Tarago Siding
Extensions—
Options Report

FOR / Engineering Services

CLIENT / John Holland Rail

DOCUMENT NO / S15066-OPT-REP-0001 REV / A DATE / 23/06/2015

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Document *Control*

Revision	Date	Description	Prepared	Reviewed	Approved
A	23/06/15	Issued for Review	Ben Keith		

1 INTRODUCTION

John Holland Rail (JHR) has commissioned BG&E Pty Limited to undertake an investigation to provide additional train standing room at an existing passing loop at Tarago NSW.

The purpose of this document is to outline and compare a selection of design options which have been identified as meeting the functional requirements of the project. The functional requirements report can be seen as Appendix A.

2 BACKGROUND INFORMATION

The Tarago Siding design project has been initiated by Pacific National and Veolia. Both of these companies have made representations to extend the multi-user siding at Tarago to permit 1000 (approx) metre long trains to be stowed and/or crossed at this location, without the need to break trains across multiple sidings.

Veolia have recently secured a contract to increase the amount of waste they are processing from 500 000 tonnes per year to 1 million tonnes per year. To process this additional volume, Veolia (through Pacific National as their train operator) will need to increase the volume of waste transported from Sydney to Crisps Creek Intermodal Terminal located 1.8km in the Down direction from the existing Tarago passing loop.

3 OPTION ASSESSMENT

Table 1 indicates a comparison for numerous criteria for the three options.

Table 1: Option Comparison

Design Aspect	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8
Length of Train Reversing Over Public Level Crossing (Length of Veolia Train is 900m train)	323m	900m	0m	0m	0m	0m	230m	0m
Drive in Drive Out	No	No	Yes	Yes	Yes	Yes	No	Yes
New turnouts required	0	0	1 (flex)	0	1 (flex)	0	0	0
Turnouts being refurbished insitu[1]	2	1	2	2	1	1	0	0
Turnout refurbished, relocated and straight railed	0	1	0	1	1	2	1	1
New catchpoints required	0	1	1	1	2	2	0	0
Catchpoints refurbished, relocated and straight railed	0	0	0	0	0	0	1 (removed only)	1
Loop available while 1 train is being stored	No	Yes	No	No	Yes	Yes	No	No
Length of New Track Required	0m	0m	0m	0m	0m	0m	470m	470m
Length of Woodlawn Siding being utilised (refurbishment)	450m	All of siding	450m	450m	All of siding	All of siding	0m	0m
Impact on Cutting	No	No	Yes	Yes	Yes	Yes	No	Yes
Impact on existing Woodlawn Pit Structure	No	Yes	No	No	Yes	Yes	No	No
Track slew onto new formation	Nil	Country End	City End	City End	City and Country End	City and Country End	Nil	Nil

1: Information provided by John Holland Rail.

4 OPTION DISCUSSION

4.1 Option 1

Description

This option utilises both the Woodlawn siding and the loop to achieve the functional requirement of 1000m standing room. No new track or turnouts, subject to John Holland Rail condition assessment, are required to achieve 1000m of standing room. It should be noted that the condition of the existing Woodlawn siding would suggest part if not all of the existing timber sleepers in the plain track and the timbers in the two turnouts and catchpoints located between them may need to be replaced.

In order to utilise the proposed storage a consist would need to pass the public level crossing by a length of 323m, based on a 900m consist, and then reverse back over the public level crossing to access the location of the proposed storage.

Operation

A train from Joppa Junction, travelling in the Down direction correctly, would need to enter the Tarago loop at 262.285km once the points at 262.285km and 262.440km has been set and continue 323m past the existing level crossing until the entire consist was past the points at 262.440km. This turnout would then need to be switched prior to the train reversing onto the Woodlawn siding.

The final storage location of consist would not allow the Loop to be used by another consist. Once the consist was stowed mainline points at 262.285km and 263.020km would need to be reset for mainline use.

Signalling

The existing shunt limits are spaced adequately and Main line Indicators (MLI's)/ shunters pushbuttons are provided to traverse the level crossing at Bugendore road. The remaining Woodlawn siding should be fenced off/booked out of use if not necessary or else further works will be required to convert both crossovers 262.450km and 262.440km to Ground Frame with duplex lock release electrically interfaced to the signalling for the MLI's. Alternatively Motorised points can be used.

4.2 Option 2

Description

This option utilises the Woodlawn siding to achieve the functional requirement of 1000m standing room. No new turnouts are required however the relocation and straight railing of 1 turnout, subject to John Holland Rail condition assessment and track slew in new formation to connect the mainline and loop to the existing Woodlawn Siding, would be required to achieve 1000m of standing room. It should be noted that the condition of the existing Woodlawn siding would suggest part if not all of the existing timber sleepers and the timbers in the two affected turnouts would need to be replaced.

Subject to condition assessment the existing track on the concrete pit may need to be removed and reconstructed.

In order to utilise the proposed storage the entire consist, 900m, would need to pass the public level crossing and then reverse over the public level crossing to access the proposed storage location.

Operation

A train from Joppa Junction, travelling in the Down direction, would need to travel on the mainline until the entire consist passed the points at 263.020km. It should be noted at this point there would be opportunity for the consist to completely clear the level crossing to allow road users to cross the public level crossing. The point's at turnout 263.020km and new reused turnout (as seen in Appendix B) would need to be correctly set prior to the consist reversing onto the Woodlawn siding.

The final storage location of consist would allow the existing Loop to be used by another consist. Once the consist was stowed mainline points at 263.020km would need to be reset for mainline use.

Signalling

This new crossover will require a new Ground Frame, or motorised points electrically interlocked with the existing MLI's. If any of the existing crossovers is to be brought into use it would have to upgrade to Ground Frame or motorised points interlocked with the MLI's.

4.3 Option 3

Description

This option utilises both the Woodlawn siding and the loop to achieve the functional requirement of 1000m standing room. This option is as per Option 1 plus the construction of a new flex turnout in the mainline at approximately 261.870km and track slew on new formation to connect the flex turnout to the existing Woodlawn siding. The consist would pass via the flex turnout to store on both the Woodlawn siding and the loop. It should be noted that the condition of the existing Woodlawn siding would suggest part if not all of the existing timber sleepers in the plain track and the timbers in the two turnouts and catchpoints located between them would need to be replaced.

Operation

A train from Joppa Junction, travelling in the Down direction would enter the Woodlawn siding through the proposed flex turnout once the points had been correctly set. The consist would continue along the siding and pass through the turnouts at 262.336km and 262.440km, which would need to be correctly set, before reaching its final storage location. The final storage location would not allow the Loop to be used by another consist. Once the consist was stowed mainline points of the new flex turnout would need to be reset for mainline use.

This option would not impede the level crossing and would allow a drive in drive out operation for the train operator.

An assessment would need to be completed to determine any potential impact on mainline speed associated with the installation of the flex turnout.

Signalling

This option would require the relocation of existing. MLI signal and maybe the relocation of the Up side Yard limit, Shunt limit and Landmark signal notice boards. It's possible that there could be issues with the sighting of the relocated C MLI) signal due to the track curvature on the approach possibly requiring the provision of a C MLI Repeater signal, although sighting looks adequate from the aerial photos. If the remainder of the Woodlawn siding was brought into use, than the Crossover 262.450km would have to feature a Ground Frame or motorised points and a Siding cut back between the two existing Woodlawn crossovers) so as to protect the new Loop line from stabled trains within the remaining Woodlawn siding if brought back into use.

4.4 Option 4

Description

This option utilises both the Woodlawn siding and the loop to achieve the functional requirement of 1000m standing room. This option is per Option 3 except that instead of using a flex turnout it would require the turnout 262.557km to be straight railed, refurbished and relocated to the mainline, subject to condition assessments by John Holland Rail. The horizontal geometry of the mainline would need to be adjusted to accommodate the straight turnout which would include tighter radius curvature on the mainline. This may impact the operating speed of the mainline. The consist would pass via the straight turnout to store in both the Woodlawn Siding and the loop. It should be noted that the condition of the existing Woodlawn siding would suggest part if not all of the existing timber sleepers in the plain track and the timbers in the two turnouts and catchpoints located between them would need to be replaced.

Operation

A train from Joppa Junction, travelling in the Down direction would enter the Woodlawn siding through the proposed reused straight turnout once the points had been correctly set. The consist would continue along the siding and pass through the turnouts at 262.336km and 262.440km, which would need to be correctly set, before reaching its final storage location. The final storage location would not allow the Loop to be used by another consist. Once the consist was stowed mainline points of the reused straight turnout would need to be reset for mainline use.

This option would not impede the level crossing and would allow a drive in drive out operation for the train operator.

An assessment would need to be completed by John Holland Rail to approve the reuse and determining potential impact on mainline speed associated with the reuse of the straight turnout.

Signalling

This option would require the relocation of existing. MLI signal and maybe the relocation of the Up side Yard limit, Shunt limit and Landmark signal notice boards. It's possible that there could be issues with the sighting of the relocated C MLI) signal due to the track curvature on the approach possibly requiring the provision of a C MLI Repeater signal, although sighting looks adequate from the aerial photos. If the remainder of the Woodlawn siding was brought into use, than the Crossover 262.450km would have to feature a Ground Frame or motorised points and a Siding cut back between the two existing Woodlawn crossovers) so as to protect the new Loop line from stabled trains within the remaining Woodlawn siding if brought back into use.

4.5 Option 5

Description

This option utilises the Woodlawn siding to achieve the functional requirement of 1000m standing room. This option is as per Option 2 plus the construction of a new flex turnout in the mainline at approximately 261.870km and track slew on new formation to connect the flex turnout to the existing Woodlawn siding. The consist would pass via the flex turnout to store on the Woodlawn siding. It should be noted that the condition of the existing Woodlawn siding would suggest part if not all of the existing timber sleepers and timbers would need to be replaced.

Operation

A train from Joppa Junction, travelling in the Down direction would enter the Woodlawn siding through the proposed flex turnout once the points had been correctly set. The consist would continue along the siding,

before reaching its final storage location. The final storage location would allow the Loop to be used by another consist. Once the consist was stowed mainline points of the new flex turnout would need to be reset to mainline use. The stored consist would exit the Woodlawn siding via a reused turnout, correctly set before entering then mainline in the Down direction.

This option would not impede the level crossing and would allow a drive in drive out storage facility for the train operator.

An assessment would need to be completed to determine any potential impact on mainline speed associated with the installation of the flex turnout.

Signalling

A new MLI would be provided on the approach to the new city side Flex turnout which would also have to feature two new ground frame's or motor operation, as would the reused new turnout at the city end, both being electrically interfaced to the MLI's using duplex locks or similar. This option may require the relocation of the Up side Yard limit; Shunt limit and Landmark signal notice boards. The existing two Woodlawn sidings crossovers should be left out of use to simplify the signalling requirements.

4.6 Option 6

Description

This option utilises the Woodlawn siding to achieve the functional requirement of 1000m standing room. This option is as per Option 5 except that instead of using a flex turnout it would require the turnout 262.450km to be straight railed, refurbished and relocated to the mainline, subject to condition assessments by John Holland Rail. The horizontal geometry of the mainline would need to be adjusted to accommodate the straight turnout which would include tighter radius curvature on the mainline. This may impact the operating speed of the mainline. The consist would pass via the straight turnout and be stowed on the Woodlawn Siding. It should be noted that the condition of the existing Woodlawn siding would suggest part if not all of the existing timber sleepers and timbers would need to be replaced.

Operation

A train from Joppa Junction, travelling in the Down direction would enter the Woodlawn siding through the proposed reused straight turnout once the points had been correctly set. The consist would continue along the siding reaching its final storage location. The final storage location would allow the existing Loop to be used by another consist. Once the consist was stowed mainline points of the reused straight turnout would need to be reset for mainline use. The stored consist would exit the Woodlawn siding via a reused turnout, correctly set before entering the mainline in the Down direction.

This option would not impede the level crossing and would allow a drive in drive out storage facility for the train operator.

An assessment would need to be completed by John Holland Rail to approve the reuse and determine any potential impact on mainline speed associated with the reuse of the straight turnout.

Signalling

A new MLI would be provided on the approach to the new city side Flex turnout which would also have to feature two new ground frame's or motor operation, as would the reused new turnout at the city end both being electrically interfaced to the MLI's using duplex locks or similar. This option may require the relocation of the Up side Yard limit; Shunt limit and Landmark signal notice boards. The existing two Woodlawn sidings crossovers should be left out of use to simplify the signalling requirements.

4.7 Option 7

Description

This option utilises the loop and additional new track to achieve the functional requirement of 1000m standing room. To achieve the 1000m of standing room the right hand turnout at 262.450km would need to be straight railed and refurbished and relocated to replace the existing catchpoints and provide connection to the mainline.

In order to utilise the proposed storage a consist would need to pass the public level crossing by a length of 230m, based on a 900m consist, and then reverse back over the public level crossing to access the location of the proposed storage.

Operation

A consist from Joppa Junction, travelling in the Down direction, would need to enter the Tarago loop, once the points were switched, at 262.285km. The consist would continue along the loop re-joining the mainline at 263.020 and passing the level crossing by 230m. Points of the turnout replacing the catchpoints would then need to be switched before the consist reverses to its final storage location.

The final storage location of consist would not allow the Loop to be used by another consist. Once the consist was stowed mainline points at 262.285km and 263.020km would need to be reset for mainline use. The final storage location of the consist does not use the Woodlawn siding.

Signalling

The existing shunt limits are spaced adequately and Main line Indicators (MLI's)/ shunters pushbuttons are provided to traverse the level crossing at Bugendore road. The remaining Woodlawn siding should be fenced off/booked out of use if not necessary or else further works will be required to convert both crossovers 262.450km and 262.440km to Ground Frame with duplex lock release electrically interfaced to the signalling for the MLI's. Alternatively Motorised points can be used.

4.8 Option 8

Description

This option utilises the existing loop to achieve the functional requirement of 1000m standing room. This option would require the turnout 262.285km to be relocated to the mainline, subject to condition assessments by John Holland Rail and additional new track. The horizontal geometry of the mainline would need to be realigned to accommodate the existing straight turnout which would include tighter radius curvature on the mainline. This may impact the operating speed of the mainline. New track would need to be constructed from the location of the relocated turnout to the existing loop at 262.336km on new formation. The location of the new track may impact on the existing cutting as shown on the concept sketches.

Operation

A consist from Joppa Junction, travelling in the Down direction, would need to enter the loop at via the relocated turnout on the mainline. The consist would continue along the loop before reaching its storage location.

The final storage location of consist would not allow the Loop to be used by another consist. The final storage location of the consist does not use the Woodlawn siding.

Signalling

Assuming the entirety of the Woodlawn siding is left out of use, this option would require the relocation of existing MLI signal and potentially the relocation of the Up side Yard limit; Shunt limit and Landmark signal notice boards. In this sense it would be similar in many ways to Option 1 from a signalling perspective.

4.9 Option Differences

To determine the option to be progressed the following decisions will need to be made:

1. Yes/No: The existing Woodlawn Siding shall be utilised wherever practicable or the existing loop shall be extended on new formation.
2. Yes/No: Subject to the Woodlawn Siding being utilised practicable, the Siding shall provide 1000m clear standing and the existing loop shall also be able to be used by another consist at the same time or part of the existing loop shall be used to achieve a siding with 1000m clear standing.
3. Yes/No: The Siding shall have mainline access at both ends or be a dead end siding with access from the entry end only requiring trains set back across the active level crossing at 263.027km.
4. Yes/No: Subject to mainline access being provided at both ends, the mainline connection at the Sydney end shall be a flex turnout matching the existing curve radius or a straight turnout with associated mainline realignment with reduced curve radius.
5. Yes/No: Motorised points shall be installed at the country and/or the Sydney end.
6. Yes/No: The existing concrete weight bridge pit structure shall be required.

Special Note: The configuration of the mainline format for the existing extended siding at the Sydney end is recommended by John Holland Rail to be a new fully welded turnout with a flexi-switch. Reusing a refurbished straight turnout from the siding or mainline in the mainline for this purpose is not considered desirable or recommended and would require the authority of the Principal Civil Engineer John Holland Rail.

APPENDIX A

Functional Requirement Report

Tarago Siding
Extensions—
Functional Requirements Report

FOR / Engineering Services

CLIENT / John Holland Rail

DOCUMENT NO / S15066-FDES-REP-0001 REV / B DATE / 4/06/2015

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Document *Control*

Revision	Date	Description	Prepared	Reviewed	Approved
A	03/06/15	Issued for Information	Ben Keith	Raymond Marks	
B	04/06/15	Issued for Review	Ben Keith	Raymond Marks	

1 INTRODUCTION

John Holland Rail (JHR) has commissioned BG&E Pty Limited to undertake an investigation to provide additional train standing room at an existing passing loop at Tarago NSW.

The purpose of this document is to outline the functional requirements associated with the project including the relevant design codes upon which the design is to be based.

2 BACKGROUND INFORMATION

The Tarago Siding design project has been initiated by Pacific National and Veolia. Both of these companies have made representations to extend the multi-user siding at Tarago to permit 1000 (approx) metre long trains to be stowed and/or crossed at this location, without the need to break trains across multiple sidings.

Veolia have recently secured a contract to increase the amount of waste they are processing from 500 000 tonnes per year to 1 million tonnes per year. To process this additional volume, Veolia (through Pacific National as their train operator) will need to increase the volume of waste transported from Sydney to Crisps Creek Intermodal Terminal located 1.8km in the Down direction from the existing Tarago passing loop.

3 SITE LOCATION AND DESCRIPTION

The site is located on the Joppa Junction to Canberra line approximately 70km North West of Canberra. Figure 1 indicates the location of the site.

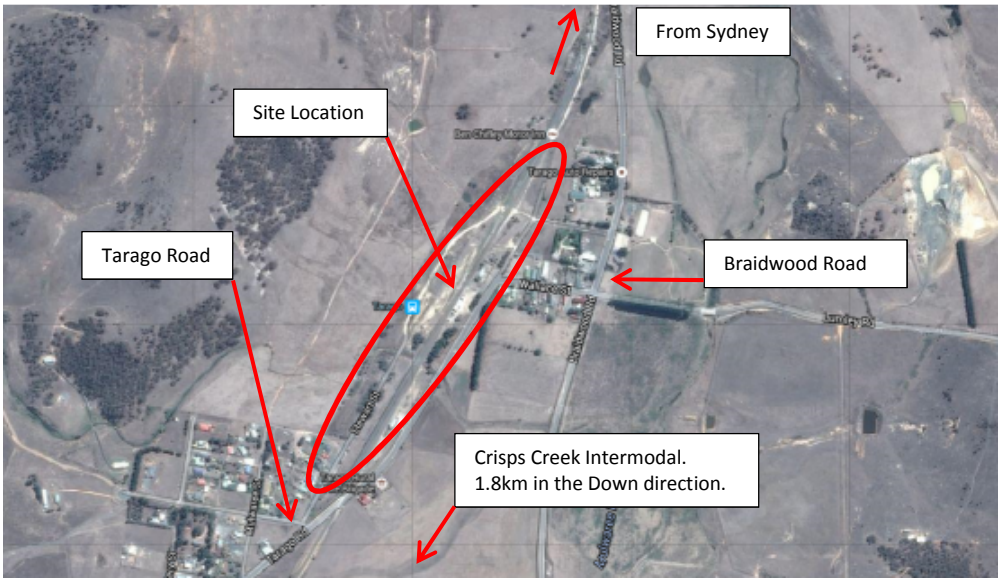


Figure 1: Site Location

3.1 Rail

Tarago is a train order crossing location. The yard limits are posted at 260.650km to 266.528km and shunting limits 261.150km to 265.940km. In general the yard consists of:

- A mainline Class 2 rail track;
- A passing loop with turnouts whose points are located at 262.285km and 263.020km; and
- An inactive siding to the west of the existing passing loop (Woodlawn Siding).

There are two crossovers from the passing loop to the siding which are locked to ensure trains can't access the siding.

It is understood the siding was used by the Woodlawn mine until it was closed in 1998. It is unclear how much use the siding has had since the mine closure however John Holland have noted the siding has been inactive since their management of CRN since January 2012. There may be a lease held by Woodlawn over the siding which needs to be determined by John Holland and extinguished if possible.

3.2 Station

The site is located at the existing Tarago Station. The station is heritage listed. A statement of heritage impact will be prepared to completely understand any potential restrictions associated with works near the station.

4 OPERATIONAL REQUIREMENTS

Veolia together with Pacific National indicated the following operational requirements while on site on the 27th May which included:

- Currently 1 x 900m train, per day, is travelling from Sydney to Crisps Creek unloading and returning on the same day. On occasion an additional shorter 400-500m train also travels from Sydney to Crisps Creek which is currently being stowed in the existing Tarago passing loop until the first train is unloaded at Crisps Creek and passes the Tarago yard limits in the Sydney (Up) direction;
- Commencing May 2016 it is planned to operate this additional train (that can stable clear in the Tarago crossing loop) Monday to Friday; and
- Commencing December 2016 it is planned to commence operating this second train at the full 900 metre length.

5 FUNCTIONAL REQUIREMENT

The primary purpose of the project is to construct additional siding length to enable Pacific National to store one train off the mainline without the need to break that train across multiple sidings, to allow other rail traffic to pass.

Pacific National have advised that a 1000m of storage length on the siding would allow storage of one train with enough room to couple an addition locomotive in case of breakdown while staying clear of mainline operations

The above forms the primary functional requirement for the project.

6 STAKEHOLDERS DESIRED FUNCTIONAL REQUIREMENTS

The design of the proposed Siding extension works will consider the operational needs of stakeholders. It is noted that John Holland Rail will coordinate the stakeholder requirements and design review comments with the stakeholders. It is understood the stakeholders are:

- Transport for New South Wales (TfNSW);
- John Holland Rail;
- Veolia;
- Pacific National; and.
- Goulburn Mulwaree Council.

Listed below are various requirements captured during the site inspection dated on the 27th of May 2015.

6.1 Transport for New South Wales

(TfNSW) are, for the design, funding the project. TfNSW while not directly indicating any operation requirements mentioned some project requirements which will need to be considered when documenting the design options and preliminary design which include:

- Production of Design Options Report detailing the most effective design scenarios with consideration of the following issues:
  - Cost;
  - Community;
  - Achieving the Functional Requirements;
  - Construction Timeframe and risk; and
  - Operational Outcomes.
- Completing the design as close as possible to the 30th of June to enable Transport for New South Wales to secure funding in order for the project to progress and be delivered before December 2016.
- Minimising project cost for the project while achieving the project functional requirements.

