HEAVY VEHICLE ROUTE ASSESSMENT - DULGUIGAN ROAD

TUMBULGUM, NSW

PREPARED BY ROADNET PTY LTD
For Tweed Shire Council
11/03/2019

Document Control Sheet

Issue No	1	2	3
Document Status	Draft	Draft	Draft
Date	23/12/2018	01/03/2019	11/03/2019
Issued To	Alana Brooks Road Safety Officer Tweed Shire Council	Alana Brooks Road Safety Officer Tweed Shire Council	Alana Brooks Road Safety Officer Tweed Shire Council
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CONTENTS

1. INTRODUCTION

RoadNet Pty Ltd (RoadNet) has been commissioned by Tweed Shire Council (TSC) to undertake a Heavy Vehicle Route Assessment of the roads between the Dulguigan Quarry and the Tweed Valley Way in Tumbulgum (refer *Figure 1.1* below).

Figure 1.1 - Heavy Vehicle Route

2. PURPOSE

The purpose of this report is to summarise the outcomes of:

(i) site inspection(s);
(ii) road classification review using the National Heavy Vehicle Regulator (NHVR) Guidelines to determine a suitable level of access under the existing road conditions;
(iii) vehicle swept path analysis at various locations and identify any potential geometric constraints;
(iv) risk assessment;

to identify any risks associated with heavy vehicles using this route and provide recommendations to mitigate any identified risks.

3. DESIGN VEHICLE

The design vehicle used for the swept path analysis for general access (Level 1) is a 19m semi-trailer. These vehicles can operate on all general access roads without a permit.

A vehicle swept path analysis was also undertaken to identify constraints for Level 2 using the template for a 26m B-double (Austroads, Design Vehicles and Turning Template Guide).

Heavy vehicles up to 20m Performance Based Standards (PBS) are able to operate on the route being assessed in this report. There are a high number of eligible vehicle combinations with various axle combinations that fall into this 20m PBS category. Not having the specific details of the 20m PBS vehicles using this route the vehicle swept path analysis has been based on a 19m semi-trailer.

Mark Foran (Roads and Maritime Services: Heavy Vehicle Access Coordinator - Freight Branch) confirmed the 19m semi-trailer template will service as a guide and be a worst case scenario to establish safety risk.

The vehicle swept path analysis, which assesses the path of different parts of a vehicle when undertaking a turning manoeuvre, has been used at specific locations along the route. AutoTURN vehicle swept paths are shown on aerial photos in *Appendix A - 19m Semi-trailer* and *Appendix B - 26m B-Double.*

4. METHODOLOGY

The heavy vehicle route assessment process included the following tasks:

- Complete National Heavy Vehicle Regulator (NHVR) road classification form and determine the appropriate level of access under the existing road conditions;
- Review heavy vehicle traffic data;
- Attend on-site commencement meeting with Tweed Shire Council representative;
- Site inspection with associated photos, video recording and measuring of road seal widths, etc;
- Identify site constraints;
- Undertake vehicle swept path analysis at specific locations along the route;
- Prepare draft Heavy Vehicle Route Assessment report and submit to Tweed Shire Council;
- Meet with Tweed Shire Council representative to discuss the format and content in the draft report;
- Undertake on-site observations to assess traffic behaviour and travel paths being utilised;
- Undertake a risk assessment reflecting risk levels associated with heavy vehicles;
- Finalise the Heavy Vehicle Route Assessment Report and submit to Council.

5. ROAD CLASSIFICATION

The "Appendix D - Sample Form for Road Classification" form (refer *Appendix C*) was completed based on site observations and lane and road shoulder width measurements taken at various locations on Dulguigan Road and the bridge on Terranora Road.

Road Formation Widths*				
Location	Left Lane Width	Right Lane Width	Right Shoulder Width	Shoulder Type
Dulguigan Rd (Ch: 0.3km)	3.5m	3.2m	2.0m	Gravel / Grass
Dulguigan Rd (Ch: 1.0km)	3.4m	3.4m	1.4m	Grass
Dulguigan Rd (Ch: 2.7km)	3.8m	4.2m	0.5m	Grass
Dulguigan Rd (Ch: 3.0km)	2.9m	3.2m	1.0m	Grass
Dulguigan Rd (Ch: 5.3km)	3.6m	3.7m	0.5m	Grass
Terranora Rd (Bridge)	4.0m	4.0m	0.0m	N/A - Face of Kerb

Table 5.1: Road Formation Widths

* Performance-Based Standards Scheme - Network Classification Guidelines (July 2007) Table 3 Road Class L2 for AADT 500 - 1,500 requires 3.1m Lane Width and 1.2m Shoulder Width.

No on-site measurements were taken in relation to the following:

- Clearance to Overhead Cables - There are 19 locations where overhead cables cross the route. It is assumed that the clearance to overhead cables is 4.5m or greater and hence Road Class L1 is appropriate.
- Clearance to Bridge - Clearance not shown on structure therefore clearance assumed to be 5m or greater.

No sight distance calculations were undertaken when assessing Ref. Item no. 2.8 - Approach visibility.

6. SITE INSPECTIONS

A site inspection was undertaken by Craig Frazer and Daniel Kerwick from RoadNet on Thursday 15th November 2018. The weather was fine and clear at the time of the site inspection. The haul route was videoed using a 'dash cam' camera as part of this inspection and road constraints identified. 'On foot' inspections were undertaken at locations where road constraints were identified and measurements taken to assist in determining recommendations to mitigate the risks at these locations.

A second site inspection was undertaken by Daniel Kerwick, Daniel Gardiner and Rob Dowker on Thursday 22nd November 2018. This site inspection involved measuring the width of the road seal at locations where the edge of road seal could not be determined from aerial photography due to vegetation cover. The weather was overcast with the occasional shower at the time of this inspection.

Two further site inspections were undertaken on 8th and 12th February 2019 to obtain seal width measurements required for road classification and observations of traffic behaviour to assist in assessing risk.

7. HAULAGE ROUTE

7.1 General

The haulage route (refer *Figure 1.1*) covered in this report commences at the access to Dulguigan Quarry (Chainage 00) and ends at the Riverside Drive / Tweed Valley Way intersection (Chainage 6100). The roads associated with this 6.1km section including 40 property accesses and the following 8 road intersections:

(i) Dulguigan Road / Palm Road intersection

(ii) Dulguigan Road / Hogans Road intersection

(iii) Dulguigan Road / Brady Place intersection

(iv) Dulguigan Road / Mayes Hill Road intersection

(v) Dulguigan Road / McAuleys Road intersection

(vi) Dulguigan Road / Terranora Road intersection

(vii) Terranora Road / Riverside Drive intersection

(viii) Riverside Drive / Tweed Valley Way intersection.

The majority of the haulage route is on Dulguigan Road, however the eastern end of the haulage route includes short sections on Terranora Road (incl. bridge over the Tweed River) and Riverside Drive (refer *Figure 7.1*).

Figure 7.1: Haulage Route - eastern end

The haulage route comprises a windy, rural road with heavy vegetation on either side. The road is delineated by a double barrier centreline (ie: limited sections with edge lines) and guide posts. Road drainage is catered for by grass swales or table drains (ie: no concrete kerbs).

Site inspections revealed low pedestrian movements and a low number of cyclists. Low pedestrian movements likely to be due to limited pedestrian attractions, however cyclist may be attracted to the area due to scenery and flat grade.

There were no buses on the road at the time of inspection however it is understand that there is a school bus that operates in the morning and mid after-noon.

At the following isolated locations (refer *Sections 7.2 - 7.6, inclusive*), vehicle swept paths (refer *Appendix A: Vehicle Swept Path - 19m Semi-trailer*) indicate heavy vehicles will travel in the opposing traffic lane:

7.2 Dulguigan Quarry Access (Ch: 00)

Vehicles turning left out of Dulguigan Quarry cross to the side of the quarry access and the other side of Dulguigan Road when undertaking this manoeuvre.

Photo 7.1 Dulguigan Road - looking north-east

Photo 7.2 Dulguigan Road - looking south-west

7.3 Dulguigan Road / Hogans Road Intersection (Ch: 2500)

Even at slow speed vehicles are tracking onto the other side of the road when negotiating this curve.

Photo 7.3 Dulguigan Road - looking east

Photo 7.4 Hogans Road - looking south

7.4 East of Dulguigan Road / Mayes Hill Road Intersection (Ch: 3650)

Even at slow speed haulage vehicles are tracking onto the other side of the road when negotiating this curve

Photo 7.5 Dulguigan Road - looking south-west

Photo 7.6 Dulguigan Road - looking north

7.5 Dulguigan Road / Terranora Road Intersection (Ch: 5400)

Vehicles travelling on Terranora Road and turning right into Dulguigan Road will track into the opposing travel lane.

