Pavement Design Report

Jambin – Goovigen
Road Floodway

Document control sheet

Prepared by	Steve Luther
Title	Principal Civil Engineer
Location	HIG Toowoomba
Project No.	P11164
Version date	January 2025

Contact for enquiries and proposed changes

If you have any questions regarding this document or if you have a suggestion for improvements, please contact:

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Version history

Version No.	Date	Changed By	Nature of Amendment
1	10/01/2025	Steve Luther	Initial Issue

Final Report

Approved by: Steve Luther RPEQ: 13118

Disclaimer:

HIG has undertaken this report based on accepted engineering practices, standards, and information available at the time of writing. It is not intended as a quote, guarantee or warranty and does not cover any latent defects.

HIG does not accept any responsibility for the authentication of accuracy of supplied information or validation of data that is outside the scope of works.

HIG is not accountable for any changes to the standards, physical infrastructure conditions or planning impacts that occur after the completion date of the assessment.

This report has been prepared specifically for the aforementioned client, site and project. It has been written solely for the purpose of providing engineering advice on the above issues for the Client specific for the site/location.

Please note that this report has been compiled based on the information that is current at the time of report printing, and that the recommendations supplied within this report are based solely on the above.

No further analysis has been undertaken beyond the project limits.

Table of Contents

1. Introduction

Harrison Infrastructure Group (HIG) has been engaged by Banana Shire Council (BRC) to design upgrade works for the Jambin – Goovigen Road floodway at Ch 10,050, which is located approximately 10 km from Jambin and approximately 1 km from Goovigen. This report covers the pavement designs for the upgrade works at the floodway.

Refer Figure 1 project location.

Figure 1 – Project Location

The existing concrete pavement in the middle of the floodway is in poor condition, with significant cracking and displacements. Asphalt surfacing over the concrete has been lost in some areas. A photo of the existing concrete floodway condition is shown below.

Figure 2 - Existing condition of concrete floodway pavement

The road approaches to the floodway are also in poor condition, with significant cracking, rutting and loss of shape. These defects indicate the existing pavement depths and material quality are inadequate for the subgrade support conditions. A photo of the existing pavement condition of the road approaches is shown below.

Figure 3 - Existing condition of road approaches

The proposed upgrade at the floodway includes:

- Bed level floodway, with improved vertical geometry to achieve required sight lines to the floodway surface.
- Concrete floodway replacement (approx. Ch 10,035 – 10,080) to be in accordance with Std Dwg. CMDG-R-094. No pavement design required for this section.
- Full reconstruction of road approaches for extent of vertical regrading (approx. Ch 10,005 – 10,035 and Ch 10,080 – 10,130). Flexible pavement with sprayed seal surfacing proposed for the road approaches.

2. Design Traffic

Traffic counts from 2022 were available for Jambin – Goovigen Road approx. 1.9 km from the Burnett Highway. Refer Appendix A. The following is a summary of the traffic counts.

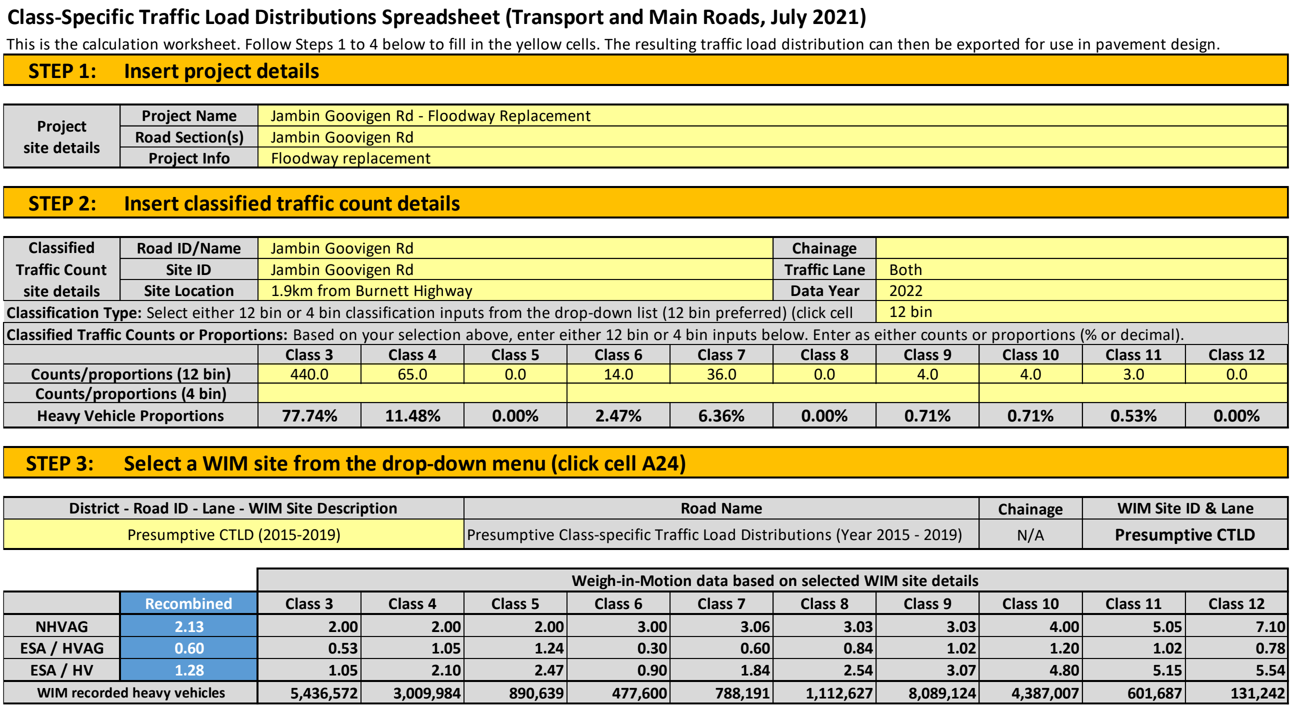
Location	AADT$_{(2022)}$	Heavy Vehicles
1.9 km from the Burnett Highway	141	28%

Table 1 - Summary of Traffic Counts (Jambin – Goovigen Road)

As no historic traffic counts are available, a presumptive heavy vehicle annual growth rate of 2% has been adopted for this pavement design (refer Table 7.4.5 of the *Pavement Design Supplement*).

2025 has been used as the estimated year of opening, and a 20-year pavement design life has been used.

As per Method 3 in Appendix E of the *Pavement Design Supplement*, the Traffic Load Distributions (TLDs) have been estimated based on presumptive class-specific TLDs and the classified vehicle count from Jambin – Goovigen Road. As shown below, NHVAG = 2.13 and ESAs/HVAG = 0.6 have been calculated.



Class-Specific Traffic Load Distributions Spreadsheet (Transport and Main Roads, July 2021)

This is the calculation worksheet. Follow Steps 1 to 4 below to fill in the yellow cells. The resulting traffic load distribution can then be exported for use in pavement design.

STEP 1: Insert project details

Project site details	**Project Name**	Jambin Goovigen Rd - Floodway Replacement
	Road Section(s)	Jambin Goovigen Rd
	Project Info	Floodway replacement

STEP 2: Insert classified traffic count details

Classified Traffic Count site details	**Road ID/Name**	Jambin Goovigen Rd	**Chainage**	
	Site ID	Jambin Goovigen Rd	**Traffic Lane**	Both
	Site Location	1.9km from Burnett Highway	**Data Year**	2022

Classification Type: Select either 12 bin or 4 bin classification inputs from the drop-down list (12 bin preferred) (click cell — 12 bin

Classified Traffic Counts or Proportions: Based on your selection above, enter either 12 bin or 4 bin inputs below. Enter as either counts or proportions (% or decimal).