6.2 John Holland

John Holland notes the following train movements through the yard as being:

- 06:00 hours first Veolia (Down direction) train arrives at Tarago and is then received at Crisps Creek for processing;

- 09:30 hours second Veolia (Down direction) train arrives at Tarago and is stabled clear of the main line;
- 10:00 hours passenger (Down direction) train arrives at Tarago and then departs travelling to Canberra;
- 10:30 hours the first Veolia train departs Crisps Creek (Up direction) and passes through Tarago crossing the first Veolia train. Second Veolia train (Down direction) then departs Tarago and is received at Crisps Creek for processing; and
- 16:25 hours the second Veolia train departs Crisps Creek (Up direction) and passes through Tarago after waiting for an Up direction passenger train to pass.

John Holland notes their preferred requirements for the project being:

- To use existing infrastructure as far as practicable where cost effective; and
- There has been enquires for other additional rail traffic on this line - Details of Access Recycling train operating requirements and potential impact upon this project to be considered if available.

6.3 Veolia

Veolia mentioned the following as a list of preferred requirements for the project:

- It is essential that Veolia operations are maintained during construction therefore the use of planned close - down periods for construction activity is critical;
- Where possible the construction and operation of the new infrastructure should aim to minimise any impacts on the Tarago community (notably the Goulburn St level crossing); and
- To optimise Veolia processing operations it is desirable to receive the second train into Crisps Creek as soon as practicable after the first train departs.

6.4 Pacific National

Pacific National mentioned the following as a list of preferred requirements for the project:

- A loop which provides drive in drive out (no reversing) with motorised points for driver operations;
- Shunters walkway provisions;
- Their HAZOP analysis identified potential for passenger train failure - therefore consider risk mitigation requirements for the Loop in addition to the Siding in design option;
- Consider additional length of one locomotive (say 30 metres) to design consist to allow for locomotive failure in regular consist; and
- Reversing trains into a dead end siding increases operating risk (derailment of tail end of train and trespassers being hit by reversing train) and operating costs (additional time involved with shunting and 2nd person required to be at and observing tail end of train).

6.5 Goulburn Mulwaree Council.

Goulburn Mulwaree Council mentioned the following as a list of preferred requirements for the project:

- Would like to see the active level crossing (Goulburn St) only activated by through train movements.

The above requirements need to be considered while developing options for the next stage of the project.

7 STANDARDS

The rail is standard gauge (1435mm) passenger and freight train railway, noting Joppa Junction to Canberra is a Class 2 line.

The technical standards proposed to be used in this design process are:

- Australian Standard AS5100
- Australian AS1742.7
- CRN TOC Manuals
- CRN CM 101 Civil Service Schedules
- CRN CP 203 Track Design
- CRN CP 211 Survey
- CRN CP 212 Contract Survey
- CRN CS 100 Civil Technical Maintenance Plan
- CRN CS 200 Track System
- CRN CS 210 Track Geometry
- CRN CS 215 Transit Space
- CRN CS 220 Rail and Rail Joints
- CRN CS 230 Sleepers and Track Support
- CRN CS 240 Ballast
- CRN CS 250 Turnout and Special Trackwork
- CRN CS 410 Formation and Earthworks
- CRN CS 420 Track Drainage
- CRN CM 521 Level Crossings
- CRN SD 014 Signalling Design Principles – Points.
- CRN SD 019 Signalling Design Principles – Train Order Working.
- CRN SD 023 Signalling Design Principles – Placement of Yard Limit Boards.
- CRN SC 024 Signs, Notice Boards & Instruction Plates
- John Holland CRN – Contractor Safety Pack
- JHR CRN Engineering Design Procedures

8 ENGINEERING REQUIREMENTS

8.1 Track

The design where practicable and cost effective will try and reuse as much of the existing track as possible. The existing timber sleepers on the disused siding site will need to be assessed and likely require replacement as it would appear the existing timber sleepers were offering little support to the rail.

Figure 2: Siding Timber Sleepers

Proposed track centres will be provided to meet current JHR CRN Engineering Standards where practicable including allowance for shunters pathways. If possible, it is proposed to design the loop extension gradients to be standing gradients so that parked wagons will not roll away under their own weight while locos are running around and without application of handbrakes. New gradients will need to be merged into the existing.

Proposed standard gauge ballasted steel sleeper track to be provided to meet current JHR CRN Engineering Standards.

Rail capping formation requirements and possible subgrade improvement works to be assessed and developed following the geotechnical investigation.

8.2 Turnout, Catchpoints and Signal

The existing turnouts in the two crossovers between the crossing loop and Woodlawn siding will be reviewed against current CRN design standards as well as a condition assessment to confirm suitability for reuse within the selected design option.

A concept design of the signalling will also be undertaken for the selected design option.

8.3 Hydrology & Yard Drainage

A flood study has been completed to accompany a development application for a neighbouring subdivision. Goulburn Mulwaree Council have indicated this is available. The outcomes of this document will be considered for the design of this project.

It is envisaged that the drainage of the rail formation will be provided by grading the new rail capping with cross fall. This will allow stormwater to run-off to the surrounding area as appropriate. Open drains located adjacent to the rail formation may be required to be cut to direct stormwater to an acceptable outfall location of which the details shall be developed during the design and illustrated in the design drawings and report.

9 GEOTECHNICAL INVESTIGATION & SURVEY

Geotechnical and Survey Investigations are due to be completed upon the selection of the preferred design option. This will include the determination of all service locations within the area of works and review of any impact the new works may have on the existing services.

The geotechnical works will advise the strength of the existing material in the location of the proposed siding and propose a capping design if required, completed to JHR standards.

The outcomes of the Geotechnical and Survey Investigations may impact on the functional requirements of the project which will be reported upon the completion of the investigations.

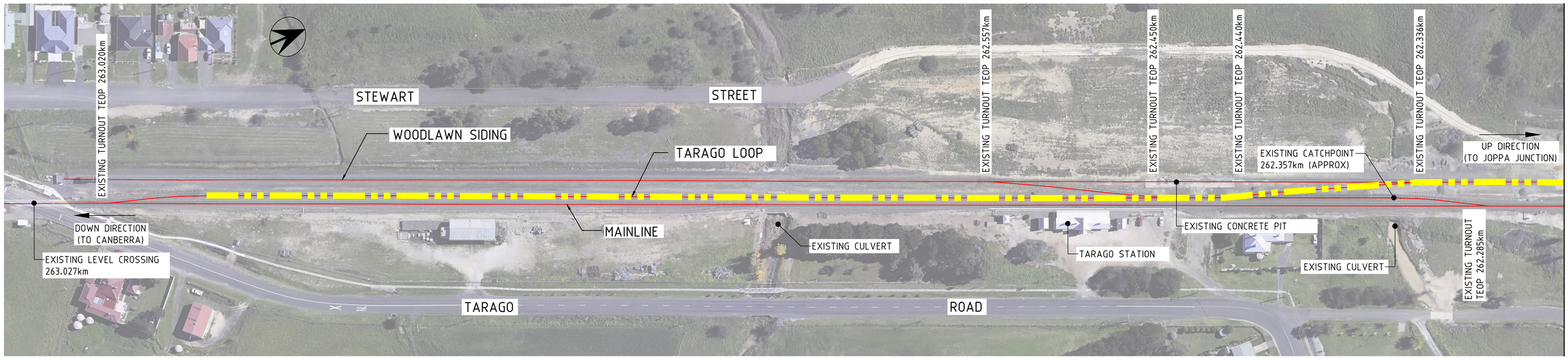
10 ENVIRONMENTAL

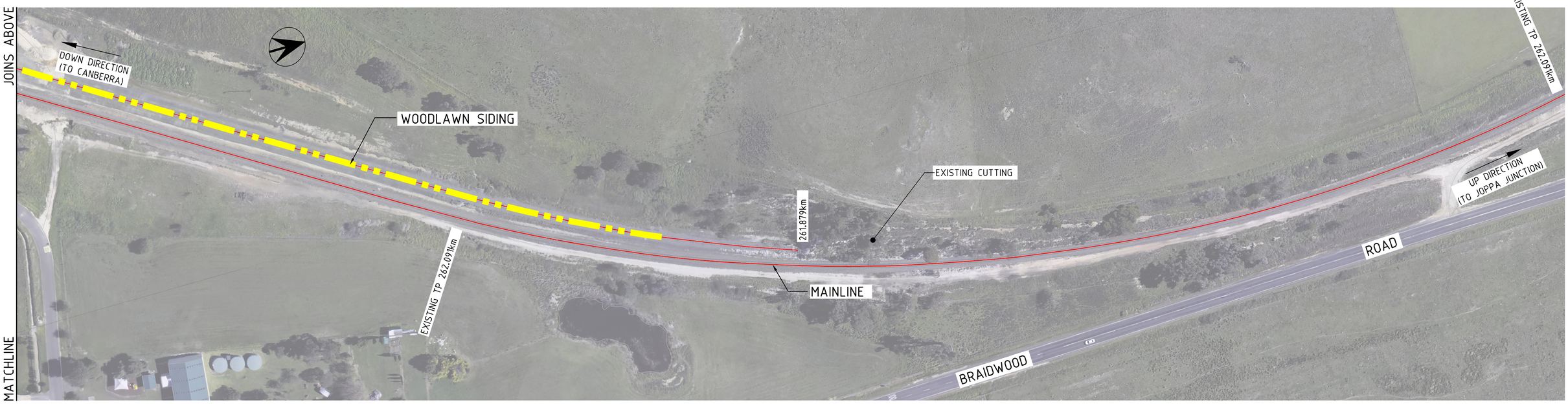
An environmental investigation is due to be completed upon the selection of the preferred design option. The Environmental Investigation includes a review, site inspection and reporting of environmental factors. This work will include consideration of the State Heritage listed Tarago Station precinct.

The outcomes of the Review of Environmental Factors may impact on the functional requirements of the project which will be reported upon the completion of the investigation.

APPENDIX B

Concept Sketches





LEGEND

- EXISTING TRACK
- NEW TRACK
- 1000m STORAGE LENGTH

0 10 20 30 40 50 60m
SCALE 1:1000 AT A1 SIZE

SKETCH ONLY

Design accepted for use by JHR-CRN.*

SIGNATURE

TITLE

DATE

**JHR-CRN signatures on this drawing do not signify acceptance of responsibility for the design. responsibility for integrity, safety and dimensional accuracy of the design remains with the approving authority*

John Holland

COUNTRY REGIONAL NETWORK

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TARAGO SIDING

263.027km TO 262.090km

OPTION 1

-

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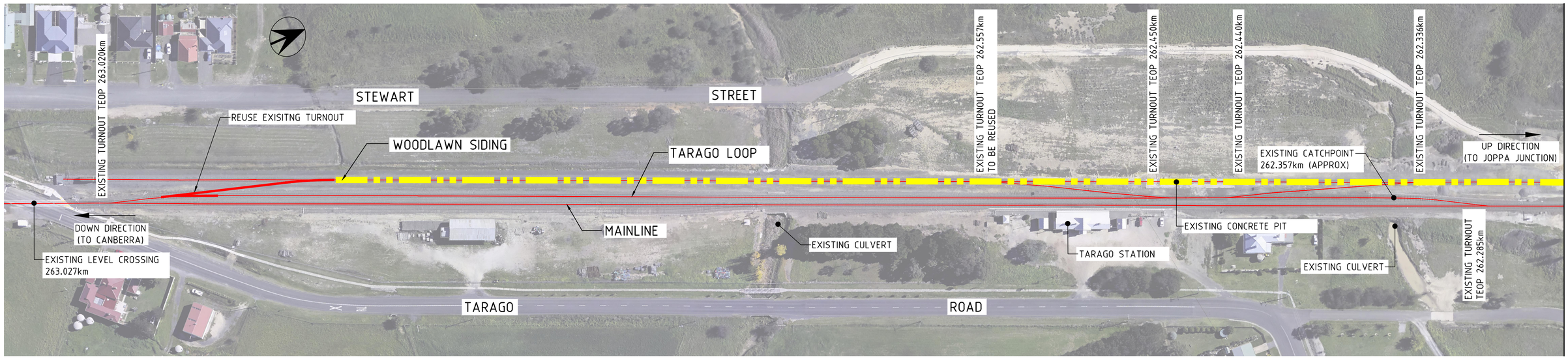

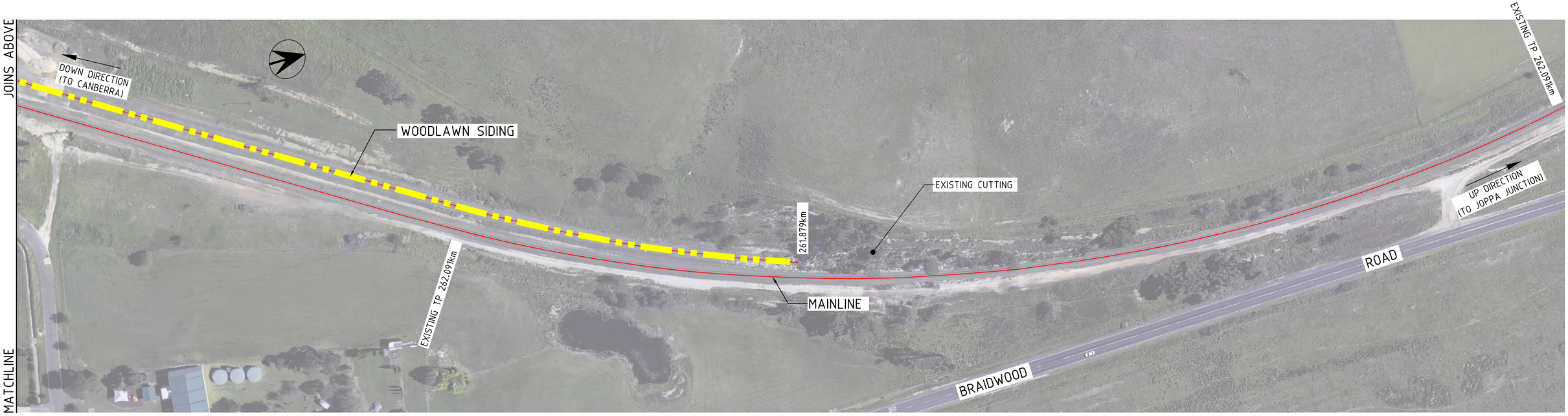

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TARAGO SIDING
263.027km TO 262.090km
OPTION 2
-

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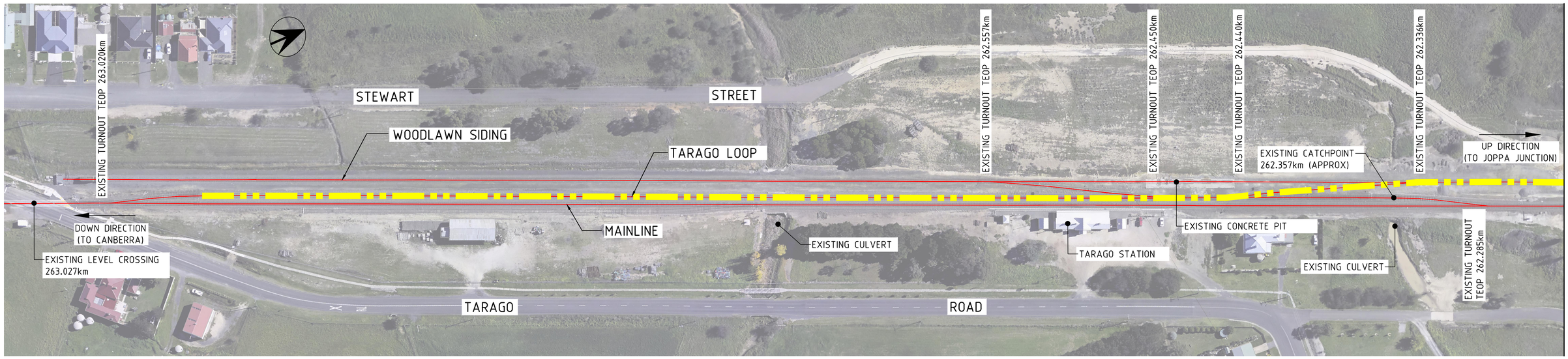

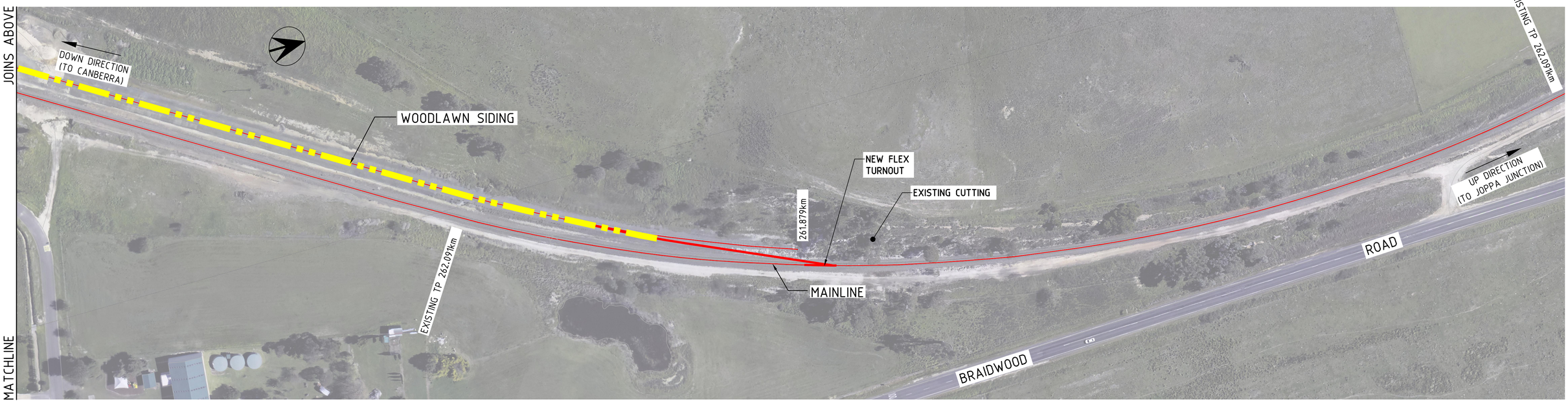

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SCALE 1:1000 AT A1 SIZE

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TARAGO SIDING

263.027km TO 262.090km

OPTION 3

-

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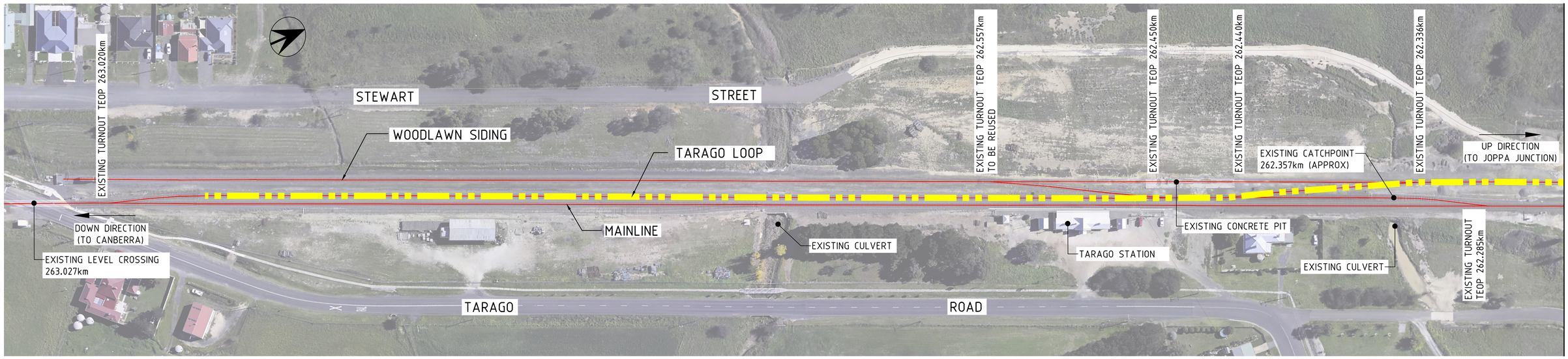

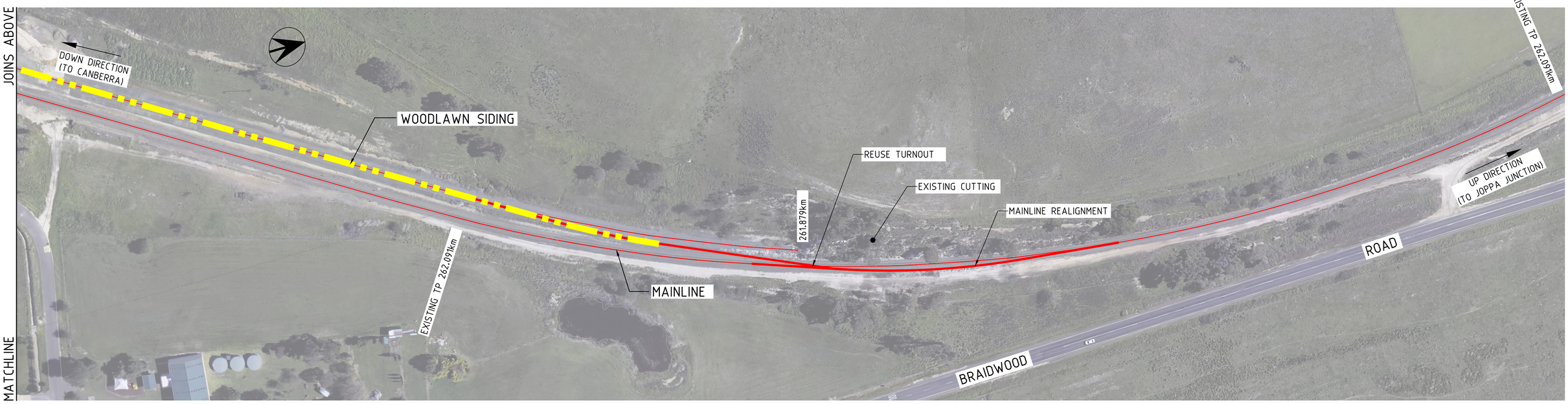

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TARAGO SIDING

263.027km TO 262.090km

OPTION 4

-

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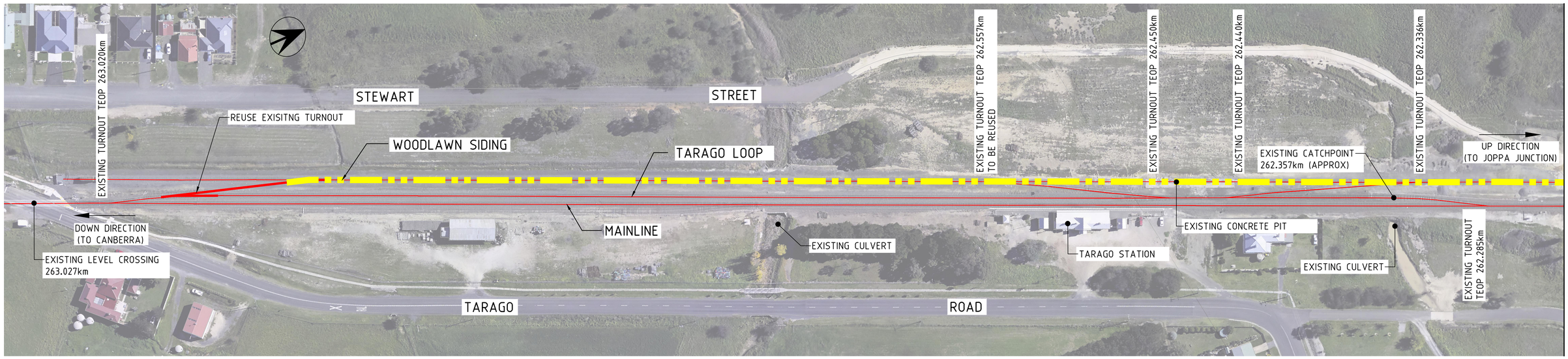