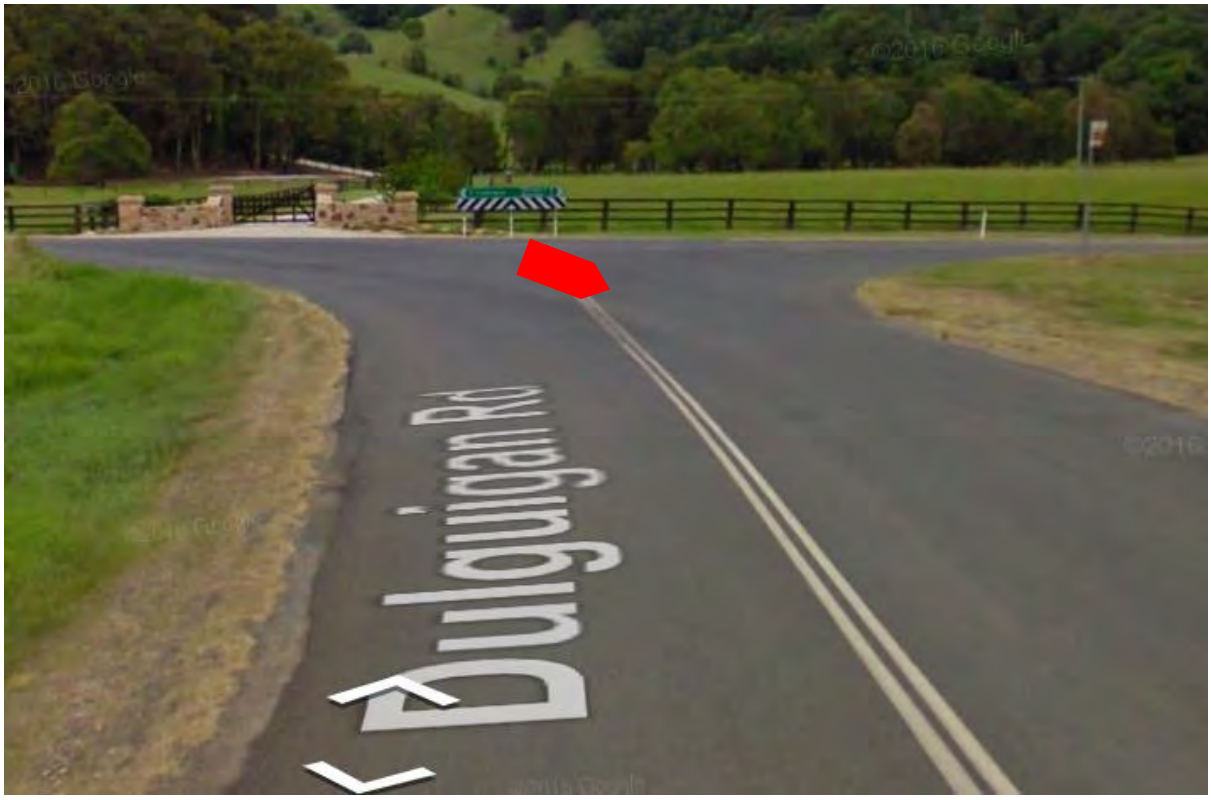


Photo 7.7 Dulguigan Road - looking north-west

Photo 7.8 Terranora Road - looking north-east

7.6 Terranora Road / Riverside Drive Intersection (Ch: 5900)

Vehicles travelling on Riverside Drive and turning right into Terranora Road cross into the opposing traffic lane. Similarly, vehicles travelling on Terranora Road and turning left into Riverside Drive will also cross into the oncoming traffic lane. There is a conflict point at this location.

Photo 7.9 Terranora Road - looking south-west

Photo 7.10 Riverside Drive - looking north-west

8. RISK ASSESSMENT

A risk assessment was undertaken on the full length of the heavy vehicle route (refer *Section 1 Figure 1.1*) with details shown in attached Risk Assessment spreadsheet (refer *Appendix D*).

The risk assessment refers to the five locations (refer *Section 7.2 - 7.6, inclusive*) where vehicle swept paths indicate that heavy vehicles (19m semi-trailer) will travel in the opposing traffic lane. The risk assessment also identifies general risks associated with the 5.4km section of Dulguigan Road.

The present risk levels consider the control measures that are in place. Recommendations to further mitigate risks have been provided in the Risk Assessment spreadsheet and are summarised in *Section 9* below.

9. RECOMMENDATIONS

1. Dulguigan Quarry Access (Ch: 00)
   Risk Assessment Ref No.1
   Undertake onsite trial of heavy vehicles exiting the Dulguigan Quarry to assess risk associated with traffic conflict both within the quarry access and on Dulguigan Road.
   Confirm quarry owners have internal protocol(s) in relation to vehicles entering and exiting the quarry and assess associated risks.
   Risk Assessment Ref No.2
   Review the present linemarking and signage layout at the quarry entrance and undertake modifications, if required.

2. Dulguigan Road / Hogans Road Intersection (Ch: 2500)
   Risk Assessment Ref No.3
   Install more prominent signage highlighting the advisory speed.
   Improve sight distance by clearing vegetation on the inside of the curve.
   Prepare a concept design (higher design speed) to determine intersection layout modifications required to ensure heavy vehicles remain in their travel lane when negotiating the curve and implement the works.

3. Dulguigan Road East of Mayes Hill Road Intersection (Ch: 3650)
   Risk Assessment Ref No.4
   Prepare a concept design to determine curve modifications (including curve widening requirements) required to ensure heavy vehicles are able to remain in their travel lane when negotiating the series of curves, with sufficient width to accommodate a double barrier centreline and possibly edge lines, and implement the works.
   Ongoing monitoring of road conditions (refer 6 below).

4. Dulguigan Road / Terranora Road Intersection (Ch: 5400)
   Risk Assessment Ref No.5
   Assess intersection traffic data to determine the potential for conflict between vehicles turning right from Dulguigan Road into Terranora Road and vehicles turning right from Terranora Road into Dulguigan Rd.
   Review linemarking layout with consideration to the position of a vehicle in Dulguigan Road waiting to turn right into Terranora Road. Implement the works.

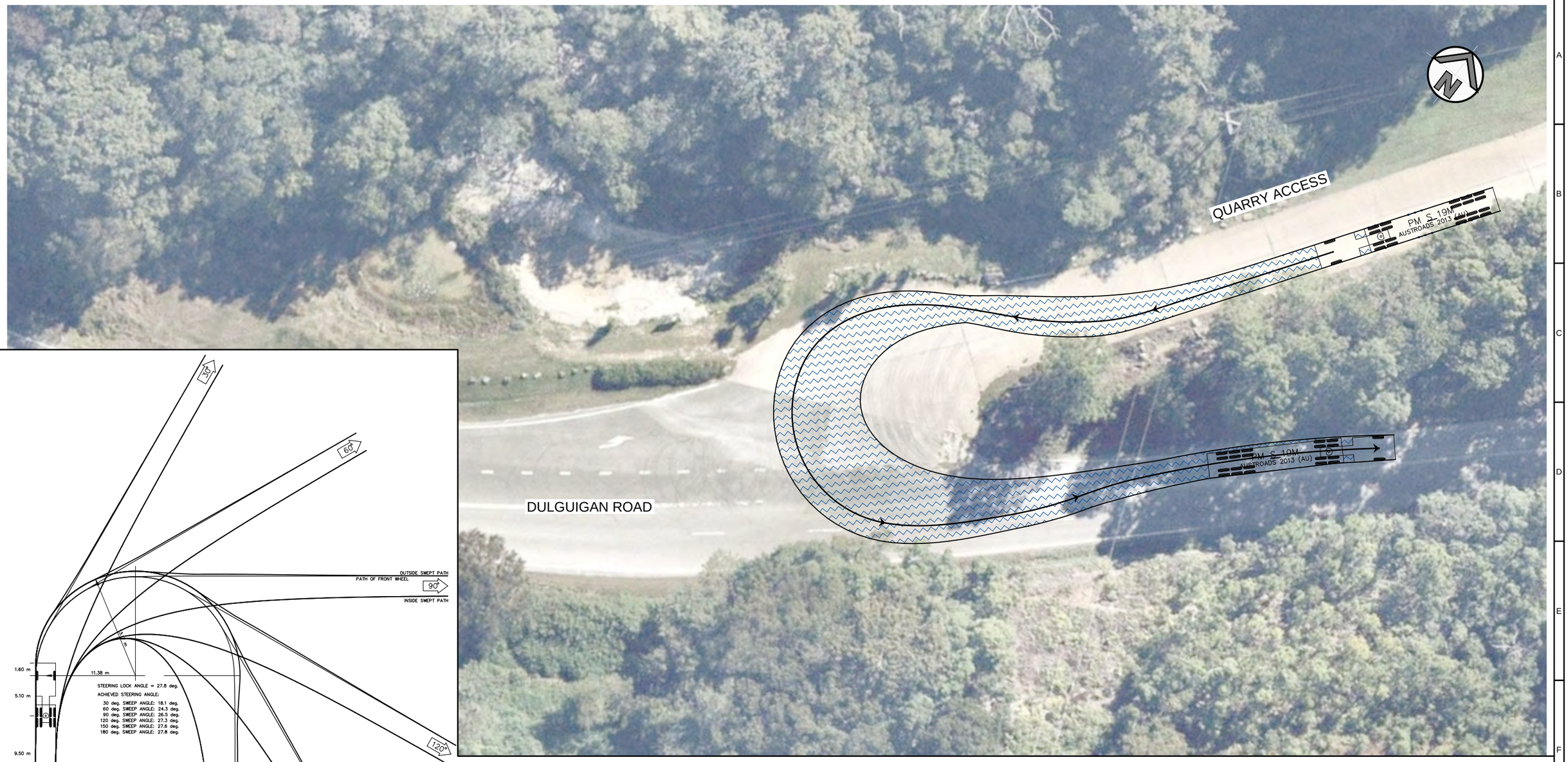
5. Terranora Road / Riverside Drive Intersection (Ch: 5900)
   Risk Assessment Ref No.6
   Ongoing monitoring of road condition including linemarking and signage with maintenance regime to maintain appropriate level of delineation.
   Prepare a concept design with the potential to realign Riverside Drive to better accommodate all traffic movements at this intersection and encourage traffic not to cross into the opposing traffic lane.
   Concept design to give consideration to the extension of the existing bridge safety barriers. Implement the works.