	Class 3	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12
Counts/proportions (12 bin)	440.0	65.0	0.0	14.0	36.0	0.0	4.0	4.0	3.0	0.0
Counts/proportions (4 bin)										
Heavy Vehicle Proportions	77.74%	11.48%	0.00%	2.47%	6.36%	0.00%	0.71%	0.71%	0.53%	0.00%

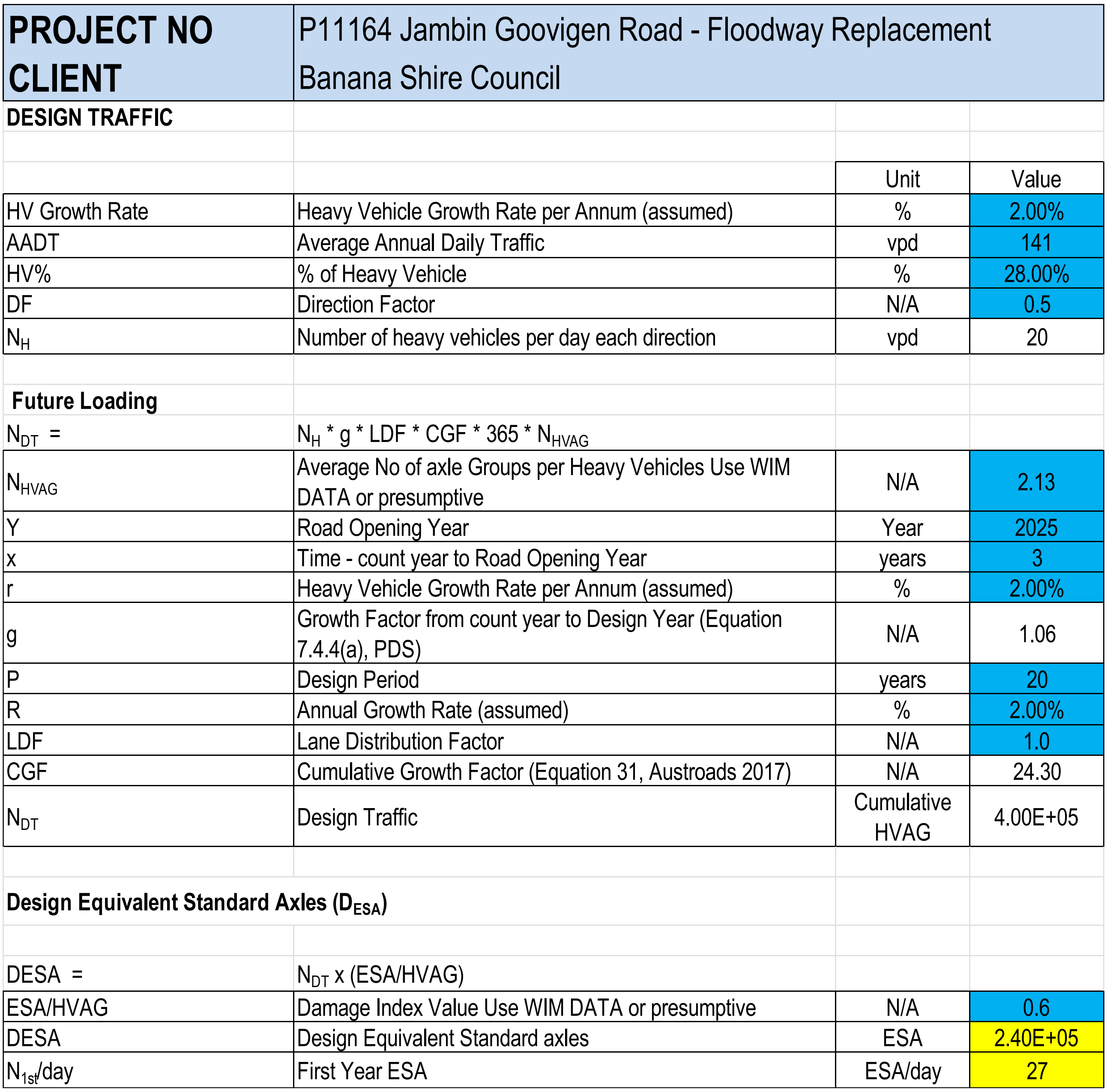
STEP 3: Select a WIM site from the drop-down menu (click cell A24)

District - Road ID - Lane - WIM Site Description	Road Name	Chainage	WIM Site ID & Lane
Presumptive CTLD (2015-2019)	Presumptive Class-specific Traffic Load Distributions (Year 2015 - 2019)	N/A	**Presumptive CTLD**

		Weigh-in-Motion data based on selected WIM site details									
	Recombined	Class 3	Class 4	Class 5	Class 6	Class 7	Class 8	Class 9	Class 10	Class 11	Class 12
NHVAG	2.13	2.00	2.00	2.00	3.00	3.06	3.03	3.03	4.00	5.05	7.10
ESA / HVAG	0.60	0.53	1.05	1.24	0.30	0.60	0.84	1.02	1.20	1.02	0.78
ESA / HV	1.28	1.05	2.10	2.47	0.90	1.84	2.54	3.07	4.80	5.15	5.54
WIM recorded heavy vehicles		5,436,572	3,009,984	890,639	477,600	788,191	1,112,627	8,089,124	4,387,007	601,687	131,242

Figure 4 - Class Specific Traffic Load Distributions (Jambin – Goovigen Road)

The following is a summary of the design traffic calculations.



PROJECT NO	P11164 Jambin Goovigen Road - Floodway Replacement		
CLIENT	Banana Shire Council		
DESIGN TRAFFIC			
		Unit	Value
HV Growth Rate	Heavy Vehicle Growth Rate per Annum (assumed)	%	2.00%
AADT	Average Annual Daily Traffic	vpd	141
HV%	% of Heavy Vehicle	%	28.00%
DF	Direction Factor	N/A	0.5
N_H	Number of heavy vehicles per day each direction	vpd	20
Future Loading			
N_{DT} =	$N_H * g * LDF * CGF * 365 * N_{HVAG}$		
N_{HVAG}	Average No of axle Groups per Heavy Vehicles Use WIM DATA or presumptive	N/A	2.13
Y	Road Opening Year	Year	2025
x	Time - count year to Road Opening Year	years	3
r	Heavy Vehicle Growth Rate per Annum (assumed)	%	2.00%
g	Growth Factor from count year to Design Year (Equation 7.4.4(a), PDS)	N/A	1.06
P	Design Period	years	20
R	Annual Growth Rate (assumed)	%	2.00%
LDF	Lane Distribution Factor	N/A	1.0
CGF	Cumulative Growth Factor (Equation 31, Austroads 2017)	N/A	24.30
N_{DT}	Design Traffic	Cumulative HVAG	4.00E+05
Design Equivalent Standard Axles (D_{ESA})			
DESA =	N_{DT} x (ESA/HVAG)		
ESA/HVAG	Damage Index Value Use WIM DATA or presumptive	N/A	0.6
DESA	Design Equivalent Standard axles	ESA	2.40E+05
N_{1st}/day	First Year ESA	ESA/day	27

Figure 5 – Design Traffic Data for Jambin – Goovigen Road

As shown above, the DESA for Jambin – Goovigen Road is 2.40 x 10^5.

3. Subgrade Evaluation

A geotechnical investigation has been completed by Douglas Partners, and is included in Appendix B.

The approx. locations of the boreholes are shown in Figure 6.

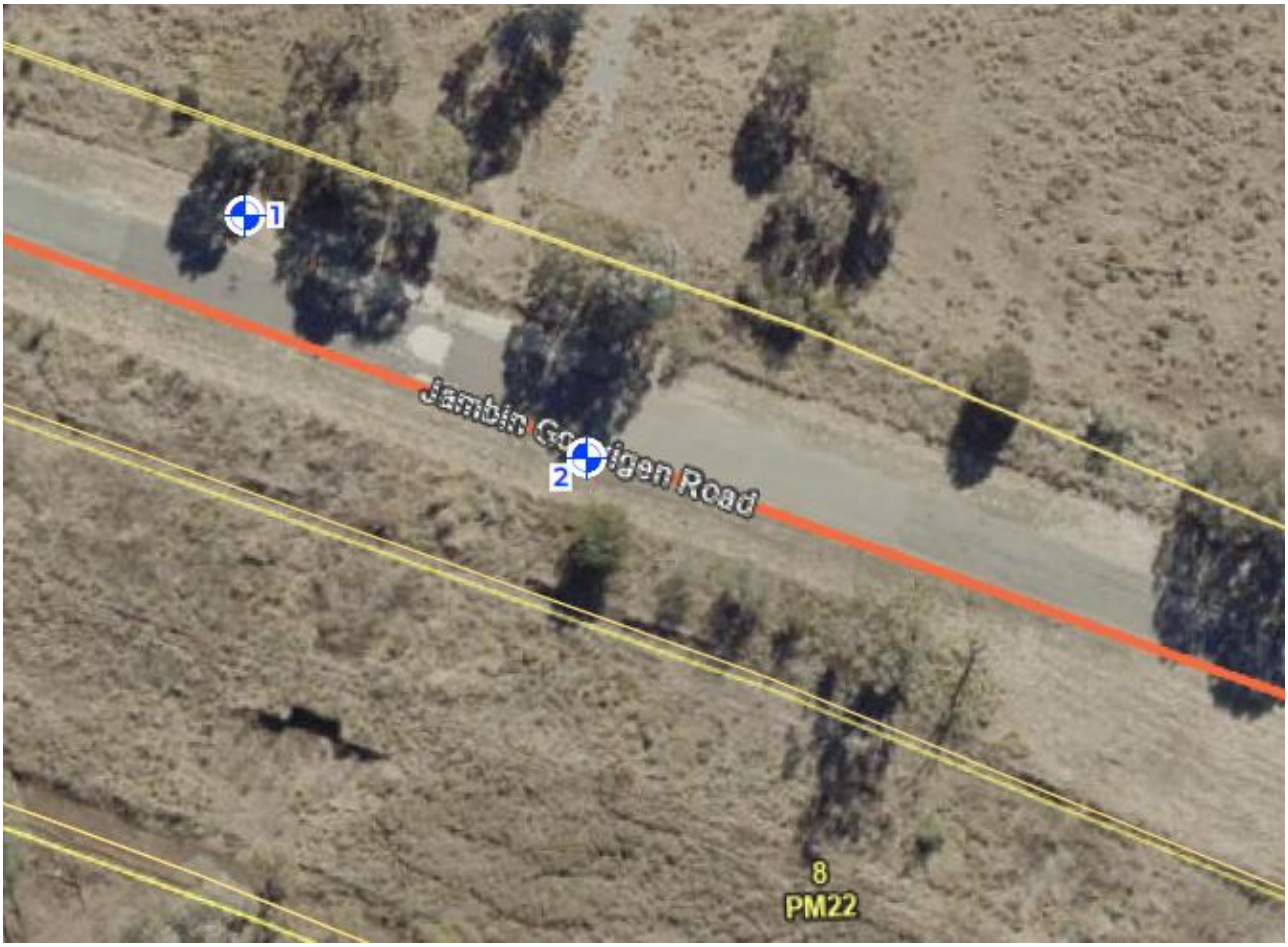
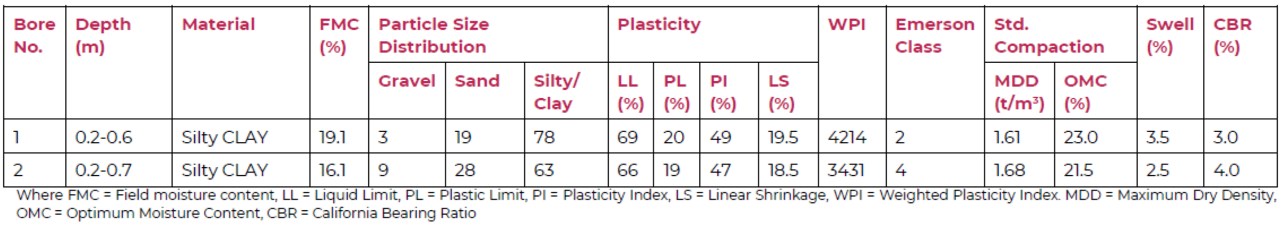