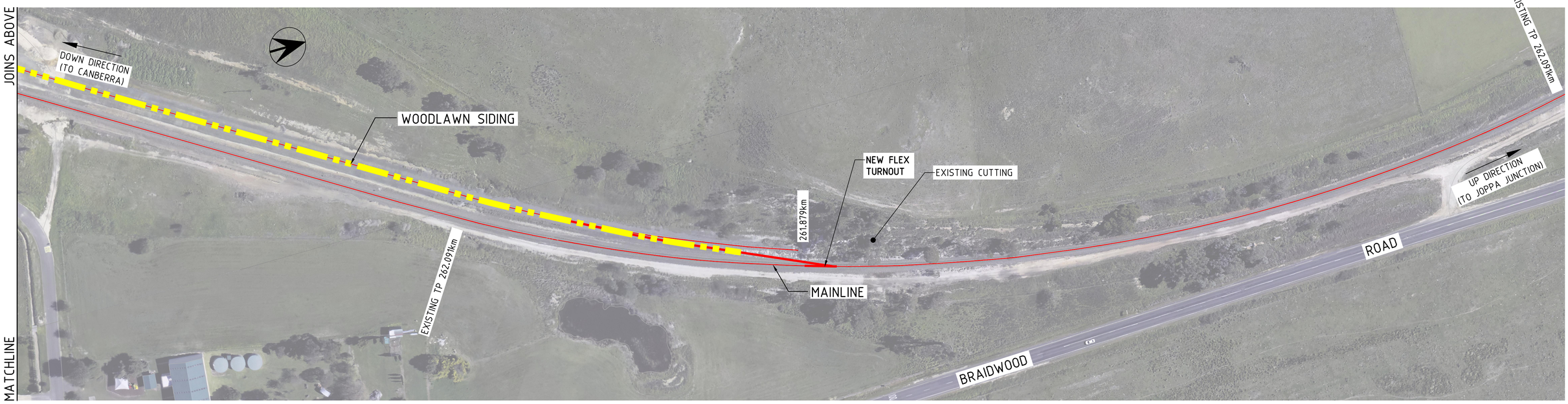

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TARAGO SIDING
263.027km TO 262.090km
OPTION 5
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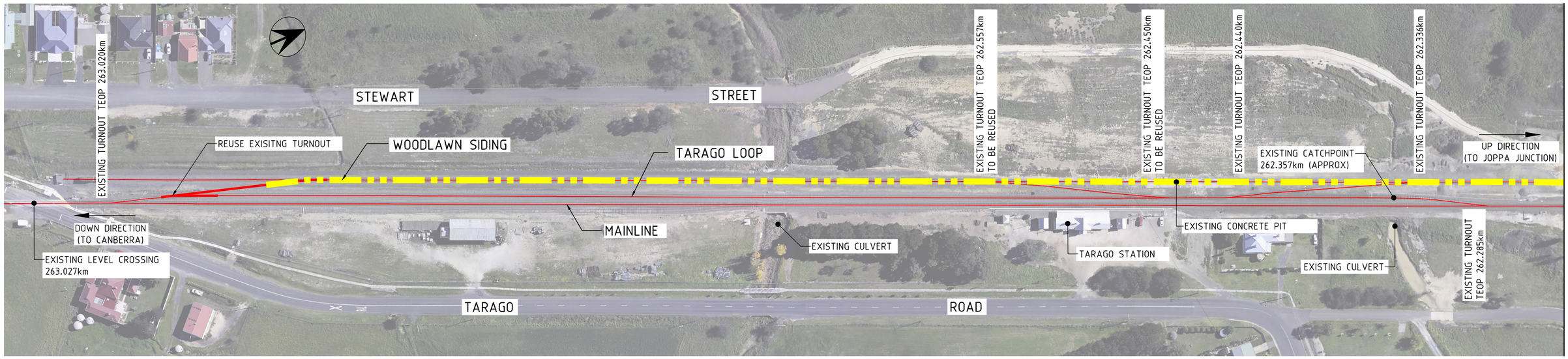

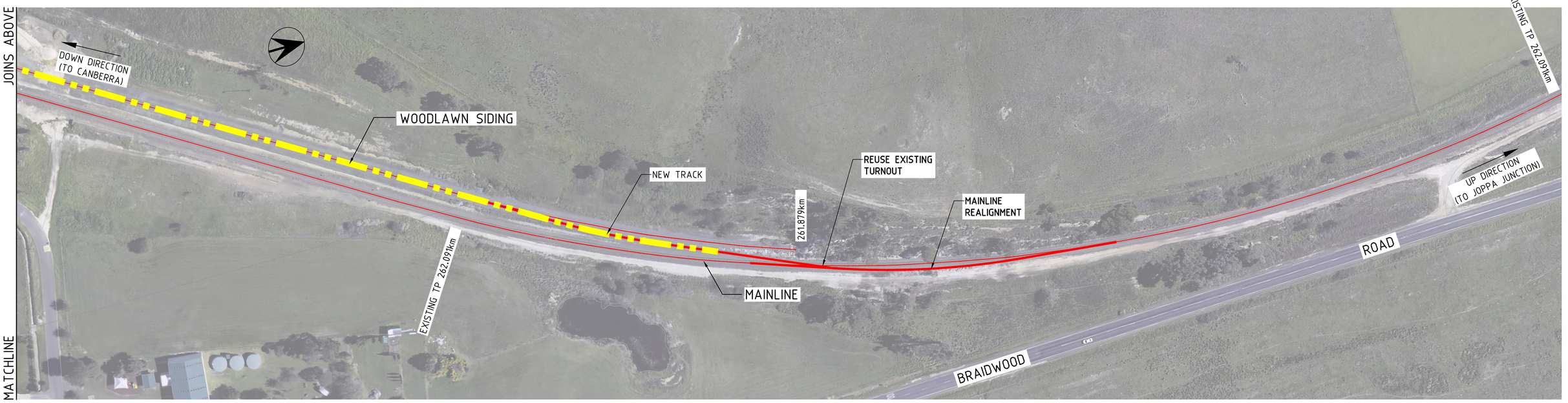

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TARAGO SIDING

263.027km TO 262.090km

OPTION 6

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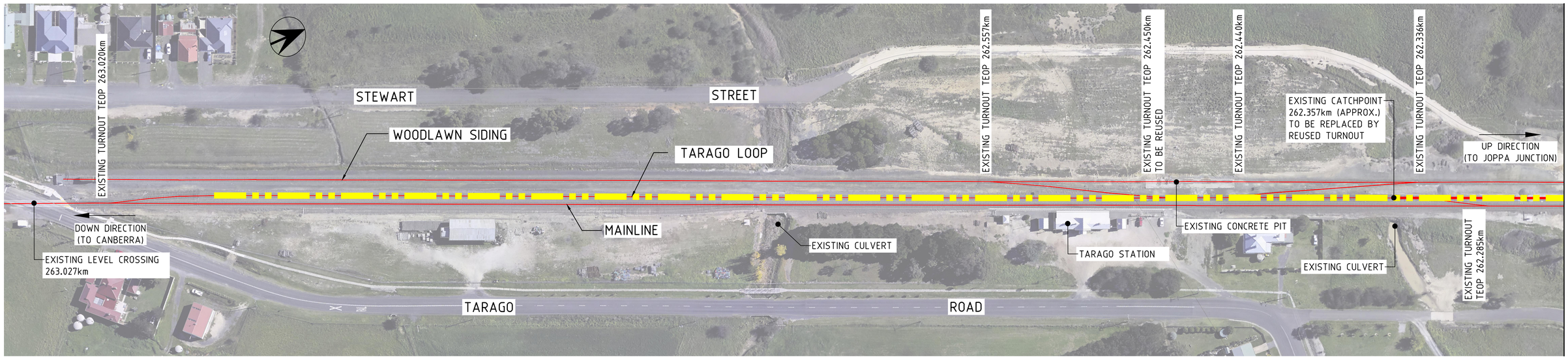

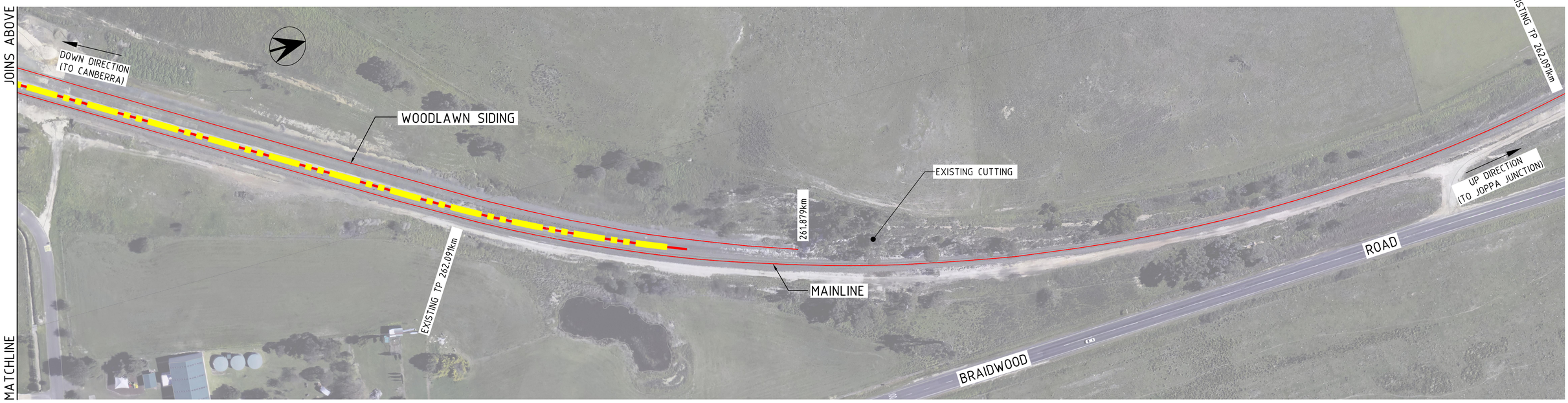

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TARAGO SIDING

263.027km TO 262.090km

OPTION 7

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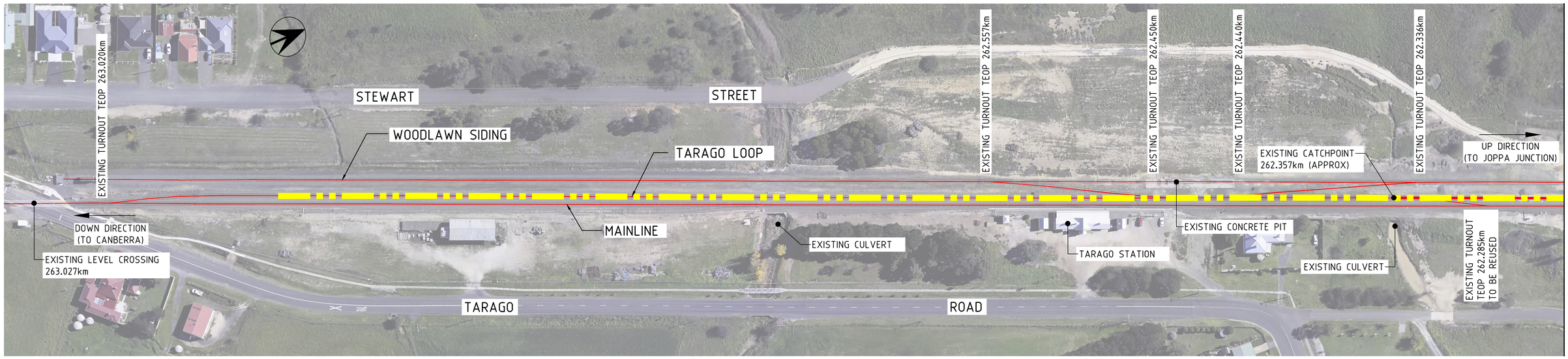

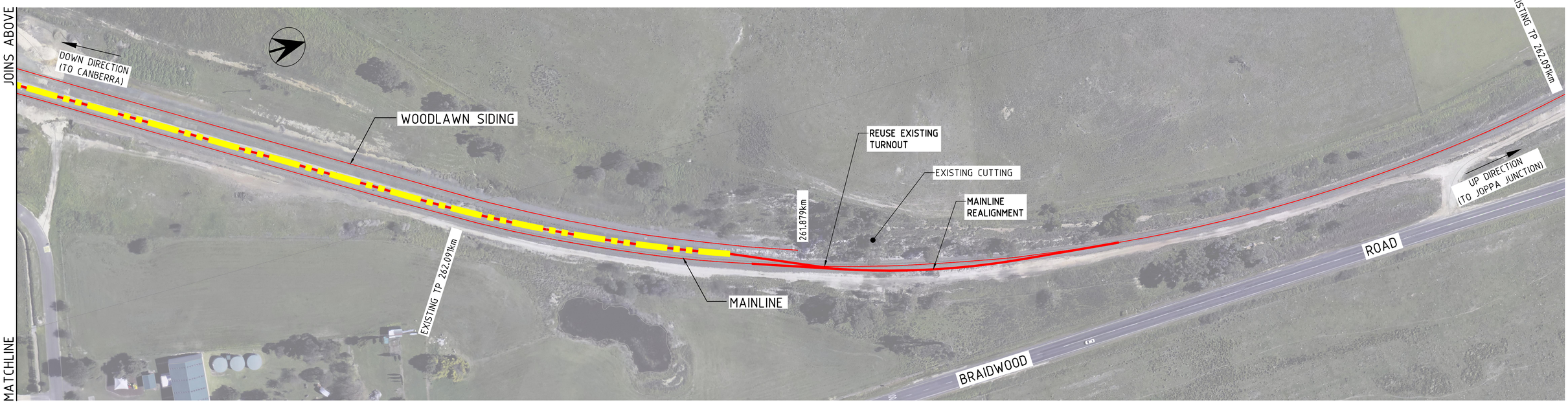

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TARAGO SIDING

263.027km TO 262.090km

OPTION 8

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John Holland Rail Country Regional Network

Tarago Passing Loop *Extension*—

Functional Specification Report

FOR / Engineering Services

CLIENT / John Holland Rail

DOCUMENT NO / S15066-FDES-REP-0001 REV / 3 DATE / 5/07/2017

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CONTENTS

Document *Control*

Revision	Date	Description	Prepared	Reviewed	Approved
A	03/06/15	Issued for Information	Ben Keith	Raymond Marks	
B	04/06/15	Issued for Review	Ben Keith	Raymond Marks	
C	13/03/17	Issued for Review	Matt W-Eyre	Ben Keith	Ben Keith
0	29/03/17	Issued for Use	Matt W-Eyre	Ben Keith	Ben Keith
1	03/04/17	Issued for Use – Amended Approvals Table	Matt W-Eyre	Ben Keith	Ben Keith
2	05/05/17	Issued for Use – Updated based on TfNSW Comments and Signalling input	Matt W-Eyre	Ben Keith	Ben Keith
3	05/07/17	Issued for Use – Updated with Comments	Bruce Fernandez	Ben Keith	Ben Keith

JHR CRN *Approvals*

Name	Position	Signature	Date
Mitch Scealy	Fixing Country Rail - Program Manager		
Ged Mohan	Acting Infrastructure Manager		
Aaron Brough	Acting Infrastructure Operations Manager		
David Scealy	Acting Routine Maintenance Manager		
Rodney Masman	Track Manager		
Ben Hope	Operation Manager		
David Mackney	Principal Track & Civil Engineer		
David Ginns	Business Development Manager		
Stewart Rendell	Principal Signal Engineer		

CRC *Approvals*

Name	Position	Signature	Date
Michael Sanders	Operations Manager		
Mark Mills	Engineering Manager		

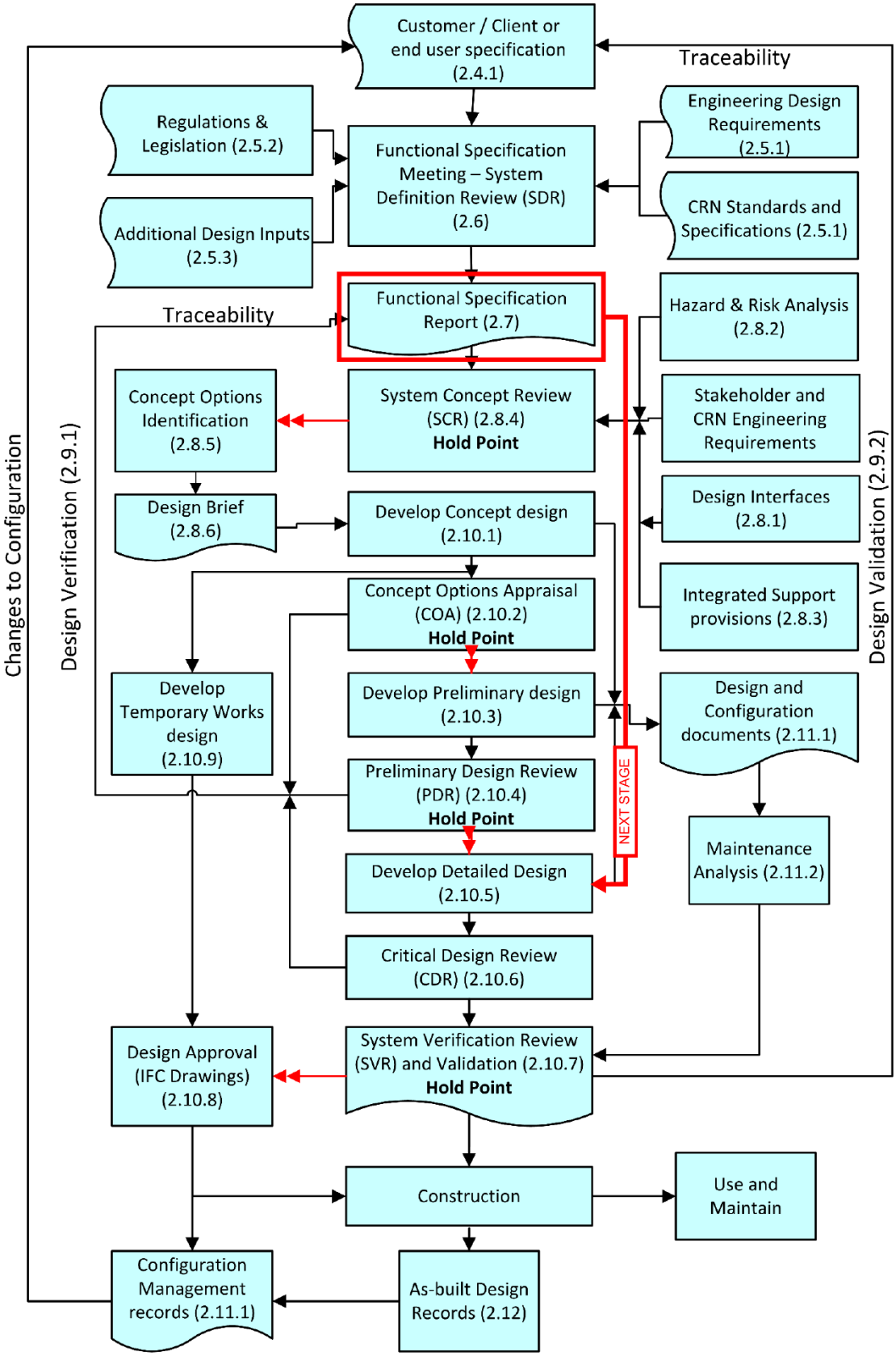


Figure 1: Design Flowchart

(Excerpt from JHR's Design Management Manual)

1 INTRODUCTION

John Holland Rail (JHR), the rail transport operator of the New South Wales (NSW) Country Regional Network (CRN) has engaged BG&E Pty Limited to undertake the detailed design and construction documentation of a passing loop extension at Tarago, summarised from the Scope of Works below:

- Provide loop extension works sufficient to allow 1000m of standing room, without fouling the mainline.

The purpose of this document is to outline the functional requirements associated with the project including the relevant design codes upon which the design is to be based.

This document, once approved, will be used to develop two Detailed Designs that satisfies the Functional Requirements specified in this document. The design process will generally be completed in accordance with the CRN Project Delivery Manual (PDM). Refer Figure 1 for the design flowchart extracted from the PDM.

2 BACKGROUND INFORMATION

The Tarago Siding design project has been initiated by Pacific National, a rail operator and Veolia, a waste services provider. Both of these companies have made representations to extend the multi-user siding at Tarago to permit approx. 1000 metre long trains to be stowed and/or crossed at this location, without the need to break trains across multiple sidings.

Veolia have secured a contract to increase the amount of waste they are processing from 500,000 tonnes per year to 1 million tonnes per year. To process this additional volume, Veolia (through Pacific National as their train operator) will need to increase the volume of waste transported from Sydney to Crisps Creek Intermodal Terminal located 1.8km in the Down direction from the existing Tarago passing loop. The following extract from the CRN Operational Strategy (Aug 2016) outlines the Waste Freight Forecast highlights the increase in expected freight activities in the coming years. An increase of 80-100% is likely for freight tonnage into the future. There are currently 21 trains or 42 train movements (Up and Down) per week into Crisp Creek.