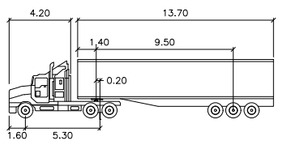
6. Dulguigan Road (Route length 5.4km)
   Risk Assessment Ref No.7
   Ongoing monitoring of road condition (edge breaks, edge drop offs, seal defects, shoulder integrity, etc) with 'quick response' maintenance regime that maximises the effective seal width.
   Prepare and implement a road widening works program with consideration to the high priority locations identified in this report.
   Risk Assessment Ref No.8
   Ongoing monitoring of roadside vegetation with 'quick response' maintenance regime (trimming, removal) that maintains sufficient clearance for maximum size vehicles using the road.

Craig Frazer

RoadNet Pty Ltd

APPENDIX A – VEHICLE SWEPT PATH (19M SEMI-TRAILER)





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LEGEND

VEHICLE BODY EXTENTS

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28 FEBRUARY 2019

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Scales

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TWEED SHIRE COUNCIL
DULGUIGAN QUARRY TO TUMBULGUM
TURNING PATH ANALYSIS
DULGUIGAN QUARRY ACCESS
19m SEMI TRAILER

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C.F.	-	1 of 10

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Drawing No. 18029G-TP-1001

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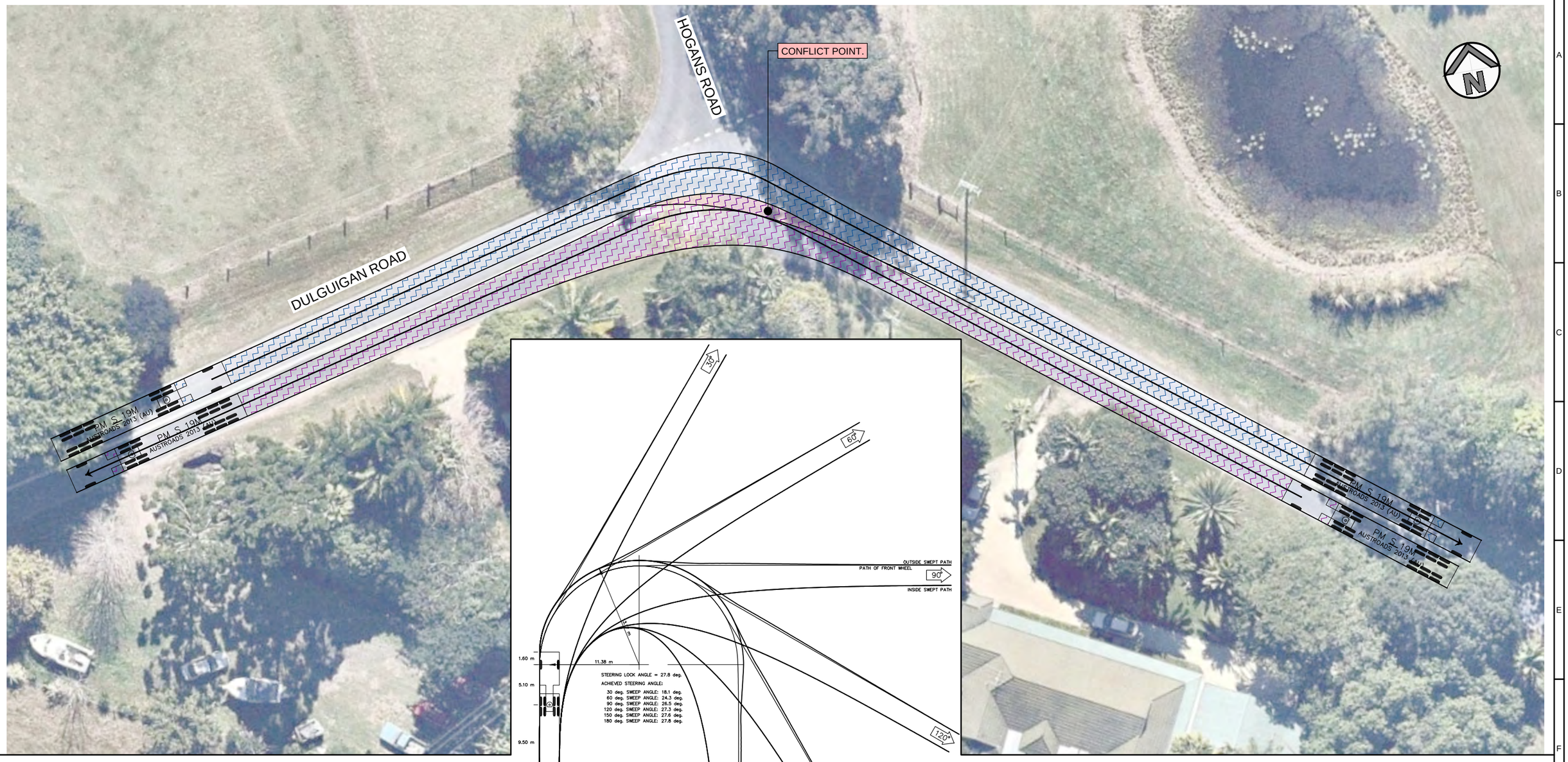

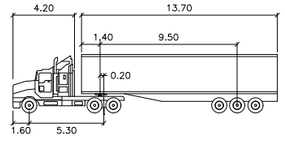

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AUSTROADS 2013 (AU)
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DULGUIGAN QUARRY TO TUMBULGUM
TURNING PATH ANALYSIS
DULGUIGAN ROAD AT HOGANS ROAD
19m SEMI TRAILER

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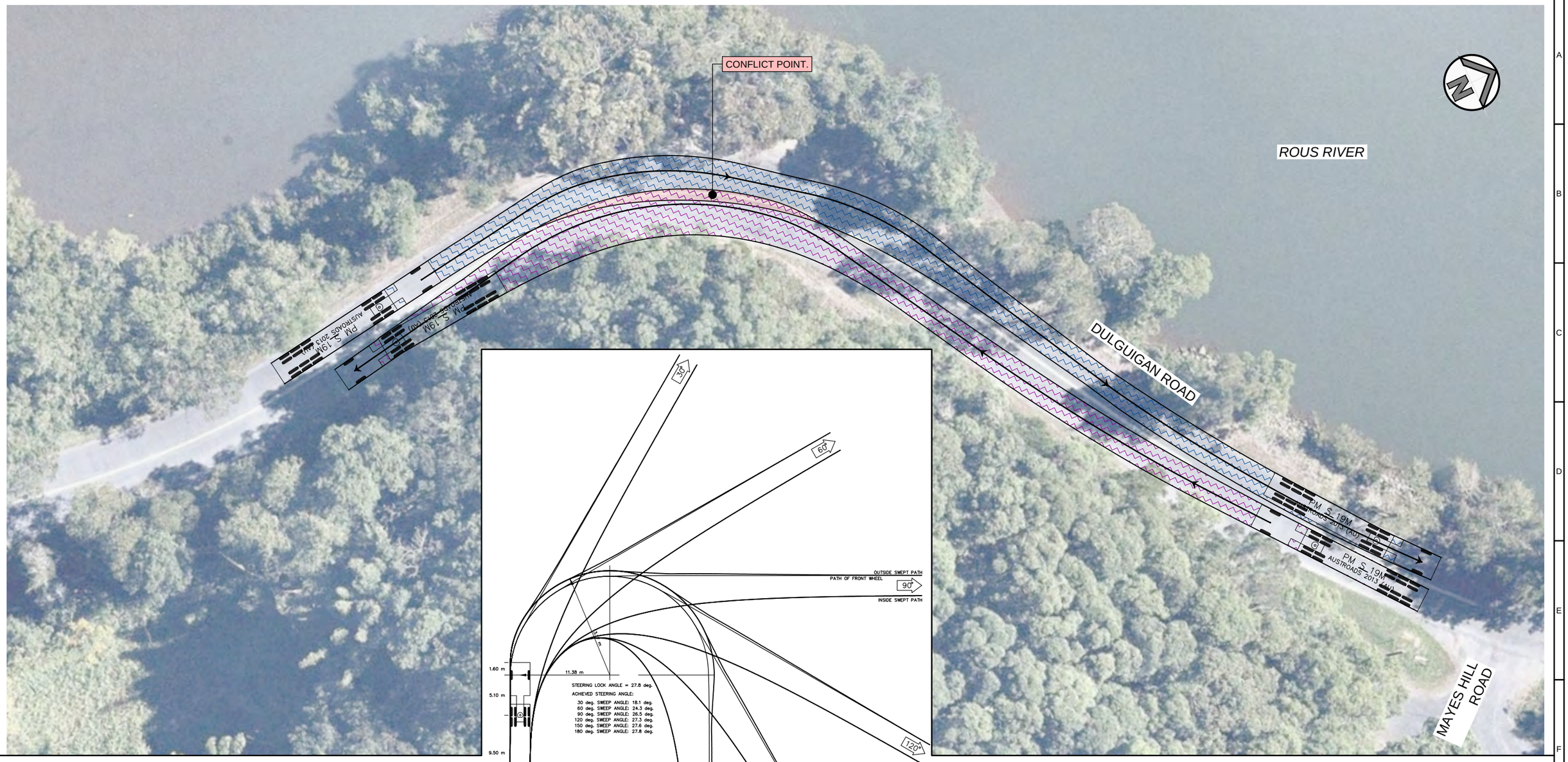