Figure 6 - Location of Boreholes

The table below shows a summary of the laboratory testing completed.



Bore No.	Depth (m)	Material	FMC (%)	Particle Size Distribution			Plasticity				WPI	Emerson Class	Std. Compaction		Swell (%)	CBR (%)
				Gravel	Sand	Silty/ Clay	LL (%)	PL (%)	PI (%)	LS (%)			MDD (t/m³)	OMC (%)		
1	0.2-0.6	Silty CLAY	19.1	3	19	78	69	20	49	19.5	4214	2	1.61	23.0	3.5	3.0
2	0.2-0.7	Silty CLAY	16.1	9	28	63	66	19	47	18.5	3431	4	1.68	21.5	2.5	4.0

Where FMC = Field moisture content, LL = Liquid Limit, PL = Plastic Limit, PI = Plasticity Index, LS = Linear Shrinkage, WPI = Weighted Plasticity Index. MDD = Maximum Dry Density, OMC = Optimum Moisture Content, CBR = California Bearing Ratio

Table 2 - Summary of Laboratory Test Results (extract from the geotechnical investigation in Appendix B)

Due to the small number of test sites, the lowest value of the soaked CBR test results (3) will be adopted as the design subgrade CBR.

The subgrade test results were also analysed in relation to their expansive nature, with reference to Table 5.2 of *Austroads Guide to Pavement Design Technology, Part 2: Pavement Structural Design*. The test results were categorised as moderate to high expansive nature.

4. Pavement Design

Due to the potential for the road approaches to the floodway to be inundated, the proposed pavement structure for the road approaches is lightly bound base pavement with sprayed seal surfacing.

In accordance with Clause 8.2.9 of the *Pavement Design Supplement*, the minimum thickness of the lightly bound base is 200 mm. This thickness of lightly bound base was also checked against the requirements of Figure 8.2.9 of the *Pavement Design Supplement*.

In accordance with Clause 8.2.8 of the *Pavement Design Supplement*, the lightly bound base is typically supported on a subbase with thickness of at least 150 mm and which achieves a vertical design modulus of at least 150 MPa at the top of the subbase. To achieve this vertical design modulus at the top of the subbase, either 150 mm of lightly bound subbase or 300 mm of unbound subbase would be required.

Circly was used to analyse these pavement structures, and the following layer depths were found to be required.

Layer	Material	Depth (mm)	
		Option 1 (Lightly Bound Subbase)	Option 2 (Unbound Subbase)
Base	Lightly Bound Base (UCS of 1.0 to 2.0 MPa at 28 days)	200	210
Subbase	Type 2.3	N/A	300
	Lightly Bound Subbase (UCS of 1.0 to 2.0 MPa at 28 days)	150	N/A

Table 3 - Summary of pavement depths required for 2 options

Refer Appendix C for Circly outputs.

The reduced depth of Option 1 is expected to be the most cost efficient pavement structure.

If construction is undertaken in dry conditions, Subgrade Treatment Type A is expected to be sufficient for the road approaches. It is recommended to also include provisional quantities of Subgrade Treatment Types B and E in the schedule in case soft subgrade conditions are encountered during construction.

5. Conclusions

A summary of the proposed pavement configuration for the road approaches to the floodway is shown below.

Layer	Material	Depth (mm)
Seal (S/S)	14 mm C170 (estimated spray rate 1.8 L/m^2, estimated spread rate 100 m^2/m^3)	6 (nom)
Prime	AMC00 (estimated spray rate 0.8 L/m^2)	N/A
Base	Lightly Bound Base (UCS of 1.0 to 2.0 MPa at 28 days)	200
Subbase	Lightly Bound Subbase (UCS of 1.0 to 2.0 MPa at 28 days)	150

Table 4 - Summary of proposed pavement configuration

6. References

Capricorn Municipal Development Guidelines: Pavement Design D2, CMDG, 2021

Guide to Pavement Design Technology Part 2: Pavement Structural Design, Austroads, 2024

Pavement Design Supplement - Supplement to 'Part 2: Pavement Structural Design' of the Austroads Guide to Pavement Technology, TMR, 2021

Appendix A – Traffic Counts

Jambin Goovigen Road

Counter CH: 1.9kms from Burnett I
Count Start: 0:00 Tuesday, 31 May 2022
Count Duration: 14
Count End: 0:00 Tuesday, 14 June 2022

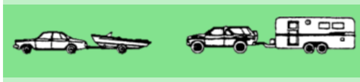
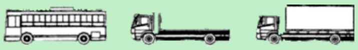
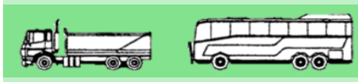
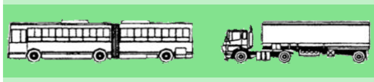
Traffic Count Details

Total Vehicles	AWDT	AADT	ADT	AADT HV	% HV	HV Classes
1984	150	141	142	40	28	4 to 12

Speed Statistics

Speed Limit	Min Speed	Av Speed	Max Speed	85% Speed	% Exceeding Speed
100 km/h	148.3	91.3	148.3	104.9	26.61 %

Vehicle Classification System

	Class 1	Count %	ADT	AWDT	AWET
	1350	68.04%	96	103	81
	Class 2	Count %	ADT	AWDT	AWET
	68	3.427	5	5	4
	Class 3	Count %	ADT	AWDT	AWET
	440	22.18	31	34	25
	Class 4	Count %	ADT	AWDT	AWET
	65	3.276	5	4	7
	Class 5	Count %	ADT	AWDT	AWET
	0	0.000	0	0	0
	Class 6	Count %	ADT	AWDT	AWET
	14	0.706	1	1	1
	Class 7	Count %	ADT	AWDT	AWET
	36	1.815	3	3	3
	Class 8	Count %	ADT	AWDT	AWET
	0	0.000	0	0	0
	Class 9	Count %	ADT	AWDT	AWET
	4	0.202	0	0	0
	Class 10	Count %	ADT	AWDT	AWET
	4	0.202	0	0	1
	Class 11	Count %	ADT	AWDT	AWET
	3	0.151	0	0	0
	Class 12	Count %	ADT	AWDT	AWET
	0	0.000	0	0	0

Appendix B – Soil Test Results

Investigation Summary Report

Client	Harrison Infrastructure Group Pty Ltd	Project No.	231327.00
Project	Floodway Replacement	Date	25 Nov. 24
Address	Jambin Goovigen Road, Goovigen	Reference	R.001.Rev0

1. Introduction

This report presents the factual results of a geotechnical investigation undertaken by Douglas Partners Pty Ltd (Douglas) for a proposed floodway replacement along Jambin Goovigen Road, Goovigen.

The investigation was undertaken at the request of Harrison Infrastructure Group Pty Ltd in general accordance with Douglas' proposal 231327.00.P.001.Rev0 dated 12 August 2024 and following authorisation to proceed dated 25 October 2024.

The investigation comprised the drilling of two bores, followed by laboratory testing of selected samples. The details of the field work and laboratory testing are presented in this report.