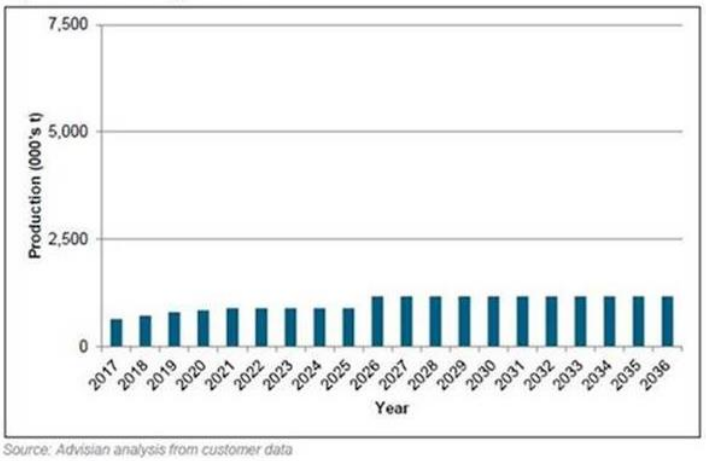


Figure 3: JHR CRN Operational Strategy Figure 4-8 Waste Freight Forecast (courtesy of JHR)

A recent project (project I.D 1415-838 and carryover I.D 1516-838) contained the Preliminary Design of the Tarago loop extension, with Functional Specifications, a Concept Options Report, and a Preliminary Design Report being the main outputs produced by the project.

The Concept Options Report identified 8 practical Options which achieved the project's functional requirements and overall objectives (BG&E Options Report S15066OPT-REP-0001). TfNSW selected Option 3 as the preferred Option. This selection is based on the following –

- Councils request that the existing level crossing be activated by through train movements only. This eliminated Options 1, 2 and 7.
- Under current and foreseeable train volumes, there appears to be insufficient demand to warrant the provision of a siding independent of and in addition to the existing loop. By utilising the existing loop length, this reduces the length of the Woodlawn siding that would need to be refurbished. This eliminated Options 5 and 6.
- It is anticipated that the construction of approximately 470m of new formation and track would be a significantly higher cost than the refurbishment of a similar length of the existing Woodlawn siding. This eliminated Option 8.
- Options 3 and 4 remained, which are variations of the original Option that was discussed on site in January between CRC, JHR, Pacific National and Veolia.

It is understood that for Option 4, realignment of the mainline would require a significant reduction in curve radius, and thus a reduced mainline speed. As there is a long term proposal by TfNSW to reduce transit times between Sydney and Canberra, any reduction in mainline speeds is not desirable. This eliminated Option 4 and only Option 3 remained as the single preferred Option (TfNSW, July 2015).

Following from the selection of the preferred Option 3, two variations of this option have been identified due to options regarding signalling. These options are noted as Option 3a and 3b and are outlined below:

- **Option 3a** – Provide Option 3 as documented within BG&E report S15066-OPT-REP-0001, using an approximate design speed of 40km/hr for the loop as requested by JHR on 08/03/2017. Higher turnout speeds are to be investigated if a practical and cost effective solution can be provided. Confirmation of the turnout speed is to be provided during Detailed Design. The proposed turnout would likely require to be a similar flexure tangential turnout. This option allows for the future provision of TMACS, which provides for an automated self-normalising motorised solution for the turnout points. This would allow the turnout to be automated and not require trains to stop before entering the loop. Note that until this measure is in place, motorised self-normalising points would be provided however would still require trains to stop before entering the loop. The MLIs between Crisps Creek and Tarago will be upgraded to have cascading aspects. A detailed turnout drawing for this option has been provided by VAE Railway Systems and is included within Appendix C; and
- **Option 3b** – Provide Option 3 as documented within BG&E report S15066-OPT-REP-0001, using a design speed of 25km/hr for the loop as noted within the JHR Scope of Works – Tarago Detailed Design Civil v3 Final. This option would require a mechanical signalling solution, requiring trains to stop before entering the loop. The MLIs between Crisps Creek and Tarago will be upgraded to have cascading aspects. The proposed turnout would likely require to be a similar flexure turnout.

3 SITE LOCATION AND DESCRIPTION

The site is located on the Joppa Junction to Canberra line approximately 70km North West of Canberra. The following Figures 3, 4 & 5 outline the project location and position within the JHR CRN network.

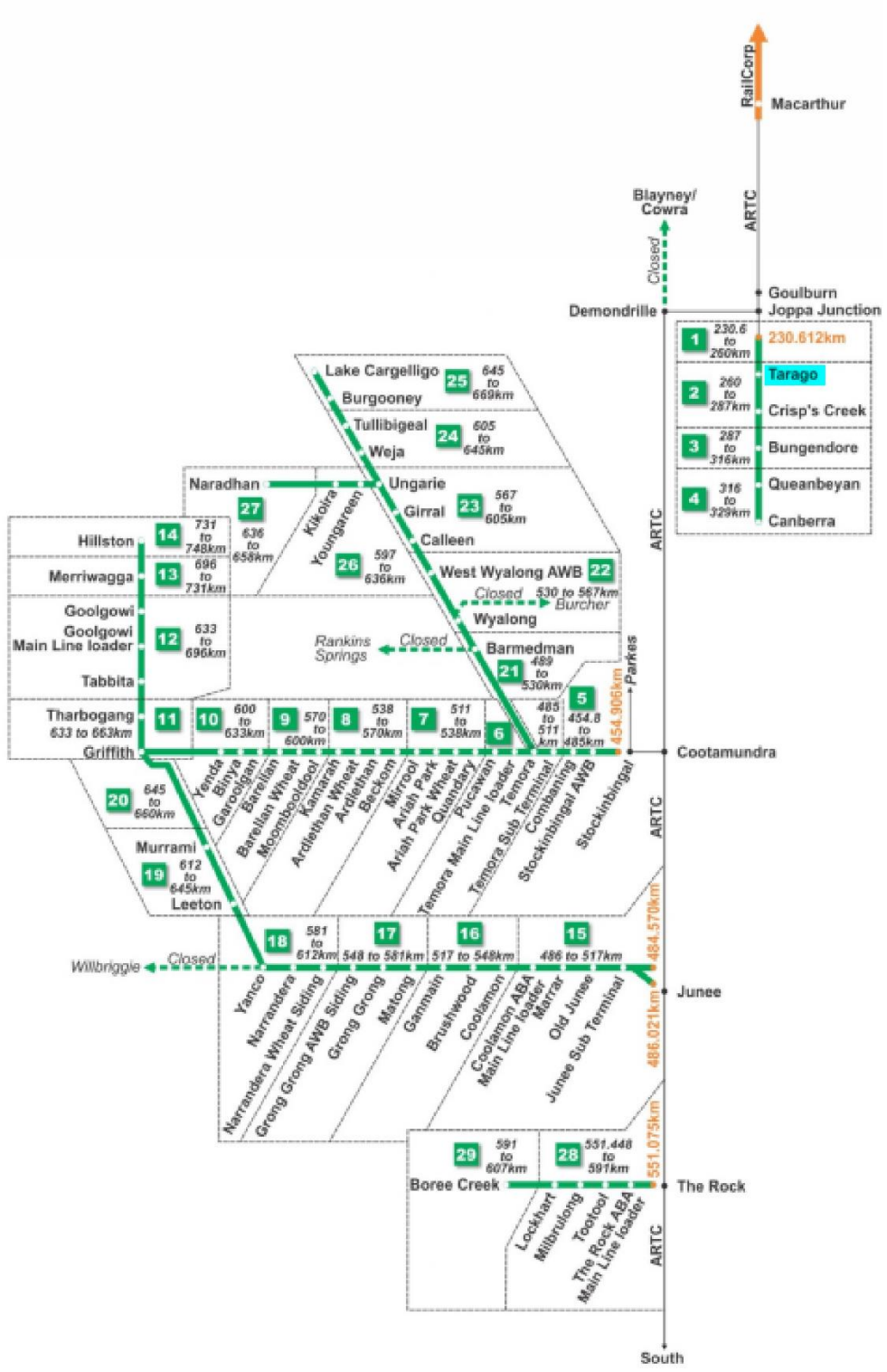


Figure 3: JHR CRN Southern Division Track Overview (courtesy of JHR)

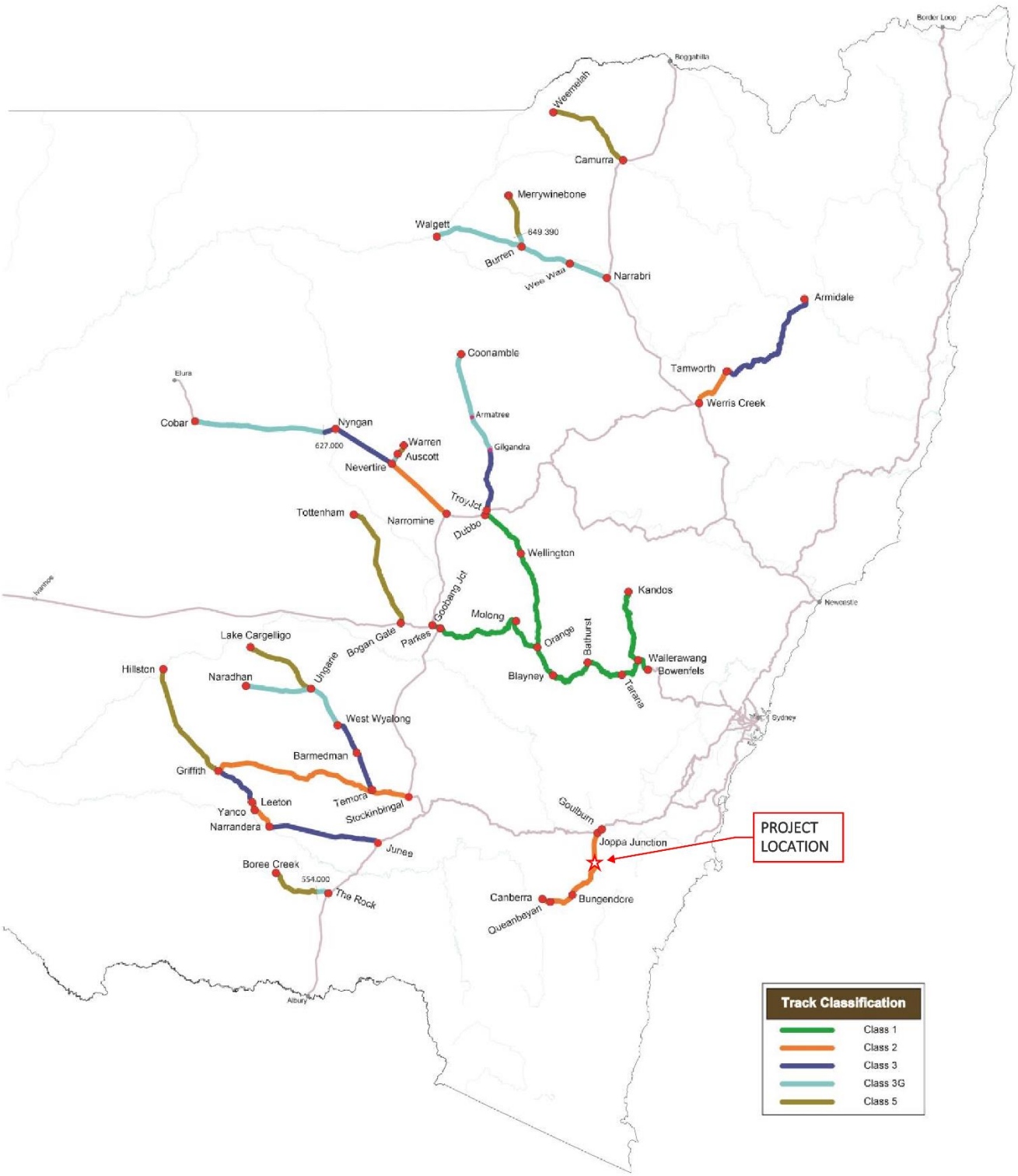


Figure 4: JHR CRN System Map (courtesy of JHR)

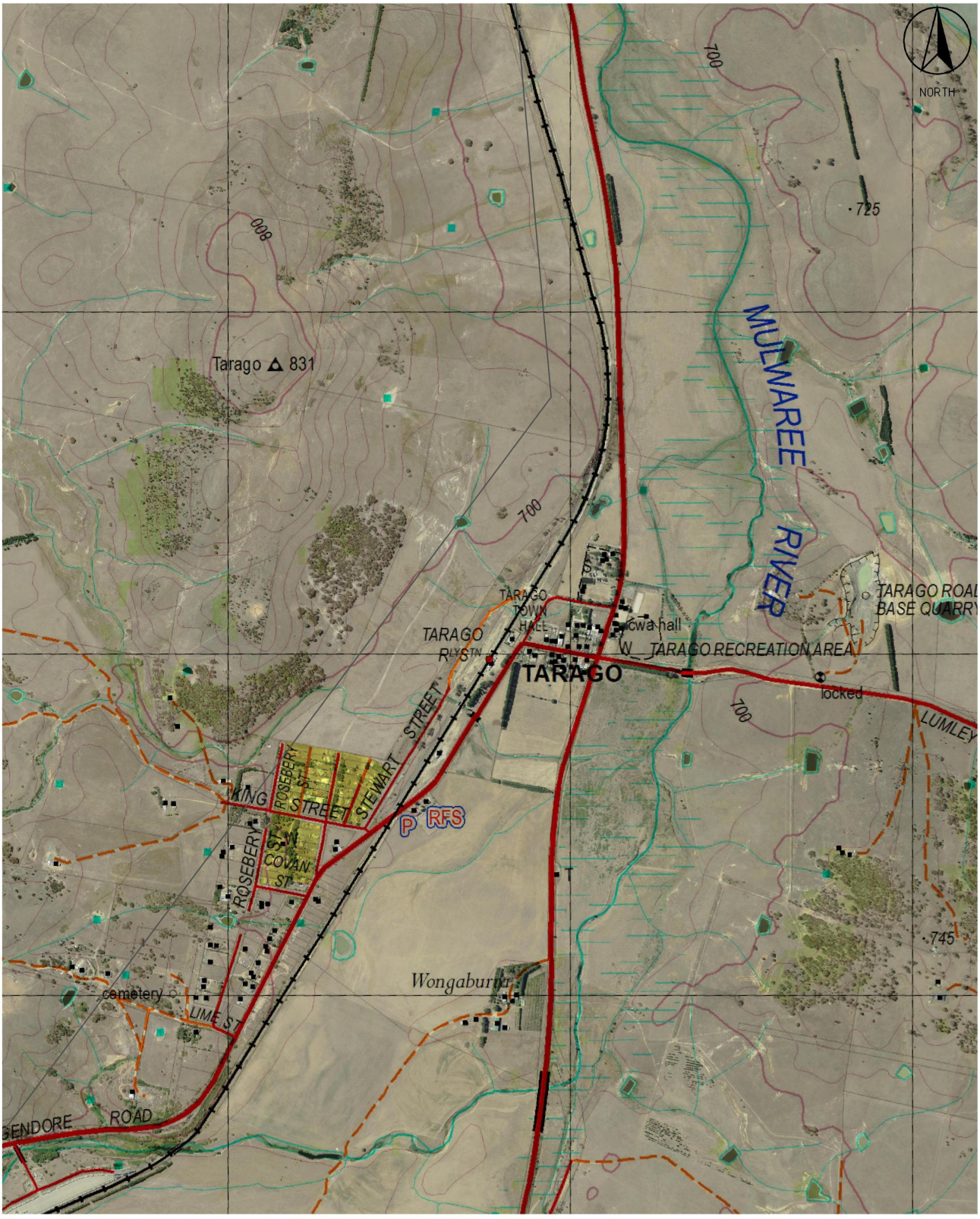


Figure 5 Aerial Map

3.1 Rail

Tarago is a train order crossing location. The yard limits are posted at 260.650km to 266.528km and shunting limits 261.150km to 265.940km. In general the yard consists of:

- TRS50230A - A mainline Class 2 rail track;
- TRS50262B - Passing loop with turnouts whose points are located at 262.285km (TOS50262A 2CA PTS) and 262.990km (TOS50262G); and
- TRS50262A - An inactive siding to the west of the existing passing loop (Woodlawn Siding).

There are two crossovers from the passing loop to the siding which are locked to ensure trains can't access the siding.

It is understood the siding was used by the Woodlawn mine until it was closed in 1998. It is unclear how much use the siding has had since the mine closure however John Holland Rail have noted the siding has been inactive since their management of CRN since January 2012. Transport for New South Wales have confirmed that there is currently no lease held over the existing Woodlawn siding.

3.2 Existing Level Crossings

There is a single existing active level crossing location at 263.027km for Goulburn Street (LCS50263A) within the limit of investigation. This crossing is unaffected by the proposed Option 3 works from a civil perspective. Note that signalling may influence the crossings operations. There is the potential to remove the existing 85km/hr speed limit through the crossing.

3.3 Existing Drainage

The following drainage structures are located about the limits of civil investigation:

- 1x 2 Cell 2.46 x 1.80m RCBC crossing at 262.660km;
- 1x 1 Cell 2.10 x 1.80m RCBC crossing at 262.660km. This culvert is an extension of the 2 Cell 2.46 x 1.80m RCBC above;
- CUS50262B - 1x 1.46m brick arch culvert crossing at 262.350km;
- CUS50262B - 1x 1.20m C.S.P crossing at 262.350km. This culvert is an extension of the brick arch culvert above;
- CUS50262A - 1x 2 Cell 1.20 x 1.20 RCBC crossing at 262.040km; and
- CUS50262A - 1x 2 Cell 1.20 x 1.20 RCBC crossing at 262.040km. This culvert is an extension of the 2 Cell 1.20 x 1.20m RCBC above.

3.4 Existing Station

The site is located at the existing Tarago Station. The station is heritage listed. A statement of heritage impact was prepared to completely understand any potential restrictions associated with works near the station. This statement is included within the Review of Environmental Factors (6173_Tarago_REF_Final) completed by NGH Environmental on 02/09/2015.

3.5 Existing Signalling

The Tarago and Crisps Creek locations are operated as a Train Order Working siding Location. It consists of mechanically operated points, released by operators keys. Between Tarago and Crisps Creek is Bungendore Rd which is an active level crossing. The points and level crossing health are indicated by MLIs. The MLIs at Crisps Creek and Tarago are not electrically connected and do not have cascaded aspects, as an interim measure, landmarks have been provided at braking distance.

4 FUNCTIONAL SPECIFICATION

The primary purpose of the project is to extend the existing passing loop to enable Pacific National to store a maximum train length of 900m off the existing mainline without the need to break that train across multiple loops. Pacific National have advised that 950m of storage length on the siding would allow storage of the 900m train with enough room to couple an addition locomotive in case of breakdown while staying clear of mainline operations. Additional clearance/movement buffer of 50m is also to be provided, resulting in a standing room length of 1000m as documented within the JHR Scope of Works. This standing room distance forms the primary functional requirement for the project.

Through correspondence with JHR CRN it was determined that the design consist for the loop extension is 58x 14.60m Wagons and 2x 22m Locomotives, totalling 891m. This has been rounded up to form the required 900m consist length.

As of May 2016 it was planned to operate the additional train (that can stable clear in the Tarago crossing loop) Monday to Friday; and from December 2016 it was planned to start operating this second train at the full 900 metre length.

The signalling specific requirements are detailed within the Signalling Functional Operational Specification or SFOS. Please refer to that document for the signalling specific requirements for both options.

5 OPERATIONAL REQUIREMENT

The following outlines the configuration for maximum consist length expected within the Tarago loop, as provided by JHR CRN:

- 2 x locomotives at 22m each or equivalent = 44m;
- 58 x wagons at 14.60m each or equivalent = 846.8m; and
- Total maximum equivalent train length = 890.8m. This has been rounded up to 900m.

It is proposed to progress the Detailed Design on this basis.

6 STAKEHOLDERS REQUIREMENTS

The design of the proposed loop extension works will consider the operational needs of stakeholders. It is noted that John Holland Rail will coordinate the stakeholder requirements and design review comments with the stakeholders. It is understood the stakeholders are:

- Transport for New South Wales (Country Rail Contracts Division);
- Transport for New South Wales (Freight Strategy Planning Division);
- John Holland Rail (Country Regional Network Division);
- Veolia;
- Pacific National;
- Rail Operators; and.
- Goulburn Mulwaree Council.

JHR shall consult with all stakeholders throughout the design process to ensure a cohesive design is delivered. It should be noted that TfNSW are the key stakeholder and that final signoff to all design elements is subject to their approval.

A project start-up meeting was held on the 23rd of February 2017 on site involving representatives from JHR, Arcadis and BG&E. Table 6.1 captures the key stakeholder requirements that were agreed during the project start-up meeting.

Table 6.1: Key Stakeholder Requirements

Item	Requirement
Project Functional/Performance Objectives	• Provide a 1000m loop to enable trains to be stored without impacting passing mainline trains. • Provide a 'drive in – drive out' loop that allows the consist to remain whole. • Class 2 loop infrastructure to support 21 Tonne axle loads. • The existing Goulburn Street level crossing is not to be fouled during passing operations.
Project Fundamentals / 'Must Haves'	• Maintain existing mainline speeds. • Minimising project construction and ongoing maintenance costs whilst achieving the project functional requirements. • Cascaded MLIs between Crisps Creek and Tarago.
Project Desirable Objectives / 'Nice to Haves'	• Provide a drivers walkway. • Reuse existing rail infrastructure wherever possible, provided they are of suitable condition and function. • Motorised turnouts. • Ability to store servicing equipment on a section of the Woodlawn Siding • Potential to remove existing 85km/hr speed limit at level crossing.

Item	Requirement
Additional Options to be Considered	• Design compatible for 25km/hr and 40km/hr entry speeds into the loop from the mainline. • Remove/decommission the country end of the existing Woodlawn Siding and reuse existing rail where possible. • 2 lever ground frames are increasingly hard to obtain as they are no longer manufactured. Spares and other replacements could become a future problem.

6.1 Transport for New South Wales

(TfNSW) are, for the design, funding the project. TfNSW while not directly indicating any operation requirements mentioned some project requirements which will need to be considered when documenting the design options and detailed design which include:

- Production of Detailed Design drawings for both Options 3a and 3b, with consideration of the following issues:
  - Cost;
  - Community;
  - Achieving the Functional Requirements;
  - Construction Timeframe and risk; and
  - Operational Outcomes.

6.2 John Holland

John Holland notes the following train movements through the yard as being:

- 06:00 hours first Veolia (Down direction) train arrives at Tarago and is then received at Crisps Creek for processing;
- 09:30 hours second Veolia (Down direction) train arrives at Tarago and is stabled clear of the main line;
- 10:00 hours passenger (Down direction) train arrives at Tarago and then departs travelling to Canberra;
- 10:30 hours the first Veolia train departs Crisps Creek (Up direction) and passes through Tarago crossing the first Veolia train. Second Veolia train (Down direction) then departs Tarago and is received at Crisps Creek for processing; and
- 16:25 hours the second Veolia train departs Crisps Creek (Up direction) and passes through Tarago after waiting for an Up direction passenger train to pass.

