the intersection would be required in the future. Furthermore, a review of the intersection's alignment shows that the visibility and stopping sight distance at the intersection is not ideal and is below the recommended standards. This could create safety concerns, especially if frequently used by heavy vehicles. Significant modifications would be required to the intersection to provide for the required sight distances.

The capacity of the Bruce Highway/Oonooie Road intersection has not been assessed as part of this study. This is because the closure of Oonooie Road would improve the operational performance of the intersection as less traffic would be travelling through the intersection.

5.3.2 Armstrong Beach Road

As stated above, the closure of Oonooie Road will increase the volume of traffic travelling along Armstrong Beach Road. This said, even with the increase in traffic predicted in 2018 to 2566 vehicles per day as shown in Figure 11, or four hundred and twenty seven (427) vehicles per hour (two-way), only one (1) lane in each direction would be required along the road.

However, Armstrong Beach Road is not currently a designated B Double Route although as detailed in Section 4.2.2 above, at times vehicles travelling to and from the CSR Fertiliser/Ethanol Plant do currently use Armstrong Beach Road.

Therefore, for this option to be suitable, an application will need to be made to Queensland Transport for use of the road by B-Doubles. However, we understand that a previous application for use of Armstrong Beach Road by B-Doubles has in the past been made but that this was rejected on the grounds of safety at the Bruce Highway/ Armstrong Beach Road intersection.

The closure of Oonooie Road will also result in increased traffic movements through the Armstrong Beach Road/Gurnetts Road intersection. As a result, a capacity assessment has been undertaken at the intersection using the SIDRA computer software during the AM and PM peak periods for the schemes design year 2018.

As part of the scheme it is proposed to re-configure the intersection either by providing a cross road intersection as shown in Figure 5 of Appendix A, or by providing a 'left-right' stagger arrangement with traffic travelling along Armstrong Beach Road having priority over traffic travelling from Gurnetts Road and Smyth Road.

The results of the SIDRA assessment (attached in Appendix D) show that the proposed Armstrong Beach Road/Gurnetts Road/Smyth Road intersection is expected to operate at below its required capacity (ie with a Degree of Saturation of less than 0.9) during both the AM and PM peak periods in 2018 with a Maximum DOS of 0.351 during the AM peak period.

5.3.3 Gurnetts Road

As stated above, if Oonooie Road is closed, the volume of traffic travelling along Gurnetts Road will increase. Based on the traffic figures shown in Figure 11, one thousand, two hundred and ninety one (1,291) vehicles per day or one hundred and forty seven (147) vehicles per hour (two-way) are expected to travel along the road in 2018. This would still only require one (1) lane in each direction to be provided although the road would need to be surfaced.

6. Summary and Conclusions

6.1 Summary

Queensland Rail propose to upgrade and expand their existing Jilalan Rail Yard and introduce additional bypass rail lines through the yard.

The proposals will impact on the operational performance of a number of rail level crossings in the area thereby potentially adding further delay to road traffic. The two (2) level crossings covered in this report include those at Oonooie Road and Smyth Road. A number of 'other' level crossings in the area that may be impacted by the scheme proposals have been the subject of a QR ALCAM risk assessment study.

The study proposes a number of measures as described below to mitigate for the impact of QR's proposals. The report does not propose measures to mitigate for the additional traffic that will be generated by CSR's proposal to expand their operation as these will be covered by others. This said, the measures proposed and summarised below, will generally cater for the additional traffic likely to be generated by CSR's expansion plans.

In terms of the Oonooie Road crossing, two (2) possible mitigation measures have been considered, namely:

- The provision of a new overpass over the rail crossing; or
- The closure of Oonooie Road which would result in traffic diverting along Armstrong Beach Road and Gurnetts Road.

6.2 Oonooie Road

6.2.1 Option 1 - Overpass

The traffic analysis undertaken shows that an overpass with one lane in each direction would be sufficient to adequately provide for future traffic requirements along Oonooie Road, even with the additional traffic likely to be generated by CSR's proposed expansion.

The additional traffic generated as a result of the increase in the number of staff working at the Jilalan Locomotive and Wagon maintenance facilities is negligible and has no discernible impact on the existing road network.

Therefore no further road upgrades would be required as a result of the provision of the overpass.

6.2.2 Option 2 - Closing Oonooie Road

The closure of Oonooie Road would divert traffic along Armstrong Beach Road and Gurnetts Road. The increased volume of traffic that would result from the diversion is unlikely to impact significantly on the capacity of the nearby road network and intersections even with the additional traffic likely to be generated by CSR's planned expansion. Although Gurnetts Road which currently has a gravel surfacing, would require sealing.

However, the diversion of heavy goods vehicles through the Bruce Highway/Armstrong Road intersection, which has inadequate visibility and stopping sight distance, would create safety concerns and would require significant improvement works to be implemented. In addition, it is likely that the intersection would require signalisation by 2018 with the additional traffic generated by the closure of Oonooie Road.

Furthermore, Armstrong Beach Road is not currently a B-Double route, and the diversion of B-Double traffic along the road may require reclassification of this route.

Therefore, of the two options it is considered that the provision of an overpass over the NCL, coal rail lines and cane rail would be the most appropriate outcome. This should be confirmed by QR and SSC.

6.3 Armstrong Beach Road

As part of the scheme proposals, the existing bridge over the rail lines on Armstrong Beach Road will need to be upgraded and a new and improved layout is required at the intersection of Armstrong Beach Road/Gurnetts Road/Smyth Road. Predicted traffic figures indicate that one (1) lane in each direction will be sufficient along Armstrong Beach Road and over the modified bridge and that a simple priority controlled intersection (ie not signalised) at Armstrong Beach Road/ Smyth Road/Gurnetts Road would be sufficient to cope with the expected level of traffic.

6.4 Smyth Road

In terms of the Smyth Road crossing, QR propose to provide an underpass under the rail lines in the vicinity of the existing crossing, thereby improving the current situation for vehicles.

6.5 Gurnetts Road

With the provision of an overpass on Oonooie Road, the additional traffic generated as a result of the increase in the number of staff working at the Jilalan Locomotive and Wagon maintenance facilities is negligible and has no discernible impact on Gurnetts Road. However, as part of the scheme it is still proposed to seal Gurnetts Road between Armstrong Beach Road and QR’s new access road.

With the additional traffic likely to use Gurnetts Road as a result of the closure of Oonooie Road, Gurnetts Road is likely to require sealing along its whole length between Armstrong Beach Road and CSR’s plant.

6.6 Conclusion

For the reasons detailed above, it is considered appropriate that a new overpass be provided as part of the scheme on Oonooie Road over the rail line to provide access and egress to CSR’s plant. This should be confirmed by QR and SSC

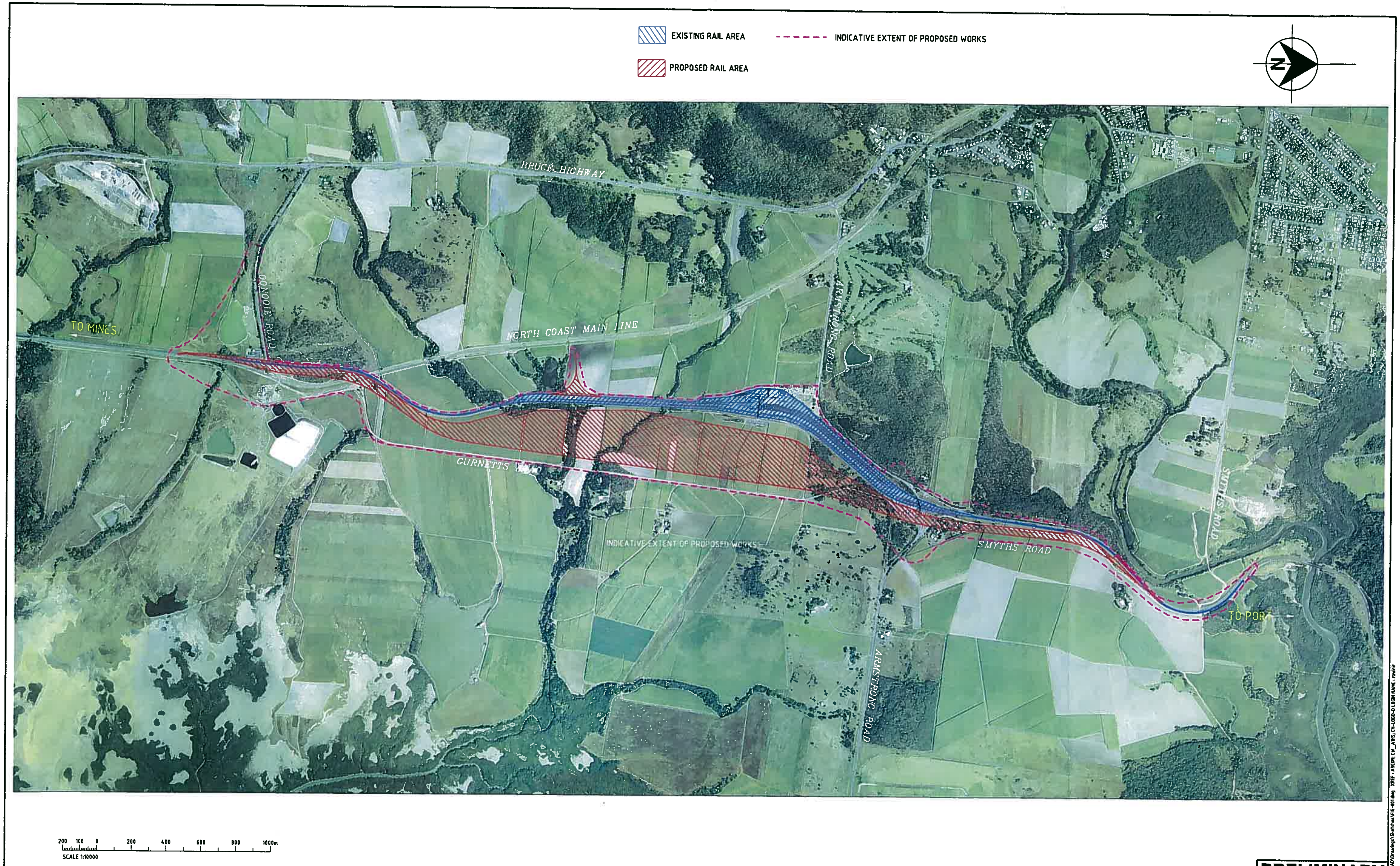
As part of the scheme, the bridge over the rail lines on Armstrong Beach Road will be either upgraded or a new bridge built. A new intersection will be provided at Armstrong Beach Road/Smyths Road/Gurnetts Road.

Gurnetts Road will be sealed between Armstrong Beach Road and QR’s new access road, as will the mouth of Smyth Road, which will be relocated as part of the project, between Armstrong Beach Road and the adjacent road embankment. A n underpass is recommended at the Smyth’s Road rail crossing.

No other road network improvements are recommended as a result of QR’s upgrade and expansion proposals.

Appendix A

Illustrative Layout Figures



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1	07.01.07	PRELIMINARY	RMR		

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Client:

Project:

JILALAN STATION
YARD UPGRADE AND
BYPASS LINE
CONCEPT DESIGN

Drawn	Signed	Date
Designed	Signed	Date
Verified	Signed	Date
Approved	Signed	Date

Drawing Title:

GENERAL SITE LOCATION
AND EXTENT OF WORKS
EXISTING AND PROPOSED
PLAN

PRELIMINARY
NFS

Project No.
HP03

Scale
SCALE-H 1:10 000

Sheet Size
A1

Drawing No.
FIG-001

Rev.
1

100mm

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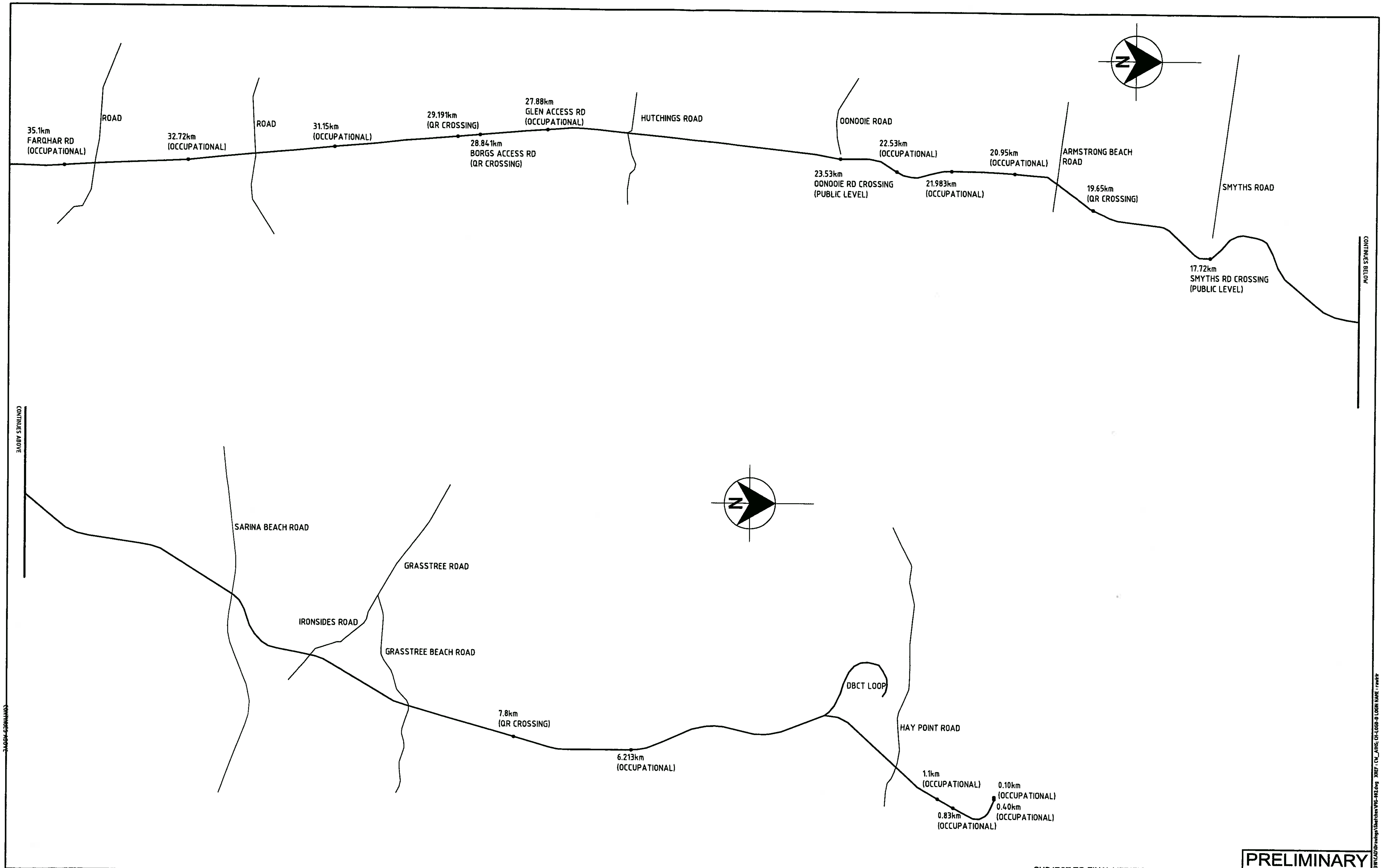

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YARD UPGRADE AND
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Verified	Signed	Date
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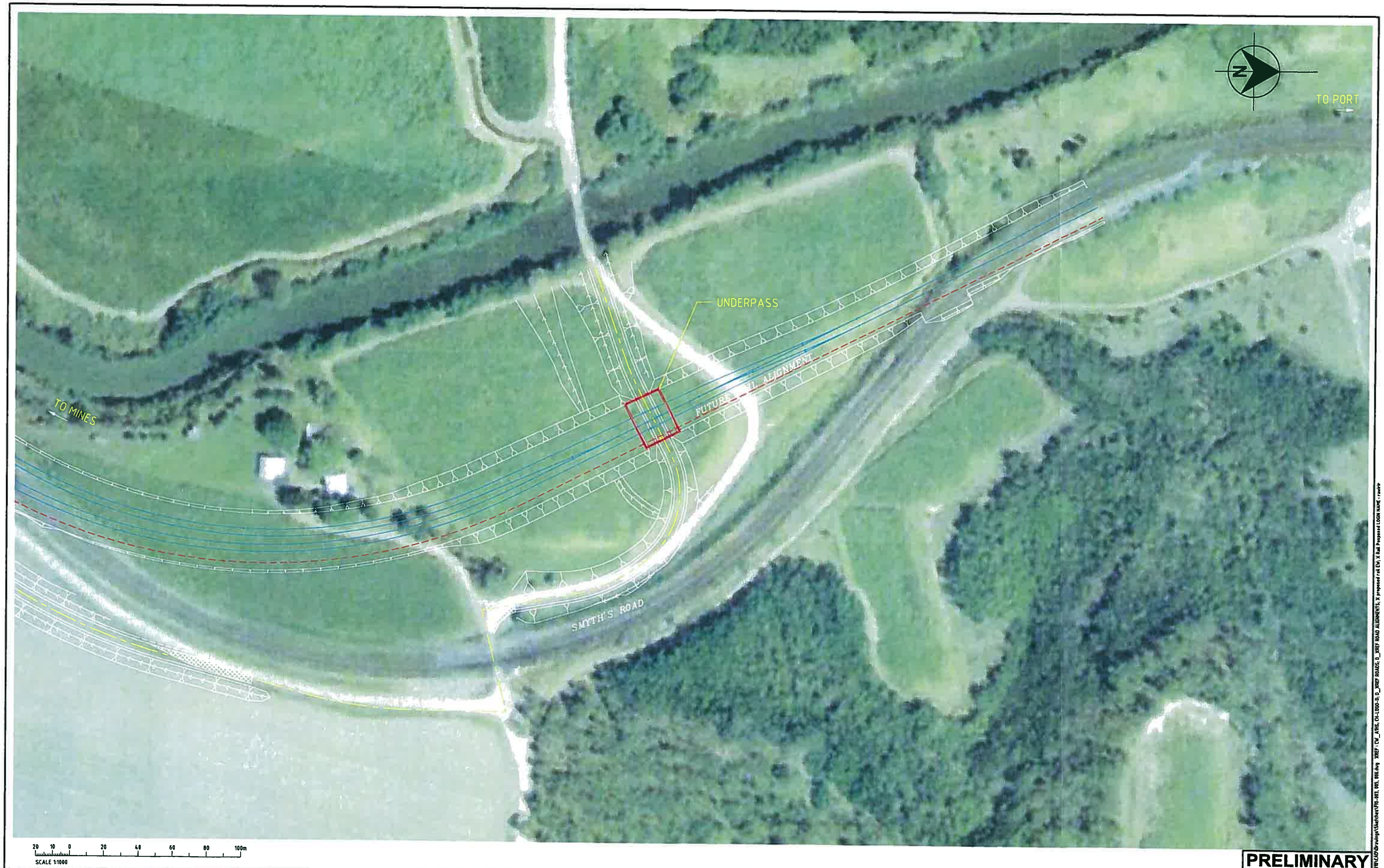
Drawing Title:
LEVEL CROSSING
LOCATION PLAN

Project No. HP03
Scale 1:50000 @ A3
Sheet Size A1
Drawing No. FIG-002
Rev. 01

22.02.2007@10:22:53 V:\Projects\Qld_RaH\HP0310\CAD\Drawings\Sketches\FIG-002.dwg XREF : CW_A1HS; CH-LOGO-Q LOGIN NAME : rawlr



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Drawing Title:
PROPOSED SMYTH'S ROAD
ROAD UNDERPASS
PLAN