This report must be read in conjunction with the attached notes entitled "About This Report" along with any other explanatory notes and should be kept in its entirety without separation of individual pages or sections.

2. Site Description

The site for the proposed floodway replacement is located along Jambin Goovigen Road, Goovigen (refer to Drawing 1 attached) approximately 800 m east of the Goovigen township.

The photograph in Figure 1 indicates typical site conditions at the time of investigation.

3. Regional Geology

Reference to the Geological Survey of Queensland's detailed surface geology mapping indicates the site is located in an area underlain by Quaternary aged floodplain alluvium described as typically comprising "*Clay, silt, sand and gravel*".

The natural subsurface conditions encountered during the investigation comprised silty clay, inferred to be alluvial, which is considered to be consistent with the geology described above.

Figure 1: Typical site conditions

4. Field Work

4.1 Field Work Methods

The field work was carried out on 31 October 2024 and comprised the drilling of two bores (designated as Bores 1 and 2). The bore locations were set out as close as practical to nominated locations, with the bore locations and surface level recorded afterwards using a DGPS device. It is important to note that Douglas is not a registered surveyor, hence the coordinates and elevations are considered to be approximate. The approximate bore locations are indicated on Drawing 1 attached.

The bores were drilled to 2.0 m depth with a 4WD ute mounted Drillman GT10-KD drilling rig using continuous flight augers fitted with a tungsten carbide (TC) bit. Dynamic cone penetrometer (DCP) and pocket penetrometer (pp) testing was carried out to assess the relative density and strength consistency of the subgrade soils. On completion, the bores were observed for groundwater seepage and then backfilled with spoil which was tamped into the holes.

The field work was undertaken by experienced geotechnical personnel who operated the drill rig, logged the bores, and collected samples for visual and tactile assessment and for subsequent laboratory testing. Strata identification was undertaken through observation of cutting returns and recovered samples. Field descriptions and samples were checked by a geotechnical engineer and have been corrected on the borehole logs where appropriate to reflect the available laboratory test results.

4.2 **Field Work Results**

The subsurface conditions encountered in the bores are described in detail on the attached borehole logs, together with accompanying notes which define the classification methods and descriptive terms used. The depths were measured below existing surface levels at the time of investigation.

In summary, the subsurface conditions encountered comprised surficial sandy gravelly clay fill to 0.15 m and 0.2 m depth in Bores 1 and 2 respectively, overlying silty clay which continued to bore termination at 2.0 m depth. The strength consistency of the clays was generally very stiff to hard initially, becoming very stiff at depth.

No groundwater seepage was observed in any of the bores at the time of drilling or prior to backfilling. It should be noted that groundwater depths and ground moisture conditions are affected by climatic conditions, soil permeability, drainage conditions and human influence; and will therefore vary time.

5. Laboratory Testing

Samples recovered from the bores were tested in the laboratory for engineering properties of plasticity and particle size distribution for classification purposes.

In addition, Standard compaction and single point soaked California bearing ratio (CBR) tests were undertaken on the samples. The samples were first screened over the 19 mm sieve, as required by the test standard, and were then compacted to 97% Standard dry density ratio at near to optimum moisture content (OMC). The samples were soaked for a minimum of 10 days under a 4.5kg surcharge.

The results of the laboratory testing are summarised in Table 1 with material test reports attached.

Table 1: Results of Laboratory Testing

Bore No.	Depth (m)	Material	FMC (%)	Particle Size Distribution			Plasticity				WPI	Emerson Class	Std. Compaction		Swell (%)	CBR (%)
				Gravel	Sand	Silty/ Clay	LL (%)	PL (%)	PI (%)	LS (%)			MDD (t/m^3)	OMC (%)		
1	0.2-0.6	Silty CLAY	19.1	3	19	78	69	20	49	19.5	4214	2	1.61	23.0	3.5	3.0
2	0.2-0.7	Silty CLAY	16.1	9	28	63	66	19	47	18.5	3431	4	1.68	21.5	2.5	4.0

Where FMC = Field moisture content, LL = Liquid Limit, PL = Plastic Limit, PI = Plasticity Index, LS = Linear Shrinkage, WPI = Weighted Plasticity Index. MDD = Maximum Dry Density, OMC = Optimum Moisture Content, CBR = California Bearing Ratio

6. Limitations

Douglas Partners Pty Ltd (Douglas) has prepared this report for the proposed floodway replacement on Jambin Goovigen Road, Goovigen. This report is provided for the exclusive use of Harrison Infrastructure Group Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of Douglas, does so entirely at its own risk and without recourse to Douglas for any loss or damage. In preparing this report Douglas has necessarily relied upon information provided by the client and/or their agents.

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

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

If you have any questions or require further clarification on any matter in this report, please feel free to contact the undersigned at our Sunshine Coast office.

Douglas Partners Pty Ltd

Caroline Jarrett
Geotechnical Engineer

Reviewed by

Brett Egen (RPEQ8597)
Principal

Attachments:
About This Report
Drawing 1 - Test Location Plan
Sampling, Testing and Excavation Methodology
Soil Descriptions
Borehole Logs
Laboratory Test Results

About this Report

October 2024

Introduction

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

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

Copyright

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Engagement Terms for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

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

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

Groundwater

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

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

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

Reports

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

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

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

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

Site Anomalies

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

Information for Contractual Purposes

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

Site Inspection

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

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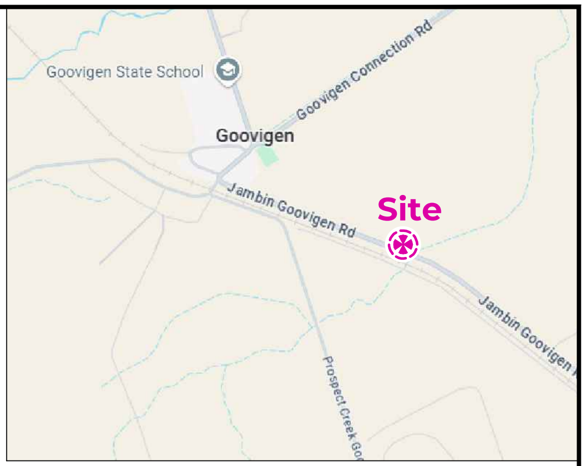

Location Plan

LEGEND:-

⊕ Bore Location and Number

REV	DESCRIPTION/COMMENT	DATE	DRAWN BY
0		01/11/2024	JST

: ZONE 56
COORDINATE REFERENCE SYSTEM: MGA2020

N

OFFICE: SUNSHINE COAST
2 Mallet Street, Kunda Park, QLD 4556

CLIENT:
Harrison Infrastructure Group Pty Ltd

SCALE:

NOTE:
- Base image from Qld Globe.
- Site locality image from Google Maps. Not to scale.

PROJECT NAME:
Floodway Replacement

PROJECT ADDRESS:
Jambin Goovigen Road, Goovigen

DRAWING TITLE:
TEST LOCATION PLAN

PROJECT No:
231327.00

DRAWING No:
1

REVISION:
0

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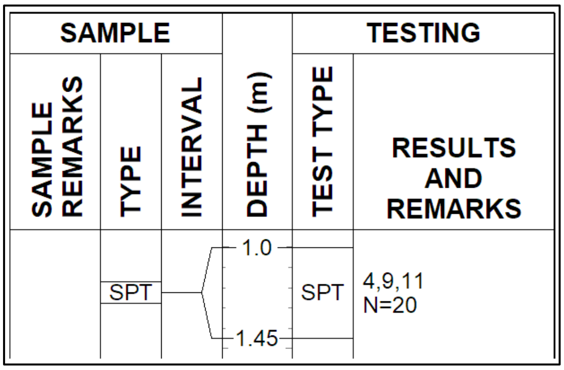
Sampling, Testing and Excavation Methodology

October 2024

Sampling and Testing

A record of samples retained, and field testing performed is usually shown on a Douglas Partners' log with samples appearing to the left of a depth scale, and selected field and laboratory testing (including results, where relevant) appearing to the right of the scale, as illustrated below:



Sampling

The type or intended purpose for which a sample was taken is indicated by the following abbreviation codes.

Sample Type	Code
Auger sample	A
Acid Sulfate sample	ASS
Bulk sample	B
Core sample	C
Disturbed sample	D
Environmental sample	ES
Driven Tube sample	DT
Gas sample	G
Piston sample	P
Sample from SPT test	SPT
Undisturbed tube sample	U[1]
Water sample	W
Material Sample	MT
Core sample for unconfined compressive strength testing	UCS

[1] – numeric suffixes indicate tube diameter/width in mm

The above codes only indicate that a sample was retained, and not that testing was scheduled or performed.

Field and Laboratory Testing

A record that field and laboratory testing was performed is indicated by the following abbreviation codes.