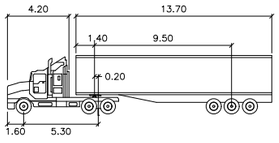

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DULGUIGAN QUARRY TO TUMBULGUM
TURNING PATH ANALYSIS
DULGUIGAN ROAD EAST OF MAYES HILL ROAD
19m SEMI TRAILER

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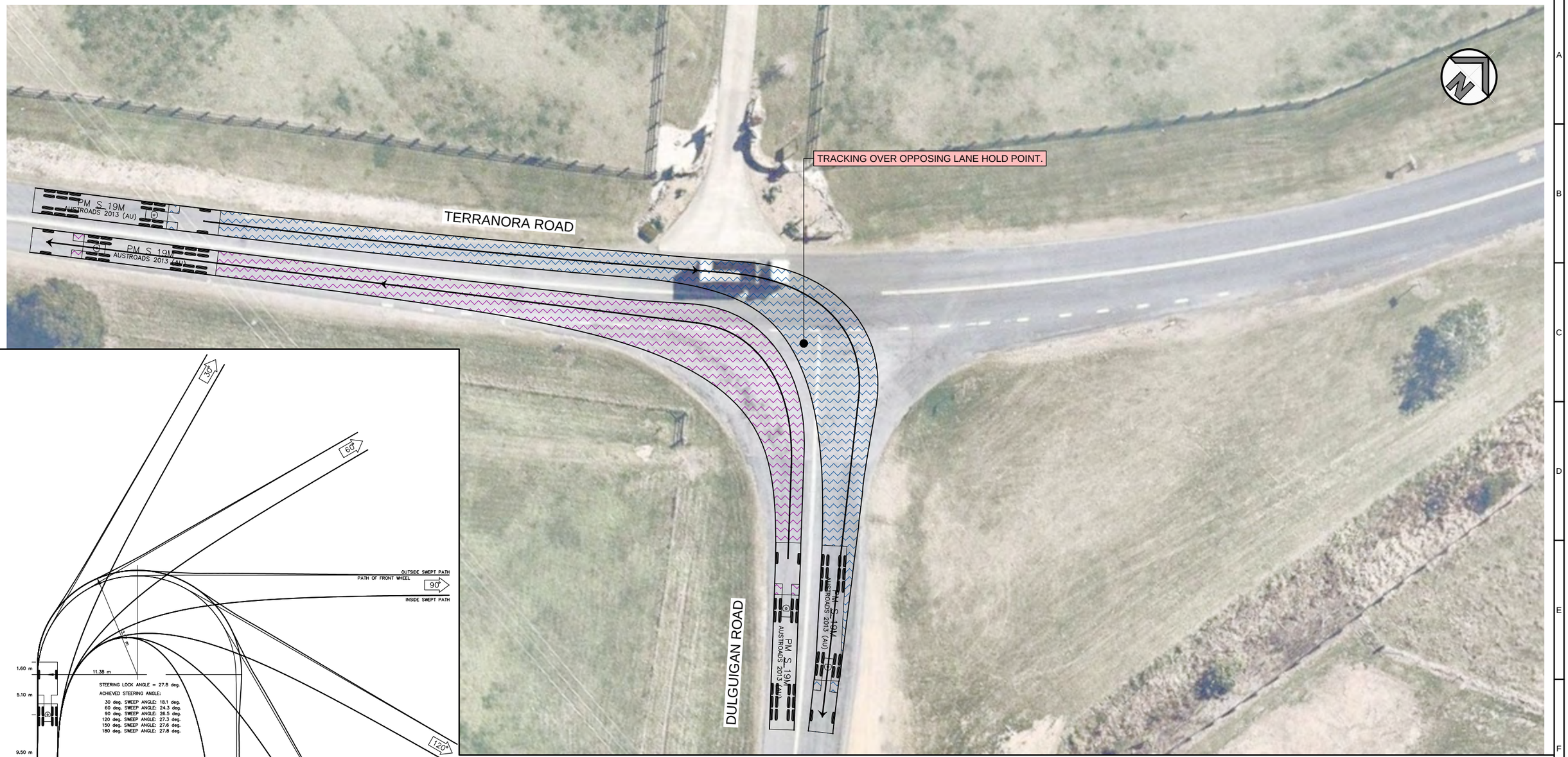

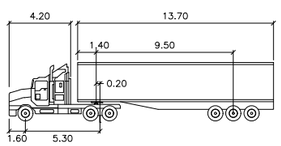

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TWEED SHIRE COUNCIL
DULGUIGAN QUARRY TO TUMBULGUM
TURNING PATH ANALYSIS
INTERSECTION OF TERRANORA ROAD AND DULGUIGAN ROAD
19m SEMI TRAILER

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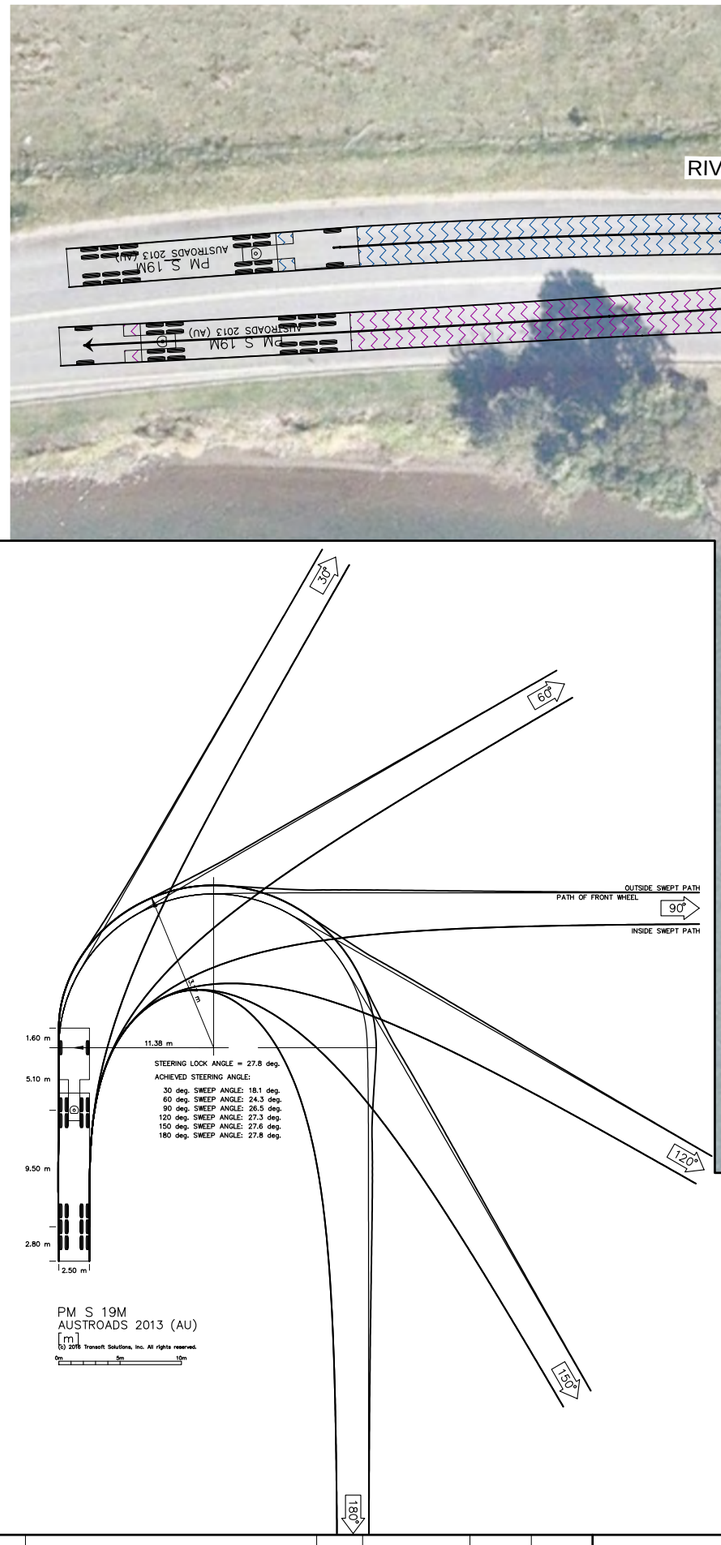