PRELIMINARY
NFS

Project No.
HP03

Scale SCALE-H 1:1000	Sheet Size A1
Drawing No. FIG-003	Rev. 1

100mm

22.02.2007@11:24:10 V:\Projects\Old_Rail\HP0310\CAD\Drawings\Sketches\FIG-003, 005, 006.dwg XREF : CW_A1HS; CH-LOGO-D; D_XREF ROADS; D_XREF ROAD ALIGNMENTS; X proposed rail EW; X Rail Proposed LOGIN NAME : rawirk

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JILALAN STATION
YARD UPGRADE AND
BYPASS LINE
CONCEPT DESIGN

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Verified	Signed	Date
Approved	Signed	Date

Drawing Title:

POTENTIAL OONOOIE ROAD
OVERPASS LOCATION
ALIGNMENT OPTIONS
PLAN

Project No. HP03

Scale SCALE-H 1:2000

Sheet Size A1

Drawing No. FIG-004

Rev. 1

22.02.2007@11:28:27 V:\Projects\Old_Rail\HP0310\CAD\Drawings\Sketches\FIG-004.dwg XREF : CW_A1HS; CH-LOGO-0; ASCON LOGIN NAME : rawirir

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JILALAN STATION
YARD UPGRADE AND
BYPASS LINE
CONCEPT DESIGN

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Designed	Signed	Date
Verified	Signed	Date
Approved	Signed	Date

Drawing Title:
POTENTIAL ARMSTRONG BEACH ROAD
BRIDGE ALIGNMENT & GURNETT'S
ARMSTRONG BEACH ROAD
SMYTH'S ROAD INTERSECTION
PLAN

PRELIMINARY
NFS

Project No.
HP03

Scale
SCALE-H 1:1000

Sheet Size
A1

Drawing No.
FIG-005

Rev.
1

100mm

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Client:

Project:
JILALAN STATION
YARD UPGRADE AND
BYPASS LINE
CONCEPT DESIGN

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Designed	Signed	Date
Verified	Signed	Date
Approved	Signed	Date

Drawing Title:
EXISTING BRUCE HIGHWAY
ARMSTRONG BEACH ROAD
INTERSECTION
PLAN

PRELIMINARY
NFS

Project No.
HP03

Scale
SCALE-H 1:500

Sheet Size
A1

Drawing No.
FIG-006

Rev.
1

100mm

Appendix B

Traffic Data

Intersection : FROM SLLAW **Survey Date :** 30/11/2006

Analysis Period : 08:00:00.00 to 11:00:00.00 Of total survey from 08:00:00.00 to 11:15:00

Job Number :

Operator : RJD

Deck T30 Mode : CA

Increments : 15

File Used : SARINA1.TTM

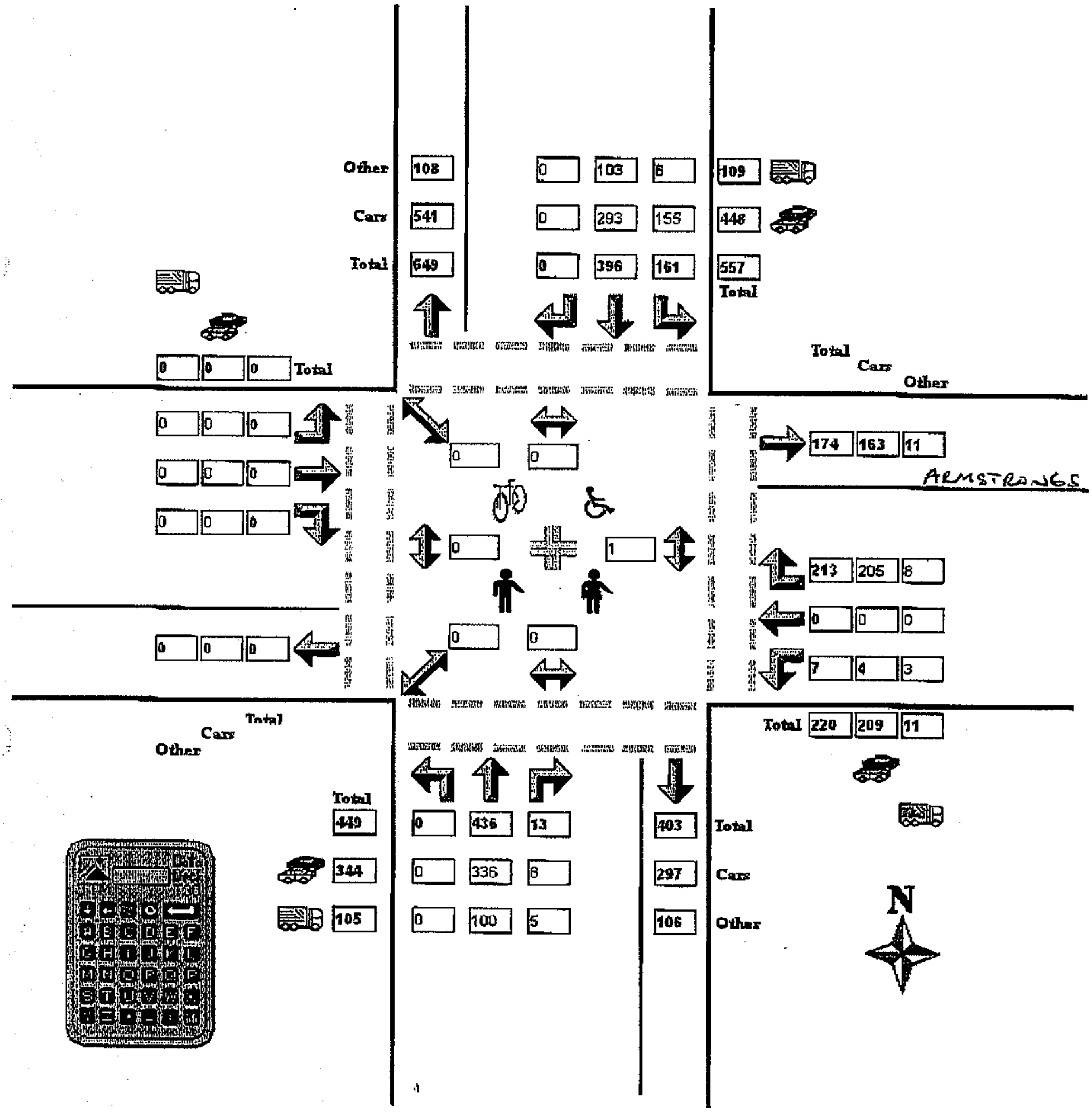
Template : "Standard Intersection", No : 1

Template File : c:\progra~1\t40\tplates\standard.tpg

Comments
FROM SARINA
ARMSTRONGS
AM
04070019

3HR

No. of DataDecks Utilised : 1 AM.



Survey & analysis conducted by , using the Data Deck T30 & associated software from TTM Equipment Pty Ltd

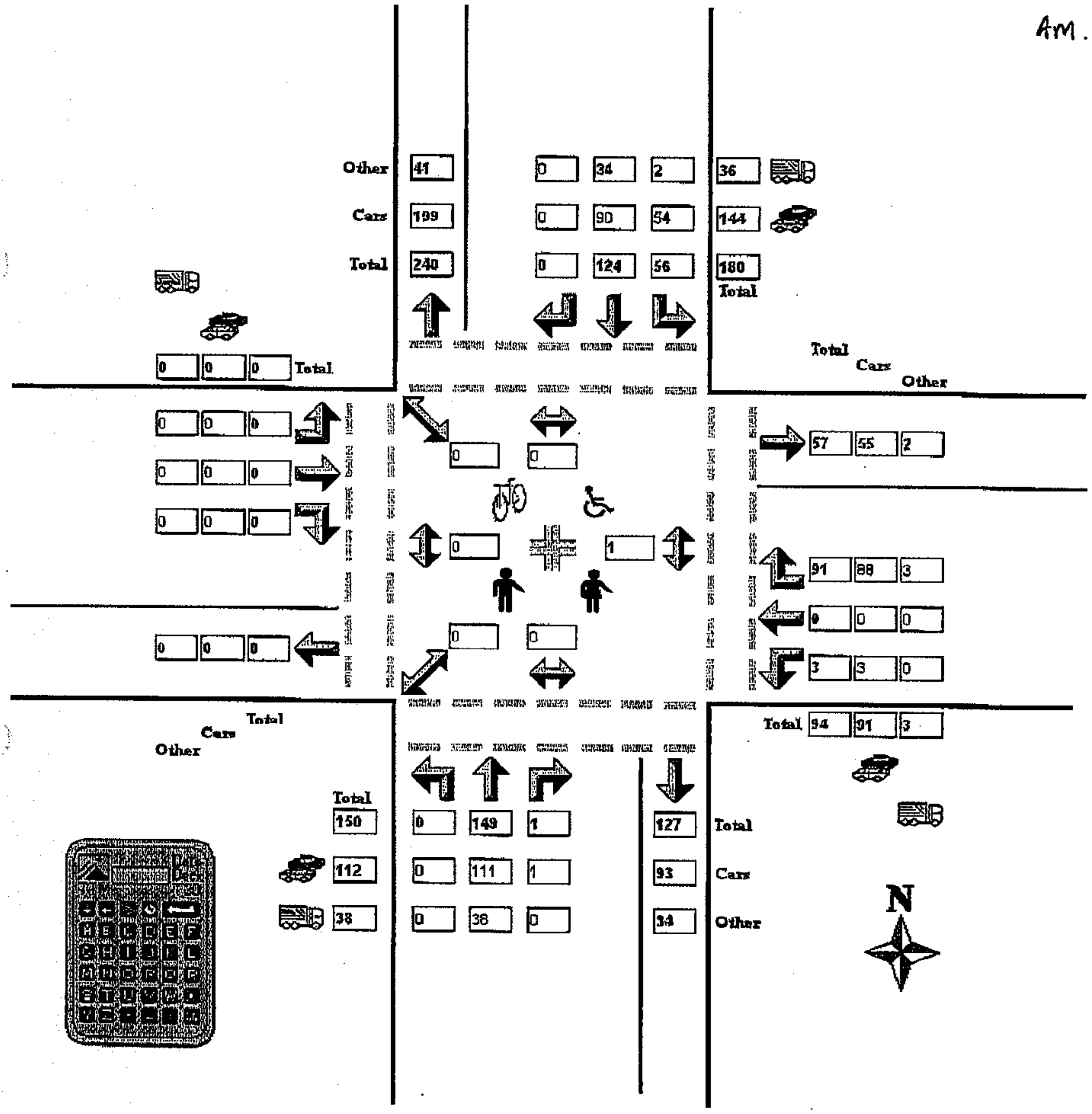
Report Printed on : 04/12/2006

Intersection : FROM.ST.LAW **Survey Date :** 30/11/2006

Analysis Period : 08:00:00.00 to 09:00:00.00 Of total survey from 08:00:00.00 to 11:15:00
Job Number :
Operator : RJD
Deck T30 Mode : CA
Increments : 15
File Used : SARINA1.TIM
Template : "Standard Intersection", No : 1
Template File : c:\progra~1\t40\tplates\standard.rpg
No. of DataDecks Utilised : 1

Comments
FROM.SARINA
ARMSTRONGS
AM
04070019

1HR.
AM.



Survey & analysis conducted by , using the Data Deck T30 & associated software from TIM Equipment Pty Ltd

Report Printed on : 04/12/2006

Intersection : from sarina

Survey Date : 30/11/2006

Analysis Period : 08:45:00.00 to 09:00:00.00 Of total survey from 08:00:00.00 to 11:15:00

Job Number :

Operator : RJD

Deck T30 Mode : CA

Increments : 15

File Used : SARINAL.TIM

Template : "Standard Intersection", No : 1

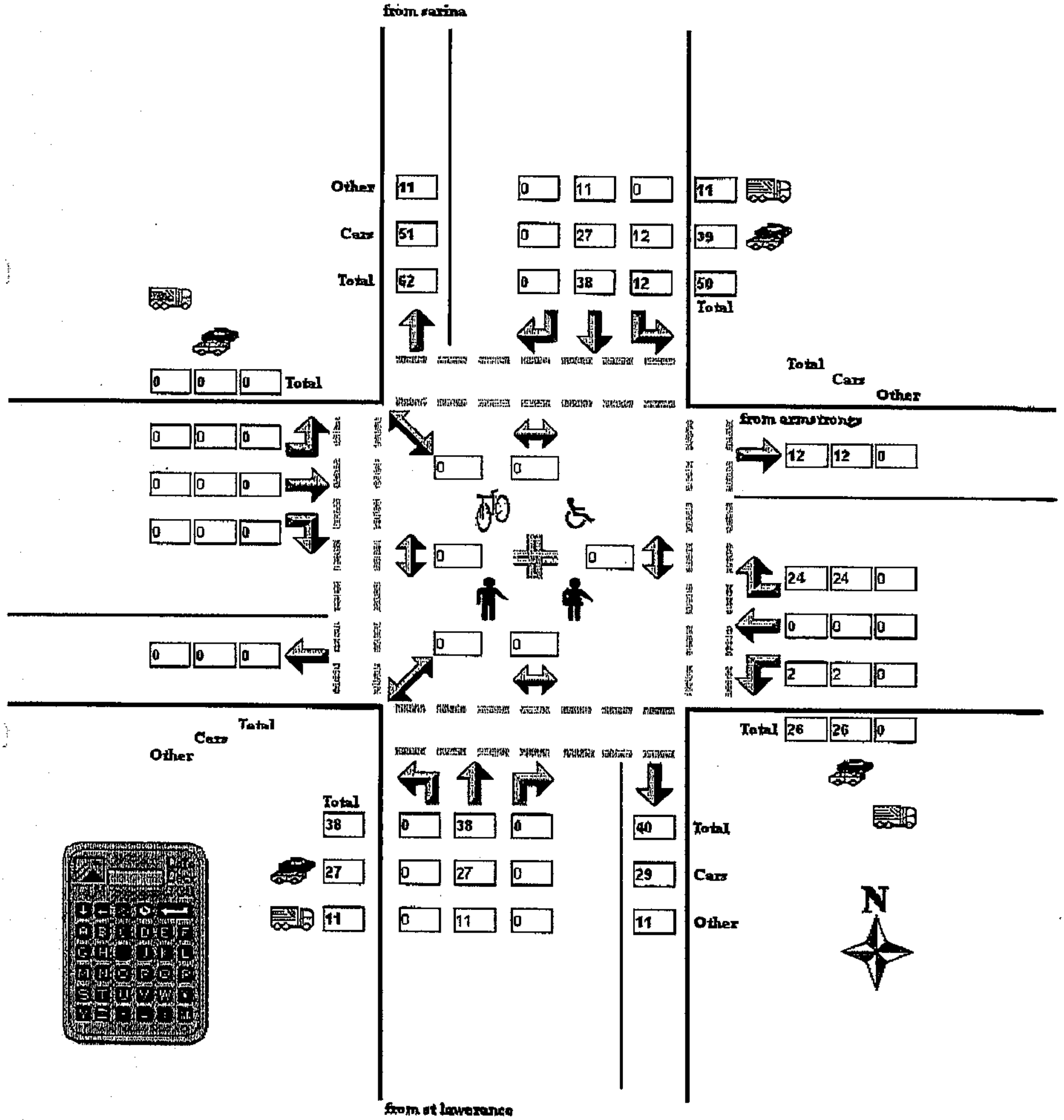
Template File : c:\progra~1\t40\tplates\standard.tpg

Comments
FROM ST.LAW

FROM SARINA
ARMSTRONGS

15 mins.
AM.

No. of DataDecks Utilised : 1



Survey & analysis conducted by , using the Data Deck T30 & associated software from TTM Equipment Pty Ltd

Report Printed on : 04/12/2006

Am

		CLASS 10 (B)		CLASS 11 (D)		CLASS 12 (T)	
		NORTH BOUND	NORTHBOUND RIGHT TURN	SOUTHBOUND	SOUTH BOUND LEFT TURN	ARMSTRONGS RIGHT TURN	ARMSTRONGS LEFT TURN
8.00	8.15	BBBBB		B			
8.15	8.30	BBB		B			
8.30	8.45	BB		BBB			
8.45	9.00	BB		/			
9.00	9.15	BBB		BB			
9.15	9.30	BBB		B			
9.30	9.45	BB		BBBB			
9.45	10.00	BB		B			
10.00	10.15	BBBBB		/			
10.15	10.30	B		B			
10.30	10.45	/		/			
10.45	11.00	BB		/			

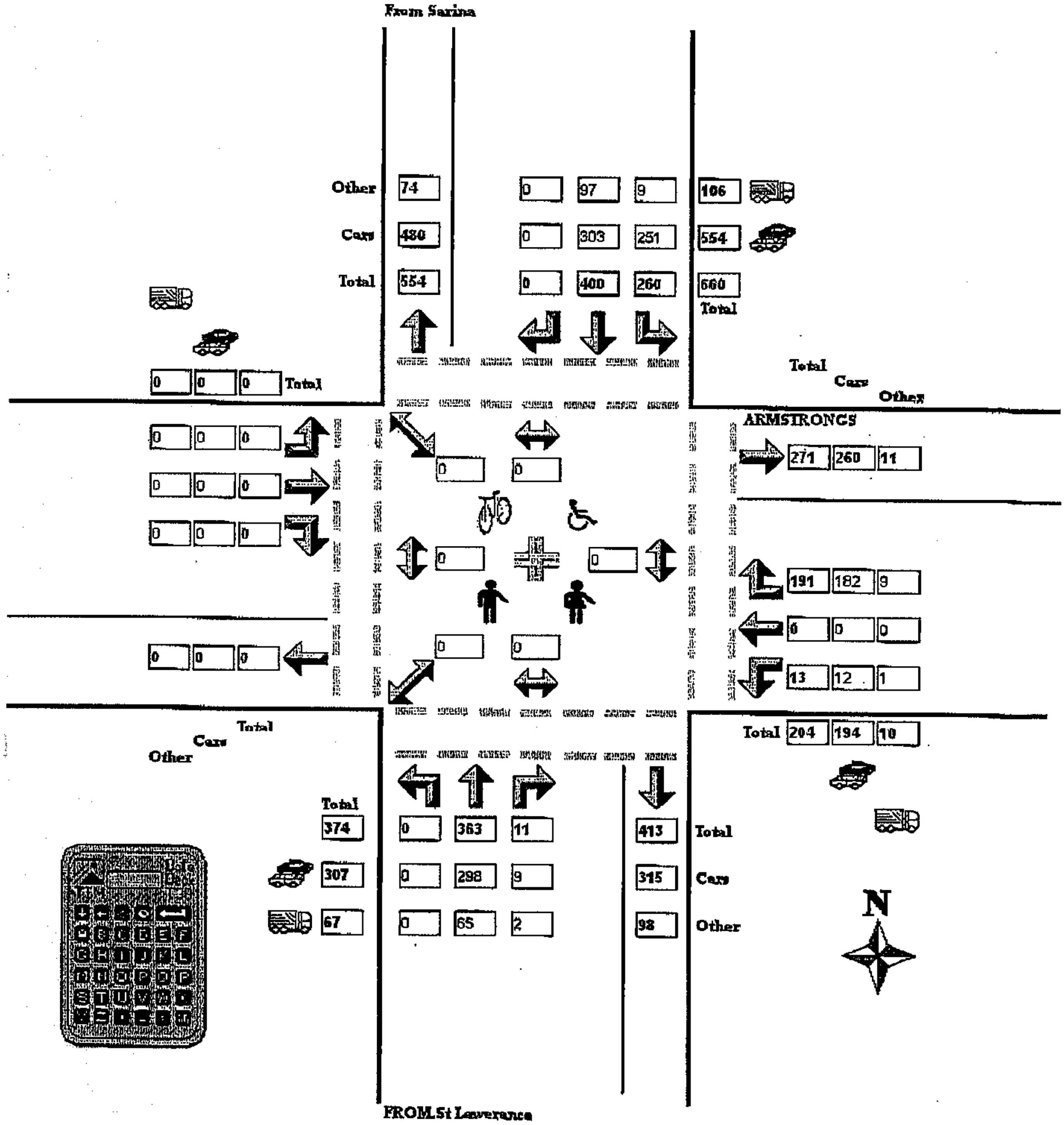
㉚ ⑭

Intersection : FROM.SARINA
Survey Date : 30/11/2006
Analysis Period : 15:00:00.00 to 18:00:00.00 Of total survey from 15:00:00.00 to 18:15:00
Job Number :
Operator : RJD
Deck T30 Mode : CA
Increments : 15
File Used : SARINA2.TIM
Template : "Standard Intersection", No : 1
Template File : c:\progra~1\t40\tplates\standard.rpg

Comments
FROM.ST.LAW

FROM.SARINA
ARMSTRONGS

3HR.
No. of DataDecks Utilised : 1
PM.