Test Type	Code
Pocket penetrometer (kPa)	PP
Photo ionisation detector (ppm)	PID
Standard Penetration Test x/y =*x* blows for *y* mm penetration HB = hammer bouncing HW = fell under weight of hammer	SPT
Shear vane (kPa)	V
Unconfined compressive strength, (MPa)	UCS

Field and laboratory testing (continued)

Test Type	Code
Point load test, (MPa), axial (A), diametric (D), irregular (I)	PLT(_)
Dynamic cone penetrometer, followed by blow count penetration increment in mm (cone tip, generally in accordance with AS1289.6.3.2)	DCP9/150
Perth sand penetrometer, followed by blow count penetration increment in mm (flat tip, generally in accordance with AS1289.6.3.3)	PSP/150

Groundwater Observations

▷	seepage/inflow
▽	standing or observed water level
NFGWO	no free groundwater observed
OBS	observations obscured by drilling fluids

Drilling or Excavation Methods/Tools

The drilling/excavation methods used to perform the investigation may be shown either in a dedicated column down the left-hand edge of the log, or stated in the log footer. In some circumstances abbreviation codes may be used.

Method	Abbreviation Code
Direct Push	DP
Solid flight auger. Suffixes: /T = tungsten carbide tip, /V = v-shaped tip	AD[1]
Air Track	AT
Diatube	DT[1]
Hand auger	HA[1]
Hand tools (unspecified)	HAND
Existing exposure	X
Hollow flight auger	HSA[1]
HQ coring	HQ3
HMLC series coring	HMLC
NMLC series coring	NMLC
NQ coring	NQ3
PQ coring	PQ3
Predrilled	PD
Push tube	PT[1]
Ripping tyne/ripper	R
Rock roller	RR[1]
Rock breaker/hydraulic hammer	EH
Sonic drilling	SON[1]
Mud/blade bucket	MB[1]
Toothed bucket	TB[1]
Vibrocore	VC[1]
Vacuum excavation	VE
Wash bore (unspecified bit type)	WB[1]

[1] – numeric suffixes indicate tool diameter/width in mm

Soil Descriptions

Terminology
Symbols
Abbreviations

March 2024

Introduction

All materials which are not considered to be "in-situ rock" are described in general accordance with the soil description model of AS 1726-2017 Part 6.1.3, and can be broken down into the following description structure:

The "classification" comprises a two character "group symbol" providing a general summary of dominant soil characteristics. The "name" summarises the particle sizes within the soil which most influence its behaviour. The detailed description presents more information about composition, condition, structure, and origin of the soil.

Classification, naming and description of soils require the relative proportion of particles of different sizes within the whole soil mixture to be considered.

Particle size designation and Behaviour Model

Solid particles within a soil are differentiated on the basis of size.

The engineering behaviour properties of a soil can subsequently be modelled to be either "fine grained" (also known as "cohesive" behaviour) or "coarse grained" ("non cohesive" behaviour), depending on the relative proportion of fine or coarse fractions in the soil mixture.

Particle Size Designation	**Particle Size (mm)**	**Behaviour Model**	
		Behaviour	**Approximate Dry Mass**
Boulder	>200	Excluded from particle behaviour model as "oversize"	
Cobble	63 - 200		
Gravel[1]	2.36 - 63	Coarse	>65%
Sand[1]	0.075 - 2.36		
Silt	0.002 - 0.075	Fine	>35%
Clay	<0.002		

[1] – refer grain size subdivision descriptions below

The behaviour model boundaries defined above are not precise, and the material behaviour should be assumed from the name given to the material (which considers the particle fraction which dominates the behaviour, refer "component proportions" below), rather than strict observance of the proportions of particle sizes. For example, if a material is named a "Sandy CLAY", this is indicative that the material exhibits fine grained behaviour, even if the dry mass of coarse grained material may exceed 65%.

Component proportions

The relative proportion of the dry mass of each particle size fraction is assessed to be a "primary", "secondary", or "minor" component of the soil mixture, depending on its influence over the soil behaviour.

Component Proportion Designation	**Definition[1]**	**Relative Proportion**	
		In Fine Grained Soil	**In Coarse Grained Soil**
Primary	The component (particle size designation, refer above) which dominates the engineering behaviour of the soil	The clay/silt component with the greater proportion	The sand/gravel component with the greater proportion
Secondary	Any component which is not the primary, but is significant to the engineering properties of the soil	Any component with greater than 30% proportion	Any granular component with greater than 30%; or Any fine component with greater than 12%
Minor[2]	Present in the soil, but not significant to its engineering properties	All other components	All other components

[1] As defined in AS1726-2017 6.1.4.4

[2] In the detailed material description, minor components are split into two further sub-categories. Refer "identification of minor components" below.

Composite Materials

In certain situations, a lithology description may describe more than one material, for example, collectively describing a layer of interbedded sand and clay. In such a scenario, the two materials would be described independently, with the names preceded or followed by a statement describing the arrangement by which the materials co-exist. For example, "INTERBEDDED Silty CLAY AND SAND".

Soil Descriptions

Classification

The soil classification comprises a two character group symbol. The first character identifies the primary component. The second character identifies either the grading or presence of fines in a coarse grained soil, or the plasticity in a fine grained soil. Refer AS1726-2017 6.1.6 for further clarification.

Soil Name

For most soils, the name is derived with the primary component included as the noun (in upper case), preceded by any secondary components stated in an adjective form. In this way, the soil name also describes the general composition and indicates the dominant behaviour of the material.

Component[1]	Prominence in Soil Name
Primary	Noun (eg "CLAY")
Secondary	Adjective modifier (eg "Sandy")
Minor	No influence

[1] – for determination of component proportions, refer component proportions on previous page

For materials which cannot be disaggregated, or which are not comprised of rock or mineral fragments, the names "ORGANIC MATTER" or "ARTIFICIAL MATERIAL" may be used, in accordance with AS1726-2017 Table 14.

Commercial or colloquial names are not used for the soil name where a component derived name is possible (for example "Gravelly SAND" rather than "CRACKER DUST").

Materials of "fill" or "topsoil" origin are generally assigned a name derived from the primary/secondary component (where appropriate). In log descriptions this is preceded by uppercase "FILL" or "TOPSOIL". Origin uncertainty is indicated in the description by the characters (?) , with the degree of uncertainty described (using the terms "probably" or "possibly" in the origin column, or at the end of the description).

Identification of minor components

Minor components are identified in the soil description immediately following the soil name. The minor component fraction is usually preceded with a term indicating the relative proportion of the component.

Minor Component Proportion Term	Relative Proportion	
	In Fine Grained Soil	In Coarse Grained Soil
With	All fractions: 15-30%	Clay/silt: 5-12% sand/gravel: 15-30%
Trace	All fractions: 0-15%	Clay/silt: 0-5% sand/gravel: 0-15%

The terms "with" and "trace" generally apply only to gravel or fine particle fractions. Where cobbles/boulders are encountered in minor proportions (generally less than about 12%) the term "occasional" may be used. This term describes the sporadic distribution of the material within the confines of the investigation excavation only, and there may be considerable variation in proportion over a wider area which is difficult to factually characterise due to the relative size of the particles and the investigation methods.

Soil Composition

Plasticity

Descriptive Term	Laboratory liquid limit range	
	Silt	Clay
Non-plastic materials	Not applicable	Not applicable
Low plasticity	≤50	≤35
Medium plasticity	Not applicable	>35 and ≤50
High plasticity	>50	>50

Note, Plasticity descriptions generally describe the plasticity behaviour of the whole of the fine grained soil, not individual fine grained fractions.

Grain Size

Type		Particle size (mm)
Gravel	Coarse	19 - 63
	Medium	6.7 - 19
	Fine	2.36 – 6.7
Sand	Coarse	0.6 - 2.36
	Medium	0.21 - 0.6
	Fine	0.075 - 0.21

Grading

Grading Term	Particle size (mm)
Well	A good representation of all particle sizes
Poorly	An excess or deficiency of particular sizes within the specified range
Uniformly	Essentially of one size
Gap	A deficiency of a particular size or size range within the total range

Note, AS1726-2017 provides terminology for additional attributes not listed here.

Soil Condition

Moisture

The moisture condition of soils is assessed relative to the plastic limit for fine grained soils, while for coarse grained soils it is assessed based on the appearance and feel of the material. The moisture condition of a material is considered to be independent of stratigraphy (although commonly these are related), and this data is presented in its own column on logs.

Applicability	Term	Tactile Assessment	Abbreviation code
Fine	Dry of plastic limit	Hard and friable or powdery	w<PL
	Near plastic limit	Can be moulded	w=PL
	Wet of plastic limit	Water residue remains on hands when handling	w>PL
	Near liquid limit	“oozes” when agitated	w=LL
	Wet of liquid limit	“oozes”	w>LL
Coarse	Dry	Non-cohesive and free running	D
	Moist	Feels cool, darkened in colour, particles may stick together	M
	Wet	Feels cool, darkened in colour, particles may stick together, free water forms when handling	W

The abbreviation code NDF, meaning “not-assessable due to drilling fluid use” may also be used.

Note, observations relating to free ground water or drilling fluids are provided independent of soil moisture condition.