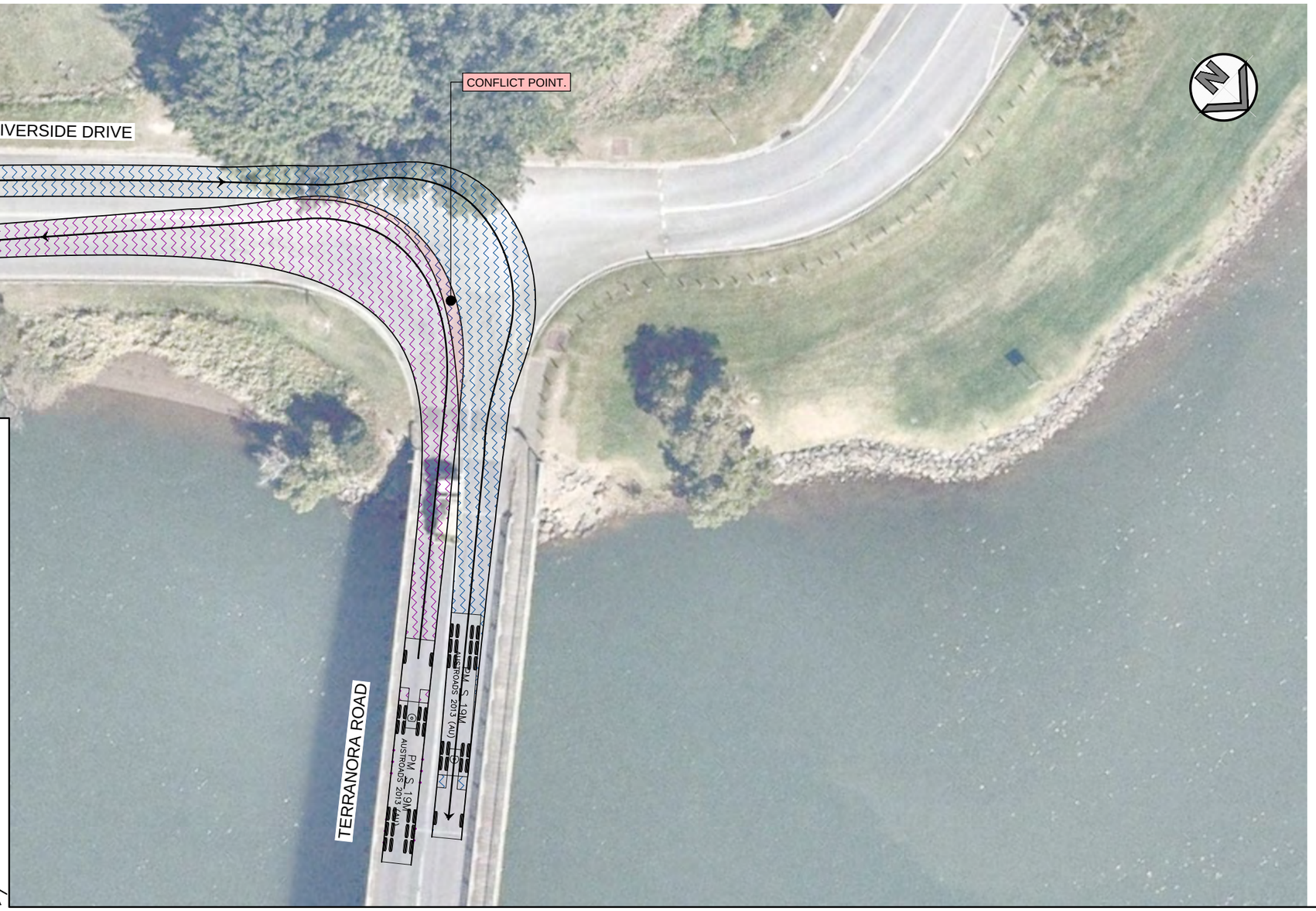

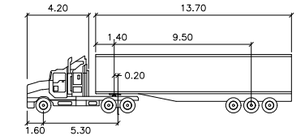

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DULGUIGAN QUARRY TO TUMBULGUM
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INTERSECTION OF RIVERSIDE DRIVE AND TERRANORA ROAD
19m SEMI TRAILER

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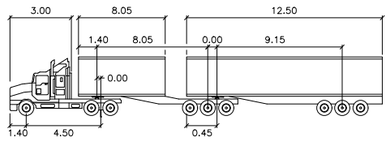
APPENDIX B - VEHICLE SWEPT PATH (26M B-DOUBLE)



B-DOUBLE 26M meters

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DULGUIGAN QUARRY TO TUMBULGUM
TURNING PATH ANALYSIS
DULGUIGAN QUARRY ACCESS
26m B-DOUBLE

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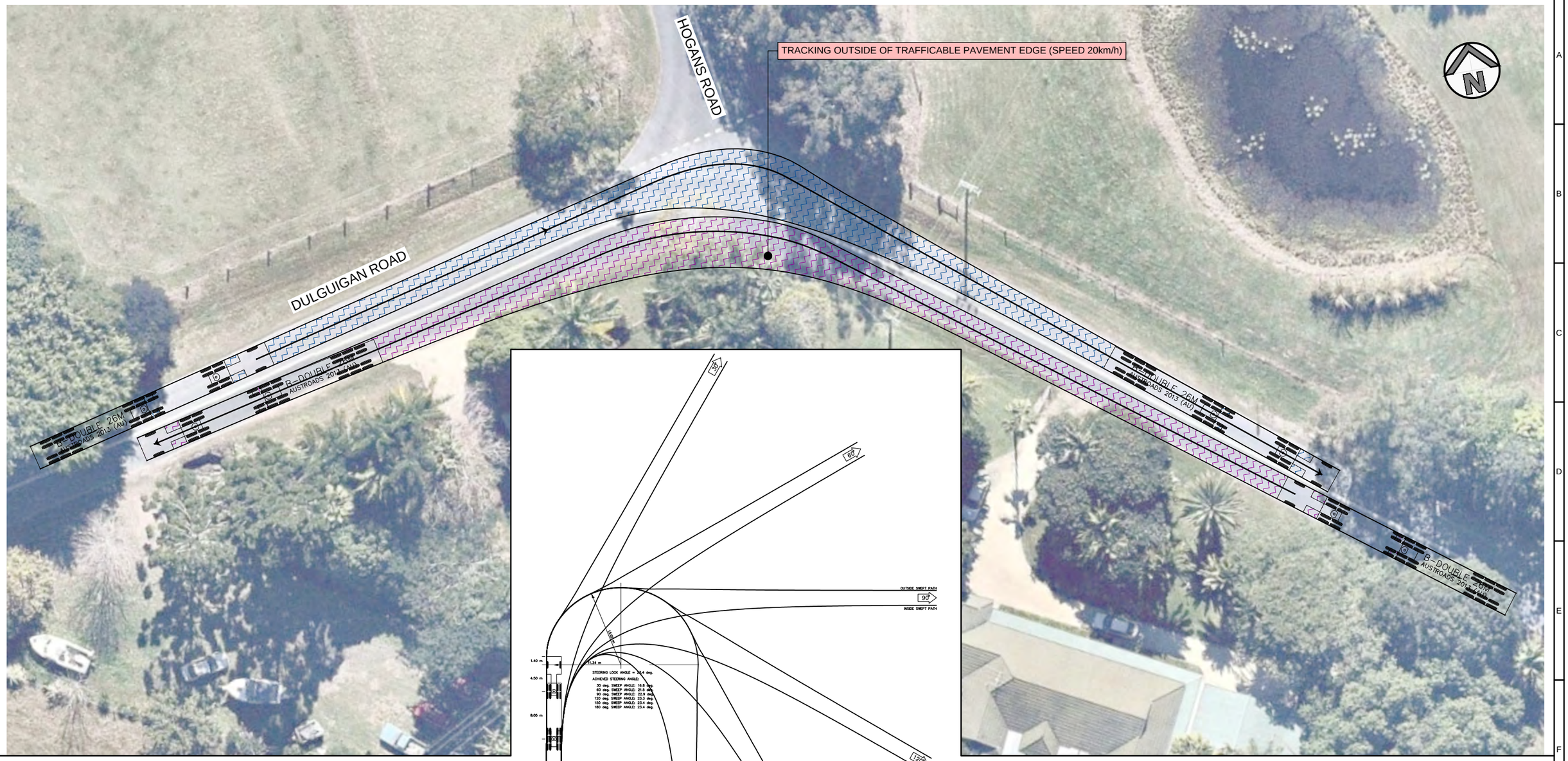

B–DOUBLE 26M meters

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B–DOUBLE 26M
AUSTROADS 2013 (AU)

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TWEED SHIRE COUNCIL
DULGUIGAN QUARRY TO TUMBULGUM
TURNING PATH ANALYSIS
DULGUIGAN ROAD AT HOGANS ROAD
26m B-DOUBLE