Survey & analysis conducted by , using the Data Deck T30 & associated software from TTM Equipment Pty Ltd

Report Printed on : 04/12/2006

Intersection : FROM SARINA

Survey Date : 30/11/2006

Analysis Period : 15:15:00.00 to 16:15:00.00 Of total survey from 15:00:00.00 to 18:15:00

Job Number :

Operator : RJD

Deck T30 Mode : CA

Increments : 15

File Used : SARINA2.TTM

Template : "Standard Intersection", No : 1

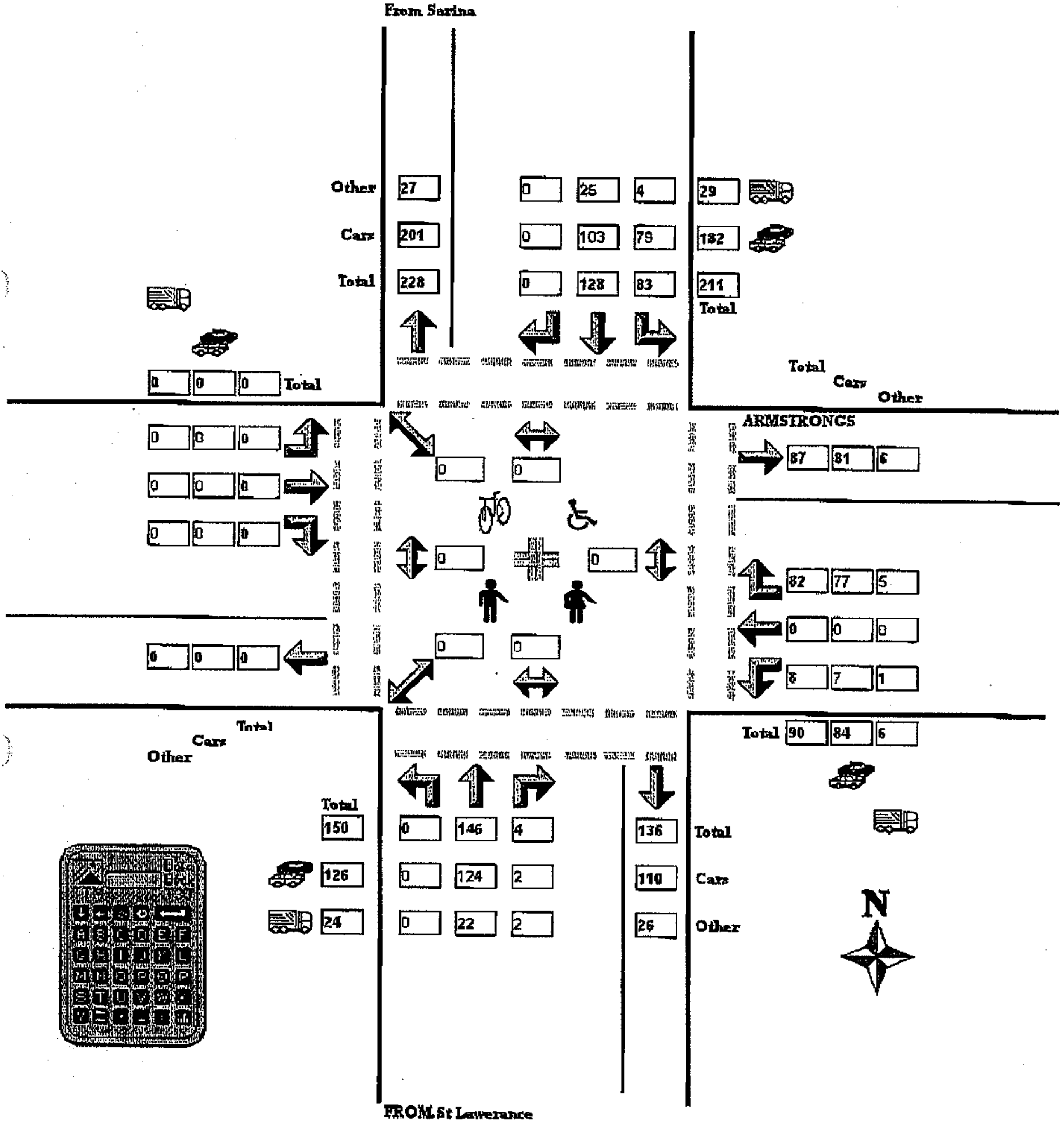
Template File : c:\progra~1\t40\tplates\standard.rpg

Comments
FROM ST.LAW

FROM SARINA
ARMSTRONGS

1HR
Pm

No. of DataDecks Utilised : 1



Survey & analysis conducted by , using the Data Deck T30 & associated software from TIM Equipment Pty Ltd

Report Printed on : 04/12/2006

Intersection : FROM SARINA

Survey Date : 30/11/2006

Analysis Period : 16:00:00.00 to 16:15:00.00 Of total survey from 15:00:00.00 to 18:15:00

Job Number :

Operator : RJD

Deck T30 Mode : CA

Increments : 15

File Used : SARINA2.TTM

Template : "Standard Intersection", No : 1

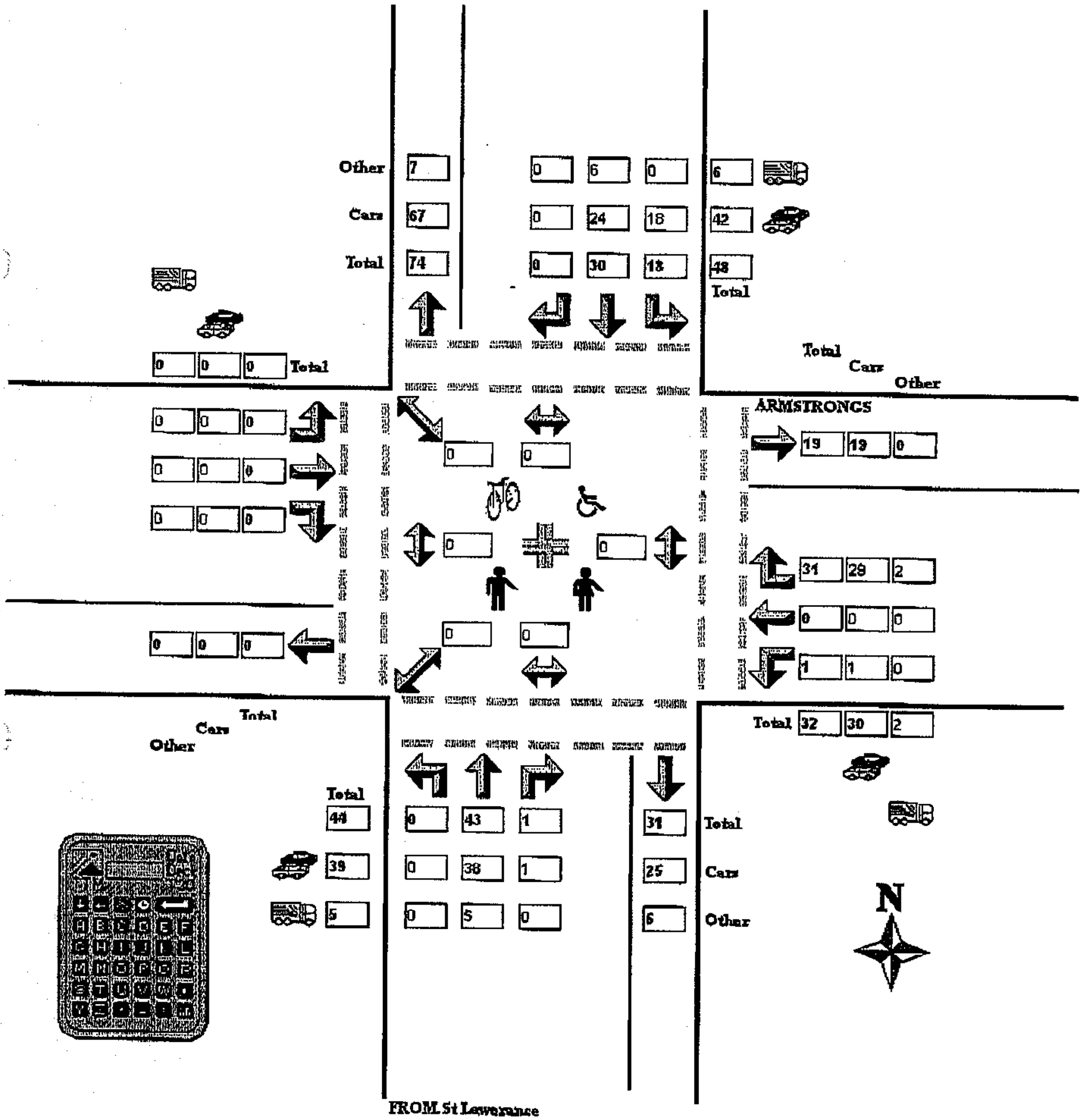
Template File : c:\progra~1\t40\tplates\standard.rpg

Comments
FROM ST.LAW

FROM SARINA
ARMSTRONGS

No. of DataDecks Utilised : 1

15mins
pm



Survey & analysis conducted by , using the Data Deck T30 & associated software from TTM Equipment Pty Ltd

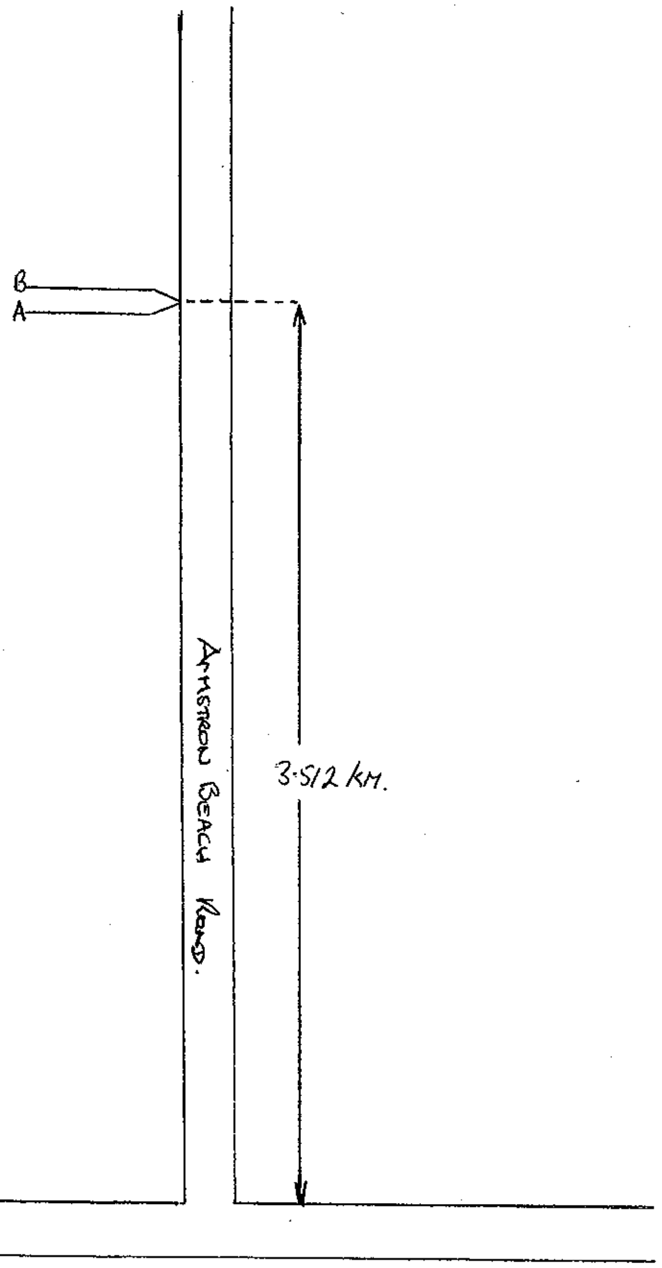
Report Printed on : 04/12/2006

PM.

		CLASS 10 (B)		CLASS 11 (D)		CLASS 12	(T)
		NORTH BOUND	NORTHBOUND RIGHT TURN	SOUTHBOUND	SOUTH BOUND LEFT TURN	ARMSTRONGS RIGHT TURN	ARMSTRONGS LEFT TURN
15.00	15.15	BB		BBBBB			
15.15	15.30	BB		BBB			
15.30	15.45	B		BB			
15.45	16.00	/		/			
16.00	16.15	BB		B			
16.15	16.30	/		BB			
16.30	16.45	/		BBB			
16.45	17.00	/		/			
17.00	17.15	/		/			
17.15	17.30	BBB		BB			
17.30	17.45	B		BB			
17.45	18.00	B		B			
		⑫		㉑			

PROJECT Armstrong Beach Road.
& JOB No. 2/3605/54

File No. 3605	**Page**
Prep.	**Date:** 23/06
Ckd:	**Date:**
SSC QA 70 Issue: 1 Rev 1 (-/4/99)	



MetroCount Traffic Executive
Weekly Vehicle Counts (Virtual Week)

VirtWeeklyVehicle-112

DATASETS:

Site:	**[3605] Armstrong Beach Road 3.512 klm in from the Bruce Highway.**
Direction:	2 - East bound, A hit first., **Lane:** 0
Survey Duration:	15:00 Wed 23 Jun 2004 to 06:49 Tue 06 Jul 2004
File:	C:\Program Files\MetroCount v225\User\Data\360505JUL2004.EC0 (Plus)
Identifier:	N167G4DQ MC56-L4 [MC55] (c)Microcom 19Sep03
Algorithm:	Factory default

PROFILE:

Filter time:	**15:00 Wed 23 Jun 2004 to 06:49 Tue 06 Jul 2004**
Included classes:	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Speed range:	0 - 160 km/hr.
Direction:	North, East, South, West (bound)
Headway:	All
Scheme:	ARX
Name:	Factory default profile
Method:	Vehicle classification
Units:	Metric (m, km, m/s, km/hr, kg, tonne)
In profile:	11563 Vehicles

MetroCount Traffic Executive
Speed Histogram

SpeedHist-114

DATASETS:

Site:	**[3605] Armstrong Beach Road 3.512 klm in from the Bruce Highway.**
Direction:	2 - East bound, A hit first., **Lane: 0**
Survey Duration:	15:00 Wed 23 Jun 2004 to 06:49 Tue 06 Jul 2004
File:	C:\Program Files\MetroCount v225\User\Data\360505JUL2004.EC0 (Plus)
Identifier:	N167G4DQ MC56-L4 [MC55] (c)Microcom 19Sep03
Algorithm:	Factory default

PROFILE:

Filter time:	**15:00 Wed 23 Jun 2004 to 06:49 Tue 06 Jul 2004**
Included classes:	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Speed range:	0 - 160 km/hr.
Direction:	North, East, South, West (bound)
Headway:	All
Scheme:	ARX
Name:	Factory default profile
Method:	Vehicle classification
Units:	Metric (m, km, m/s, km/hr, kg, tonne)
In profile:	11563 Vehicles

Class Speed Matrix

Report Id: ClassMatrix-122
Site ID: 3605.0E
Location: **Armstrong Beach Road 3.512 klm in from the Bruce Highway.**
Filter time: **15:00 Wed 23 Jun 2004 to 06:49 Tue 06 Jul 2004**
Scheme: ARX
Filter: CL(1 2 3 4 5 6 7 8 9 10 11 12) DR(NESW) SP(0,160) HW(all)

Speed Bin (km/hr)	Class 1	2	3	4	5	6	7	8	9	10	11	12	Speed Total	
0 - 10	.	.	.	.	.	.	.	.	.	.	.	.	0	0.0%
10 - 20	.	.	.	.	.	.	.	.	.	.	.	.	0	0.0%
20 - 30	.	3	.	.	.	.	.	.	.	.	.	.	3	0.0%
30 - 40	.	3	.	.	.	.	.	.	.	1	.	.	4	0.0%
40 - 50	.	10	.	.	.	.	.	.	.	.	1	.	11	0.1%
50 - 60	.	21	3	.	.	.	.	1	.	1	.	.	26	0.2%
60 - 70	.	150	29	4	.	.	1	.	.	.	1	.	185	1.6%
70 - 80	1	880	96	33	31	1	3	2	.	2	.	1	1050	9.1%
80 - 90	6	2593	152	63	99	2	5	4	1	3	1	.	2929	25.3%
90 - 100	11	3786	97	66	69	1	1	3	3	3	.	.	4040	34.9%
100 - 110	14	2291	25	33	17	.	.	1	.	2	1	.	2384	20.6%
110 - 120	9	636	10	7	3	.	.	1	.	.	.	.	666	5.8%
120 - 130	2	169	1	4	4	.	.	.	.	.	.	.	180	1.6%
130 - 140	5	41	.	2	3	.	.	.	.	.	.	.	51	0.4%
140 - 150	2	20	.	.	.	.	.	.	.	.	.	.	22	0.2%
150 - 160	1	9	.	.	2	.	.	.	.	.	.	.	12	0.1%
Class Total	51 0.4%	10612 91.8%	413 3.6%	212 1.8%	228 2.0%	4 0.0%	10 0.1%	12 0.1%	4 0.0%	12 0.1%	4 0.0%	1 0.0%	11563	

71.3% at or below 100 KMH

28.7% Above 100 KPH.