Consistency/Density/Compaction/Cementation/Extremely Weathered Material

These concepts give an indication of how the material may respond to applied forces (when considered in conjunction with other attributes of the soil). This behaviour can vary independent of the composition of the material, and on logs these are described in an independent column and are generally mutually exclusive (i.e it is inappropriate to describe both consistency and compaction at the same time). The method by which the behaviour is described depends on the behaviour model and other characteristics of the soil as follows:

- In fine grained soils, the “consistency” describes the ease with which the soil can be remoulded, and is generally correlated against the materials undrained shear strength;
- In granular materials, the relative density describes how tightly packed the particles are, and is generally correlated against the density index;
- In anthropogenically modified materials, the compaction of the material is described qualitatively;
- In cemented soils (both natural and anthropogenic), the cemented “strength” is described qualitatively, relative to the difficulty with which the material is disaggregated; and
- In soils of extremely weathered material origin, the engineering behaviour may be governed by relic rock features, and expected behaviour needs to be assessed based the overall material description.

Quantitative engineering performance of these materials may be determined by laboratory testing or estimated by correlated field tests (for example penetration or shear vane testing). In some cases, performance may be assessed by tactile or other subjective methods, in which case investigation logs will show the estimated value enclosed in round brackets, for example (VS).

Consistency (fine grained soils)

Consistency Term	Tactile Assessment	Undrained Shear Strength (kPa)	Abbreviation Code
Very soft	Extrudes between fingers when squeezed	<12	VS
Soft	Mouldable with light finger pressure	>12 - ≤25	S
Firm	Mouldable with strong finger pressure	>25 - ≤50	F
Stiff	Cannot be moulded by fingers	>50 - ≤100	St
Very stiff	Indented by thumbnail	>100 - ≤200	VSt
Hard	Indented by thumbnail with difficulty	>200	H
Friable	Easily crumbled or broken into small pieces by hand	-	Fr

Relative Density (coarse grained soils)

Relative Density Term	Density Index	Abbreviation Code
Very loose	<15	VL
Loose	>15 - ≤35	L
Medium dense	>35 - ≤65	MD
Dense	>65 - ≤85	D
Very dense	>85	VD

Note, tactile assessment of relative density is difficult, and generally requires penetration testing, hence a tactile assessment guide is not provided.

Soil Descriptions

Compaction (anthropogenically modified soil)

Compaction Term	Abbreviation Code
Well compacted	WC
Poorly compacted	PC
Moderately compacted	MC
Variably compacted	VC

Cementation (natural and anthropogenic)

Cementation Term	Abbreviation Code
Moderately cemented	MOD
Weakly cemented	WEK

Extremely Weathered Material

AS1726-2017 considers weathered material to be soil if the unconfined compressive strength is less than 0.6 MPa (i.e. less than very low strength rock). These materials may be identified as "extremely weathered material" in reports and by the abbreviation code XWM on log sheets. This identification is not correlated to any specific qualitative or quantitative behaviour, and the engineering properties of this material must therefore be assessed according to engineering principles with reference to any relic rock structure, fabric, or texture described in the description.

Soil Origin

Term	Description	Abbreviation Code
Residual	Derived from in-situ weathering of the underlying rock	RS
Extremely weathered material	Formed from in-situ weathering of geological formations. Has strength of less than 'very low' as per as1726 but retains the structure or fabric of the parent rock.	XWM
Alluvial	Deposited by streams and rivers	ALV
Fluvial	Deposited by channel fill and overbank (natural levee, crevasse splay or flood basin)	FLV
Estuarine	Deposited in coastal estuaries	EST
Marine	Deposited in a marine environment	MAR
Lacustrine	Deposited in freshwater lakes	LAC
Aeolian	Carried and deposited by wind	AEO
Colluvial	Soil and rock debris transported down slopes by gravity	COL
Slopewash	Thin layers of soil and rock debris gradually and slowly deposited by gravity and possibly water	SW
Topsoil	Mantle of surface soil, often with high levels of organic material	TOP
Fill	Any material which has been moved by man	FILL
Littoral	Deposited on the lake or seashore	LIT
Unidentifiable	Not able to be identified	UID

Cobbles and Boulders

The presence of particles considered to be "oversize" may be described using one of the following strategies:

- Oversize encountered in a minor proportion (when considered relative to the wider area) are noted in the soil description; or
- Where a significant proportion of oversize is encountered, the cobbles/boulders are described independent of the soil description, in a similar manner to composite soils (described above) but qualified with "MIXTURE OF".

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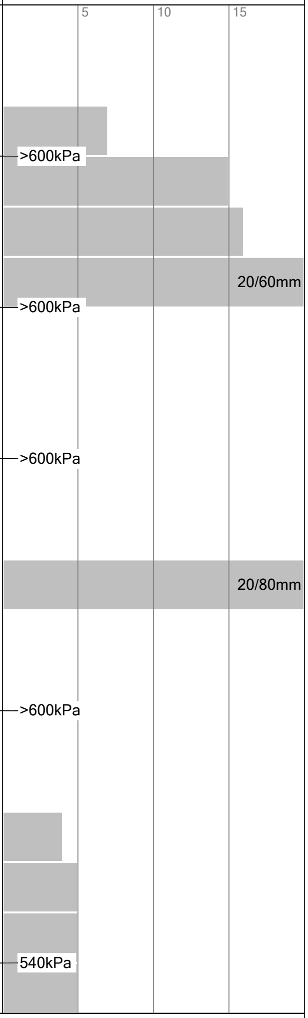
BOREHOLE LOG

CLIENT: Harrison Infrastructure Group Pty Ltd
PROJECT: Floodway Replacement
LOCATION: Jambin Goovigen Road, Goovigen, QLD

SURFACE LEVEL: 124.7 AHD
COORDINATE: E:224919.5, N:7326590.2
DATUM/GRID: MGA2020 Zone 55
DIP/AZIMUTH: 90°/---°

LOCATION ID: 1
PROJECT No: 231327.00
DATE: 31/10/24
SHEET: 1 of 1

GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) ▨ DENSITY.(*) ▩	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
			FILL / Sandy Gravelly CLAY (CL): brown; low plasticity; fine to medium sand; fine to coarse gravel.		FILL	H	D		D		0.15		
		0.15	Silty CLAY (CH): dark brown; high plasticity; with fine to coarse sand.		possibly ALV	H	M w=PL		B		0.20	PP	>600kPa
											0.60	PP	>600kPa
	124											PP	>600kPa
		1									1	DCP9/100	
												PP	>600kPa
	123					VSt						PP	540kPa
		2	Borehole discontinued at 2.00m depth. Limit of Investigation.										
	122												



NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Drillman GT10-KD
METHOD: AD/T to 2m
REMARKS: No groundwater seepage observed at the time of investigation

OPERATOR: DK

LOGGED: DK
CASING: Uncased

Refer to explanatory notes for symbol and abbreviation definitions

Douglas PARTNERS

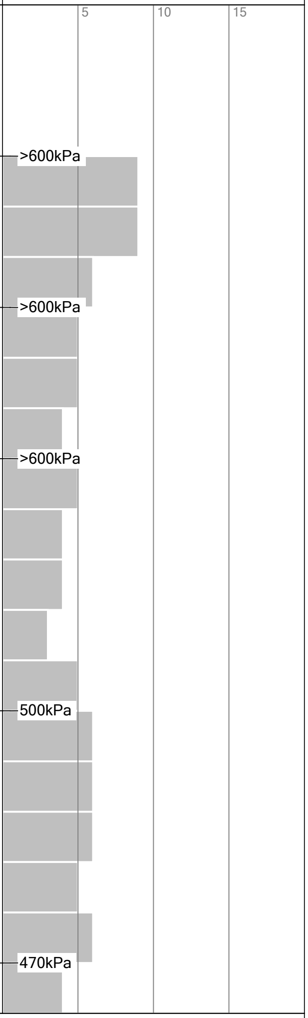
BOREHOLE LOG

CLIENT: Harrison Infrastructure Group Pty Ltd
PROJECT: Floodway Replacement
LOCATION: Jambin Goovigen Road, Goovigen, QLD

SURFACE LEVEL: 124.8 AHD
COORDINATE: E:224950.5, N:7326568.3
DATUM/GRID: MGA2020 Zone 55
DIP/AZIMUTH: 90°/---°

LOCATION ID: 2
PROJECT No: 231327.00
DATE: 31/10/24
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN(#)	CONSIS.(*) ▩ DENSITY.(*) ▨	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
			FILL / Sandy Gravelly CLAY (CL): brown; low plasticity; fine to medium sand; fine to coarse gravel.		FILL	H	D					DCP9/100	
		0.20	Silty CLAY (CH): dark brown; high plasticity; with fine to coarse sand.			VSt to H					0.20		
												PP	>600kPa
									B				
												PP	>600kPa
											0.70		
	124												
												PP	>600kPa
		1			possibly ALV	VSt	M w<PL				1		
												PP	500kPa
	123												
												PP	470kPa
		2	Borehole discontinued at 2.00m depth. Limit of Investigation.										
	122												