John Holland notes their preferred requirements for the project being:

- There has been enquires for other additional rail traffic on this line - Details of Access Recycling train operating requirements and potential impact upon this project to be considered if available.

6.3 Pacific National

Pacific National mentioned the following as a list of preferred requirements for the project:

- A loop which provides drive in drive out (no reversing) with motorised points for driver operations;
- Drivers walkway provisions;

6.4 Goulburn Mulwaree Council.

Goulburn Mulwaree Council mentioned the following as a list of preferred requirements for the project:

- Would like to see the active level crossing (Goulburn St) only activated by through train movements.

7 STANDARDS

The rail is standard gauge (1435mm) passenger and freight train railway, noting Joppa Junction to Canberra is a Class 2 line.

The technical standards proposed to be used in this design process are:

- Australian Standard AS5100
- Australian AS1742.7
- CRN TOC Manuals
- CRN CM 101 Civil Service Schedules
- CRN CP 203 Track Design
- CRN CP 211 Survey
- CRN CP 212 Contract Survey
- CRN CS 100 Civil Technical Maintenance Plan
- CRN CS 200 Track System
- CRN CS 210 Track Geometry
- CRN CS 215 Transit Space
- CRN CS 220 Rail and Rail Joints
- CRN CS 230 Sleepers and Track Support
- CRN CS 240 Ballast
- CRN CS 250 Turnout and Special Trackwork
- CRN CS 410 Formation and Earthworks
- CRN CS 420 Track Drainage
- CRN CM 521 Level Crossings
- CRN SD 014 Signalling Design Principles – Points.
- CRN SD 019 Signalling Design Principles – Train Order Working.
- CRN SD 023 Signalling Design Principles – Placement of Yard Limit Boards.
- CRN SC 024 Signs, Notice Boards & Instruction Plates
- John Holland CRN – Contractor Safety Pack
- JHR CRN Engineering Design Procedures

8 ENGINEERING REQUIREMENTS

8.1 Track

Track design will be completed in accordance with the design standards specified in Appendix A where possible and the following general criteria:

- Minimum track centres will meet current JHR CRN CS 215;
- Standard gauge ballasted sleeper track will meet current JHR CRN CS 200;
- Rail capping and formation requirements to be designed in accordance with JHR CRN CS 410; and
- Turnouts are to be in accordance with JHR CRN CS 250.

The existing track and turnouts may be reused as required, subject to a condition assessment.

Refer Appendix A for a summary of Design Criteria adopted for the Project, in which acceptable limits have been tailored to suit the specific project whilst maintaining engineering compliance.

8.2 Turnout, Catchpoints and Derail Blocks

The existing turnouts in the two crossovers between the crossing loop and Woodlawn siding will be reviewed against current CRN design standards as well as a condition assessment to confirm suitability for reuse within the selected design option.

The proposed turnouts for each option are outlined below:

- **Option 3a** – Provide Option 3 as documented within BG&E report S15066-OPT-REP-0001, using an approximate design speed of 40km/hr for the loop as requested by JHR on 08/03/2017. Higher turnout speeds are to be investigated if a practical and cost effective solution can be provided. Confirmation of the turnout speed is to be provided during Detailed Design. The proposed turnout would likely require to be a similar flexure tangential turnout. Cascaded MLIs would also be provided as part of this option. A detailed turnout drawing for this option has been provided by VAE Railway Systems and is included within Appendix C; and
- **Option 3b** – Provide Option 3 as documented within BG&E report S15066-OPT-REP-0001, using a design speed of 25km/hr for the loop as noted within the JHR Scope of Works – Tarago Detailed Design Civil v3 Final. The proposed turnout would likely require to be a similar flexure turnout. This design would also have cascaded MLIs between Crisps Creek and Tarago.

For both options the existing 1 in 10.5 Woodlawn siding is to be removed.

8.3 Shunters and Drivers Walkway

The following outlines the proposed drivers walkway requirements to be applied to the Detailed Design.

- **Shunters Walkway** – No shunters walkway is proposed as part of these works.
- **Drivers Walkway** – A driver's walkway approximately 1.2m wide is proposed along the length of the loop, where practical. Note that the drivers walkway for Option 3a will be rationalised wherever

possible as the mainline turnouts are automated with TMACS, no driver's walkway is envisaged as being required.

8.4 Hydrology & Yard Drainage

During a site inspection a Goulburn Mulwaree Council officer indicated that a flood study had been completed to assist in planning a development immediately west of the Tarago Yard. A copy of this flooding report can be seen as Appendix D.

Through the review of this report and conversations with council it became apartment that the flooding study had been completed based on a "pre developed" scenario and had not been updated to consider the impacts of the development. The flood study does not assess any potential impacts the development may have on culverts under rail.

The flood study also doesn't access the adequacy of the existing culverts to convey pre developed flows. Existing culverts which are affected by the design may be extended as required to maintain the existing hydraulic capacity. The existing 'inlet' to the C.S.P at 262.350km (CUS50262B) is to be replaced with a new grated inlet to drain the catchment between the loop and mainline. Subsoil drainage is proposed along the city cutting where track clearance varies.

It is envisaged that the drainage of the rail formation will be provided by grading the new rail capping with cross fall. This will allow stormwater to run-off to the surrounding area as appropriate. Open drains located adjacent to the rail formation may be required to be cut to direct stormwater to an acceptable outfall location of which the details shall be developed during the design and illustrated in the design drawings and report.

Proposed turnouts and loops works are to provide coplanar capping grading with the existing mainline to provide a free draining single plane which discharges into the proposed/existing drainage. Open drainage will then be developed from the mainline/siding capping shoulder where possible to provide the required cross sections.

8.5 Signalling

The two options proposed will have significantly different signalling solutions due to the required operation of the points.

Option 3a – Provide motor points at both ends of the Tarago loop. Upgrade the signalling control system to a Microlok CBI to operate the points. MLIs and point indicators will be provided as required to indicate the status of the points. A new multicore will be trenched from Bungendore Rd to A location at Crisps Creek. The existing cable between A location and B location will also be upgraded to a larger multicore. A fibre optic cable will be run from the Sydney end of the loop to the country end. The level crossing hut at Bungendore road will be replaced by a new hut along with a backup generator.

Option 3b – Maintain the ground frames at either end of the loop. Relocate the Sydney end C MLI to the new TOP and provide MLI repeater if required. The existing multicore cable will be extended from the existing frame C to the new frame C. A new multicore will be trenched from Bungendore Rd to A location at Crisps Creek. The existing cable between A location and B location will also be upgraded to a larger multicore.

The Signalling Functional Operational Specification or SFOS will provide the technical detail for the operational aspects as well as the signalling infrastructure.

9 GEOTECHNICAL INVESTIGATION & SURVEY

Golder Associates have been engaged to complete the Geotechnical investigation, assessment and pavement/formation design for the project. All required site works to inform the Detailed Design have been completed and are reported in Golder's report 1527567-003-R-Rev1. Once complete, Golder Associates are to review the proposed Detailed Design formation design to confirm the adequacy of the.

Ontrack Survey & Design were engaged to complete the detailed survey works for the project. This survey was received by BG&E on July 6th, 2015 and will be used to develop the proposed Detailed Design.

10 REVIEW OF ENVIRONMENTAL FACTORS

NGH Environmental were engaged to complete a Review of Environmental Factors which is documented within NGH Report Tarago_REF_Final FULL.

Once complete, NGH are to review the proposed Detailed Design to confirm the required outcomes of the REF and its alignment with the design.

APPENDIX A

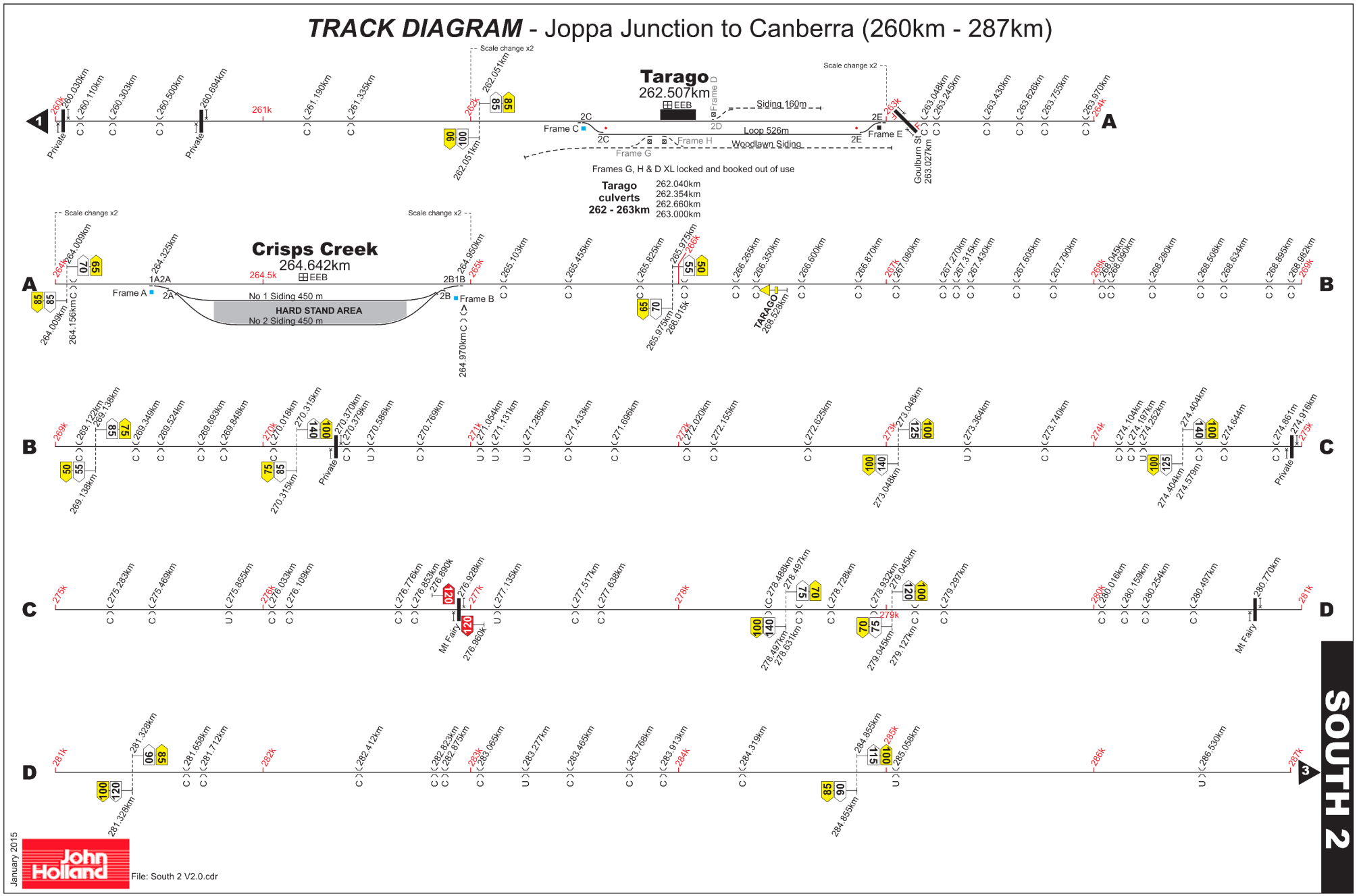
Project Design Criteria

Item	Standard		Reference
GENERAL			
Gauge	Standard (1435mm)		CRN CS Cl.7.4.1
Rolling Stock Outline	1994 Structure Gauge		CRN CS 215 Cl.5.1
Train length to adopt (max)	Maximum total length of 900m		JHR Tarago DD Scope of Works
Loop length to adopt	1000m		JHR Tarago DD Scope of Works
Track centres	Minimum compliant centres would be 4000mm from mainline to loop, and 5200mm from loop to Woodlawn siding.		CRN CS 215 Cl.7.1.4
Loop speed	40km/hr (Approximate) (Option 3a) 25km/hr (Option 3b)		JHR Tarago DD Scope of Works
Mainline posted speed	90km/hr (Normal) / 100km/hr (HST)		JHR CRN Southern Track Diagram
Minimum Horizontal Clearance to Structures	4300mm to cuttings without road access		CRN CS 215 Table 1 An engineering waiver is to be sought for this standard due to the proximity of the existing cutting face to the mainline.
TRACK STRUCTURE			
Track class (Mainline and Siding)	Class 2: 47kg/m Rail – 21 tonne axle load (reuse of existing rail to be considered)		CRN CS 200 Cl.4.3 & 5.3.1
Sleepers	Steel sleepers for loop extension works As requested by JHR CRN Heavy Duty concrete sleepers are to be provided a minimum length of 40m either side of the turnout.		CRN CS 230 Cl.5.1
Spacing of sleepers	600mm ±20mm		CRN CS 230 Cl.5.2.4.1
Fastenings	To suit sleepers		CRN CS 230 Appendix 1
Ballast size	Enhanced ballast profile		CRN CS 240 Cl.5.1
Design ballast depth	270mm min (steel sleepers) 300mm min (concrete sleepers)		CRN CS 240 Cl.5.2.5 Table 5
Ballast shoulder width	400mm		CRN CS 240 Cl.5.2.3
GEOMETERY			
Gradient (ruling grade may not be compromised)	Existing grade of adjacent track (desirable)	1:100 (desirable max.)	CRN CS 210 Table 1
Horizontal curve radius	400m (desirable min.)	160m (absolute min.)	CRN CS 210 Table 1
Vertical curves radius	1300m (desirable min.)	800m (absolute min.)	CRN CS 210 Cl.7.3
Superelevation	50mm (turnout max.) Existing superelevation through mainline curve to be reduced		CRN CS 250 Cl.5.1.3

Superelevation deficiency	75mm (Class 1 Normal standard) 110mm (Class 1 HST standard Refer Note 1	CRN CS 250 Cl.5.1.3 An engineering waiver is to be sought for this standard as Class 1 mainline superelevation deficiency is proposed to be applied to a Class 2 track.
FORMATION		
Shoulder	4250mm for mainline and loop works. 3000mm for siding works.	CRN CS 410 Cl.4.4 Table 1
Ballast – batter to formation	1 in 1.5 (Vertical : Horizontal)	CRN CS 240 Cl.5.2.3
Capping layer thickness	150mm min	CRN CS 410 Cl.7
Structural Fill	As documented within Golders Report 1527567-003-Rev0	CRN CS 410 Cl.6.2 & 7
Embankment batter (formation)	1 in 2 (Vertical : Horizontal)	CRN CS 410 Cl.6.6
TURNOUT AND CATCHPOINTS		
Turnout	Option Dependent. Option 3a provides approximately 40km/hr rated 1:12 R500 similar flexure turnout. Refer to Appendix C for a detailed drawing provided by VAE Railway Systems. Option 3b provides 25km/hr rated similar flexure turnout. Turnout details are to be determined.	CRN CS 250 Table 2 & Table 3
Clearance point	3.42m (Radius=0)	CRN CS 250 Cl.5.4.7 CRN CS 215 Appendix 2

APPENDIX B

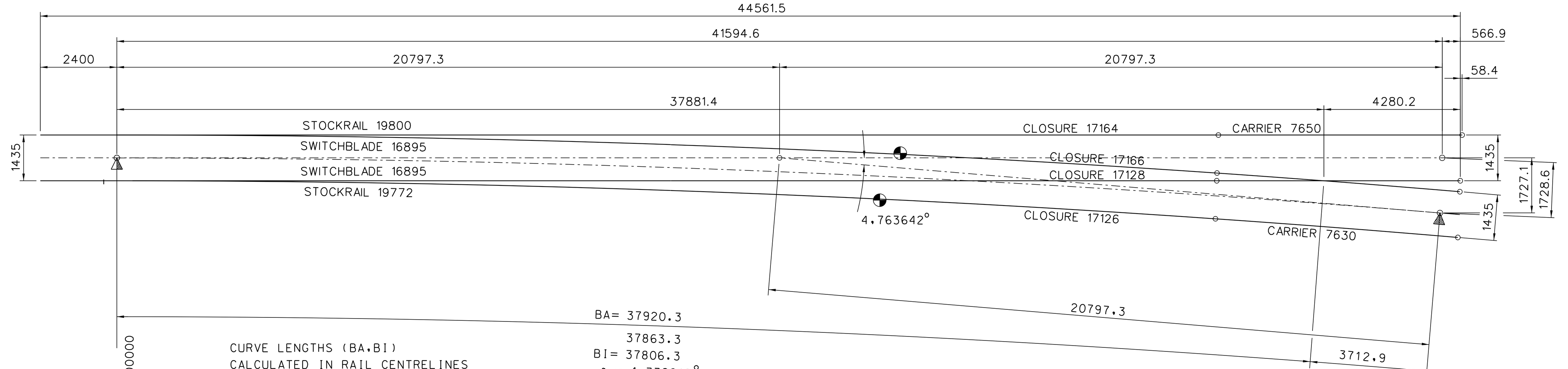
JHR CRN Southern Section Track Diagram


TRACK DIAGRAM - Joppa Junction to Canberra (260km - 287km)
Tarago
262.507km
EEB
Siding 160m
Loop 526m
Woodlawn Siding
Frame C
Frame D
Frame E
Frame G
Frame H
Frames G, H & D XL locked and booked out of use
Tarago culverts 262 - 263km
262.040km
262.354km
262.660km
263.000km
Crisps Creek
264.642km
EEB
HARD STAND AREA
No 1 Siding 450 m
No 2 Siding 450 m
Frame A
Frame B
TARAGO
Private
Mt Fairy
Goulburn St
263.027km
SOUTH 2
January 2015
John Holland
File: South 2 V2.0.cdr

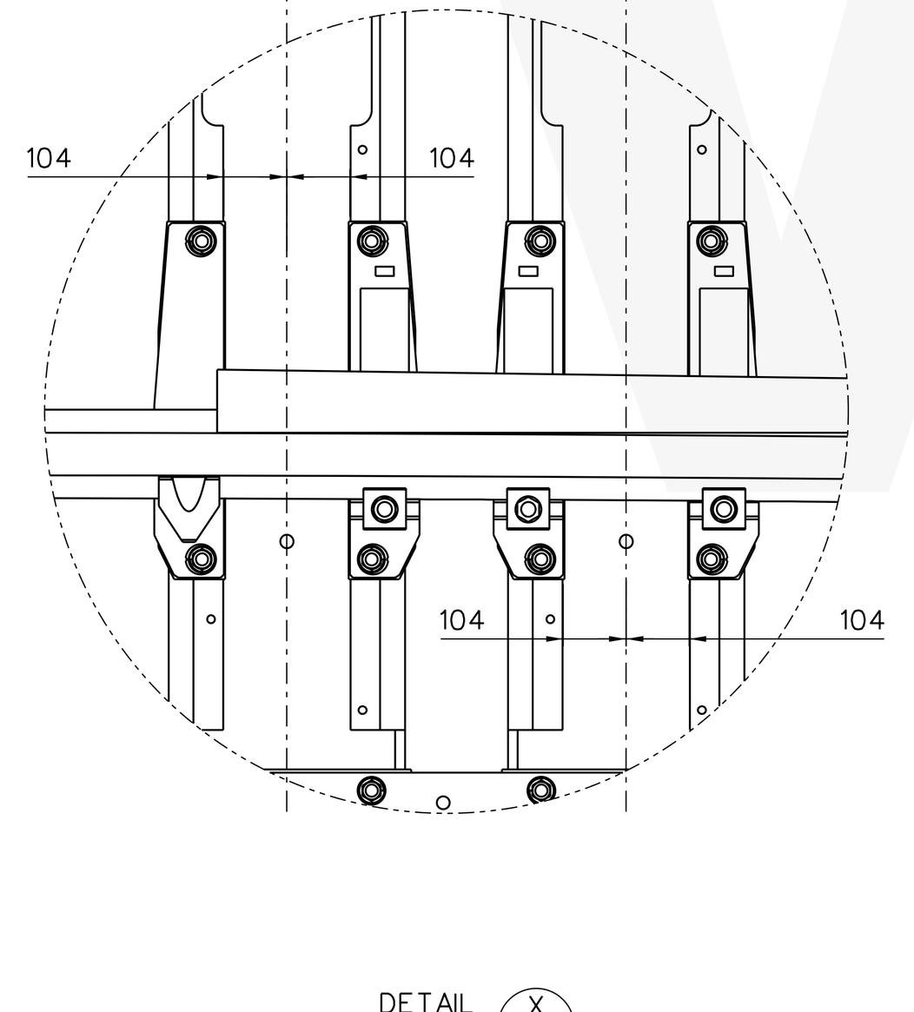
APPENDIX C

VAE 1:12-R500 Tangential Turnout

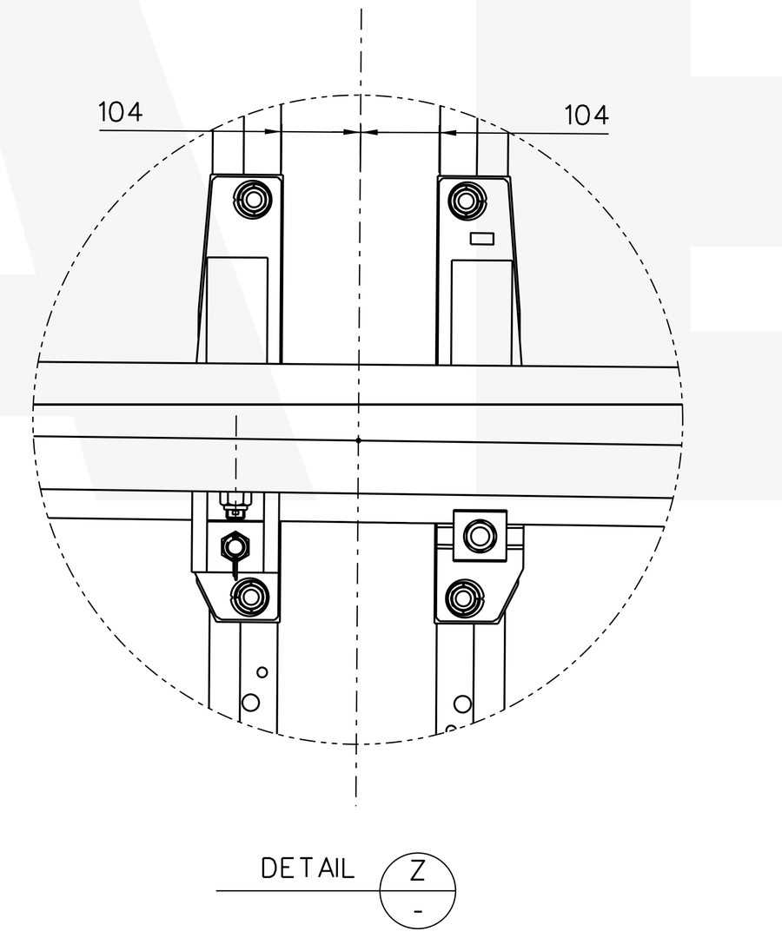
GENERAL ARRANGEMENT
Scale 1:50



TURNOUT GEOMETRY
Scale 1:100



DETAIL X



DETAIL Z

PLATE LIST			
DESCRIPTION	QTY	DRAWING	PART No.
SWITCH PLATING			
IB-1L	4	VAM 13577	E2500105
IB-1R	4	VAM 13577	E2500104
IB-2L	1	VAM 13578	E2500107
IB-2R	1	VAM 13578	E2500106
IB-5L	1	VAM 14586	E2500127
IB-5R	1	VAM 14586	E2500128
AS60-10	32	VAE 14820	E7100027
AS60-101	2	VAM 10002	
AS60-102	1	VAM 10003	
AS60-103	1	VAM 10003	
AS60-980L	1	VAM 12549	
AS60-980R	1	VAM 12549	
AS60-981L	1	VAM 12550	
AS60-981R	1	VAM 12550	
AS60-108L	1	VAM 10005	
AS60-108R	1	VAM 10005	
AS60-109L	1	VAM 10005	
AS60-109R	1	VAM 10005	
AS60-110L	1	VAM 10006	
AS60-110R	1	VAM 10006	
AS60-111L	1	VAM 10006	
AS60-111R	1	VAM 10006	
AS60-112L	1	VAM 10006	
AS60-112R	1	VAM 10006	
AS60-113L	1	VAM 10006	
AS60-113R	1	VAM 10006	
AS60-114L	1	VAM 10006	
AS60-114R	1	VAM 10006	
AS60-141L	1	VAM 10006	
AS60-141R	1	VAM 10006	
CDP ROLLER PLATING			
CDP ROLLER SR2	8	078221	E2500018
GUARDRAIL PLATING			
AS60-140	18	VAM 13110	
STANDARD PLATING			
PANDROL 485S	144	ISP-96485	E7100007
PANDROL 487S	6	ISP-96487	E7100008
PANDROL 488S	6	ISP-96488	E7100009
PANDROL 489S	6	ISP-96489	E7100010
CROSSING PLATING			
AS60-169	1	VAM 10008	
AS60-170	1	VAM 10008	
AS60-171	1	VAM 10008	
AS60-172	1	VAM 10008	
AS60-173	1	VAM 10007	
AS60-174	1	VAM 10007	
AS60-175	1	VAM 10009	
AS60-176	1	VAM 10009	
AS60-177	1	VAM 10009	
AS60-178	1	VAM 10009	
AS60-179	1	VAM 10009	
AS60-180	1	VAM 10009	
AS60-181	1	VAM 10009	
AS60-182	1	VAM 10009	
AS60-183	1	VAM 10009	
AS60-184	1	VAM 10009	
AS60-185	1	VAM 10007	
AS60-186	1	VAM 10007	
AS60-187	1	VAM 10008	
AS60-188	1	VAM 10008	
AS60-189	1	VAM 10008	