Light truck or less 99.6%

MetroCount Traffic Executive
Class Speed Matrix

ClassMatrix-113

DATASETS:

Site:	**[3605] Armstrong Beach Road 3.512 klm in from the Bruce Highway.**
Direction:	2 - East bound, A hit first., **Lane:** 0
Survey Duration:	15:00 Wed 23 Jun 2004 to 06:49 Tue 06 Jul 2004
File:	C:\Program Files\MetroCount v225\User\Data\360505JUL2004.EC0 (Plus)
Identifier:	N167G4DQ MC56-L4 [MC55] (c)Microcom 19Sep03
Algorithm:	Factory default

PROFILE:

Filter time:	**15:00 Wed 23 Jun 2004 to 06:49 Tue 06 Jul 2004**
Included classes:	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Speed range:	0 - 160 km/hr.
Direction:	North, East, South, West (bound)
Headway:	All
Scheme:	ARX
Name:	Factory default profile
Method:	Vehicle classification
Units:	Metric (m, km, m/s, km/hr, kg, tonne)
In profile:	11563 Vehicles

Weekly Vehicle Counts (Virtual Week)

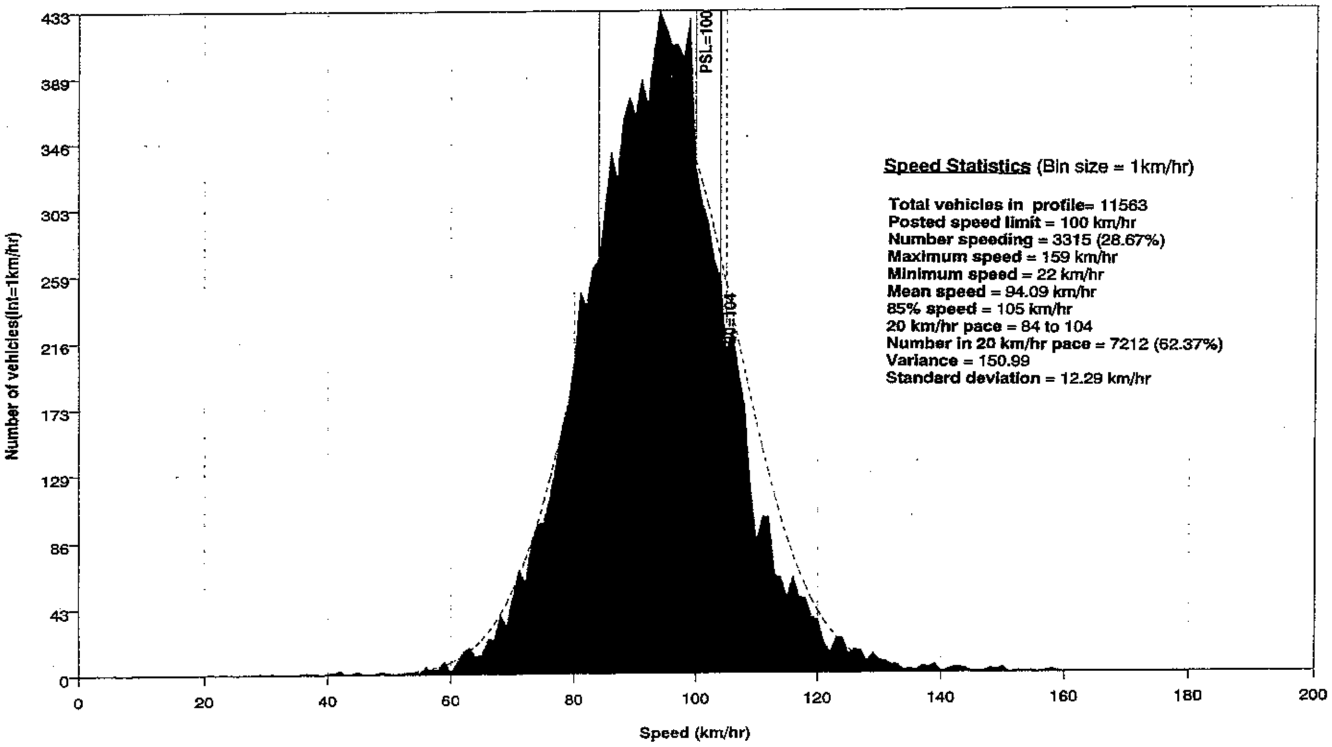
Report Id: VirtWeeklyVehicle-112
Site ID: 3605.0E
Location: **Armstrong Beach Road 3.512 klm in from the Bruce Highway.**
Filter time: **15:00 Wed 23 Jun 2004 to 06:49 Tue 06 Jul 2004**
Scheme: ARX
Filter: CL(1 2 3 4 5 6 7 8 9 10 11 12) DR(NESW) SP(0,160) HW(all)

	MON	TUE	WED	THU	FRI	SAT	SUN	AVERAGES 5-DAY	AVERAGES 7-DAY
Hour period									
0000-0100	2.5	1.0	4.0	5.0	2.5	3.0	5.0	3.0	3.3
0100-0200	0.5	0.0	1.0	4.0	2.5	1.5	7.0	1.6	2.4
0200-0300	1.5	1.0	5.0	1.5	2.0	3.0	4.5	2.2	2.6
0300-0400	5.0	1.0	3.0	2.0	2.0	3.5	3.5	2.6	2.9
0400-0500	4.0	1.0	3.0	1.5	3.5	3.0	4.0	2.6	2.9
0500-0600	17.5	8.5	17.0	19.0	21.0	11.0	8.5	16.6	14.6
0600-0700	43.0	35.0	40.0	22.0	29.5	17.0	13.5	33.9	28.6
0700-0800	56.0	60.0	64.0	51.5	55.5	36.5	38.0	57.4	51.6
0800-0900	**78.0<**	52.0	69.0	61.0	69.5	64.0	63.0	65.9	65.2
0900-1000	67.5	65.0	70.0	65.5	**78.5<**	77.0	77.0	69.3	71.5
1000-1100	68.0	64.0	**74.0<**	**72.0<**	70.0	96.0	**103.5<**	**69.6<**	**78.2<**
1100-1200	69.0	**79.0<**	68.0	64.5	60.0	**98.5<**	86.0	68.1	75.0
1200-1300	**72.0<**	69.0	73.0	**82.0<**	71.5	**93.0<**	**87.0<**	73.5	**78.2<**
1300-1400	48.0	64.0	75.0	62.5	91.0	57.5	76.5	68.1	67.8
1400-1500	32.0	63.0	67.0	60.0	85.0	72.5	75.0	61.4	64.9
1500-1600	32.5	64.0	**91.0<**	70.0	72.5	78.5	77.0	66.0	69.4
1600-1700	52.5	**82.0<**	86.0	75.0	**92.5<**	69.0	55.5	**77.6<**	73.2
1700-1800	40.0	80.0	75.5	79.0	83.5	81.0	51.5	71.6	70.1
1800-1900	19.0	56.0	49.0	44.5	57.0	44.5	38.5	45.1	44.1
1900-2000	11.0	25.0	21.5	16.5	32.0	19.5	19.5	21.2	20.7
2000-2100	4.5	12.0	15.5	12.5	31.0	18.5	14.5	15.1	15.5
2100-2200	5.0	8.0	10.0	13.5	27.0	22.0	11.0	12.7	13.8
2200-2300	4.0	16.0	14.5	7.5	10.5	13.0	7.0	10.5	10.4
2300-2400	3.0	8.0	13.0	5.0	14.0	12.0	6.5	8.6	8.8
TOTALS									
12Hr 7-19	634	798	861	787	886	868	828	793.6	809.2
16Hr 6-22	698	878	948	852	1006	945	887	876.5	887.8
18Hr 6-24	705	902	976	864	1030	970	900	895.6	906.9
24Hr 0-24	736	914	1009	897	1064	995	933	924.2	935.6
AM HR	0800	1100	1000	1000	0900	1100	1000		
PEAK	78	79	74	72	78	98	103		
PM HR	1200	1600	1500	1200	1600	1200	1200		
PEAK	72	82	91	82	92	93	87		

* - No data.

Speed Histogram

Report Id : SpeedHist-114 (Units: Metric (m, km, m/s, km/hr, kg, tonne))
Site ID: 3605.0E
Location: Armstrong Beach Road 3.512 km in from the Bruce Highway.
Time range : [15:00 Wed 23 Jun 2004] to [06:49 Tue 06 Jul 2004]
Scheme : ARX
Profile : CL(1 2 3 4 5 6 7 8 9 10 11 12) DR(NESW) SP(0,160) HW(all)
Method : Classified vehicles



Speed Statistics (Bin size = 1km/hr)

Total vehicles in profile= 11563
Posted speed limit = 100 km/hr
Number speeding = 3315 (28.67%)
Maximum speed = 159 km/hr
Minimum speed = 22 km/hr
Mean speed = 94.09 km/hr
85% speed = 105 km/hr
20 km/hr pace = 84 to 104
Number in 20 km/hr pace = 7212 (62.37%)
Variance = 150.99
Standard deviation = 12.29 km/hr

SARINA SHIRE COUNCIL
MEETING INFORMATION BULLETIN

SUMMARY – TRAFFIC COUNTERS

OONOOIE ROAD

A traffic counter was installed on Oonooie Road and collected data from Monday 8 September 2003 to Thursday 18 September 2003. The location was on 285 metres from the intersection with the Bruce Highway. A total of 2,509 vehicles were counted giving a five day daily average of 292 vehicles per day. Vehicles were classified according to the AustRoads 94 Vehicle Classification System and comprised:

- Light Vehicles (sedan, wagon, 4WD utility, motorcycle etc.) – 20.9%
- Light Vehicles Towing (trailer, caravan, boat etc.) – 1.7%
- Two axle truck or bus – 6.3%
- Three axle truck or bus – 5.5%
- Five axle articulated vehicle or rigid vehicle and trailer – 16.7%
- Six or more axle articulated vehicle or rigid vehicle and trailer – 40.8%
- B Double – 8.1%

This indicates that predominant vehicle use of Oonooie Road is by heavy vehicles accessing the Oonooie Ponds. It is noted that this count was undertaken during the cane crushing season.

The posted speed limit of this road is 100 km/h. The maximum speed recorded was 117 km/h and the minimum speed was 15 km/h. The 85th percentile speed was 74km/h. There were 4 passenger vehicles and 2 medium vehicles recorded above 100km/h.

MetroCount Traffic Executive
Class Speed Matrix

ClassMatrix-129

DATASETS:

Site:	**[03696] Oonooie Rd.**
Direction:	1 - North bound, A hit first., **Lane:** 0
Survey Duration:	13:00 Thu 08 Jul 1999 to 14:51 Thu 15 Jul 1999
File:	H:\MC5500\03696715.EC0 (Regular)
Identifier:	H281TVWX MC55-2 [MC50] (c)Microcom 6/05/98
Algorithm:	Factory default

PROFILE:

Filter time:	**13:00 Thu 08 Jul 1999 to 14:51 Thu 15 Jul 1999**
Included classes:	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
Speed range:	10 - 160 km/hr.
Direction:	North, East, South, West (bound)
Headway:	All
Scheme:	Scheme F
Name:	Factory default profile
Method:	Vehicle classification
Units:	Metric (m, km, m/s, km/hr, kg, tonne)
In profile:	1243 Vehicles

Class Speed Matrix

Report Id: ClassMatrix-129
Site ID: 03696.0N
Location: **Oonooie Rd.**
Filter time: **13:00 Thu 08 Jul 1999 to 14:51 Thu 15 Jul 1999**
Scheme: Scheme F
Filter: CL(1 2 3 4 5 6 7 8 9 10 11 12 13) DR(NESW) SP(10,160) HW(all)

Speed Bin (km/hr)	Class													Speed Total	
	1	2	3	4	5	6	7	8	9	10	11	12	13		
10 - 20	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0.0%
20 - 30	.	6	2	.	.	.	.	.	.	.	.	.	.	8	0.6%
30 - 40	.	4	1	.	.	.	.	1	.	1	.	.	.	7	0.6%
40 - 50	.	13	.	.	1	3	.	.	2	15	.	.	.	34	2.7%
50 - 60	.	16	4	.	3	18	.	.	59	104	.	.	13	217	17.5%
60 - 70	.	49	5	.	7	38	.	1	104	187	.	.	29	420	33.8%
70 - 80	.	83	11	.	10	44	.	.	52	154	.	.	11	365	29.4%
80 - 90	.	51	6	.	3	26	.	.	30	45	.	.	7	168	13.5%
90 - 100	.	22	2	.	.	.	.	.	.	.	.	.	.	24	1.9%
100 - 110	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0.0%
110 - 120	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0.0%
120 - 130	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0.0%
130 - 140	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0.0%
140 - 150	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0.0%
150 - 160	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0.0%
Class Total	0	244	31	0	24	129	0	2	247	506	0	0	60	1243	
	0.0%	19.6%	2.5%	0.0%	1.9%	10.4%	0.0%	0.2%	19.9%	40.7%	0.0%	0.0%	4.8%		

MetroCount Traffic Executive
Class Speed Matrix

ClassMatrix-127

DATASETS:

Site:	**[05043] Gurnetts Road**
Direction:	1 - North bound, A hit first., **Lane:** 0
Survey Duration:	15:00 Wed 07 Apr 1999 to 12:45 Thu 15 Apr 1999
File:	H:\MC5500\05043415.EC0 (Regular)
Identifier:	H281TVWX MC55-2 [MC50] (c)Microcom 6/05/98
Algorithm:	Factory default

PROFILE:

Filter time:	**15:00 Wed 07 Apr 1999 to 12:45 Thu 15 Apr 1999**
Included classes:	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
Speed range:	10 - 160 km/hr.
Direction:	North, East, South, West (bound)
Headway:	All
Scheme:	Scheme F
Name:	Factory default profile
Method:	Vehicle classification
Units:	Metric (m, km, m/s, km/hr, kg, tonne)
In profile:	2207 Vehicles

Class Speed Matrix

Report Id: ClassMatrix-127
Site ID: 05043.0N
Location: **Gurnetts Road**
Filter time: **15:00 Wed 07 Apr 1999 to 12:45 Thu 15 Apr 1999**
Scheme: Scheme F
Filter: CL(1 2 3 4 5 6 7 8 9 10 11 12 13) DR(NESW) SP(10,160) HW(all)

Speed Bin (km/hr)	Class 1	2	3	4	5	6	7	8	9	10	11	12	13	Speed Total	
10 - 20	.	2	.	.	.	.	.	.	.	.	.	.	.	2	0.1%
20 - 30	.	1	.	.	.	.	.	.	.	.	.	.	.	1	0.0%
30 - 40	.	4	1	.	.	.	.	.	.	.	.	.	.	5	0.2%
40 - 50	.	71	5	1	5	1	1	.	.	.	.	.	.	84	3.8%
50 - 60	14	551	28	.	7	4	.	.	.	.	.	.	.	604	27.4%
60 - 70	30	956	56	.	8	4	.	.	.	.	.	.	.	1054	47.8%
70 - 80	10	376	19	.	.	.	.	.	.	.	.	.	.	405	18.4%
80 - 90	5	39	1	.	.	.	.	.	.	.	.	.	.	45	2.0%
90 - 100	.	6	.	.	.	.	.	.	.	.	.	.	.	6	0.3%
100 - 110	.	1	.	.	.	.	.	.	.	.	.	.	.	1	0.0%
110 - 120	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0.0%
120 - 130	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0.0%
130 - 140	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0.0%
140 - 150	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0.0%
150 - 160	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0.0%
Class Total	59 2.7%	2007 90.9%	110 5.0%	1 0.0%	20 0.9%	9 0.4%	1 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	2207	

MetroCount Traffic Executive
Speed Histogram

SpeedHist-126

DATASETS:

Site:	**[3727] Smyth Road (bitumen section south end)**
Direction:	1 - North bound, A hit first., **Lane:** 0
Survey Duration:	09:00 Mon 13 Nov 2000 to 10:30 Mon 20 Nov 2000
File:	H:\MetroCount v220\User\Data\372720NOV2000.EC0 (Plus)
Identifier:	A8456SAZ MC56-1 [MC55] (c)Microcom 07/06/99
Algorithm:	Factory default

PROFILE:

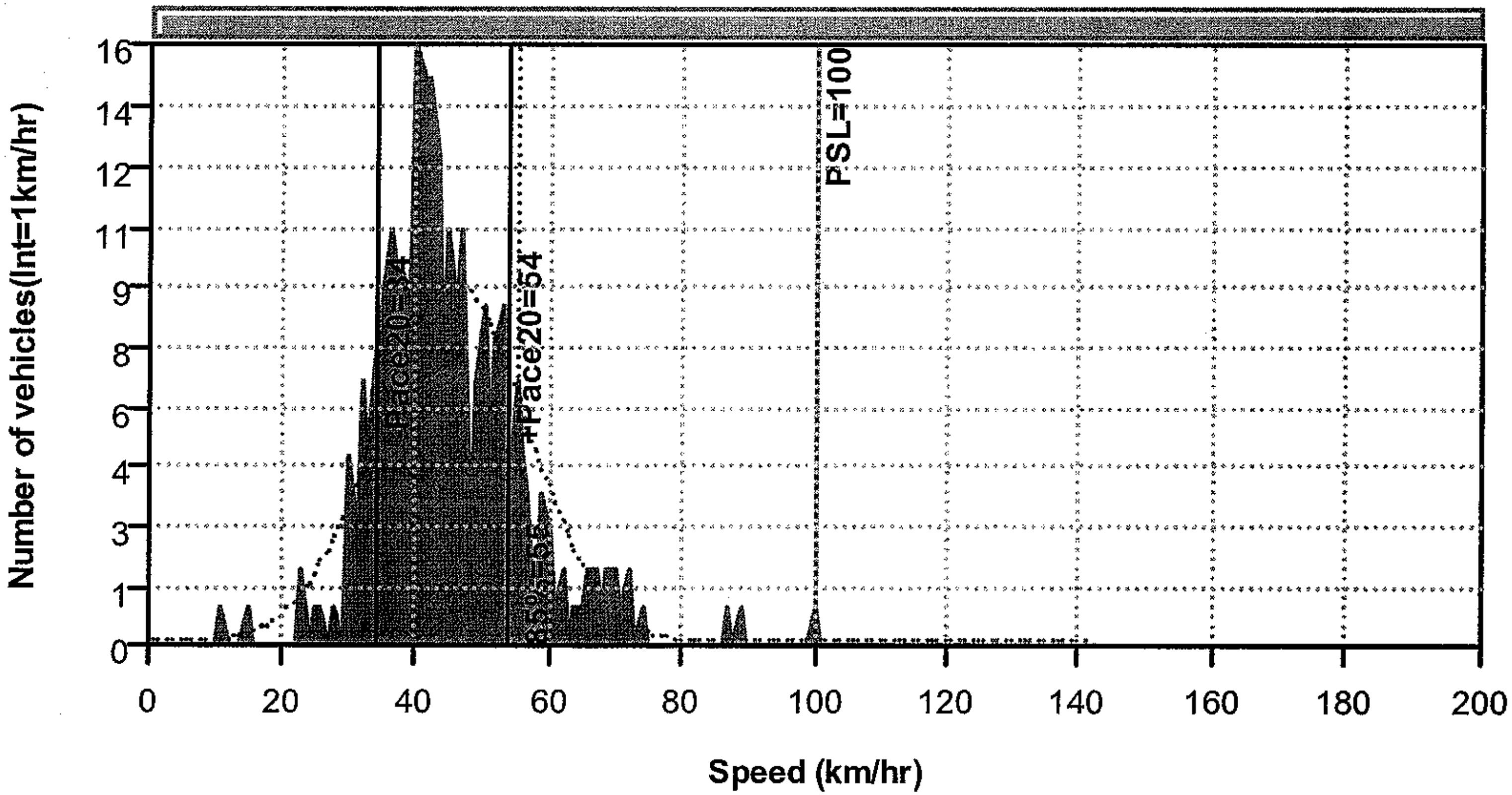
Filter time:	**09:00 Mon 13 Nov 2000 to 10:30 Mon 20 Nov 2000**
Included classes:	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
Speed range:	10 - 160 km/hr.
Direction:	North, East, South, West (bound)
Headway:	All
Scheme:	Scheme F
Name:	Factory default profile
Method:	Vehicle classification
Units:	Metric (m, km, m/s, km/hr, kg, tonne)
In profile:	270 Vehicles

Speed Statistics (Bin size = 1km/hr)

Total vehicles in profile= 270
Posted speed limit = 100 km/hr
Number speeding = 1 (0.37%)
Maximum speed = 100 km/hr
Minimum speed = 12 km/hr
Mean speed = 45.47 km/hr
85% speed = 55 km/hr
20 km/hr pace = 34 to 54
Number in 20 km/hr pace = 195 (72.22%)
Variance = 126.79
Standard deviation = 11.26 km/hr

Speed Histogram

Report Id : SpeedHist-126 (Units: Metric (m, km, m/s, km/hr, kg, tonne))
Site ID: 3727.0N
Location: Smyth Road (bitumen section south end)
Time range : [09:00 Mon 13 Nov 2000] to [10:30 Mon 20 Nov 2000]
Scheme : Scheme F
Profile : CL(1 2 3 4 5 6 7 8 9 10 11 12 13) DR(NESW) SP(10,160) HW(all)
Method : Classified vehicles



Class Speed Matrix

Report Id: ClassMatrix-125
Site ID: 3727.0N
Location: **Smyth Road (bitumen section south end)**
Filter time: **09:00 Mon 13 Nov 2000 to 10:30 Mon 20 Nov 2000**
Scheme: Scheme F
Filter: CL(1 2 3 4 5 6 7 8 9 10 11 12 13) DR(NESW) SP(10,160) HW(all)