NOTES: (#)Soil origin is "probable" unless otherwise stated. (*)Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: Drillman GT10-KD
METHOD: AD/T to 2m
REMARKS: No groundwater seepage observed at the time of investigation

OPERATOR: DK

LOGGED: DK
CASING: Uncased

Douglas PARTNERS

Refer to explanatory notes for symbol and abbreviation definitions

Material Test Report

Report Number: **231327.00-1**
Issue Number: 1
Date Issued: 21/11/2024
Client: Harrison Infrastructure Group Pty Ltd
Po Box 4568, Bundaberg QLD
Contact: Chris Curd
Project Number: 231327.00
Project Name: Floodway Replacement
Project Location: Jambin Goovigen Road, Goovigen QLD
Work Request: 30647
Sample Number: SS-30647A
Date Sampled: 31/10/2024
Dates Tested: 01/11/2024 - 18/11/2024
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **Bore 1, Depth: 0.2 - 0.6 m**

Douglas Partners Pty Ltd
Sunshine Coast Laboratory
2 Mallet Street Kunda Park QLD 4556
Phone: (07) 5351 0400
Email: martin.cook@douglaspartners.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

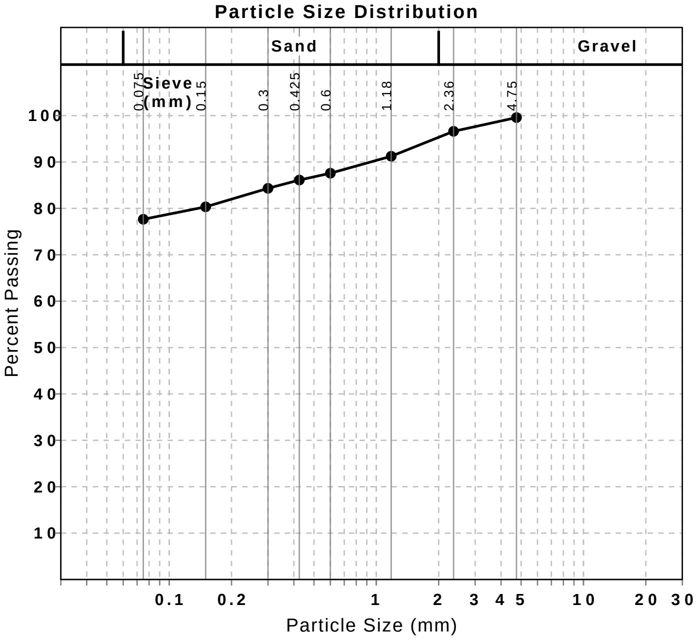
Approved Signatory: Martin Cook
Assistant Laboratory Manager
Laboratory Accreditation Number: 828

Particle Size Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
4.75 mm	**100**		
2.36 mm	**97**		
1.18 mm	**91**		
0.6 mm	**88**		
0.425 mm	**86**		
0.3 mm	**84**		
0.15 mm	**80**		
0.075 mm	**78**		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	69		
Plastic Limit (%)	20		
Plasticity Index (%)	**49**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**19.5**		
Cracking Crumbling Curling	None		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description			
Nature of Water	Distilled		
Temperature of Water (^{o}C)	24		



Material Test Report

Report Number:	**231327.00-1**
Issue Number:	1
Date Issued:	21/11/2024
Client:	Harrison Infrastructure Group Pty Ltd Po Box 4568, Bundaberg QLD
Contact:	Chris Curd
Project Number:	231327.00
Project Name:	Floodway Replacement
Project Location:	Jambin Goovigen Road, Goovigen QLD
Work Request:	30647
Sample Number:	SS-30647A
Date Sampled:	31/10/2024
Dates Tested:	01/11/2024 - 12/11/2024
Sampling Method:	Sampled by Engineering Department *The results apply to the sample as received*
Sample Location:	**Bore 1, Depth: 0.2 - 0.6 m**

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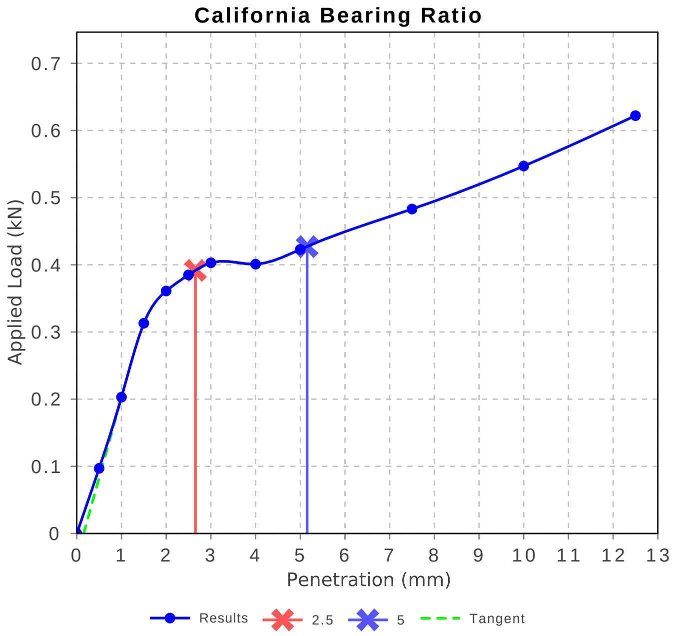
Approved Signatory: Martin Cook
Assistant Laboratory Manager
Laboratory Accreditation Number: 828

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**3.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	AS1289 3.1.2		
Maximum Dry Density (t/m^3)	1.61		
Optimum Moisture Content (%)	23.0		
Laboratory Density Ratio (%)	97.0		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.51		
Field Moisture Content (%)	19.1		
Moisture Content at Placement (%)	22.8		
Moisture Content Top 30mm (%)	31.5		
Moisture Content Rest of Sample (%)	25.6		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	10		
Curing Hours (h)	96.0		
Swell (%)	3.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Material Test Report

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Email: martin.cook@douglaspartners.com.au

Report Number:	**231327.00-1**
Issue Number:	1
Date Issued:	21/11/2024
Client:	Harrison Infrastructure Group Pty Ltd Po Box 4568, Bundaberg QLD
Contact:	Chris Curd
Project Number:	231327.00
Project Name:	Floodway Replacement
Project Location:	Jambin Goovigen Road, Goovigen QLD
Work Request:	30647
Sample Number:	SS-30647B
Date Sampled:	31/10/2024
Dates Tested:	01/11/2024 - 18/11/2024
Sampling Method:	Sampled by Engineering Department *The results apply to the sample as received*
Sample Location:	**Bore 2, Depth: 0.2 - 0.7 m**

Accredited for compliance with ISO/IEC 17025 - Testing

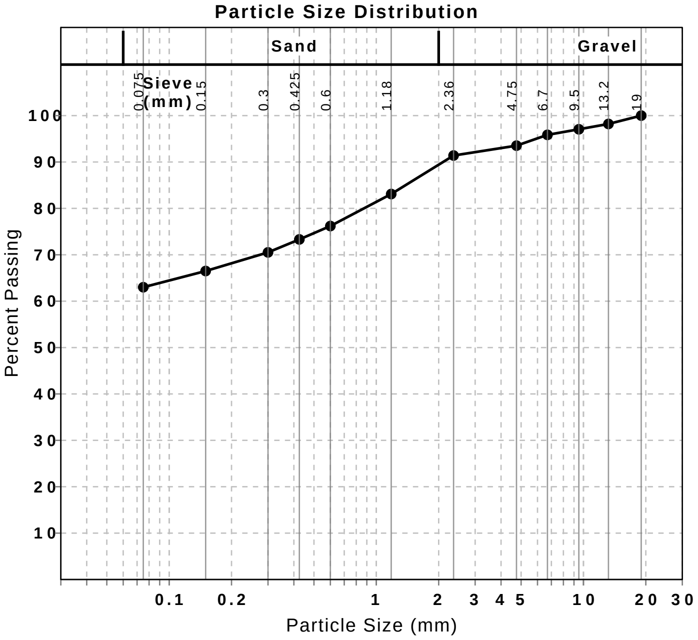
Approved Signatory: Martin Cook
Assistant Laboratory Manager
Laboratory Accreditation Number: 828

Particle Size Distribution (AS1289 3.6.1)			
Sieve	Passed %	Passing Limits	
19 mm	**100**		
13.2 mm	**98**		
9.5 mm	**97**		
6.7 mm	**96**		
4.75 mm	**94**		
2.36 mm	**91**		
1.18 mm	**83**		
0.6 mm	**76**		
0.425 mm	**73**		
0.3 mm	**71**		
0.15 mm	**66**		
0.075 mm	**63**		

Atterberg Limit (AS1289 3.1.2 & 3.2.1 & 3.3.1)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Liquid Limit (%)	66		
Plastic Limit (%)	19		
Plasticity Index (%)	**47**		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.1.2		
Linear Shrinkage (%)	**18.5**		
Cracking Crumbling Curling	Cracking		