BILL OF MATERIAL				
ITEM	DESCRIPTION	QTY	DRAWING	PART No.
1	1:12 COMPOUND V-CROSSING	1	VAM 13452	A3500058/59
2	STOCKRAIL STRAIGHT - 19800 Long.	1	VAM 10073	
3	STOCKRAIL CURVED - 19772 Long.	1	VAM 10073	
4	SWITCHBLADE STRAIGHT - 16895 Long.	1	VAM 10071	
5	SWITCHBLADE CURVED - 16895 Long.	1	VAM 10072	
6	CLOSURE STRAIGHT - 17164 Long.	1	VAM 10340	
7	CLOSURE STRAIGHT - 17128 Long.	1	VAM 10340	
8	CLOSURE CURVED - 12363 Long. (17166 Long.) *	1	VAM 10340	
9	CLOSURE CURVED - 12323 Long. (17126 Long.) *	1	VAM 10340	
10	CARRIER STRAIGHT - 7650 Long.	1	VAM 10340	
11	CARRIER CURVED - 7630 Long.	1	VAM 10340	
12	UIC33 GUARDRAIL STRAIGHT - 5000 Long.	1	VAM 10032	
13	UIC33 GUARDRAIL CURVED 5000 Long.	1	VAM 10338	
14	GUARDRAIL SHIM 2mm	9	VAM 12577	79818600001
15	GUARDRAIL SHIM 1mm	9	VAM 12577	79818600004
16	BOLT SQ HD 120 x M24 GD RAIL	18	VAE 87672	L5224008
17	NUT M24 STRUCTURAL BLACK	18		L3324001
18	WASHER DOUBLE SPRING M24x8MM	18		L3824002
19	SWITCH STOPS	20	VAM 10070	
20	BOLT HEX M24x90 COMMERCIAL BLACK	20		L1224090
21	NUT M24 STRUCTURAL BLACK	20		L3324001
22	WASHER DOUBLE SPRING M24x8MM	20		L3824002
23	ANTI-CREEP ASSEMBLY	2	VAM 12495	N1600014
24	RAIL CLIP 60KG	4	VAM 11149	E9300139
25	NUT NYLOC THIN M24	4		L1924204
26	WASHER DOUBLE SPRING M24x8MM	4		L3824002
27	WASHER M24 STRUCTURAL	4		L3724001
28	IBAV SPRING PLATE	48	VAE 85554	79813500004
29	IBAV SPRING PIN	32	VAE 85555	79816400015
30	IBAV SPRING PIN INBEARER	16	VAM 11482	L7100009
31	G.I.J. CURVED - 4800 Long.	2	VAM 12809	C6900076
32	PANDROL CLIP e2003 - ATTACHED	72	PAND E21027	E9100004
33	T/O 500-12 CP PADSET & FASTENERS-RIC ALL	1		E9400229
34	PANDROL CLIP e2003 - PACKED	472	PAND E21027	E9100004
35	PANDROL CLIP e1629	8		E9100012
36	SCREW SPIKES SS8	1060	DEL HSR602	L5700002
37	DOUBLE SPRING WASHERS	1060		L3824002
38	OP ASSY 500M EP SPHERO IB 60KG	1	M10-735	J1500141
	OP ASSY 500M 84M SPHERO IB 60KG	1	M10-734	J1500142
	OP ASSY 500M 84M C/LOCK IB 60KG	1	M10-834	J1500143
39	SPHERO SW ASSY 1435 DEV1 60KG - RIC	1	VAM 14726	J2800174
40	CON TIES 500:12 T/O FP IB-CP END INFILL	1		G3900287
41	BOLT COUNTERSUNK 80 x M24 HT	2		L3624080
42	BOLT COUNTERSUNK NIBNECK 90 x M24 HT	2	VAM 11745	L5324004
43	NUT NYLOC M24	12		L1324204
44	SPLIT PIN 5 x 63	4		L1605063
45	STRUCTURAL WASHER M24	4		L3724001
46	WASHER SPRING 27x10x10	2		L3827001
47	NUT M27 STRUCTURAL	2		L3327001
48	BOLT CSK SKT 100 x M27 GD 8.8	2		L3627101
49	WASHER BELVILLE 56/25 x 6mm	8		450082934
50	BOLT "D" HD 75mm x M24 GALV GD 8.8	8	VAE 87699	L5324005
51	K-CLIP SPECIAL INBEARER	8	VAM 13445	E9300181
52	INBEARER ASSEMBLY SW 60KG W/O PLATES	1	VAM 14429	J2600023
53	REAR INBEARER ASSY 500 W/O PLATES-RIC	1	VAM 14052	J2600032

* - LENGTH OF CLOSURES AS DELIVERED PRIOR TO GIJ INSTALLATION

NOTES

DRAWN FOR A RIGHT HAND TURNOUT, LEFT HAND TURNOUT TO BE A MIRROR IMAGE. IN BOTH INSTANCES BASE PLATES AS60-102, AS60-103, AS60-980L(R), AS60-981L(R), AS60-108L(R) TO AS60-114L(R) PLUS AS60-141R(L) ARE TO REMAIN ON THE SAME SIDE OF THE TURNOUT.

ALL CLOSURES ALLOW FOR A 3mm GAP AT THE RAIL JOINTS.

= 485S PANDROL PLATE U.N.O.

= GLUED INSULATED JOINT

R2 = CDP ROLLER (2 ROLLER) LOCATIONS

REFERENCES

ANTI-CREEP CUTTING DRG. No. VAM 10070

SWITCH AND STOCKRAIL SECTIONS DRG No. VAE 101983

SECTION TO GUARDRAIL ASSEMBLY DRG No. VAE 103662

RIGHT HAND TURNOUT PART No. A1500410

LEFT HAND TURNOUT PART No. A1500411

References	Drawn	Date	Part No.
CV 0442174 CV 0518997	DKH	13/10/14	SEE ABOVE
	Checked: DCC	Scale: 1:50	Predecessor: VAM 15236
	Approved:	Weight (kg):	Specification: AS 1085.1

voestalpine VAE Railway Systems PTY LTD
Mackay, Australia A.B.N. 71 011 073 108

500M 1:12 TURNOUT INBEARER CONC. SLEEPERS
60KG FULLY PLATED – CURVED END INFILL
GENERAL LAYOUT – COMPLETE SUPPLY

Size	Sheet No.	Dwg. No.	Rev.
A1	1 of 1	VAM 15767	0

VAE Form No. EF-0403

APPENDIX D

Flood Study Summary Report

SEEC

Strategic Environmental & Engineering Consulting

Flood Study Summary Report

for Proposed Subdivision of Lot 101 DP 1155857 Tarago

Prepared by:

Alyssa Burnus & Jason Armstrong
SEEC Reference 11000079

27 May 2011

SEEC

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Document Certification

This report has been developed based on agreed requirements as understood by SEEC at the time of investigation. It applies only to a specific task on the nominated lands. Other interpretations should not be made, including changes in scale or application to other projects.
Any recommendations contained in this report are based on an honest appraisal of the opportunities and constraints that existed at the site at the time of investigation, subject to the limited scope and resources available. Within the confines of the above statements and to the best of my knowledge, this report does not contain any incomplete or misleading information.

Jason Armstrong (OMIEAust)
Senior Civil Designer
SEEC
27 May 2011

Alyssa Burnus
Civil Engineer
SEEC
27 May 2011

TABLE OF CONTENTS

1 Introduction

SEEC has been commissioned to provide this Flood Study to accompany a Development Application for a proposed rural-residential subdivision of Lot 1 DP 1155857, Mulwaree Street, Tarago. This study has been prepared in accordance with the guidelines and recommendations set out in ***Australian Rainfall & Runoff 1997*** and ***Goulburn Mulwaree Council.***

This summary report outlines the procedures used to determine the approximate flood levels for the 20 and 100 year ARI flood events within the boundaries of the proposed subdivision. This flood analysis is based on a desktop study and visual interpretation of the upstream and downstream catchment areas, and a survey provided by Southern Cross Consulting Surveyors of the site itself. The accuracy of this flood study is controlled by the level of detail obtainable from the desktop study and the survey provided.

Any results, assumptions or conclusions provided within this report are suitable only for the purpose of Development Application and should not be used for any other reason. This flood study will provide the relevant flood information in order to help define appropriate lot boundaries, house, driveway and onsite wastewater treatment locations based on the extent of the 20 and 100 year flood events.
This flood study includes:

(i) A general description of the site and the surrounding catchment area;

(ii) A catchment analysis to determine the peak flows through the site, and;

(iii) Flood calculations and results using HEC-RAS 4.0, a one dimensional, Quasi-2D river modelling package that calculates the depth and velocity of flows.

2 Proposed Development

It is proposed to subdivide existing Lot 1, DP 1155857 into several individual lots with a minimum lot size of 1 Ha each. At present there is no subdivision layout plan available. This Flood Study will be used in conjunction with various other assessments to produce a constraints map for the site which will aid planners in determining a suitable layout for the subdivision. It is acticipated that access to the subdivision will be via a new road extension of Mulwarree Street.

3 Site Description

3.1 General Location

Lot 1 of DP 1155857, Mulwaree Street occupies approximately 34 ha of grazing land (**Figure 1**). It is located immediately west of the townshop of Tarago and is bordered by similar rural properties to the north and west, residential dwellings to the south and by Goulburn-Canberra railway line to the east. A gravel access road also exists in-between the rail line and the eastern boundary of the property. The Mulwaree River is located on the eastern side of the township of Tarago.

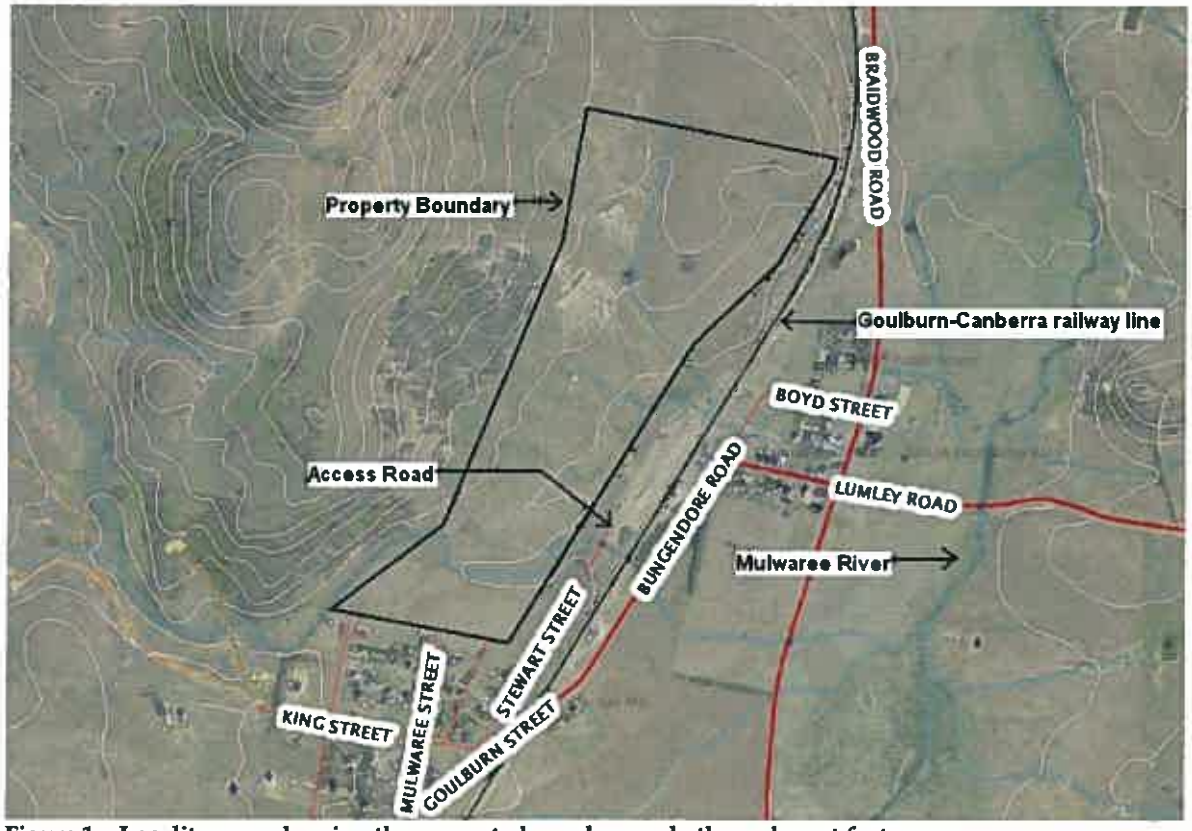

Figure 1 – Locality map showing the property boundary and other relevant features

3.2 Topography and Drainage

The majority of the northern part of the site consists of gentle to moderate undulating slopes falling towards the south east. However, the southern portion of the site is low lying and prone to flooding.

There are several drainage lines that flow into the south-eastern flood prone portion of the site. Flows from these drainage lines flow offsite via a series of culverts located under the access road and railway line before eventually flowing east into the Mulwaree River located approximately 700m downstream of the site.

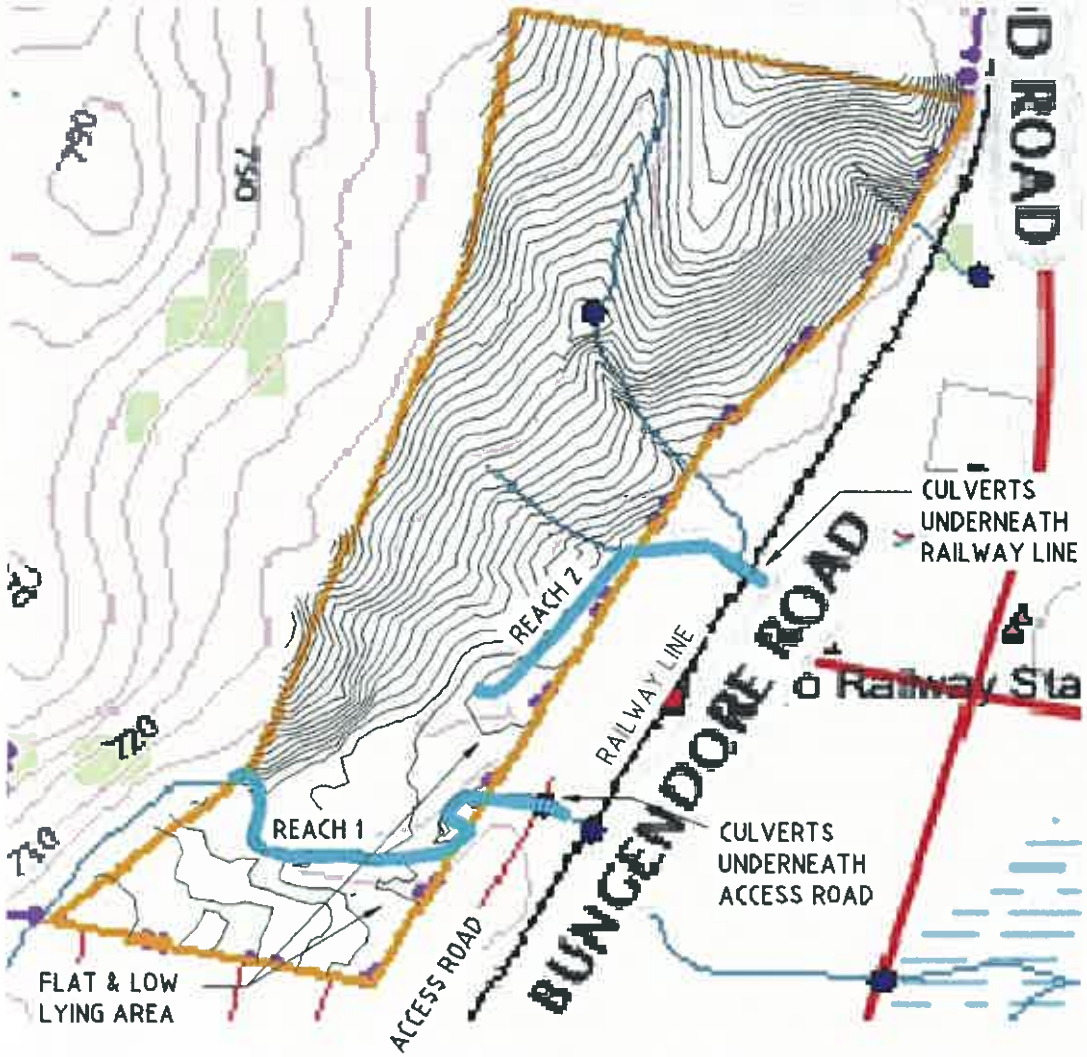

Figure 2 – Plan showing topography and drainage lines

There are two significant drainage lines located within the southern flood prone portion of the site. These have been referred to as Reach 1 and Reach 2 shown in **Figure 2** above.

The site contains several other minor drainage lines to the north that are relatively narrow and steep. Flows from these have been included into the catchment calculations where required, but they generally do not have a direct impact on existing site flooding issues.
The access road and railway line downstream of Reach 1 and Reach 2 respectively are raised on embankments to a level above the lower end of the site. The embankments act as a flow restriction at both these locations.

The culverts underneath these embankments provide a passage for flows from Reaches 1 and 2 to leave the site. During larger storm events, flows within both reaches will exceed the capacity of the culverts and back up behind the access road/railway line onto the site.

The culverts underneath the access road and railway line in the locations of Reach 1 and 2 are listed below:

(i) Reach 1 – Culverts underneath access road
- Triple 1800 x 2400mm box culvert

(ii) Reach 2 – Culverts underneath railway line
- Single 1300mm diameter pipe

3.3 Catchment Area Description

The majority of the catchment area for the site consists of undeveloped rural lands. The site and upstream catchment area was split into four sub-catchments 1, 2, 3 and 4 (refer to **Figure 3**). The sub-catchment areas distribute flows into the relevant reaches as follows:

- Sub-catchment 1 (634.3 ha) drains into Reach 1.
- Sub-catchment 2 (35.2 ha) and sub-catchment 3 (23.4 ha) drain into Reach 2.

- Sub-catchment 4 is relatively steeply inclined. The drainage line within this sub-catchment drains freely off the site and eventually into Mulwaree River. Therefore this drainage line will not be subject to flooding and its sub-catchment does not distribute flows into any of the low lying area or flood prone reaches on the site.