Speed Bin (km/hr)	Class 1	2	3	4	5	6	7	8	9	10	11	12	13	Speed Total	
10 - 20	.	2	.	.	.	.	.	.	.	.	.	.	.	2	0.7%
20 - 30	.	4	1	.	.	.	.	.	.	.	.	.	.	5	1.9%
30 - 40	.	58	9	.	7	3	.	.	.	.	.	.	.	77	28.5%
40 - 50	.	92	12	.	2	1	.	.	.	.	.	.	.	107	39.6%
50 - 60	.	40	14	.	.	1	.	.	.	.	.	.	.	55	20.4%
60 - 70	.	9	6	.	.	.	.	.	.	.	.	.	.	15	5.6%
70 - 80	.	5	1	.	.	.	.	.	.	.	.	.	.	6	2.2%
80 - 90	.	1	1	.	.	.	.	.	.	.	.	.	.	2	0.7%
90 - 100	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0.0%
100 - 110	.	.	.	.	1	.	.	.	.	.	.	.	.	1	0.4%
110 - 120	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0.0%
120 - 130	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0.0%
130 - 140	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0.0%
140 - 150	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0.0%
150 - 160	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0.0%
Class Total	0 0.0%	211 78.1%	44 16.3%	0 0.0%	10 3.7%	5 1.9%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	270	

MetroCount Traffic Executive
Class Speed Matrix

ClassMatrix-125

DATASETS:

Site:	**[3727] Smyth Road (bitumen section south end)**
Direction:	1 - North bound, A hit first., **Lane:** 0
Survey Duration:	09:00 Mon 13 Nov 2000 to 10:30 Mon 20 Nov 2000
File:	H:\MetroCount v220\User\Data\372720NOV2000.EC0 (Plus)
Identifier:	A8456SAZ MC56-1 [MC55] (c)Microcom 07/06/99
Algorithm:	Factory default

PROFILE:

Filter time:	**09:00 Mon 13 Nov 2000 to 10:30 Mon 20 Nov 2000**
Included classes:	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
Speed range:	10 - 160 km/hr.
Direction:	North, East, South, West (bound)
Headway:	All
Scheme:	Scheme F
Name:	Factory default profile
Method:	Vehicle classification
Units:	Metric (m, km, m/s, km/hr, kg, tonne)
In profile:	270 Vehicles

MetroCount Traffic Executive
Weekly Vehicle Counts (Virtual Week)

VirtWeeklyVehicle-124

DATASETS:

Site: **[3727] Smyth Road (bitumen section south end)**
Direction: 1 - North bound, A hit first., **Lane:** 0
Survey Duration: 09:00 Mon 13 Nov 2000 to 10:30 Mon 20 Nov 2000
File: H:\MetroCount v220\User\Data\372720NOV2000.EC0 (Plus)
Identifier: A8456SAZ MC56-1 [MC55] (c)Microcom 07/06/99
Algorithm: Factory default

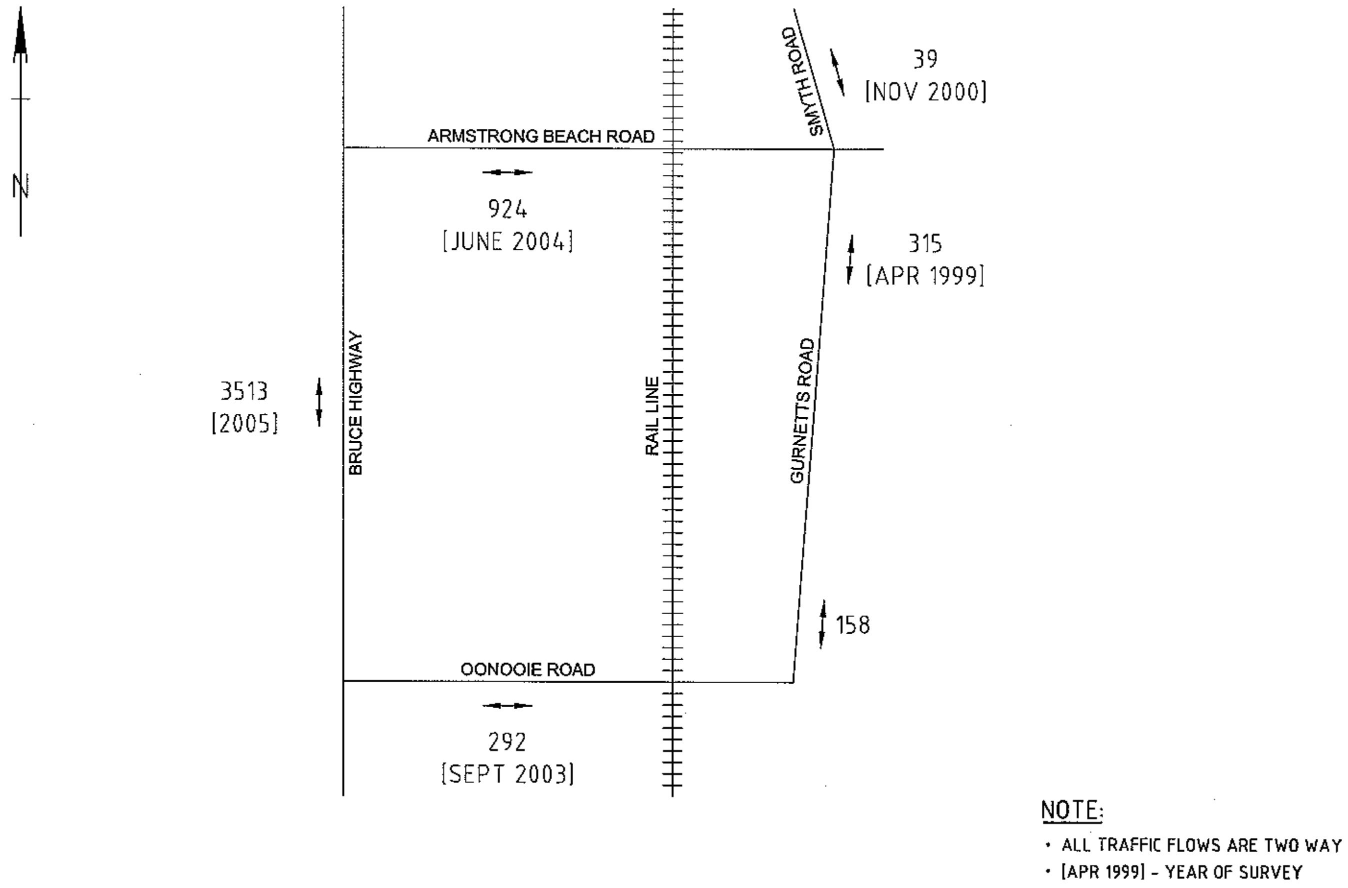
PROFILE:

Filter time: **09:00 Mon 13 Nov 2000 to 10:30 Mon 20 Nov 2000**
Included classes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
Speed range: 10 - 160 km/hr.
Direction: North, East, South, West (bound)
Headway: All
Scheme: Scheme F
Name: Factory default profile
Method: Vehicle classification
Units: Metric (m, km, m/s, km/hr, kg, tonne)
In profile: 270 Vehicles

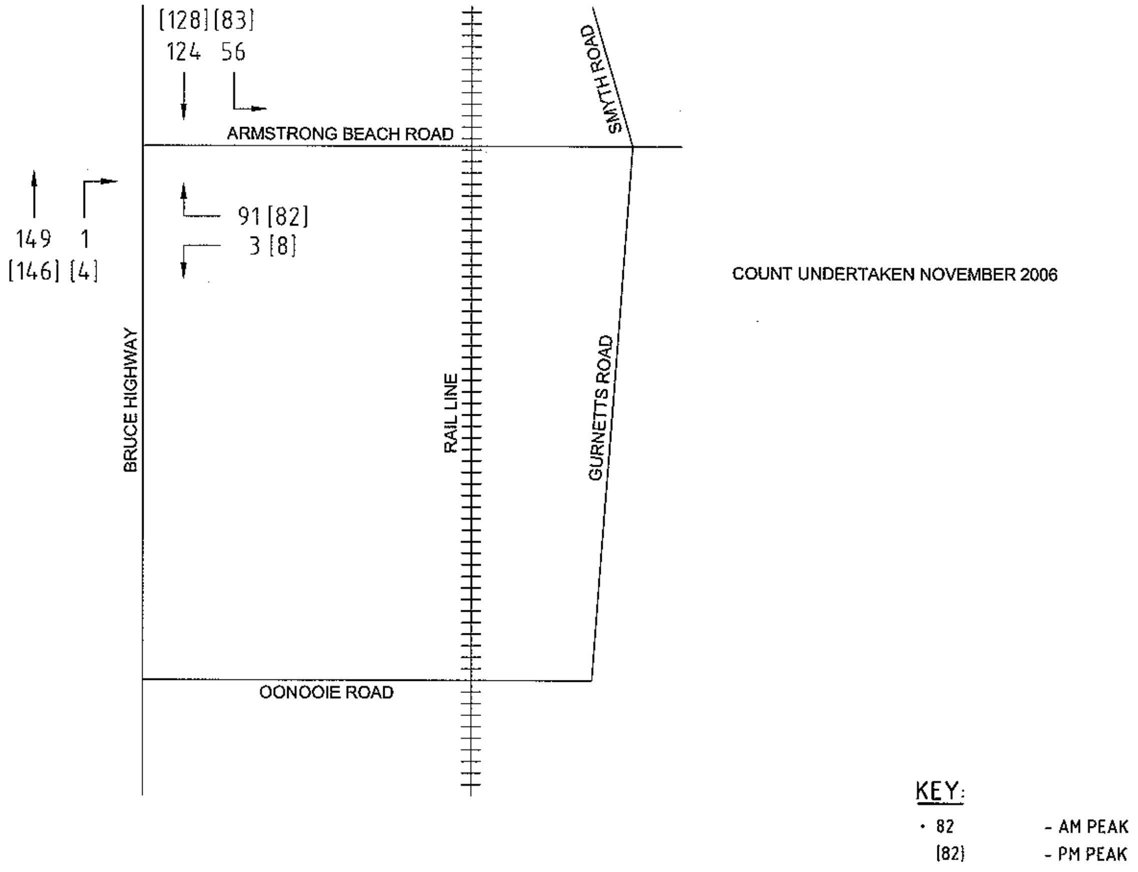
Appendix C

Traffic Flow Figures

DAILY TRAFFIC FLOWS



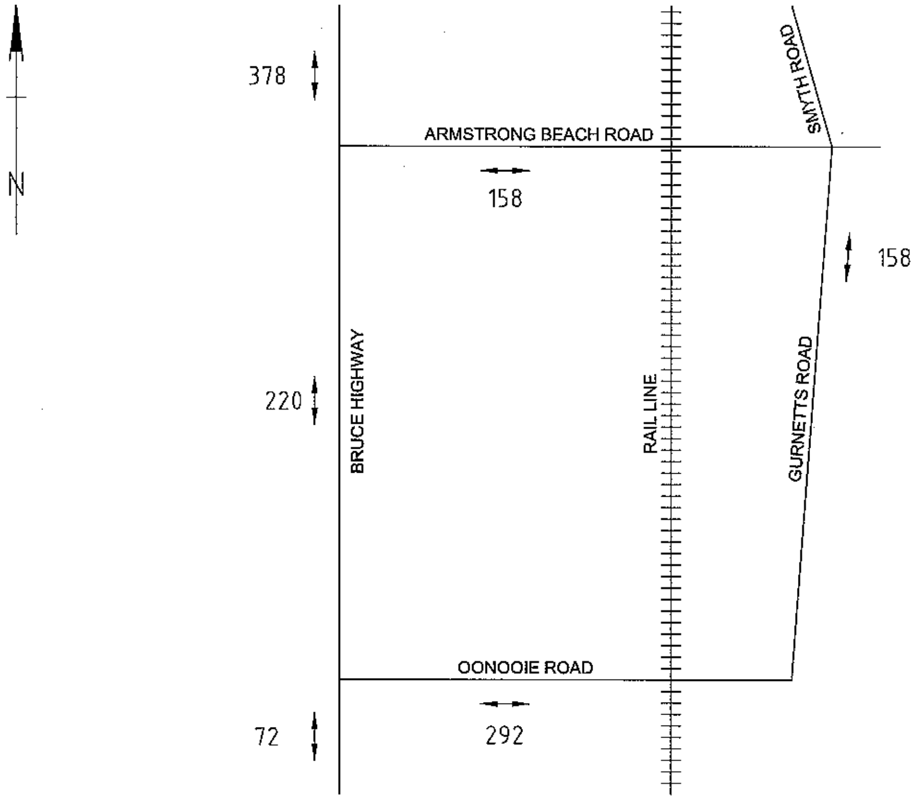
PEAK PERIOD TRAFFIC FLOW



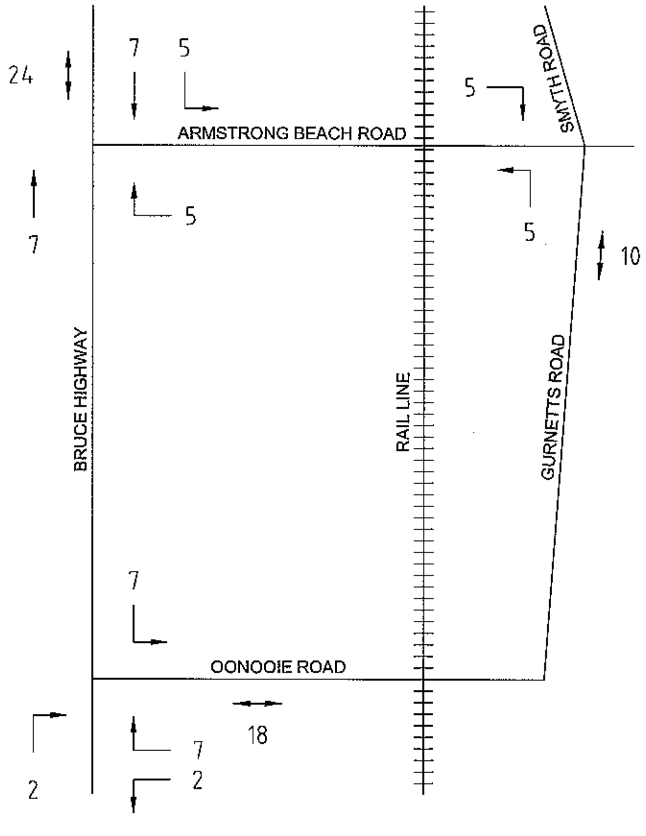
JILALAN TRAFFIC IMPACT ASSESSMENT

FIGURE 1:
SURVEYED TRAFFIC
FLOWS

DAILY TRAFFIC FLOWS



PEAK PERIOD TRAFFIC FLOW



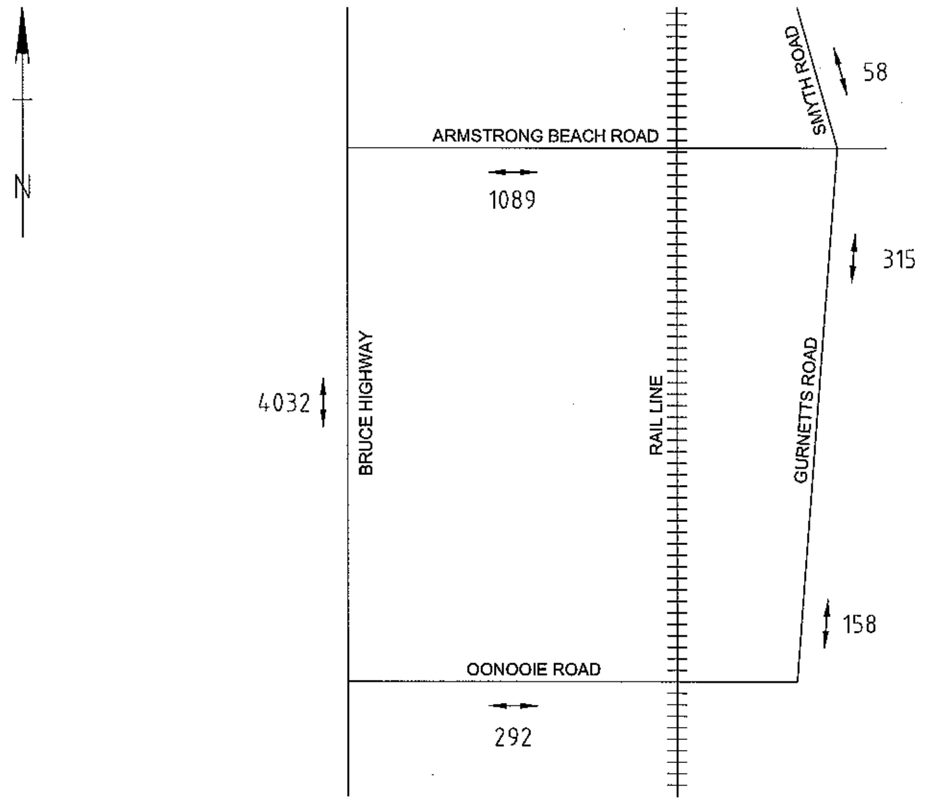
KEY:

- ALL TRAFFIC OPERATING ALONG OONOOIE RD ASSUMED TO BE CSR TRAFFIC
- 50% OF TRAFFIC OPERATING ALONG GUNETTS RD ASSUMED TO BE CSR TRAFFIC
- CSR OPERATE BETWEEN 4am AND 8pm ie OVER 16 HRS
- CSR TRAFFIC DURING PEAK HOUR ASSUMED TO BE $\frac{1}{16}$ OF DAILY FLOW
- 84% OF CSR VEHICLES ASSUMED TO TRAVEL TO AND FROM THE NORTH

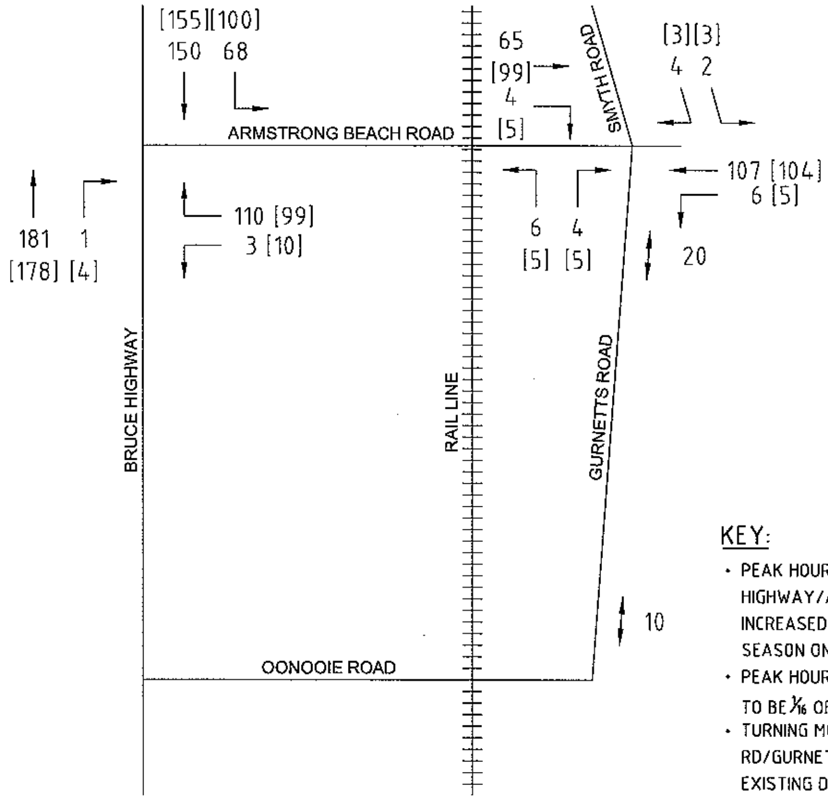
JILALAN TRAFFIC IMPACT ASSESSMENT

FIGURE 2:
ESTIMATED CSR
TRAFFIC (CURRENT)