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**4 ***		
Soil Description			
Nature of Water	Distilled		
Temperature of Water (^{o}C)	24		
* Mineral Present	Carbonate		



Material Test Report

Report Number: **231327.00-1**
Issue Number: 1
Date Issued: 21/11/2024
Client: Harrison Infrastructure Group Pty Ltd
Po Box 4568, Bundaberg QLD
Contact: Chris Curd
Project Number: 231327.00
Project Name: Floodway Replacement
Project Location: Jambin Goovigen Road, Goovigen QLD
Work Request: 30647
Sample Number: SS-30647B
Date Sampled: 31/10/2024
Dates Tested: 01/11/2024 - 12/11/2024
Sampling Method: Sampled by Engineering Department
The results apply to the sample as received
Sample Location: **Bore 2, Depth: 0.2 - 0.7 m**

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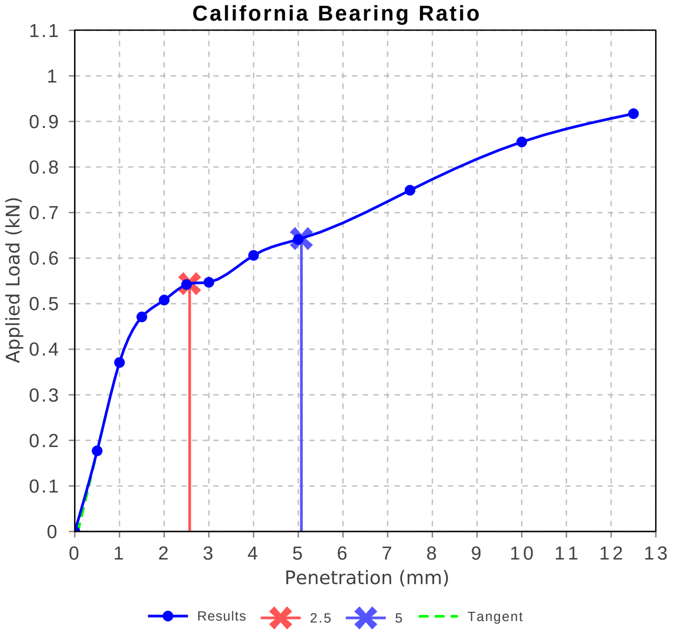
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Martin Cook
Assistant Laboratory Manager
Laboratory Accreditation Number: 828

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**4.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	AS1289 3.1.2		
Maximum Dry Density (t/m^3)	1.68		
Optimum Moisture Content (%)	21.5		
Laboratory Density Ratio (%)	97.0		
Laboratory Moisture Ratio (%)	100.5		
Dry Density after Soaking (t/m^3)	1.58		
Field Moisture Content (%)	16.1		
Moisture Content at Placement (%)	21.4		
Moisture Content Top 30mm (%)	28.5		
Moisture Content Rest of Sample (%)	22.8		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	10		
Curing Hours (h)	96.0		
Swell (%)	2.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)	0		



Appendix C – Circly Outputs

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CIRCLY  - Version 7.0 (1 February 2022)

   Layer no.  3 is INCLUDED in max. CDF calculation
Job Title: P11164_Jambin Floodway

Design Method: Austroads 2017

NDT (cumulative heavy vehicle axle groups over design period): 4.00E+05

Traffic Load Distribution:

   ID: Jambin Goovigen Rd
   Name: Jambin Goovigen Rd 2022 count with presumptive TLD
   ESA/HVAG: 0.603

Details of Load Groups:

   Load   Load                  Load                  Load            Radius    Pressure/    Exponent
   No.    ID                    Category              Type                      Ref. stress
    1     ESA750-Full           ESA750-Full           Vertical Force     92.1    0.75         0.00
    2     SAST53                SAST53                Vertical Force    102.4    0.80         0.00

   Load Locations:
   Location   Load                  Gear          X          Y      Scaling     Theta
   No.        ID                    No.                             Factor
    1         ESA750-Full            1          -165.0        0.0   1.00E+00      0.00
    2         ESA750-Full            1           165.0        0.0   1.00E+00      0.00
    3         ESA750-Full            1          1635.0        0.0   1.00E+00      0.00
    4         ESA750-Full            1          1965.0        0.0   1.00E+00      0.00
    1         SAST53                 1             0.0        0.0   1.00E+00      0.00
    2         SAST53                 1          2130.0        0.0   1.00E+00      0.00

Details of Layered System:

   ID: P11164_SLBB Title: P11164_Jambin Floodway_SLBB

   Layer  Lower    Material               Isotropy   Modulus    P.Ratio
   No.    i/face   ID                                (or Ev)    (or vvh)  F          Eh         vh
    1     rough    LB-NSL-0600            Aniso.     6.00E+02   0.35      4.44E+02   3.00E+02   0.35
    2     rough    LB-NSL-0240            Aniso.     2.40E+02   0.35      1.78E+02   1.20E+02   0.35
    3     rough    SG-CBR03.0             Aniso.     3.00E+01   0.45      2.07E+01   1.50E+01   0.45

   Performance Relationships:
   Layer  Location Material               Component  Perform.   Perform.   Shift
   No.             ID                                Constant   Exponent   Factor
    3     top      SG-CBR03.0             EZZ         0.009150    7.000

   Reliability Factors:
   Project Reliability: Austroads 90%
   Layer  Reliability  Material
    No.   Factor       Type
    3      1.00       _TMR Subgrade (AGPT02)


Automatic layer thickness design:
   Layer number to be designed:  1
   Minimum thickness:  0
   Maximum thickness:  5000

Strains:

   Layer  Thickness  Material               Axle      Unitless
   No.               ID                               Strain
    3       0.00    SG-CBR03.0
                                            SADT(80): 1.558E-03

Results:

   Layer  Thickness  Material               Axle      CDF
   No.               ID                     Group
    1      180.77    LB-NSL-0600                          n/a

    2      150.00    LB-NSL-0240                          n/a

    3       0.00    SG-CBR03.0             Total:    9.994E-01
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CIRCLY  - Version 7.0 (1 February 2022)

   Layer no.  3 is INCLUDED in max. CDF calculation
Job Title: P11164_Jambin Floodway

Design Method: Austroads 2017

NDT (cumulative heavy vehicle axle groups over design period): 4.00E+05

Traffic Load Distribution:

   ID: Jambin Goovigen Rd
   Name: Jambin Goovigen Rd 2022 count with presumptive TLD
   ESA/HVAG: 0.603

Details of Load Groups:

   Load   Load                  Load                  Load            Radius    Pressure/    Exponent
   No.    ID                    Category              Type                      Ref. stress
    1     ESA750-Full           ESA750-Full           Vertical Force     92.1    0.75         0.00
    2     SAST53                SAST53                Vertical Force    102.4    0.80         0.00

   Load Locations:
   Location   Load                  Gear          X          Y      Scaling     Theta
   No.        ID                    No.                             Factor
    1         ESA750-Full            1          -165.0        0.0   1.00E+00      0.00
    2         ESA750-Full            1           165.0        0.0   1.00E+00      0.00
    3         ESA750-Full            1          1635.0        0.0   1.00E+00      0.00
    4         ESA750-Full            1          1965.0        0.0   1.00E+00      0.00
    1         SAST53                 1             0.0        0.0   1.00E+00      0.00
    2         SAST53                 1          2130.0        0.0   1.00E+00      0.00

Details of Layered System:

   ID: P11164_SLBB Title: P11164_Jambin Floodway_SLBB

   Layer  Lower    Material               Isotropy   Modulus    P.Ratio
   No.    i/face   ID                                (or Ev)    (or vvh)  F          Eh         vh
    1     rough    LB-NSL-0600            Aniso.     6.00E+02   0.35      4.44E+02   3.00E+02   0.35
    2     rough    UG-SL-0210             Aniso.     2.10E+02   0.35      1.56E+02   1.05E+02   0.35
    3     rough    SG-CBR03.0             Aniso.     3.00E+01   0.45      2.07E+01   1.50E+01   0.45

   Performance Relationships:
   Layer  Location Material               Component  Perform.   Perform.   Shift
   No.             ID                                Constant   Exponent   Factor
    3     top      SG-CBR03.0             EZZ         0.009150    7.000

   Reliability Factors:
   Project Reliability: Austroads 90%
   Layer  Reliability  Material
    No.   Factor       Type
    3      1.00       _TMR Subgrade (AGPT02)

   Details of Layers to be sublayered:
   Layer no.  2:  Austroads (2004) sublayering

Automatic layer thickness design:
   Layer number to be designed:  2
   Minimum thickness:  0
   Maximum thickness:  5000

Strains:

   Layer  Thickness  Material               Axle      Unitless
   No.               ID                               Strain
    3       0.00    SG-CBR03.0
                                            SADT(80): 1.558E-03

Results:

   Layer  Thickness  Material               Axle      CDF
   No.               ID                     Group
    1      200.00    LB-NSL-0600                         n/a

    2      196.52    UG-SL-0210                          n/a

    3       0.00    SG-CBR03.0             Total:    9.985E-01
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