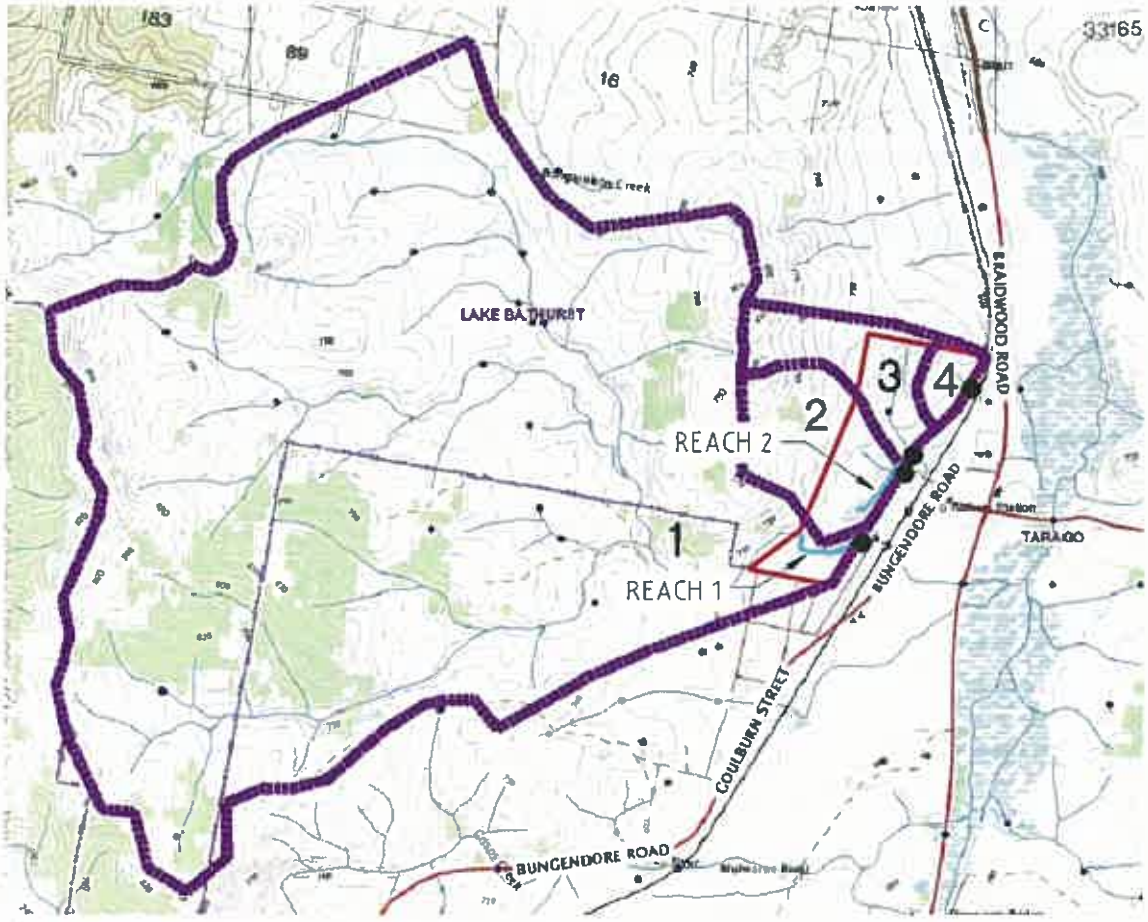

Figure 3 – Catchment Plan

4 Peak Flow Calculations

The peak flow calculations for the catchment were based on the probabilistic rational formula described in Australian Rainfall and Runoff 1987 (ARR 1987). The calculations were based on the formula below:

$$Q_y = 0.00278 \times C_{10} \times F_y \times I_{tc,y} \times A \quad \text{.....(1)}$$

Where:

Q_y = peak flow rate (m^3/s) of average recurrence interval (ARI) of Y years

C_{10} = runoff co-efficient, (dimensionless) for ARI of Y years, Figure 5.1 in ARR 1987

$I_{tc,y}$ = Average Rainfall Intensity, (*mm/hr*) for the design duration of t_c hours and ARI of Y years

FF_y= frequency factor, Table 5.1 of ARR 1987

A = area of catchment (*ha*)

4.1 Rainfall Data

The Intensity Frequency Duration (IFD) rainfall data for the site has been based on data presented in Australian Rainfall and Runoff and site specific calculations for Tarago. A copy of the IFD chart for the site is attached at **Appendix 1**.

4.2 Peak Flow Results

Estimates for the 20 and 100 year ARI peak storm flows for the relevant sub-catchment areas are shown in **Tables 1 and 2** respectively.

Table 1 - 20 Year ARI Peak Flow Estimates

Sub-Catchment Area	Peak Flow (20YR ARI), Q (m^3/s)
1	30
2	3
3	2

Table 2 - 100 Year ARI Peak Flow Estimates

Sub-Catchment Area	Peak Flow (20YR ARI), Q (m^3/s)
1	54
2	5.4
3	3.6

5 HEC-RAS Modelling

Based on the supplied survey data a HEC-RAS model was produced incorporating both Reach 1 and Reach 2 using AUTODESK Civil 3D. This model included design centrelines representing the particular drainage line locations and a series of cross sections along these centrelines representing the surface topography. Refer to **Drawing 11000079-FS01 (Appendix 2)** for the locations of the centrelines and critical cross sections.

The access track and railway line embankments and culvert details were entered into HEC-RAS in the necessary locations. A 50% blockage factor was assumed for all of the culverts modelled.

The peak flows were entered into the HEC-RAS Model and a Sub Critical Flow Regime was adopted to determine the water level in the drainage line for the 20 year and 100 year ARI storm events.

A value of 0.04 was adopted as the manning coefficient for both the channel flow and over bank areas. This manning coefficient was adopted since the majority of the site including the channels currently exists as grassed lands. From the topographic map and the site survey data it was determined that the drainage line within the site has an average grade of approximately 1%.

6 Results

The flood extents across the site for the 20 and 100 year ARI storm events have been determined and are displayed on **Drawing 11000079-FS01 (Appendix 2)**. It can be seen that a portion of the land towards the south eastern corner of the site and along the eastern boundary of the site will become inundated during both storm events. The width of this inundation varies for each event as shown.

Considering the 100 year ARI flood level, the flood planning level (FPL) can be determined. The FPL is 0.5 m above the 100 year ARI flood level. The floor level of a new residence should be set at a height on or above this FPL.

The maximum depth, velocity and flow rate and the water surface level (WSL) for the relevant cross sections have also been determined and are provided in **Tables 3 and 4**.

Table 3 - 20 Year ARI Flood Results

Cross Section	Velocity (m/s)	Depth (m)	Flowrate (m^3/s)	WSL (AHD)
Reach 1				
10	0.78	1.70	30	689.29
80	1.30	1.55	30	689.71
140	1.53	0.69	30	690.43
200	1.45	1.26	30	690.99
260	1.83	1.20	30	691.37
348	0.82	0.94	30	692.04
Reach 2				
0	0.07	1.50	2.20	687.83
60	0.08	1.14	2.20	687.83
140	0.92	0.16	2.20	687.84
233	0.50	0.15	2.20	688.87

Table 4 - 100 Year ARI Flood Results

Cross Section	Velocity (m/s)	Depth (m)	Flowrate (m^3/s)	WSL (AHD)
Reach 1				
10	0.54	2.28	54	689.87
80	1.08	1.90	54	690.05
140	1.85	0.82	54	690.56
200	0.95	1.43	54	691.18
260	2.23	1.39	54	691.56
348	1.02	1.13	54	692.23
Reach 2				
0	0.12	1.57	4	687.91
60	0.14	1.21	4	687.91
140	0.79	0.25	4	687.93
233	0.63	0.20	4	688.92

7 Conclusions and Recommendations

This report outlines relevant flood information necessary to help planners determine the layout and associated planning conditions for the proposed rural-residential subdivision of Lot 1 of DP 1155857 Mulwaree Street, Tarago.

Section 6 of this report details the results of this flood study. It illustrates the flood extents within the site and critical flow details for both the 20 year and 100 year ARI flood events. The results of this report can be used to determine the location of lot boundaries, house, driveway and onsite wastewater treatment systems.

8 References

(i) ***Australian Rainfall and Runoff, A Guide to Flood Estimation, Volume 1 and Volume 2:*** The Institution of Engineers Australia, 1997

(ii) ***Goulburn Malwaree Council – Development Specification – D1***

(iii) ***HEC-RAS River Analysis System Version 4.0 Beta:*** U.S. Army Corps of Engineers

(iv) ***Detailed Survey Plan and Detail Plan Showing Culverts East of Lot 1 DP 1155857:*** Southern Cross Consulting Surveyors

9 Appendicies

9.1 Appendix 1 – IFD Table

```
********** RAINER ******************************
      DEPARTMENT of CONSERVATION and LAND MANAGEMENT
Date: 25/05/2011


Rainfall Intensity (mm/h) for TARAGO
       1 hour, 2 years : 22.30
      12 hour, 2 years :  4.50
      72 hour, 2 years :  1.30
       1 hour, 50 years : 46.00
      12 hour, 50 years :  8.50
      72 hour, 50 years :  2.60
               Skewness :  0.12
Geographical factor F2 :  4.29
Geographical factor F50: 15.60
```

\DUR ARI	5m	6m	10m	20m	30m	1h	2h	3h	6h	12h	24h	48h	72h	User
1	56	53	42.9	31.0	25.1	17.0	11.0	8.46	5.41	3.47	2.20	1.36	0.99	0.00
2	74	70	56	40.7	32.9	22.1	14.3	11.0	6.99	4.47	2.84	1.76	1.29	0.00
5	101	95	76	55	43.9	29.2	18.7	14.3	9.00	5.69	3.65	2.28	1.68	0.00
10	118	111	89	63	51	33.6	21.4	16.3	10.2	6.42	4.13	2.60	1.92	0.00
20	141	131	106	75	60	39.4	24.9	18.9	11.8	7.40	4.78	3.02	2.24	0.00
50	171	160	128	90	72	47.2	29.7	22.5	14.0	8.70	5.65	3.58	2.67	0.00
100	196	182	146	103	82	53	33.5	25.3	15.6	9.71	6.32	4.02	3.00	0.00
User	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

```
Estimated Rainfall Factor (R): 1260   Estimated 1:10 Storm (S10): 860
```

Expanded Rainfall Intensity table for TARAGO

	Years						
min	1	2	5	10	20	50	100
7	49.7	65	89	104	123	150	171
8	47.1	62	84	98	117	142	161
9	44.9	59	80	93	111	134	153
10	42.9	56	76	89	106	128	146
11	41.2	54	73	85	101	122	139
12	39.6	52	70	82	97	117	134
13	38.2	50	68	79	93	113	129
14	36.9	48.5	65	76	90	109	124
15	35.7	46.9	63	74	87	105	120
16	34.6	45.5	61	71	84	102	116
17	33.6	44.2	59	69	81	99	112
18	32.7	42.9	58	67	79	96	109
19	31.8	41.8	56	65	77	93	106
20	31.0	40.7	55	63	75	90	103
21	30.3	39.7	53	62	73	88	100
22	29.6	38.8	52	60	71	86	97
23	28.9	37.9	51	59	69	84	95
24	28.3	37.1	49.6	57	68	82	93
25	27.7	36.3	48.5	56	66	80	91
26	27.1	35.5	47.5	55	65	78	89
27	26.6	34.8	46.5	54	63	76	87
28	26.0	34.1	45.6	53	62	75	85
29	25.6	33.5	44.7	52	61	73	83
30	25.1	32.9	43.9	51	60	72	82
31	24.7	32.3	43.1	49.8	59	71	80
32	24.2	31.7	42.3	48.9	58	69	79
33	23.8	31.2	41.6	48.1	57	68	77
34	23.4	30.7	40.9	47.3	56	67	76
35	23.1	30.2	40.2	46.5	55	66	75
36	22.7	29.7	39.6	45.7	54	65	73
37	22.4	29.3	39.0	45.0	53	64	72
38	22.0	28.8	38.4	44.3	52	63	71
39	21.7	28.4	37.8	43.6	51	62	70
40	21.4	28.0	37.2	43.0	50	61	69
41	21.1	27.6	36.7	42.3	49.7	60	68
42	20.8	27.2	36.2	41.7	49.0	59	67
43	20.6	26.9	35.7	41.2	48.3	58	66
44	20.3	26.5	35.2	40.6	47.7	57	65
45	20.0	26.2	34.7	40.1	47.0	56	64
46	19.8	25.8	34.3	39.5	46.4	56	63
47	19.5	25.5	33.9	39.0	45.8	55	62
48	19.3	25.2	33.4	38.5	45.2	54	61
49	19.1	24.9	33.0	38.1	44.7	54	61
50	18.9	24.6	32.6	37.6	44.1	53	60
51	18.6	24.3	32.2	37.1	43.6	52	59
52	18.4	24.1	31.9	36.7	43.1	52	58
53	18.2	23.8	31.5	36.3	42.6	51	58
54	18.0	23.5	31.2	35.9	42.1	50	57
55	17.8	23.3	30.8	35.5	41.6	49.9	56
56	17.6	23.0	30.5	35.1	41.1	49.3	56
57	17.5	22.8	30.2	34.7	40.7	48.8	55
58	17.3	22.6	29.8	34.3	40.2	48.2	55
59	17.1	22.3	29.5	34.0	39.8	47.7	54

9.2 Appendix 2 – Flood Map, 20 Year & 100 Year ARI Flood Extents (Drawing below - Not to scale. Refer to A1 plan provided for correctly scaled drawing)

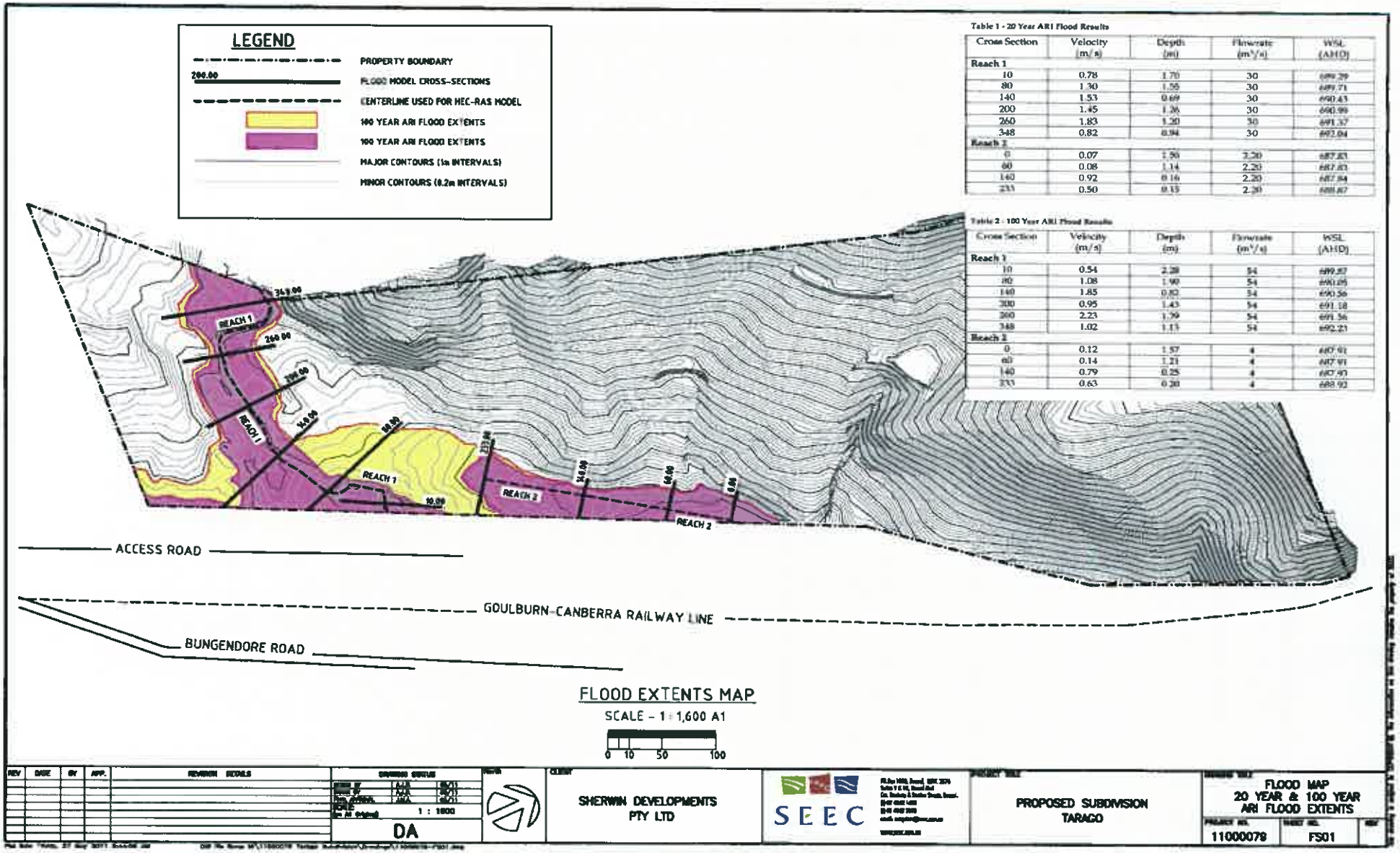

Table 1 - 20 Year ARI Flood Results

Cross Section	Velocity (m/s)	Depth (m)	Flowrate (m^3/s)	WSL (AHD)
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80	1.30	1.55	30	689.71
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260	1.83	1.20	30	691.37
348	0.82	0.94	30	692.04
Reach 2				
0	0.07	1.50	2.20	687.83
60	0.08	1.14	2.20	687.83
140	0.92	0.16	2.20	687.94
233	0.50	0.15	2.20	688.07

Table 2 - 100 Year ARI Flood Results

Cross Section	Velocity (m/s)	Depth (m)	Flowrate (m^3/s)	WSL (AHD)
Reach 1				
10	0.54	2.28	54	689.87
80	1.08	1.90	54	690.09
140	1.85	0.82	54	690.56
200	0.95	1.43	54	691.18
260	2.23	1.79	54	691.56
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Reach 2				
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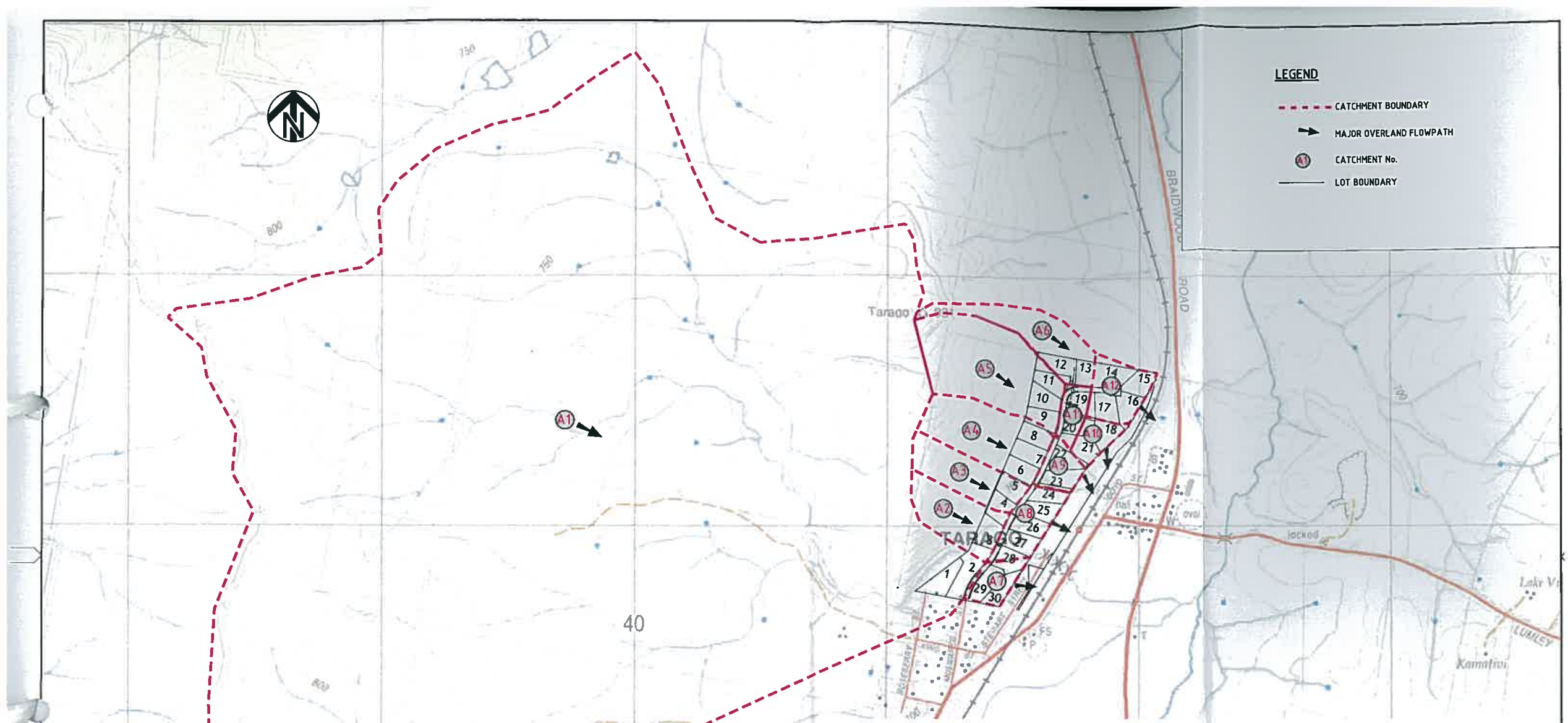
60	0.14	1.21	4	687.91
140	0.79	0.25	4	687.93
233	0.63	0.20	4	688.93



CATCMENT No.	AREA (ha)	PIT/HW No.	STORMWATER PIPES & CULVERT	ROAD CHAINAGE	TOC	INTENSITY (mm/h)I	RUNOFF COEFFICIENT	Q2 (cms)	SLOPE	VELOCITY
1	634.3	HW1-HW2	3 x 1800mm x 2400mm	334.654						
2	7.0	HW1/1 -HW2/ 1	600(H)X900(W) CULVERT	467.468	10.68	104.86	0.52	1.06	1.50%	1.75
3	7.0	HW1/2-HW2/ 2	600(H)X900(W) CULVERT	604.659	13.52	95.95	0.5	0.93	1.67%	1.75
4	11.0	HW1/3-HW2/ 3	2x600(H)X900(W) CULVERT	753.659	13.48	96.07	0.5	1.47	2.06%	2.74
5	17.0	HW1/4-HW2/ 4	2x600(H)X900(W) CULVERT	956.403	15.92	88.41	0.48	2.00	2.00%	2.47
6	7.8	HW1/5-HW2/ 5	600(H)X900(W) CULVERT	1155	16.47	85.96	0.46	0.86	0.81%	2.65
		HW3/6	1x Ø750mm (under swale Q5)							
7	2.8		Sheds towards the east	NA						
8	5.0		Sheds towards the east	NA						
9	2.8		Sheds towards the east	NA						
10	2.4		Sheds towards the east	NA						
11	2.3		Sheds towards swale	NA						
12	5.1		Sheds towards the east	NA						

NOTE
1. REFER NOTE 1, DRG No. 3002352-DDD-265

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PLOT DATE: 04 Feb 2014 TIME: 12:07:42

EXTERNAL REFERENCE FILES:
X_TSUB_AT
X_TSUB_SUB
X_TSUB_SURVX
X_TSUB_UTLX
X_TSUB_EASE
X_TSUB_CATCHMENT
X_TSUB_CONT
X_TSUB_DES_CTRL

REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVR No.	APPROVAL
01	30.10.2013	PRELIMINARY SKETCH PLAN ISSUE	WVR001	K.B.
02	15.11.2013	CONSTRUCTION CERTIFICATE	WVR002	K.B.
03	09.12.2013	REVISED ISSUE FOR CONSTRUCTION	WVR 004	K.B.
04	04.02.2014	REVISED ISSUE FOR CONSTRUCTION CERTIFICATE	WVR006	K.B.