DAILY TRAFFIC FLOWS



PEAK PERIOD TRAFFIC FLOW



KEY:

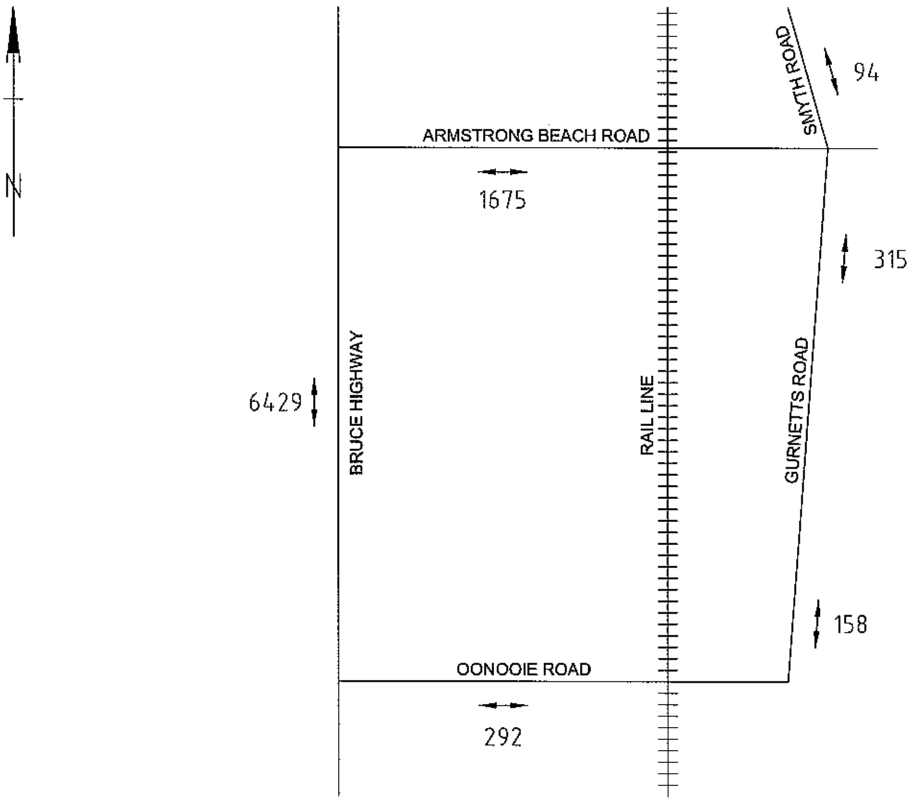
- PEAK HOUR TRAFFIC FLOWS AT BRUCE HIGHWAY/ARMSTRONG BEACH RD HAVE BEEN INCREASED BY 10% TO FACTOR FOR THE HARVEST SEASON ON TOP OF NORMAL GROWTH FACTOR
- PEAK HOUR TRAFFIC ALONG GURNETTS RD ASSUMED TO BE 1/16 OF DAILY TRAFFIC
- TURNING MOVEMENTS AT ARMSTRONG BEACH RD/GURNETTS RD HAVE BEEN ESTIMATED BASED ON EXISTING DIRECTIONAL SPLIT ON ARMSTRONG BEACH
- RD

82	- AM PEAK
[82]	- PM PEAK

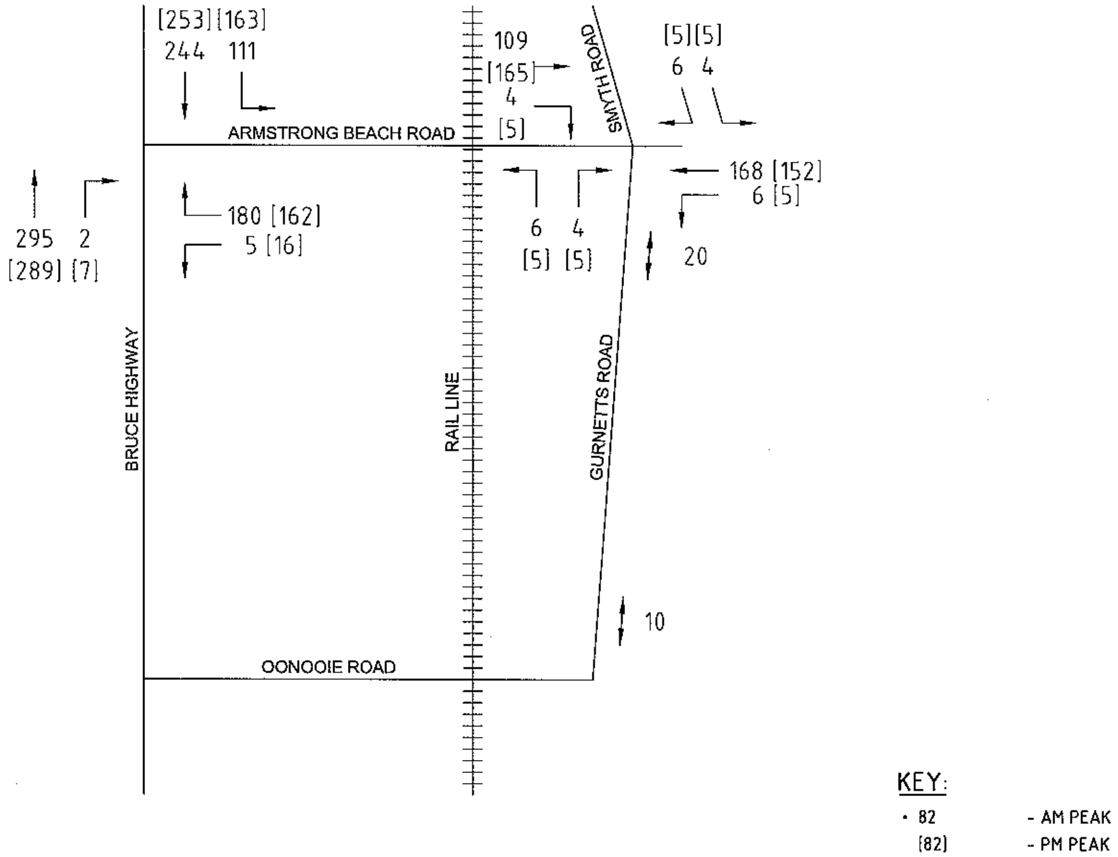
JILALAN TRAFFIC IMPACT ASSESSMENT

FIGURE 3:
2008 "BASE" TRAFFIC FLOWS

DAILY TRAFFIC FLOWS



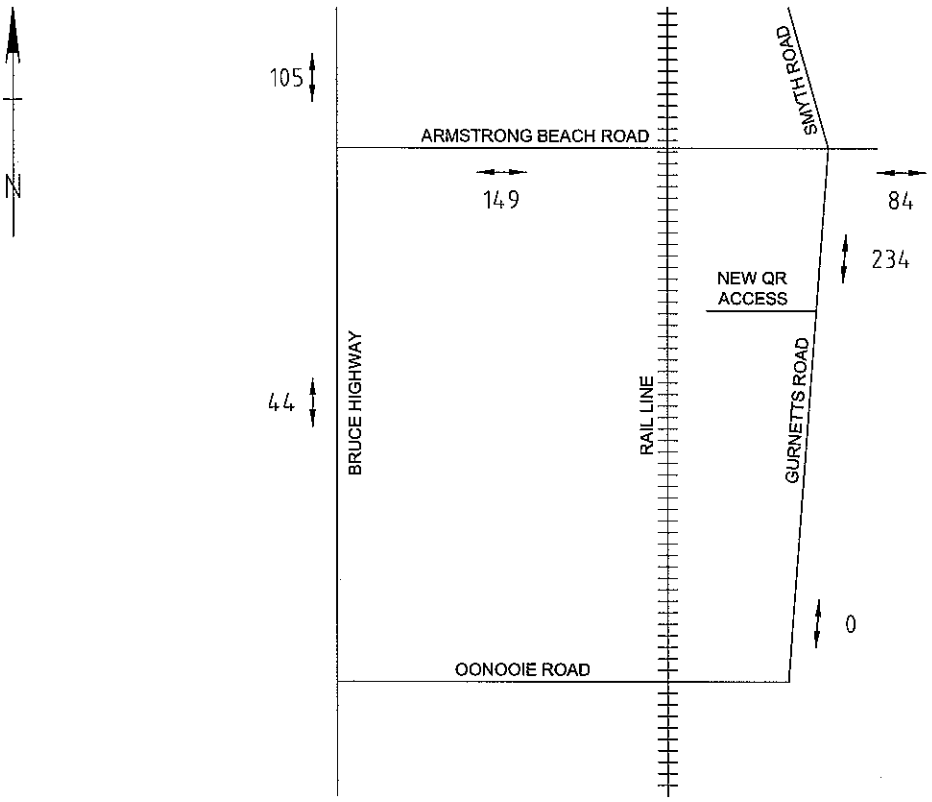
PEAK PERIOD TRAFFIC FLOW



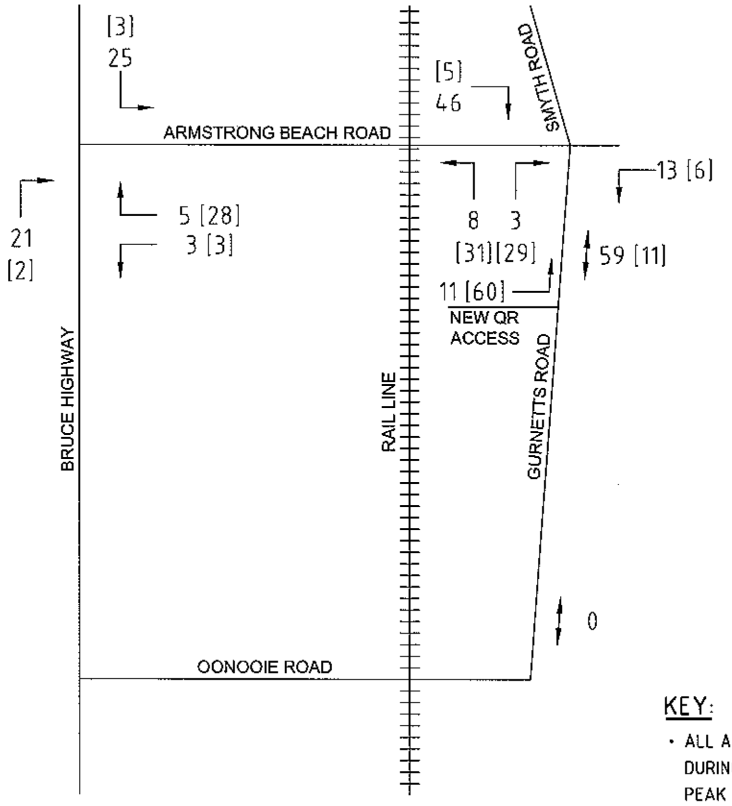
JILALAN TRAFFIC IMPACT ASSESSMENT

FIGURE 4:
2018 'BASE' TRAFFIC
FLOWS

DAILY TRAFFIC FLOWS



PEAK PERIOD TRAFFIC FLOW



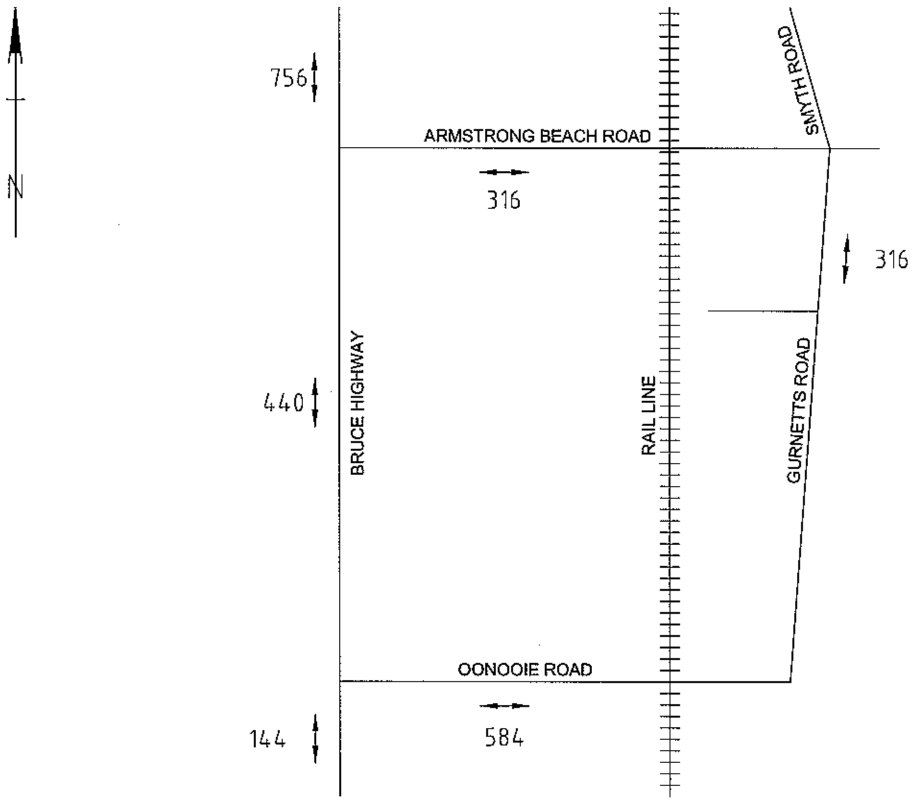
KEY:

- ALL ADDITIONAL QR TRAFFIC ASSUMED TO ARRIVE DURING THE AM PEAK AMD DEPART DURING THE PM PEAK
- 82 - AM PEAK
  [82] - PM PEAK

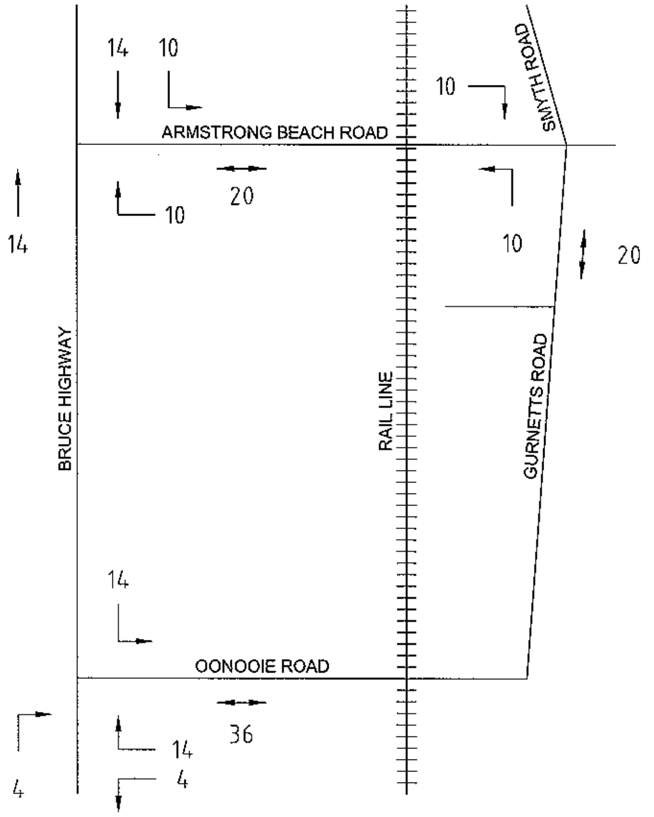
JILALAN TRAFFIC IMPACT ASSESSMENT

FIGURE 5:
ADDITIONAL QR TRAFFIC

DAILY TRAFFIC FLOWS



PEAK PERIOD TRAFFIC FLOW



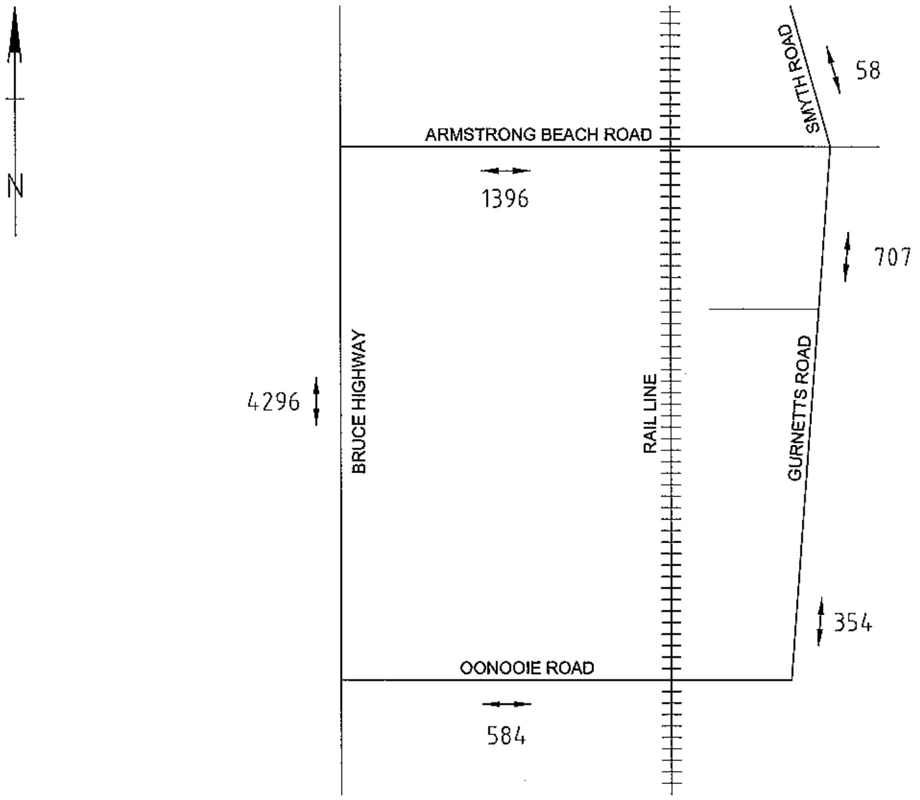
KEY:

- ESTIMATED CSR TRAFFIC (FROM FIG. 2) ASSUMED TO DOUBLE

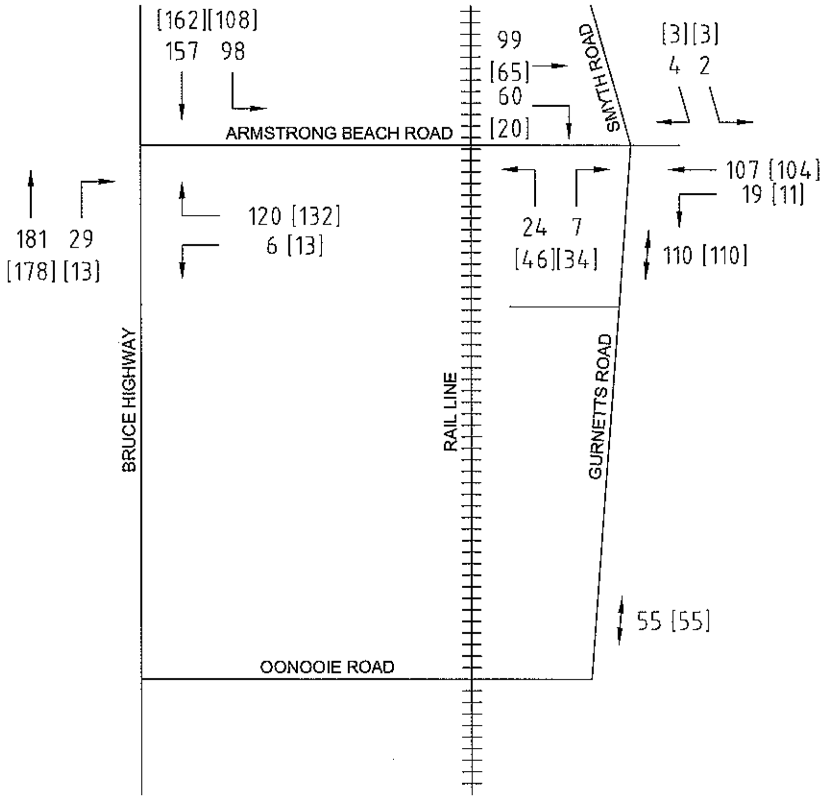
JILALAN TRAFFIC IMPACT ASSESSMENT

FIGURE 6:
CSR TRAFFIC AFTER
EXPANSION

DAILY TRAFFIC FLOWS



PEAK PERIOD TRAFFIC FLOW



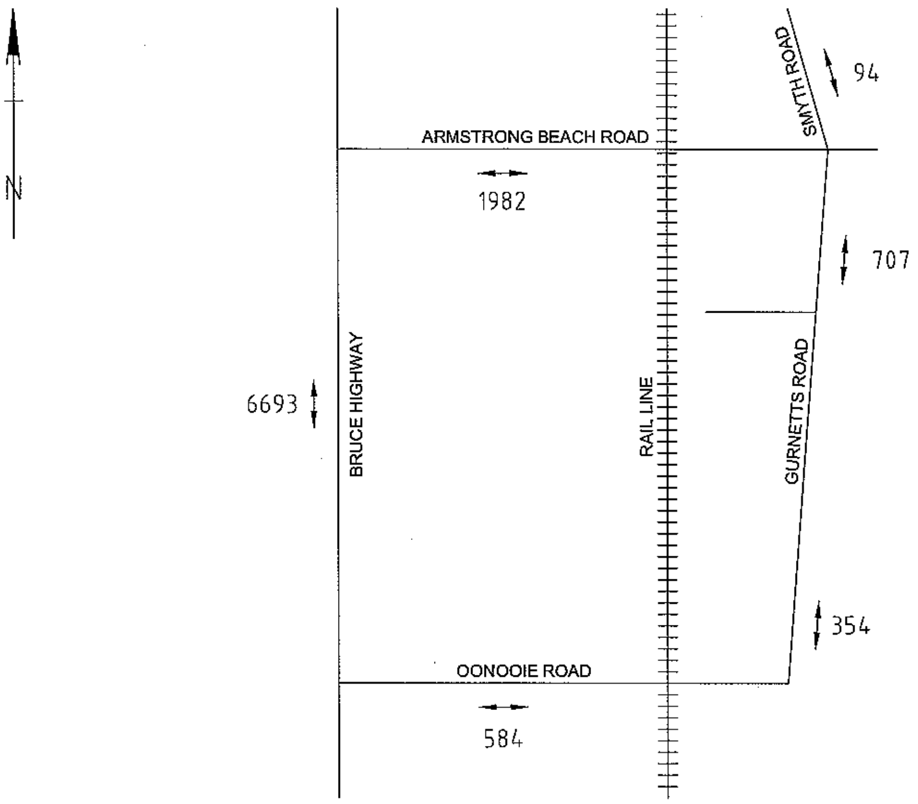
KEY:

82	- AM PEAK
[82]	- PM PEAK

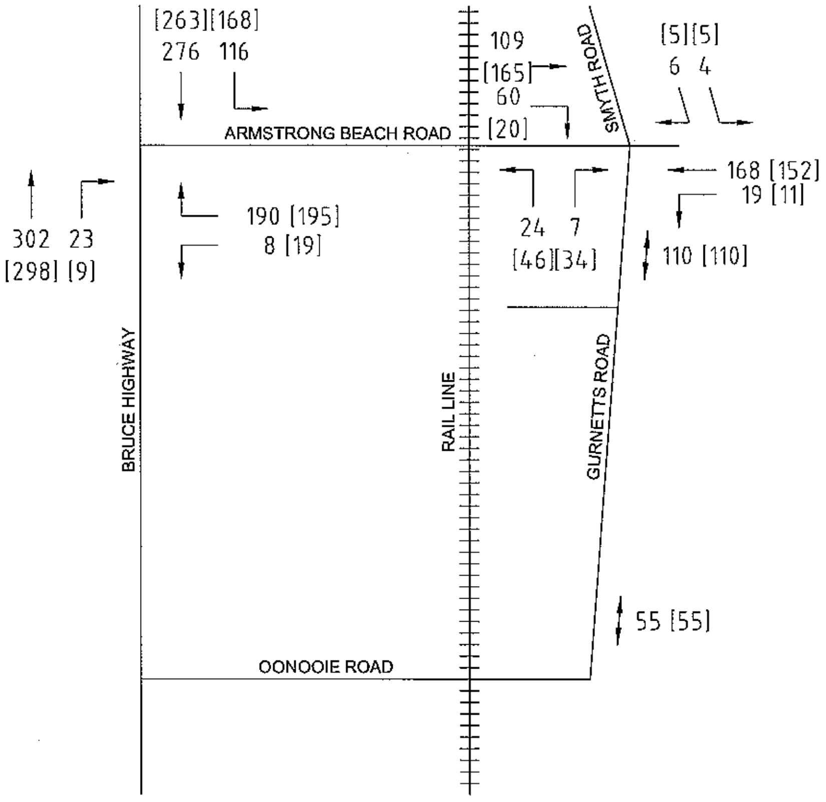
JILALAN TRAFFIC IMPACT ASSESSMENT

FIGURE 7:
2008 'DESIGN' TRAFFIC FLOWS

DAILY TRAFFIC FLOWS



PEAK PERIOD TRAFFIC FLOW



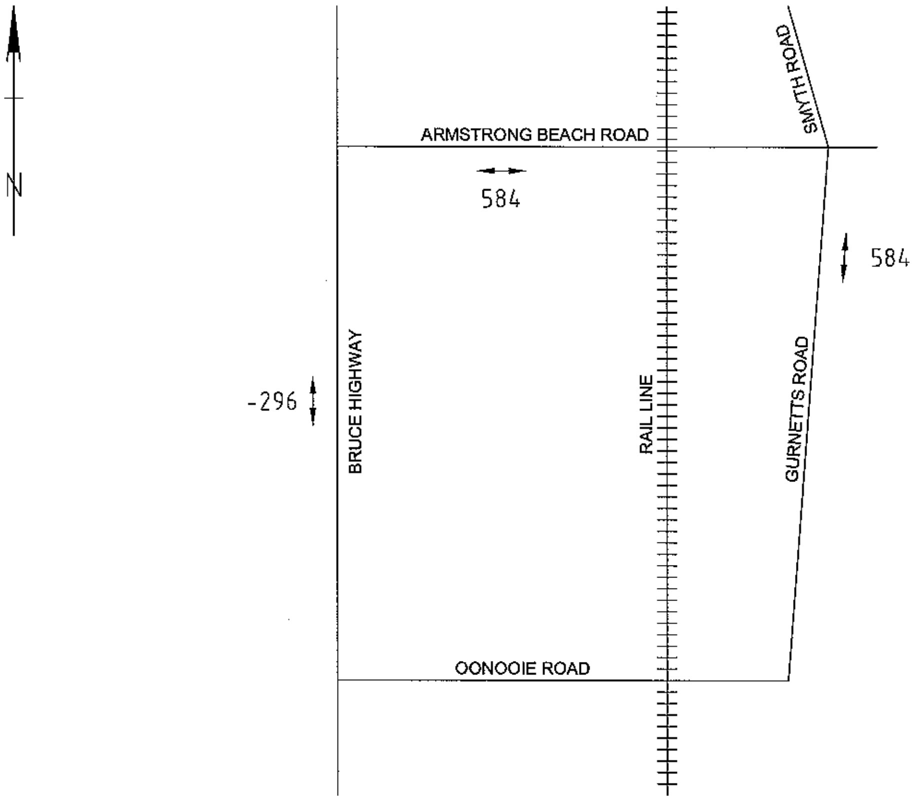
KEY:

• 82	- AM PEAK
[82]	- PM PEAK

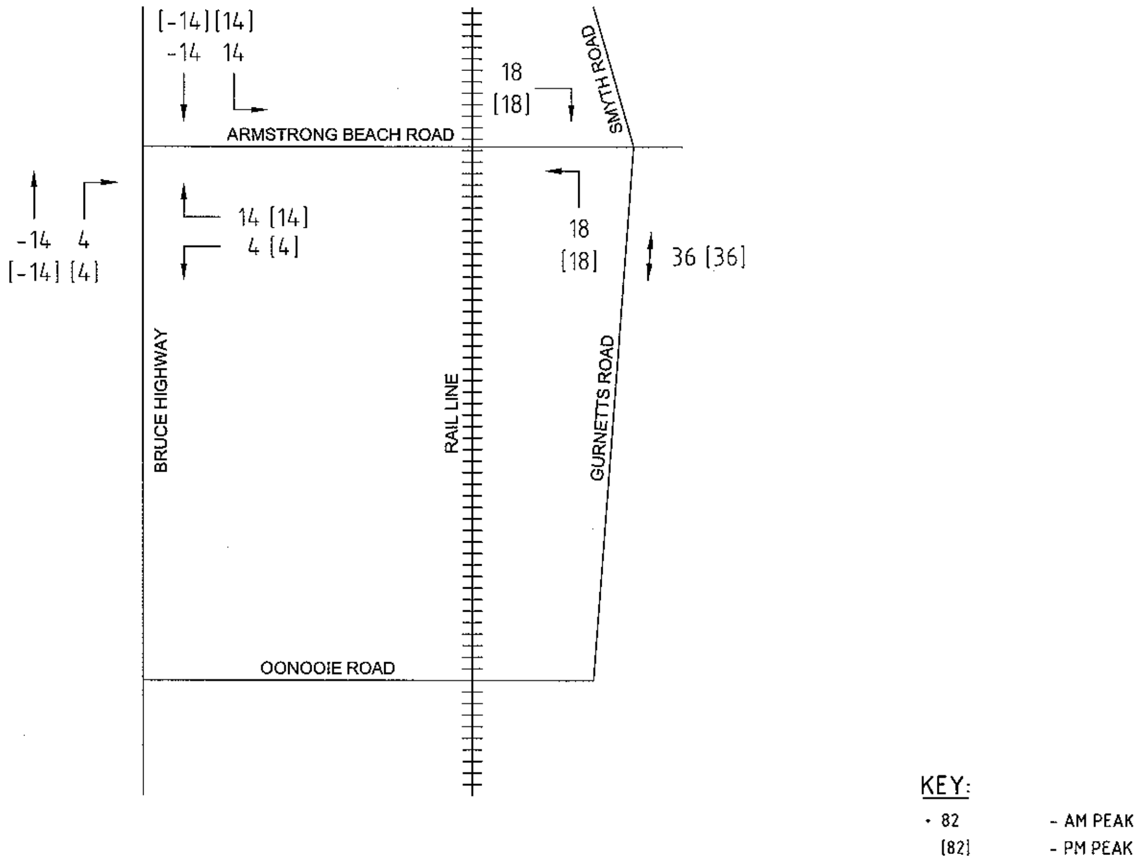
JILALAN TRAFFIC IMPACT ASSESSMENT

FIGURE 8:
2018 'DESIGN' TRAFFIC FLOWS

DAILY TRAFFIC FLOWS



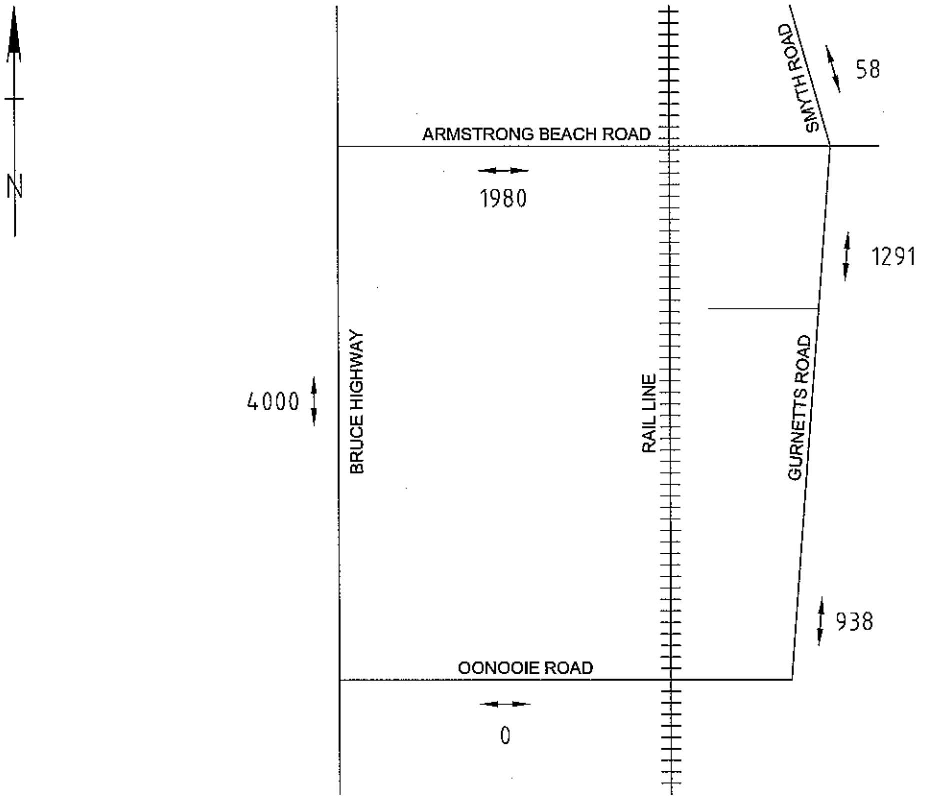
PEAK PERIOD TRAFFIC FLOW



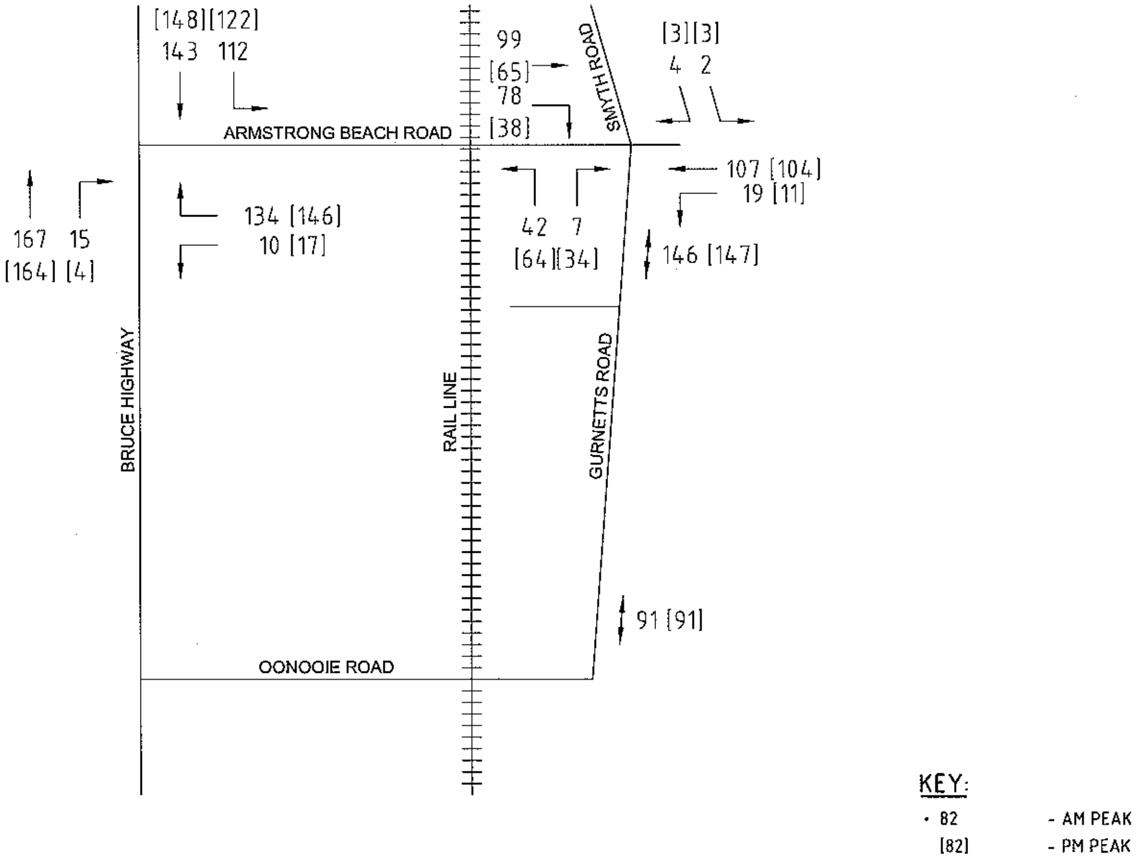
JILALAN TRAFFIC IMPACT ASSESSMENT

FIGURE 9:
REDIRECTED TRAFFIC DUE TO
CLOSURE OF OONOOIE RD

DAILY TRAFFIC FLOWS



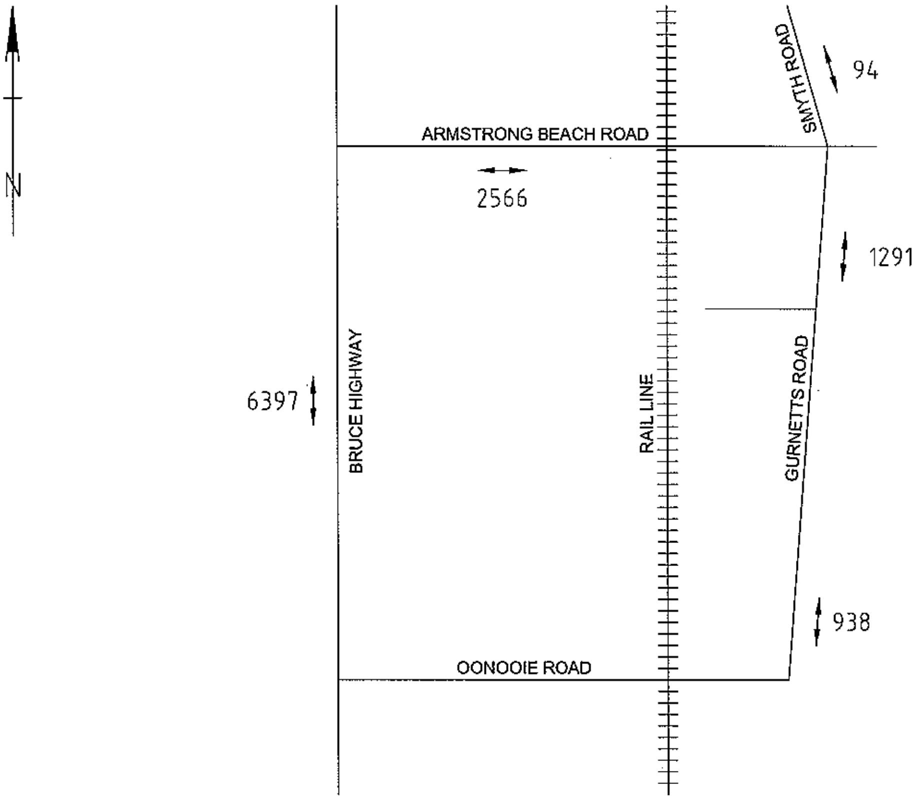
PEAK PERIOD TRAFFIC FLOW



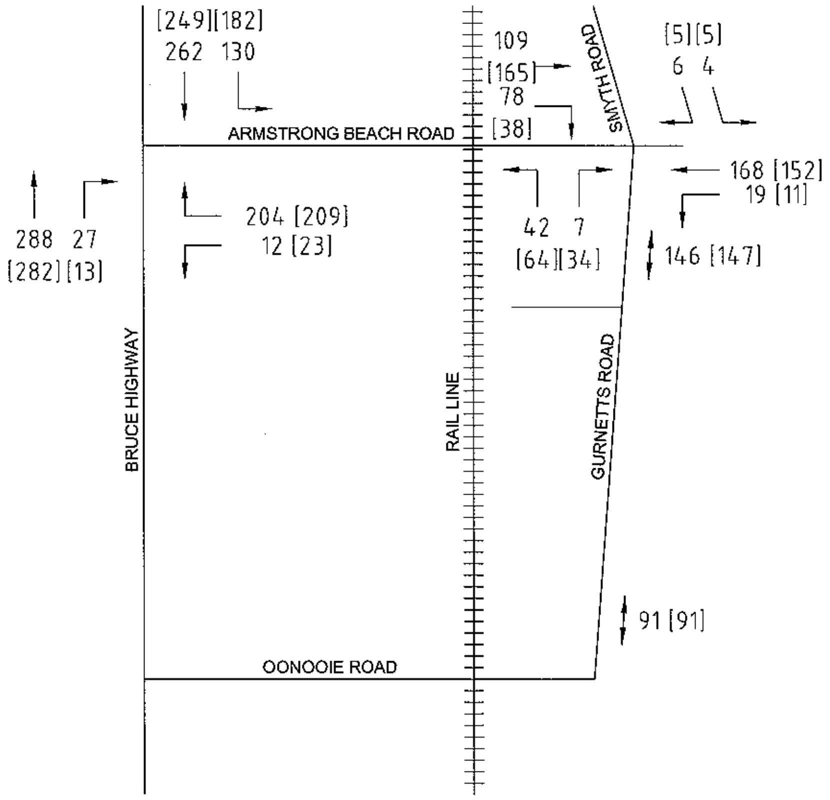
JILALAN TRAFFIC IMPACT ASSESSMENT

FIGURE 10:
2008 TRAFFIC FLOWS WITH
THE CLOSURE OF OONOOIE RD

DAILY TRAFFIC FLOWS



PEAK PERIOD TRAFFIC FLOW



KEY:

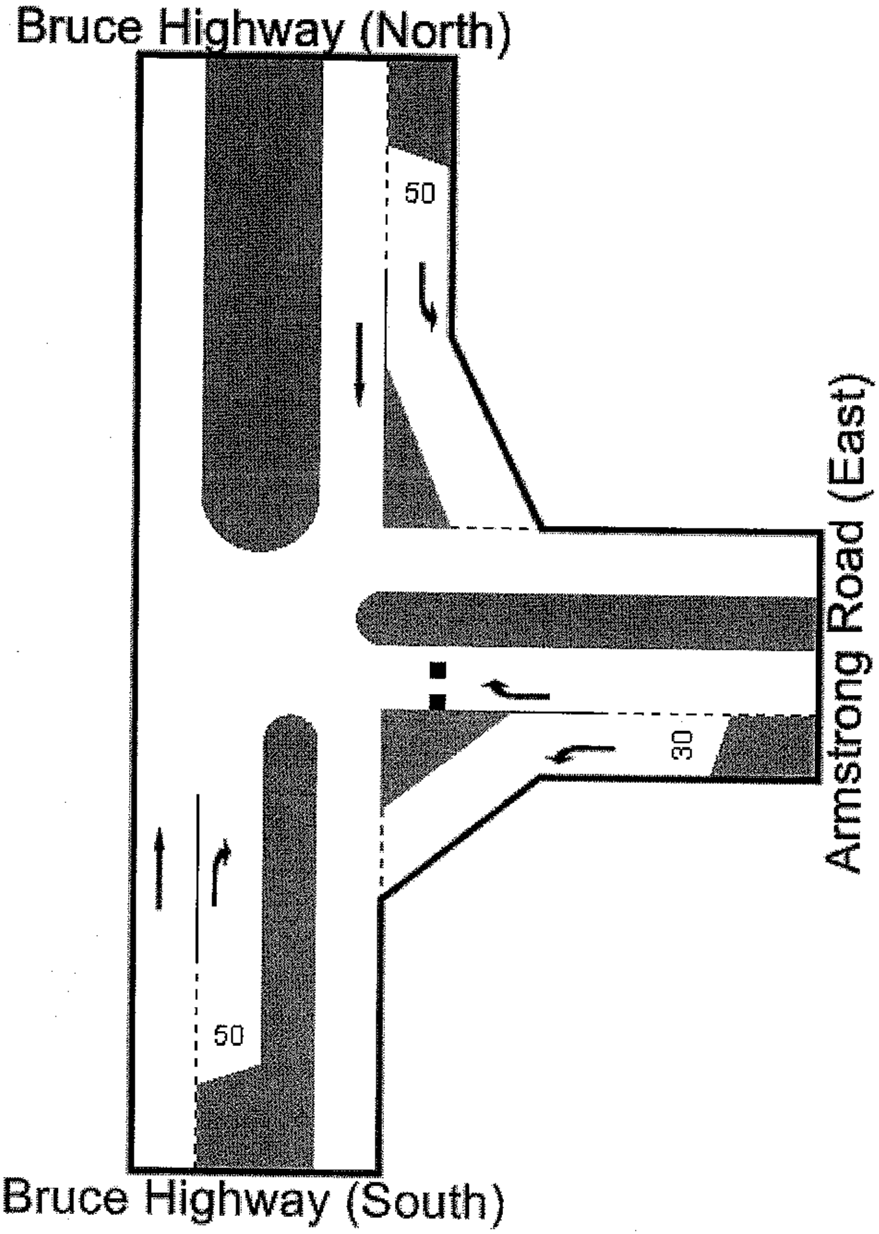
• 82	- AM PEAK
[82]	- PM PEAK

JILALAN TRAFFIC IMPACT ASSESSMENT

FIGURE 11:
2018 TRAFFIC FLOWS WITH
THE CLOSURE OF OONOOIE RD

Appendix D

SIDRA Output


Bruce Highway (North)
50
Armstrong Road (East)
30
50
Bruce Highway (South)

SIDRA INTERSECTION

Movement Summary

2008 AM - Bruce Hwy / Armstrong Road

2008 Traffic Flows with closure of Oonooie Road

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bruce Highway (South)										
2	T	167	18.0	0.086	0.0	LOS A	0	0.00	0.00	80.0
3	R	15	20.0	0.017	12.3	LOS B	1	0.38	0.66	54.8
Approach		**182**	**18.1**	**0.086**	**1.0**	**LOS A**	**1**	**0.03**	**0.05**	**77.4**
Armstrong Road (East)										
4	L	10	20.0	0.014	9.5	LOS A	0	0.34	0.59	48.0
6	R	134	17.9	0.354	18.2	LOS C	18	0.65	0.94	40.5
Approach		**144**	**18.1**	**0.354**	**17.6**	**LOS C**	**18**	**0.63**	**0.91**	**40.9**
Bruce Highway (North)										
7	L	112	17.9	0.057	8.1	LOS A	0	0.00	0.60	49.8
8	T	143	18.2	0.073	0.0	LOS A	0	0.00	0.00	60.0
Approach		**255**	**18.0**	**0.073**	**3.5**	**LOS A**		**0.00**	**0.26**	**55.0**
All Vehicles		**581**	**18.1**	**0.354**	**6.2**	**Not Applicable**	**18**	**0.16**	**0.36**	**55.9**

SIDRA SOLUTIONS

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Processed Jan 30, 2007 04:48:18PM

SIDRA
INTERSECTION

Movement Summary

2008 PM - Bruce Hwy / Armstrong Road

2008 Traffic Flows with closure of Oonooie Road

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bruce Highway (South)										
2	T	164	18.3	0.084	0.0	LOS A	0	0.00	0.00	80.0
3	R	4	25.0	0.005	12.5	LOS B	0	0.40	0.64	54.7
Approach		**168**	**18.5**	**0.084**	**0.3**	**LOS A**	**0**	**0.01**	**0.02**	**79.2**
Armstrong Road (East)										
4	L	17	17.6	0.024	9.5	LOS A	1	0.34	0.60	47.9
6	R	146	17.8	0.382	18.5	LOS C	20	0.65	0.95	40.2
Approach		**163**	**17.8**	**0.383**	**17.6**	**LOS C**	**20**	**0.62**	**0.92**	**40.9**
Bruce Highway (North)										
7	L	122	18.0	0.063	8.1	LOS A	0	0.00	0.60	49.8
8	T	148	18.2	0.076	0.0	LOS A	0	0.00	0.00	60.0
Approach		**270**	**18.1**	**0.076**	**3.6**	**LOS A**		**0.00**	**0.27**	**54.9**
All Vehicles		**601**	**18.1**	**0.382**	**6.5**	**Not Applicable**	**20**	**0.17**	**0.37**	**55.2**

SIDRA SOLUTIONS

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SIDRA
INTERSECTION

Movement Summary

2018 AM - Bruce Hwy / Armstrong Road

2018 Traffic Flow with Closure of Oonooie Road

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bruce Highway (South)										
2	T	288	18.1	0.148	0.0	LOS A	0	0.00	0.00	80.0
3	R	27	18.5	0.035	13.4	LOS B	1	0.48	0.73	53.5
Approach		**315**	**18.1**	**0.148**	**1.1**	**LOS A**	**1**	**0.04**	**0.06**	**77.1**
Armstrong Road (East)										
4	L	12	16.7	0.017	10.5	LOS B	1	0.43	0.64	47.2
6	R	204	18.1	0.976	91.3	LOS F	121	0.99	1.92	17.2
Approach		**216**	**18.1**	**0.977**	**86.9**	**LOS F**	**121**	**0.96**	**1.85**	**17.8**
Bruce Highway (North)										
7	L	130	17.7	0.067	8.1	LOS A	0	0.00	0.60	49.8
8	T	262	17.9	0.134	0.0	LOS A	0	0.00	0.00	60.0
Approach		**392**	**17.9**	**0.134**	**2.7**	**LOS A**		**0.00**	**0.20**	**56.1**
All Vehicles		**923**	**18.0**	**0.976**	**21.9**	**Not Applicable**	**121**	**0.24**	**0.54**	**40.6**

SIDRA SOLUTIONS

A0105, CONNEL WAGNER, Large Office
Produced by SIDRA Intersection 3.0.060813.12

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Processed Jan 30, 2007 04:53:04PM

SIDRA
INTERSECTION

Movement Summary

2018 PM - Bruce Hwy / Armstrong Road

2018 Traffic Flows with Closure of Oonooie Road

Give-way

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Bruce Highway (South)										
2	T	282	13.1	0.145	0.0	LOS A	0	0.00	0.00	80.0
3	R	13	15.4	0.017	13.1	LOS B	1	0.48	0.70	53.6
Approach		**295**	**13.2**	**0.145**	**0.6**	**LOS A**	**1**	**0.02**	**0.03**	**78.5**
Armstrong Road (East)										
4	L	23	13.0	0.032	10.2	LOS B	1	0.43	0.65	47.4
6	R	209	12.9	0.826	46.0	LOS E	67	0.93	1.44	26.6
Approach		**232**	**12.9**	**0.827**	**42.5**	**LOS E**	**67**	**0.88**	**1.37**	**27.8**
Bruce Highway (North)										
7	L	182	13.2	0.093	7.9	LOS A	0	0.00	0.60	49.8
8	T	249	12.9	0.128	0.0	LOS A	0	0.00	0.00	60.0
Approach		**431**	**13.0**	**0.128**	**3.4**	**LOS A**		**0.00**	**0.25**	**55.2**
All Vehicles		**958**	**13.0**	**0.826**	**12.0**	**Not Applicable**	**67**	**0.22**	**0.45**	**48.9**

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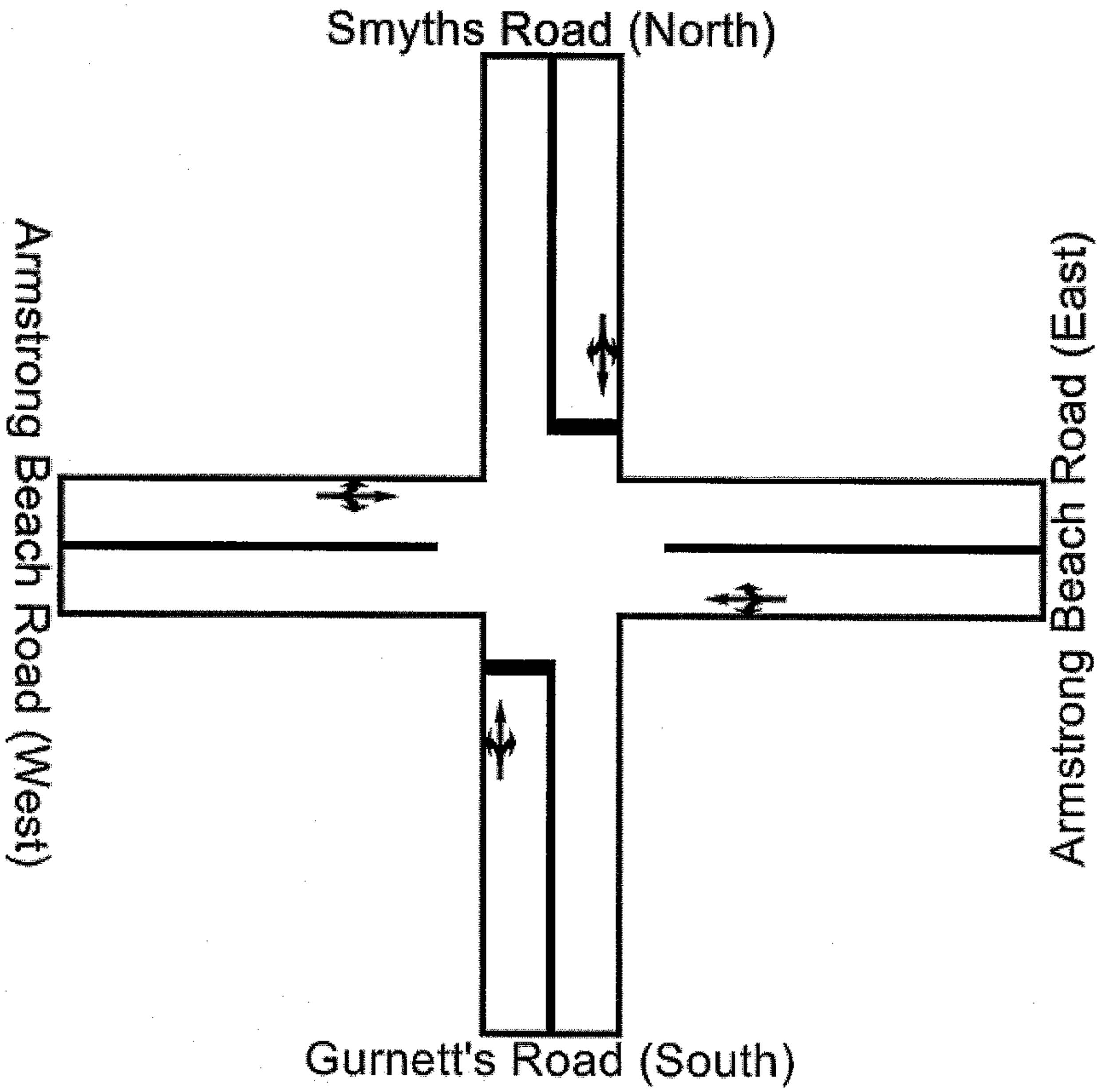
Smyths Road (North)
Armstrong Beach Road (West)
Armstrong Beach Road (East)
Gurnett's Road (South)

SIDRA INTERSECTION

Movement Summary

2018 AM

Armstrong Beach Road / Smyths Road / Gurnetts Road

Two-way stop

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Gurnetts Road (South)										
1	L	42	73.8	0.149	21.0	LOS C	8	0.50	0.91	36.6
2	T	10	0.0	0.149	16.1	LOS C	8	0.50	0.97	36.9
3	R	7	71.4	0.149	20.9	LOS C	8	0.50	0.98	36.5
Approach		**59**	**61.0**	**0.149**	**20.2**	**LOS C**	**8**	**0.50**	**0.93**	**36.6**
Armstrong Beach Road (East)										
4	L	19	73.7	0.121	11.8	LOS B	8	0.33	0.45	43.1
5	T	168	17.9	0.121	0.8	LOS A	8	0.33	0.00	53.7
6	R	10	20.0	0.120	10.0	LOS A	8	0.33	0.65	42.8
Approach		**197**	**23.4**	**0.121**	**2.3**	**LOS A**	**8**	**0.33**	**0.08**	**51.8**
Smyths Road (North)										
7	L	4	50.0	0.047	24.8	LOS C	2	0.53	0.78	32.4
8	T	2	50.0	0.048	24.6	LOS C	2	0.53	0.97	32.5
9	R	6	50.0	0.047	24.6	LOS C	2	0.53	0.91	32.3
Approach		**12**	**50.0**	**0.047**	**24.7**	**LOS C**	**2**	**0.53**	**0.87**	**32.4**
Armstrong Beach Road (West)										
10	L	10	100.0	0.208	15.5	LOS C	20	0.54	0.31	39.2
11	T	109	18.3	0.208	3.6	LOS A	20	0.54	0.00	50.5
12	R	78	74.7	0.208	15.1	LOS C	20	0.54	0.74	40.0
Approach		**198**	**44.9**	**0.208**	**8.8**	**LOS A**	**20**	**0.54**	**0.31**	**45.0**
All Vehicles		**466**	**38.0**	**0.208**	**7.9**	**Not Applicable**	**20**	**0.45**	**0.30**	**45.8**

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INTERSECTION

Movement Summary

2018 PM

Armstrong Beach Road / Smyths Road / Gurnetts Road

Two-way stop

Vehicle Movements

Mov ID	Turn	Dem Flow (veh/h)	%HV	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Prop. Queued	Eff. Stop Rate	Aver Speed (km/h)
Gurnetts Road (South)										
1	L	64	75.0	0.350	26.5	LOS D	24	0.58	0.98	32.3
2	T	10	0.0	0.345	21.6	LOS C	24	0.58	1.06	32.5
3	R	34	73.5	0.351	26.3	LOS D	24	0.58	1.05	32.2
Approach		**108**	**67.6**	**0.349**	**26.0**	**LOS D**	**24**	**0.58**	**1.01**	**32.3**
Armstrong Beach Road (East)										
4	L	11	72.7	0.106	12.2	LOS B	8	0.40	0.40	42.7
5	T	152	17.8	0.106	1.2	LOS A	8	0.40	0.00	52.6
6	R	10	20.0	0.106	10.4	LOS B	8	0.40	0.67	42.5
Approach		**173**	**21.4**	**0.106**	**2.4**	**LOS A**	**8**	**0.40**	**0.06**	**51.2**
Smyths Road (North)										
7	L	5	40.0	0.039	22.4	LOS C	2	0.54	0.81	34.2
8	T	2	50.0	0.039	22.2	LOS C	2	0.54	0.95	34.4
9	R	5	40.0	0.039	22.3	LOS C	2	0.54	0.90	34.1
Approach		**12**	**41.7**	**0.039**	**22.3**	**LOS C**	**2**	**0.54**	**0.87**	**34.2**
Armstrong Beach Road (West)										
10	L	10	100.0	0.164	14.7	LOS B	17	0.52	0.32	39.7
11	T	165	18.2	0.165	2.8	LOS A	17	0.52	0.00	50.7
12	R	38	73.7	0.165	14.3	LOS B	17	0.52	0.71	40.9
Approach		**213**	**31.9**	**0.165**	**5.4**	**LOS A**	**17**	**0.52**	**0.14**	**48.0**
All Vehicles		**506**	**36.2**	**0.351**	**9.2**	**Not Applicable**	**24**	**0.49**	**0.32**	**44.0**

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