Drawn	Designed	Job No.
D.G.	-	18029G
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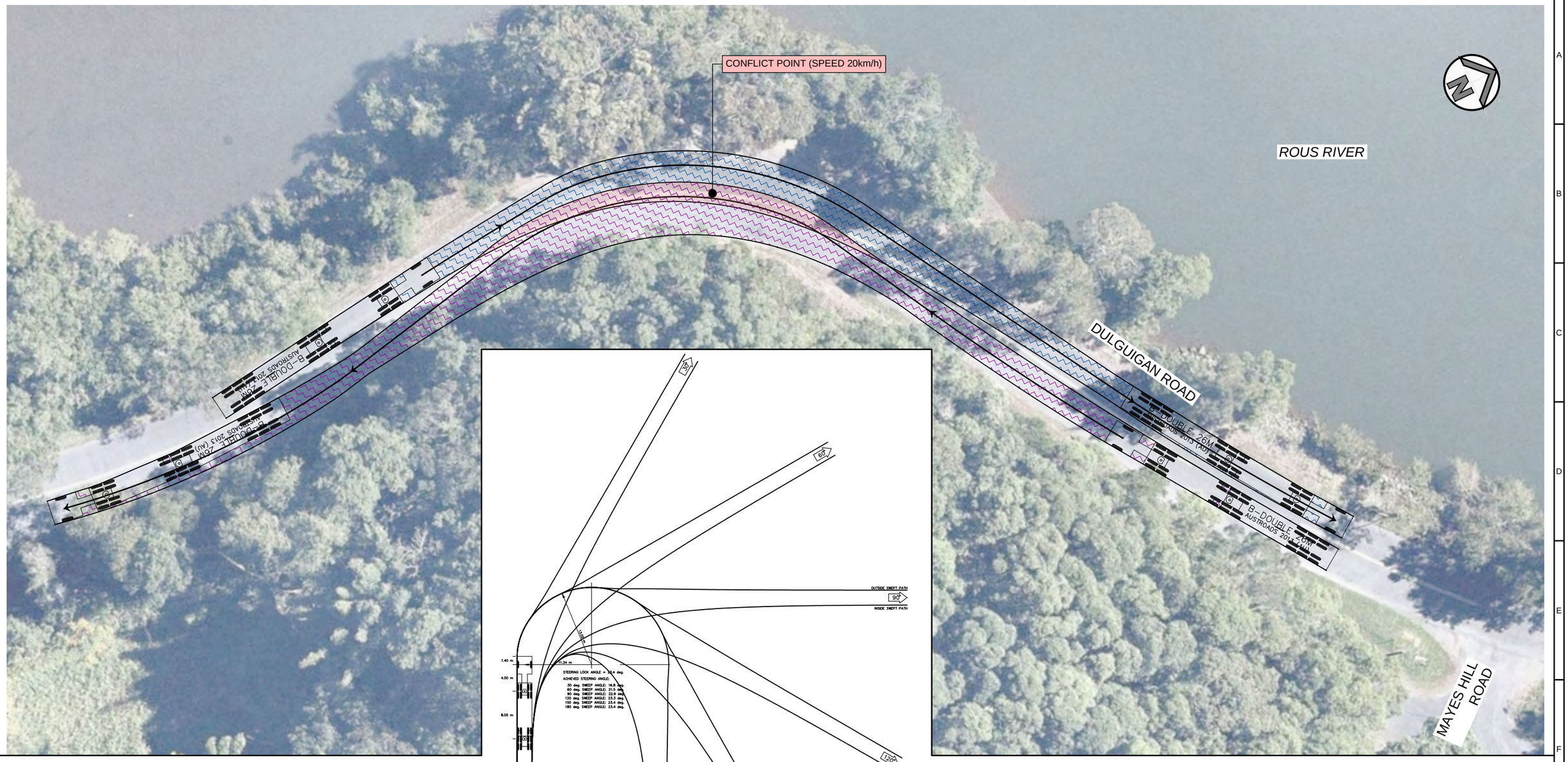
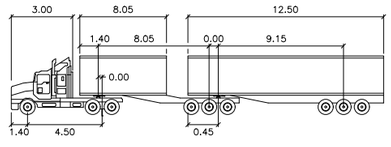
C.F.	-	7 of 10

Engineering Certification | No. | Signature | Date

Drawing No. 18029G-TP-1007 | Revision 02

Plotted By: samf Plot Date: 28/02/19 - 17:39 Cad File: X:\2018\Jobs\Tweed Valley RSAs - 18029G\DES\GIN\AutoCAD\Superseded\TP-1000 Rev1\TP-1000B.dwg





B-DOUBLE 26M meters

Tractor Width	: 2.50	Lock to Lock Time	: 6.0
Trailer Width	: 2.50	Steering Angle	: 23.4
Tractor Track	: 2.50	Articulating Angle	: 70.0
Trailer Track	: 2.50		

LEGEND

VEHICLE BODY EXTENTS

FINAL ISSUE
28 FEBRUARY 2019

No.	Revision / Amendment Description	Initials	Certification	No.	Date
02	FOR INFORMATION				
01	FOR INFORMATION				

Scales

0 4 8 12 16 20m

SCALE 1:200 (A1)

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TWEED SHIRE COUNCIL
DULGUIGAN QUARRY TO TUMBULGUM
TURNING PATH ANALYSIS
DULGUIGAN ROAD EAST OF MAYES HILL ROAD
26m B-DOUBLE

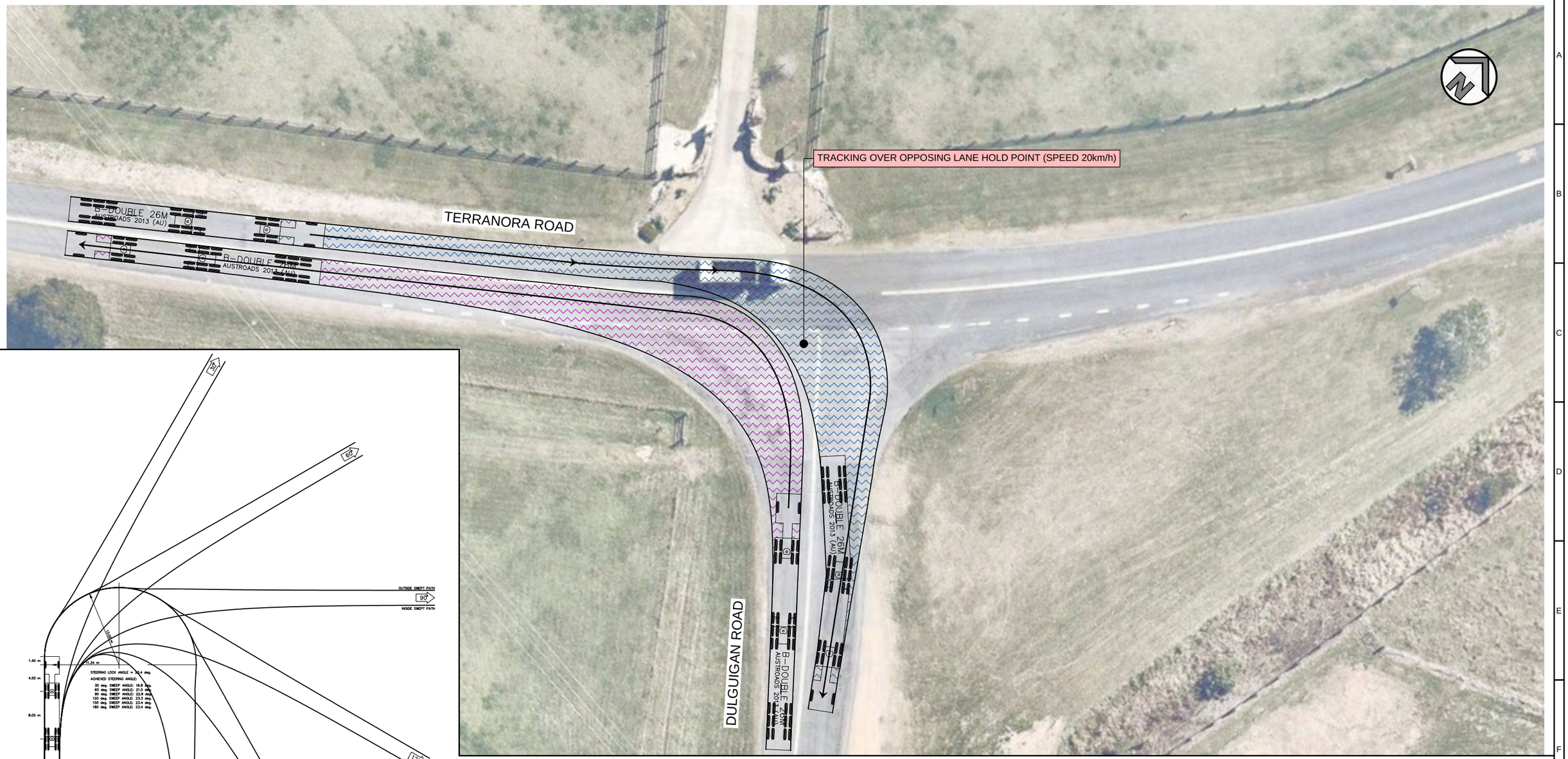
Drawn	Designed	Job No.
D.G.	-	18029G
Checked	Checked	Sheet No.
C.F.	-	8 of 10

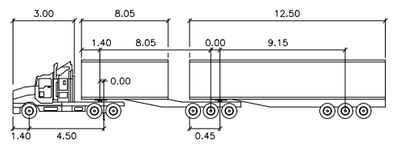
Engineering Certification | No. | Signature | Date

Drawing No. 18029G-TP-1008

Revision 02

Plotted By: samf Plot Date: 28/02/19 - 17:39 Cad File: X:\2018Jobs\Tweed Valley RSAs - 18029G\DESIGN\AutoCAD\Superseded\TP-1000 Rev1\TP-1000B.dwg





B-DOUBLE 26M meters

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Trailer Width	: 2.50	Steering Angle	: 23.4
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LEGEND

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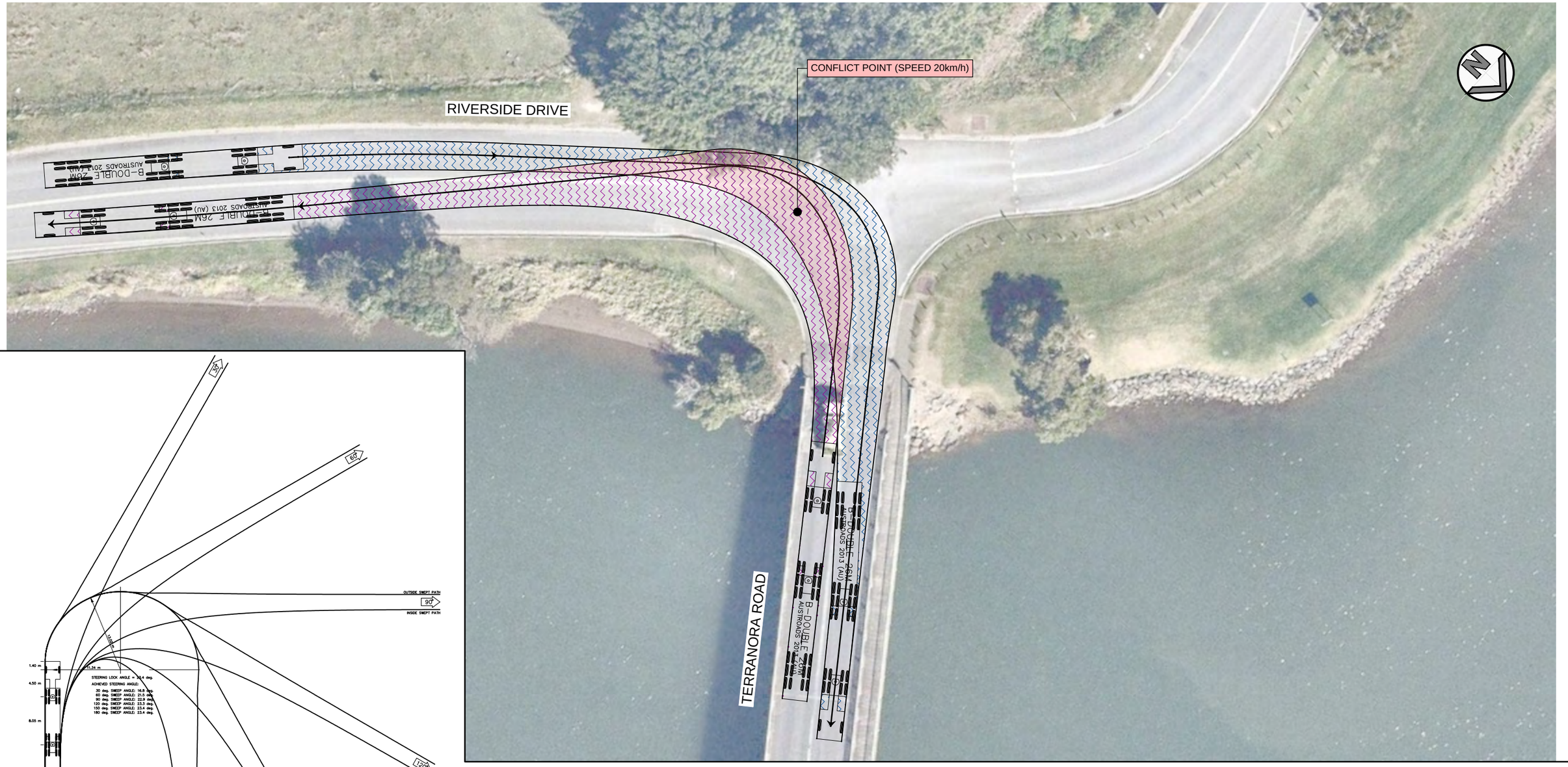
TWEED SHIRE COUNCIL
DULGUIGAN QUARRY TO TUMBULGUM
TURNING PATH ANALYSIS
INTERSECTION OF TERRANORA ROAD AND DULGUIGAN ROAD
26m B-DOUBLE

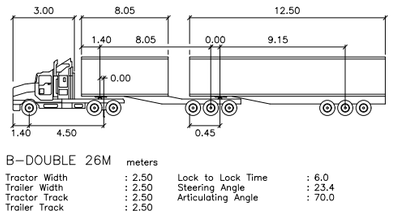
Drawn	Designed	Job No.
D.G.	-	18029G
Checked	Checked	Sheet No.
C.F.	-	9 of 10

Engineering Certification | No. | Signature | Date

Drawing No.	Revision
18029G-TP-1009	02

Plotted By: stamf Plot Date: 28/02/19 - 17:40 Cad File: X:\2018\Jobs\Tweed Valley RSAs - 18029G\DESIGN\AutoCAD\Superseded\TP-1.000 Rev1\TP-1000B.dwg





B-DOUBLE 26M meters

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Trailer Width	: 2.50	Steering Angle	: 23.4
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LEGEND

VEHICLE BODY EXTENTS

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TWEED SHIRE COUNCIL
DULGUIGAN QUARRY TO TUMBULGUM
TURNING PATH ANALYSIS
INTERSECTION OF RIVERSIDE DRIVE AND TERRANORA ROAD
26m B-DOUBLE

Drawn: D.G.	Designed: -	Job No.: 18029G	
Checked: C.F.	Checked: -	Sheet No.: 10 of 10	
Engineering Certification	No.	Signature	Date
Drawing No.: 18029G-TP-1010		Revision: 02	

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APPENDIX C - ROAD CLASSIFICATION

APPENDIX D – SAMPLE FORM FOR ROAD CLASSIFICATION

Road name: Dulguigan Road

References: Onsite inspection and limited measurements

Ref. item no.	Road performance measures		Assign road access class				Comments
	Description	**Performance levels**					
	Physical and operational considerations		**L1**	**L2**	**L3**	**L4**	
0	Road widths - Minimum lane and shoulder width for sealed rural roads - Minimum carriageway width for unsealed roads - Minimum bridge width on rural roads - Minimum lane width for urban/township roads - Minimum lane width for horizontal curves	 Table 3 Table 4 Table 6 Table 2 Table 5	**X**				Refer Sec. 5 Table 5.1.
2.3	Overtaking provision - Minimum establishment sight distance - Maximum distance between overtaking opportunities - Overtaking lanes - Relationship between overtaking difficulty at specified Level of Service and effects due to extent of overtaking lane, sight distance profile and opposing traffic	 Table 8 Table 9 L1, L2 -1 km L3, L4 -1.25 km L1 - Fig. 4 L2 - Fig. 5 L3 - Fig. 6 L4 - Fig. 7	Not Applicable				
0	Low speed offtracking and intersection requirement	Intersection geometric requirements to be determined by each representative Scheme vehicle class and swept path software	**X**				Vehicle swept paths indicate 19m semi-trailer will cross into the opposing traffic lanes at isolated locations.
2.5 2.6	Signalised intersection and railway crossings - Minimum green plus intergreen time - Stacking distances at	Table 12 Tables 12 & 13 Table 13	Not Applicable				

	intersections and railway level crossings - Warning time at railway level crossings						
2.7	Entry length onto highways - Entry lengths a function of grade and main road operating speed	Table 14	Not Applicable				
2.8	Approach visibility - Minimum sight distance as a function of grade and operating speed	Table 15	**X**				Refer Sec. 5 - No sight distance calculations performed. On-site observations indicate limited sight distance based on operating traffic speeds.
2.9	Vertical clearance - Minimum overhead clearance	L1 - 4.5 m L2 - 4.8 m L3 - 4.8 m L4 - 4.8 m	**X**				Refer Sec. 5 - No clearance measurements taken. On-site observations indicate sufficient clearance to overhead cables and structure.
2.10	Off-road parking - Maximum spacing - Clearance from edge of pavement as a function of speed	L1 – 80 km L2 – 80 km L3 – 80 km L4 – 120 km Table 18	Not Applicable				
2.11	Roadside infrastructure - Widths of entry and exit lanes and radius of curvature to minimise damages to roadside furniture	(same requirements as low speed offtracking)	Not Applicable				

APPENDIX D - RISK ASSESSEMENT

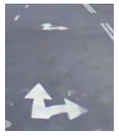
RISK ASSESSMENT - Dulguigan Road Heavy Vehicle Route Assessment

Project: 18029G Tweed Shire Council - Heavy Vehicle Route Assessment

Client: Tweed Shire Council (TSC)

Reference: Vehicle Swept Paths Analysis and On-site Observations undertaken Friday 8th and Tuesday 12th February 2019

Revision: 11th March 2019

Ref No.	Specific Activity	Hazard	Risk	Frequency	Severity	Risk Level	Control measures	Recommended Actions	Action by Whom	Frequency	Severity	Risk Level
Dulguigan Quarry Access (Ch: 00) - Swept path analysis (Drawing No. 18029G-TP-1001 Rev 02) and on-site observations undertaken to assess risk associated with heavy vehicles exiting Dulguigan Quarry and turning left onto Dulguigan Road, and heavy vehicles travelling on Dulguigan Road and turning right to enter Dulguigan Quarry. Swept path analysis indicates 'almost certain' that 19m heavy vehicles will cross into opposing lane when exiting the quarry and turning left onto Dulguigan Road. No trucks exited the quarry at the time of on-site observation. Markings on the road surface indicate that vehicles utilise the opposing lane however these markings may relate the heavy vehicles entering and not exiting the quarry.											
1	Heavy vehicles exiting Dulguigan Quarry and turning left (eastbound) onto Dulguigan Road	Heavy vehicles entering opposing traffic lane resulting in potential for head-on vehicle collision.	Vehicle damage and injury	Occasional	Serious	High	Wide access at Dulguigan Quarry provides an area for heavy vehicles to use when exiting the quarry and turning left onto Dulguigan Road.	Undertake trial in conjunction with quarry owners to assess actual vehicle swept path for the longest heavy vehicle utilised at the quarry to determine if heavy vehicle cross into the opposing lanes (turn lane, through lane) when exiting the quarry and turning left onto Dulguigan Road.	TSC Representative / Quarry Owner	Improbable	Serious	Medium
							Reasonable sight distance for drivers of heavy vehicles when exiting the quarry and turning left onto Dulguigan Road, and for motorists travelling westbound on Dulguigan Road. Dulguigan Road widening on southern side provides a travel path for westbound traffic if an evasive manoeuvre is required.	Confirm quarry operators have internal protocol(s) in relation to heavy / light vehicles entering and exiting the quarry to prevent the risk of heavy vehicle exiting the quarry striking heavy / light vehicle in Dulguigan Road that is stopped to turn right into quarry, or striking westbound traffic on Dulguigan Road.				
							Combined "Trucks Entering" and "50m" sign installed prior to Dulguigan Quarry access. 					
2	Heavy vehicles travelling westbound on Dulguigan Road and turning right into Dulguigan Quarry	Heavy vehicles stopped in westbound lane on Dulguigan Road waiting to turn right may result in rear end collisions.	Vehicle damage and injury	Occasional	Minor	Medium	Dulguigan Road has been widened at this location to allow westbound traffic to pass heavy vehicles stopped to turn right into the Dulguigan Quarry access.	Review the present linemarking and signage layout at the quarry access, and implement modifications, if required.	TSC Design Representative	Improbable	Minor	Low
							Combined symbolic "right curve" sign and "65km/h" advisory speed sign followed by combined "Turning Traffic" and "100m" sign installed prior to Dulguigan Quarry access. 					
							Linemarking denoting right turn movement into Dulguigan Quarry provided. 					
Dulguigan Road / Hogans Road Intersection (Ch 2500) - Vehicle swept paths (Drawing No. 18029G-TP-1002 Rev 02) and on-site observation showed the travel path for a number of heavy and light vehicles travelling eastbound on Dulguigan Road was close to the road centreline or partly within the opposing travel lane when negotiating the curve. Observed travel speeds appeared to exceed the posted 25km/h advisory speed. Driver behaviour altered with high level of compliance (ie: remaining in travel lane) when other vehicles were present.											
3	Heavy vehicle travelling eastbound or westbound on Dulguigan Road	Heavy vehicles entering opposing traffic lane resulting in potential for head-on vehicle collision. 	Vehicle damage and injury	Occasional	Serious	High	Combined symbolic "curve and side road" sign and "25km/h" speed advisory sign installed in Dulguigan Road on both approaches to the curve at Hogans Road. Note: The speed environment on both approaches to the curve at Hogans Road makes it unlikely that motorists will adopt the advisory speed of 25km/hr when negotiating the curve. 	Install more prominent signage highlighting the advisory speed.	TSC Design Representative / TSC Maintenance Representative	Improbable	Serious	Medium
							Reasonable sight distance for 25km/h advisory speed. 	Remove vegetation to provide additional sight distance around the curve. (Note: This action may result in vehicles travelling at higher speeds around the curve and thus increase the likelihood of vehicles travelling in the opposing travel lane.)				
								Redesign curve and intersection layout to higher design speed and implement works.				

Dulguigan Road east of Mayes Hill Road (Ch: 3650) - Vehicle swept paths (Drawing No. 18029G-TP-1003 Rev 02) and on-site observation showed the travel path for heavy vehicles travelling westbound on Dulguigan Road was close to the road centreline or partly within the opposing traffic lane when negotiating the series of curves.													
4	Heavy vehicle travelling eastbound or westbound on Dulguigan Road	Heavy vehicle entering opposing traffic lane resulting in head-on vehicle collision.	Vehicle damage and injury	Occasional	Serious	High	Combined symbolic "Windy Road" and "45km/h" speed advisory sign installed on both approaches to a series of bends in the vicinity of Mayes Hill Road. CAMs also provided to assist in delineating this series of bends. 	Review road geometry and the potential to widen seal width sufficiently (including curve widening requirements) to accommodate a double barrier centreline and possibly edge lines through this series of bends, and implement works.	TSC Design Representative / TSC Maintenance Representative	Improbable	Serious	Medium
							Ongoing monitoring of road pavement condition and the undertaking of pavement repairs when required. 	Continue monitoring of road condition (edge breaks, edge drop offs, seal defects, shoulder integrity, etc) with maintenace regime to maintain maximum effective seal width.				
Dulguigan Road / Terranora Road Intersection (Ch: 5400) - Vehicle swept paths (Drawing No. 18029G-TP-1004 Rev 02) and on-site observation showed a high percentage of heavy and light vehicles northbound on Terranora Road and turning right into Dulguigan Road were crossing into the opposing travel lane when negotiating the right turn manoeuvre. Driver behaviour altered with high level of compliance when other vehicles were present.													
5	Heavy vehicle turning right form Terranora Road into Dulguigan Road	Heavy vehicle striking vehicle waiting to turn right from Dulguigan Road into Terranora Road.	Vehicle damage and injury	Improbable	Minor	Low	Very good sight distance on all approaches to the intersection. Standard linemarking and signage provided.	Review linemarking layout at intersection with consideration to the position of a vehicle in Dulguigan Road waiting to turn right into Terranora Road.	TSC Design Representative	Improbable	Minor	Low
Terranora Road / Riverside Drive Intersection (Ch: 5900) - Vehicle swept paths (Drawing No. 18029G-TP-1005 Rev 02) and on-site observation showed a high percentage of heavy and light vehicles travelling on Riverside Drive and turning right into Terranora Road were crossing into the opposing travel lane when undertaking the right turn manoeuvre. Driver behaviour altered and high level of compliance when other vehicles were present.													
6	Heavy vehicle turning right form Riverside Drive into Terranora Road	Heavy vehicle striking vehicle waiting to turn right from Terranora Road into Riverside Drive.	Vehicle damage and injury	Occasional	Minor	Medium	Reasonable sight distance on 2 of the 3 approached to the intersection with poor sight distance on Terranora Road approach. Combined symbolic "Intersection" sign and "Reduce Speed" sign installed on Terranora Road prior to the intersection. 	Continue monitoring of road condition including linemarking and signage with maintenace regime to maintain appropriate level of delineation.	TSC Infrastructure Delivery Representative / TSC Maintenance Representative	Improbable	Minor	Low
							Ongoing monitoring of linemarking, signage and pavment and the undertaking of repairs or replacement when required.	Review intersection geometry and the potential to realign Riverside Drive to better accommodate all traffic movements. Implement works.				
Dulguigan Road (Route Length 5.4km) - On-site observations and measurements reveal narrow seal width for road with reasonably high number of heavy vehicles, and isolated pavement failures on outer edge of seal.													
7	Heavy vehicles travelling eastbound and westbound on Dulguigan Road	Narrow seal width may result in heavy vehicles crossing the road centreline or leaving the sealed road surface, resulting in the possibility of head-on or 'off road' collisions.	Vehicle damage and injury	Occasional	Serious	High	Ongoing monitoring of road pavement condition and the undertaking of pavement repairs when required.	Continue monitoring of road condition (edge breaks, edge drop offs, seal defects, shoulder integrity, etc) with 'quick response' maintenace regime to maintain maximum effective seal width.	TSC Infrastructure Delivery Representative / TSC Maintenance Representative	Improbable	Serious	Medium
							Signage such at "60 Truck Speed Limit", symbolic "Road Narrows" signs and "Advisory Speed" signs used to control heavy vehicle speeds and advise drivers of narrow road seal width.  	Prepare and implement a road widening works program with consideration to the high priority locations identified in this risk assessment. Implement works.				
8	Heavy vehicles travelling eastbound and westbound on Dulguigan Road	Vegetation extending into roadway may result in heavy vehicles crossing the road centreline and entering the opposing travel lane, resulting in the possibility of head-on collisions.	Vehicle damage and injury	Improbable	Serious	Medium	Ongoing monitoring of vegetation and the undertaking of vegetation maintenance when required.	Continue monitoring of vegetation with 'quick response' maintenance regime (trimming, removal) that maintains sufficient clearance for maximum size, heavy vehicles using the road.		Improbable	Serious	Medium

NOTE: 1. The above Risk Assessment is based on general access (Level 1) 19m semi-trailer. Based on a review of swept paths associated with (Level 2) 26m B-double the risk of a high number of these heavy vehicles is deemed not acceptable unless road modifications (horizontal geometry, road widening) are implemented.

2. Pedestrians, cyclists and bus operations are excluded from the above Risk Assessment.

Based on Risk Assessment from Austroads: Guide to Road Safety Part 6: Road Safety Audit - Section 4.8

C. Risk ranking of safety issues

The following tables may be useful to provide an indication of the level of risk and how to respond to it. Determine into which category in Table 4.1 and Table 4.2 the issue best fits. From this select the risk category in Table 4.3 and its suggested treatment approach in Table 4.4. This is not a scientific system and professional judgement should be used. Section 9.3 provides an evidence based approach to prioritising the treatment of works emanating from road safety audits of existing roads.

Table 4.1: How often is the problem likely to lead to a crash?

Frequency	Description
Frequent	Once or more per week
Probable	Once or more per year (but less than once a week)
Occasional	Once every five or ten years
Improbable	Less often than once every ten years

Table 4.2: What is the likely severity of the resulting crash type?

Severity	Description	Examples
Catastrophic	Likely multiple deaths	High-speed, multi-vehicle crash on a freeway. Car runs into crowded bus stop. Bus and petrol tanker collide. Collapse of a bridge or tunnel.
Serious	Likely death or serious injury	High or medium-speed vehicle/vehicle collision. High or medium-speed collision with a fixed roadside object. Pedestrian or cyclist struck by a car.
Minor	Likely minor injury	Some low-speed vehicle collisions. Cyclist falls from bicycle at low speed. Left-turn rear-end crash in a slip lane.
Limited	Likely trivial injury or property damage only	Some low-speed vehicle collisions. Pedestrian walks into object (no head injury). Car reverses into post.

Table 4.3: The resulting level of risk

	Frequent	Probable	Occasional	improbable
Catastrophic	Intolerable	Intolerable	Intolerable	High
Serious	Intolerable	Intolerable	High	Medium
Minor	Intolerable	High	Medium	Low
Limited	High	Medium	Low	Low

Table 4.4: Treatment approach

Risk	Suggested treatment approach
Intolerable	Must be corrected.
High	Should be corrected or the risk significantly reduced, even if the treatment costs is high.
Medium	Should be corrected or the risk significantly reduced, if the treatment cost is moderate, but not high.
Low	Should be corrected or the risk reduced, if the treatment cost is low.