TITLE	NAME
DRAFTER	R. GOOSEN
DRAFTING CHECK	A. BRISCOE
DESIGNER	M. DOWNES
DESIGN CHECK	K. BROMLEY
PROJECT MANAGER	K. BROMLEY
PROJECT DIRECTOR	S.TILDSLEY

SCALES AT A1 SIZE DRAWING
SCALE 1:7500 (50 0 100 200 300)

CONSTRUCTION CERTIFICATE ISSUE

DESIGNER
SMEC
SMEC AUSTRALIA PTY LTD
© ABN 47 065 475 149
SUITE 2, LEVEL 1, 243 NORTHBOURNE AVENUE
LYNEHAM ACT 2602 AUSTRALIA
PH (02) 6234 1900 FAX (02) 6234 1966
SMEC PROJECT No 3002352

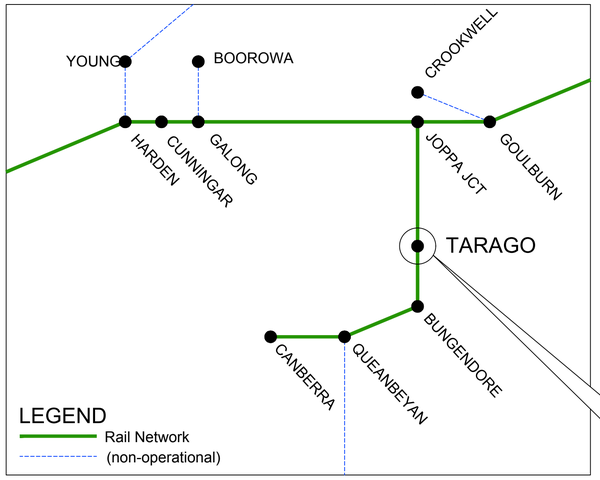
CLIENT: SHERWIN DEVELOPMENTS

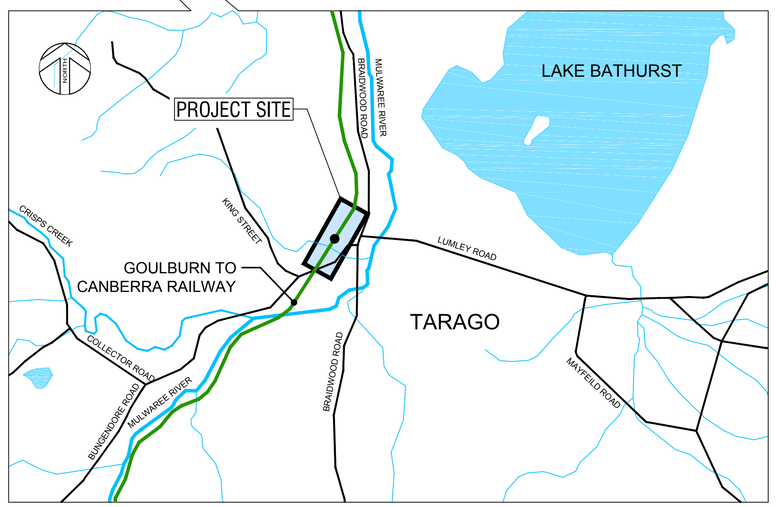
PROJECT TITLE: TARAGO LOT 1 DP1155858
PROPOSED RESIDENTIAL SUBDIVISION

CATCHMENT PLAN

SCALE	PHASE	PROJECT / DRAWING No.	REVISION
AS SHOWN	PRELIMINARY	3002352-DDW-401	04

TARAGO
LOOP EXTENSION
261.280km - 263.100km
JHR CRN ASSET No. TRS50230A, TRS502626B, TRS50262A





TARAGO - OPTION 1	
DRAWING NUMBER	DRAWING TITLE
CC000162-C-1001	DRAWING INDEX AND LOCALITY PLAN
CC000162-C-1002	GENERAL NOTES
CC000162-C-1050	GENERAL ARRANGEMENT PLAN
CC000162-C-1100	PLAN AND PROFILE (MX01) 261.280km - 261.750km SHEET 1
CC000162-C-1101	PLAN AND PROFILE (MX01) 261.750km - 262.150km SHEET 2
CC000162-C-1102	PLAN AND PROFILE (MC01) 261.850km - 262.450km SHEET 1
CC000162-C-1103	PLAN AND PROFILE (MC01) 262.450km - 263.100km SHEET 2
CC000162-C-1300	TYPICAL SECTION SHEET 1
CC000162-C-1301	TYPICAL SECTION SHEET 2
CC000162-C-1302	TYPICAL SECTION SHEET 3
CC000162-C-1350	CULVERT DETAIL - SECTION A

Design accepted for use by JHR-CRN*

SIGNATURE

TITLE

DATE

**JHR-CRN signatures on this drawing do not signify acceptance of responsibility for the design. Responsibility for integrity, safety and dimensional accuracy of the design remains with the approving authority.*

REV	BY	DATE	DESCRIPTION	APPD.
0	S.O'B	14.07.17	ISSUED FOR CONSTRUCTION	B.K.

A1 Original | Co-ordinate System: MGA Zone 50 | Height Datum: A.H.D. | Scale: NTS

NSW GOVERNMENT Transport for NSW

John Holland | COUNTRY REGIONAL NETWORK

Brisbane Office—
74-76 Bowen St, Spring Hill QLD 4000
P / +61 7 3167 3300
E / info@bgeeng.com
bgeeng.com—

PROJECT No. S15066

DRAWN J.B.
DRG CHECK S.W.
DESIGNED S.W.
DESIGN CHECK B.K.
APPROVED

TARAGO LOOP EXTENSION
261.280km - 263.100km
DRAWING INDEX AND LOCALITY PLAN

FILE No. S15066-DRG-C-1001	SHEET: 1 OF 1	A1
STATUS: FOR CONSTRUCTION	AWP PROJECT No. 1617-341	©
DRG No. CC000162-C-1001 0	EDMS No.	

DeskSite No. 18159067 Rev 5 P:\BGE\CYD\S15066\100 Drawings\102 Civil\Autocad\S15066-DRG-C-1001 By: Adam Evans Plot Date: 14/7/2017 3:48 PM

1. GENERAL

1. REFER TO ALL NOTES ON THESE DRAWINGS AND PREVIOUSLY MENTIONED DOCUMENTATION BEFORE BEGINNING CIVIL WORKS.
2. JOHN HOLLAND RAIL STANDARDS AND SPECIFICATIONS TAKE PRECEDENCE OVER ALL OTHER STANDARDS AND SPECIFICATIONS
3. TECHNICAL SPECIFICATIONS OR SPECIFIC INSTRUCTIONS ON DRAWINGS TAKE PRECEDENCE OVER THESE NOTES.
4. DO NOT DEPART FROM THE DESIGN UNLESS AUTHORISED IN WRITING BY THE DESIGN ENGINEER.
5. SPECIFICATIONS FROM JOHN HOLLAND RAIL SPECIFICALLY
   - CRN CP 201 - MEASURING GAUGES
   - CRN CP 202 - TRACK TOOLS
   - CRN CP 203 - TRACK DESIGN
   - CRN CP 204 - PRODUCT APPROVAL
   - CRN CP 205 - FIELD TESTING
   - CRN CP 206 - TRACK CONSTRUCTION
   - CRN CP 211 - SURVEY
   - CRN CP 212 - CONTRACT SURVEY
   - CRN CP 213 - TRACKSIDE SIGNS
   - CRN CP 221 - INSULATED JOINTS
   - CRN CP 222 - RAIL FLAW DETECTION
   - CRN CP 231 - TIMBER SLEEPERS AND BEARERS
   - CRN CP 232 - CONCRETE SLEEPERS
   - CRN CP 233 - STEEL SLEEPERS
   - CRN CP 237 - RESILIENT BASEPLATES
   - CRN CP 241 - BALLAST
   - CRN CP 251 - TURNOUTS
   - CRN CP 411 - EARTHWORKS MATERIALS
   - CRN CP 512 - WORKSITE DEMARCATION FENCES
5. THESE DRAWINGS SHALL BE READ IN CONJUNCTION WITH ALL OTHER CONSULTANT'S DRAWINGS AND SPECIFICATIONS AND WITH ANY OTHER WRITTEN INSTRUCTIONS THAT MAY BE ISSUED DURING THE COURSE OF THE CONTRACT. ANY DISCREPANCY SHALL BE REFERRED TO THE DESIGN ENGINEER BEFORE PROCEEDING WITH THE WORK. CONSTRUCTION FROM THESE DRAWINGS, AND THEIR ASSOCIATED CONSULTANT'S DRAWINGS, IS NOT TO COMMENCE UNTIL APPROVED BY THE RELEVANT AUTHORITIES.
6. JOHN HOLLAND RAIL OCCUPATIONAL HEALTH AND SAFETY PRACTICES MUST BE COMPLIED WITH.
7. ALL DIMENSIONS AND LEVELS SHOWN ON THE DRAWINGS SHALL BE VERIFIED BY THE CONTRACTOR ON SITE. CIVIL DRAWINGS SHALL NOT BE SCALED FOR DIMENSIONS. THE DESIGN ENGINEER SHALL BE NOTIFIED OF ANY DISCREPANCIES PRIOR TO CONSTRUCTION.
8. ALL DIMENSIONS ARE IN METRES (m) AND ALL LEVELS ARE IN METRES (m) TO AUSTRALIAN HEIGHT DATUM (AHD) U.N.O
9. IF THERE IS DOUBT REGARDING THE CIVIL DESIGN, CONTACT THE DESIGN ENGINEER FOR CLARIFICATION.
10. ALL ABBREVIATIONS ARE AS FOLLOWS:

EGL	EXISTING GROUND LEVEL
RL	REDUCED LEVEL
E	EASTING COORDINATE
N	NORTHING COORDINATE
AHD	AUSTRALIAN HEIGHT DATUM
U.N.O	UNLESS NOTED OTHERWISE
uPVC	UNPLASTICISED POLYVINYL CHLORIDE
PE	POLYETHYLENE
RCP	REINFORCED CONCRETE PIPE
RCBC	REINFORCED CONCRETE BOX CULVERT
VCP	VITRIFIED CLAY PIPE
FFU	FIBRE REINFORCED FOAMED URETHANE
FRC	FIBRE REINFORCED COMPOSITE
FSL	FINISHED SURFACE LEVEL
IL	INVERT LEVEL
GD	GRATED DRAIN
TWL	TOP WATER LEVEL
IJ	ISOLATION JOINT
DEJ	DOWELLED EXPANSION JOINT
SJ	SAWN JOINT
KJ	KEYED JOINT
WPJ	TROWELED WEAKENED PLANE JOINT
EJ	EXPANSION JOINT
TOTP	TURNOUT TANGENT POINT
TOEP	TURNOUT END POINT
THEO. PT.	CROSSING THEORETICAL POINT
POINTS	TOE OR TIP OF SWITCHRAIL
TOP	TOE OF POINTS
TOS	TOE OF SWITCH

2. SURVEY

1. THE EXISTING SITE CONDITIONS SHOWN ON THE FOLLOWING DRAWINGS HAVE BEEN DERIVED FROM SURVEY INFORMATION SUPPLIED BY ONTRACK SURVEY AND DESIGN.
2. SHOULD DISCREPANCIES BE ENCOUNTERED DURING CONSTRUCTION BETWEEN THE SURVEY DATA AND ACTUAL FIELD DATA, CONTACT THE DESIGN ENGINEER.
3. THE CONTRACTOR SHALL ARRANGE ALL SURVEY SETOUT TO BE CARRIED OUT BY A SURVEYOR, APPROVED BY JOHN HOLLAND RAIL.
4. BENCH MARK, SURVEY PEGS, LEVEL PEGS OR SUPPLEMENTARY REFERENCE MARKS SHALL NOT BE ADJUSTED OR MOVED WITHOUT WRITTEN APPROVAL FROM THE SUPERINTENDENT. THE CONTRACTOR SHALL TRANSFER ANY PEGS AFFECTED BY THE PROPOSED WORKS TO SIDE POSITIONS CLEAR OF OPERATIONS AND SHALL NOTE THE EXTENT OF THE MOVEMENT IN DISTANCE AND LEVEL.
5. VERTICAL DATUM IS AHD 71. HORIZONTAL DATUM IS MGA ZONE 55 BASED ON THE STATIC ADJUSTED CONTROL USING GPS AND CONTROL POINT COORDINATES.
6. EXISTING SURFACE LEVELS ARE APPROXIMATE.

3. EXISTING SERVICES AND FEATURES

1. THE CONTRACTOR MUST CONFIRM THE EXACT LOCATION AND EXTENT OF EXISTING SERVICES PRIOR TO CONSTRUCTION AND NOTIFY ANY CONFLICT WITH THE DRAWINGS IMMEDIATELY TO THE ENGINEER/SUPERINTENDENT.
2. EXISTING SERVICES, UNLESS SHOWN ON SURVEY PLAN, HAVE BEEN PLOTTED FROM DBYD SERVICES SEARCH PLANS AND, AS SUCH, THEIR ACCURACY CANNOT BE GUARANTEED.
3. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO COMPLETE A DYBD SEARCH AND TO ESTABLISH THE LOCATION AND LEVELS OF ALL EXISTING SERVICES PRIOR TO THE COMMENCEMENT OF ANY WORK. ANY DISCREPANCIES SHALL BE REPORTED TO THE ENGINEER/SUPERINTENDENT. CLEARANCES SHALL BE OBTAINED FROM THE RELEVANT SERVICE AUTHORITY. SEARCH RESULTS ARE TO BE KEPT ON SITE AT ALL TIMES.
4. THE CONTRACTOR HAS A DUTY OF CARE WHEN EXCAVATING NEAR SERVICES. DO NOT ASSUME DEPTHS OR ALIGNMENTS OF CABLES OR PLANT AS THESE MAY VARY SIGNIFICANTLY. THE CONTRACTOR MUST ACCEPT ALL RESPONSIBILITY FOR DAMAGE TO EXISTING SERVICES AS SERVICE AUTHORITIES MAY SEEK COMPENSATION FOR DAMAGE CAUSED TO THEIR PROPERTY AND SUBSEQUENT LOSSES.
5. THE CONTRACTOR SHALL ALLOW FOR THE PROTECTION, EXCAVATION AND REMOVAL OR RELOCATION (IF REQUIRED) TO RELEVANT AUTHORITIES GUIDELINES OF ALL EXISTING SERVICES IN AREAS AFFECTED BY WORKS WITHIN THE WORK AREA OR AS SHOWN ON THE DRAWINGS UNLESS DIRECTED OTHERWISE BY THE ENGINEER/SUPERINTENDENT.
6. INTERRUPTION TO SUPPLY OF EXISTING SERVICES SHALL BE DONE SO AS NOT TO CAUSE ANY INCONVENIENCE TO RAIL TRAFFIC. CONTRACTOR TO GAIN APPROVAL FROM JOHN HOLLAND RAIL FOR TIME OF INTERRUPTION.
7. IF EXISTING SERVICE UTILITY COVERS AND GRATES OR SURROUNDING SURFACE LEVELS ARE TO BE LOWERED, THE CONTRACTOR IS TO MAKE CERTAIN THAT MINIMUM COVERS (IN ACCORDANCE WITH RELEVANT SERVICE AUTHORITY GUIDELINES) TO SERVICES ARE MAINTAINED. IF MINIMUM COVERS AREN'T MAINTAINED, THE CONTRACTOR IS TO LOWER OR PROTECT SERVICES TO THE SATISFACTION OF THE RELEVANT SERVICE AUTHORITY/SUPERINTENDENT.

4. SEDIMENT AND EROSION CONTROL

1. EROSION AND SEDIMENT CONTROL IS THE RESPONSIBILITY OF THE CONTRACTOR.
2. ALL SEDIMENT TRAPPING STRUCTURES AND DEVICES ARE TO BE INSPECTED AFTER STORMS FOR STRUCTURAL DAMAGE OR CLOGGING. DAMAGED SEDIMENT TRAPPING STRUCTURES ARE TO BE REPAIRED AND ANY TRAPPED MATERIAL IS TO BE REMOVED TO AN APPROPRIATE LOCATION.
3. ALL TOPSOIL IS TO BE STOCKPILED ON SITE (AWAY FROM TREES AND DRAINAGE LINES) AS ADVISED BY JHR AND IN ACCORDANCE WITH RELEVANT GUIDELINES. MEASURES SHALL BE APPLIED TO PREVENT EROSION OF THE STOCKPILES.
4. ALL EARTHWORK AREAS SHALL BE ROLLED EACH EVENING TO SEAL THE EARTHWORKS. DUST SUPPRESSION SHALL BE CARRIED OUT IN ACCORDANCE WITH RELEVANT GUIDELINES.
5. UPON COMPLETION OF ALL EARTHWORKS OR AS DIRECTED BY RELEVANT AUTHORITY, SOIL CONSERVATION TREATMENTS SHALL BE APPLIED SO AS TO RENDER AREAS THAT HAVE BEEN DISTURBED EROSION PROOF WITHIN 14 DAYS.
6. EROSION AND SILT PROTECTION MEASURES ARE TO BE MAINTAINED AT ALL TIMES.
7. ALL VEHICLES LEAVING THE SITE SHALL BE CLEANED AND INSPECTED BEFORE LEAVING SITE TO LIMIT SEDIMENT TRACKING TO ROADWAYS.

5. RAIL FORMATION AND EARTHWORKS

1. REFER TO 'EXISTING SERVICES AND FEATURES' NOTES BEFORE COMMENCING BULK EARTHWORKS.
2. TECHNICAL SPECIFICATIONS OR SPECIFIC INSTRUCTIONS CONTAINED IN THE GEOTECHNICAL REPORT TAKE PRECEDENCE OVER THESE NOTES.
3. ALL TOPSOIL, ORGANIC MATTER AND FILL MATERIAL SHALL BE REMOVED FROM ALL AREAS UNDER PROPOSED WORK LOCATIONS TO A DEPTH OF 100 mm AND TO THE SATISFACTION OF THE GEOTECHNICAL ENGINEER. AREAS TO BE FULLY STRIPPED OF DARK BROWN UPPER ORGANIC ALLUVIUM.
4. CONTRACTOR SHALL PLACE SAFETY BARRIERS AROUND EXCAVATIONS IN ACCORDANCE WITH JOHN HOLLAND RAIL SAFETY REGULATIONS.
5. REFER AS.3798 AND JOHN HOLLAND RAIL SPECIFICATIONS FOR BULK EARTHWORKS TESTING REQUIREMENTS.
6. ALL GENERAL BACKFILL TO BE COMPACTED TO NOT LESS THAN 95% OF THE STANDARD MAX. DRY DENSITY TO AS.1289 IN MAXIMUM 150mm LAYERS, U.N.O.
7. ANY EXCAVATION THAT IS 3.0m FROM THE NEAREST RAIL OF THE EXISTING OPERATING TRACK THAT HAS A SLOPE GREATER THAN 1 IN 1 IS TO BE SHORED IN A MANNER APPROVED BY JOHN HOLLAND RAIL.
8. AT NO TIME IS EXCAVATION ADJACENT TO EXISTING TRACK TO BE CLOSER THAN 3.0m FROM THE NEAREST EXISTING RAIL WITHOUT TRACK POSSESSION.
9. ANY EXCAVATION WITHIN 3.0m OF THE NEAREST RAIL OF THE EXISTING OPERATING TRACK, WHICH EXCEEDS 300mm DEPTH BELOW FORMATION LEVEL SHALL BE BACKFILLED THE SAME DAY AND NOT REMAIN AS AN OPEN EXCAVATION OVERNIGHT. THE CONTRACTOR'S WORK METHOD AND PROGRAMMING SHALL FULLY COMPLY WITH THIS REQUIREMENT.
10. ITP'S ARE TO BE COMPLETED BY THE CONTRACTOR AND RECEIVED BY THE DESIGN ENGINEER AND JOHN HOLLAND RAIL.

RAIL FORMATION AND EARTHWORKS (cont.)

11. EXISTING STRUCTURES TO BE ABANDONED WITHIN 3.0m FROM THE NEAREST RAIL OF A NEW OR EXISTING OPERATIONAL TRACK ARE TO BE DEMOLISHED BELOW FORMATION TO A DEPTH APPROVED BY JOHN HOLLAND RAIL.
12. CONSTRUCTION OF EARTHWORKS TO BE IN ACCORDANCE WITH JOHN HOLLAND RAIL SPECIFICATIONS PARTICULARLY NOTING CRN CM 411.
13. THE CAPPING LAYER SHALL BE SPREAD IN UNIFORM LAYERS TO ACHIEVE THE SPECIFIED COMPACTED THICKNESS FOR THE FULL WIDTH OF THE CAPPING LAYER. THE METHOD EMPLOYED SHALL ENSURE THERE IS NO RUTTING, THE COMPACTED LAYER IS NOT DISTURBED AND SEGREGATION DOES NOT OCCUR.
14. COMPACTION OF CAPPING LAYER SHALL ACHIEVE THE MINIMUM RELATIVE COMPACTION OF 95% MAXIMUM DRY DENSITY OBTAINED BY AS.1289 5.2.1 AND WITH 9Kg SURCHARGE AS DETAILED IN CRN CP 411 TABLE 12.
15. THE CAPPING MATERIAL SHALL BE WELL MIXED THROUGHOUT THE LAYER SO THAT ALL VOIDS ARE FILLED. THE TOP OF THE FINAL LAYER SHALL BE GRADED AND TRIMMED AS NECESSARY.
16. CAPPING AND PAVEMENT DESIGN HAS BEEN COMPLETED BY GOLDER ASSOCIATES.
17. BULK EARTHWORK MATERIALS ARE TO CONFORM WITH EARTHWORKS MATERIALS SPECIFICATIONS - CRN CP 411
18. CAPPING LAYER MATERIALS ARE TO CONFORM WITH THE REQUIREMENTS OF JOHN HOLLAND RAIL AND IN ACCORDANCE WITH EARTHWORKS MATERIALS SPECIFICATIONS - CRN CP 411
19. STRUCTURAL ZONE MATERIALS ARE TO CONFORM WITH THE REQUIREMENTS OF JOHN HOLLAND RAIL AND BE IN ACCORDANCE WITH EARTHWORKS MATERIALS SPECIFICATION (CRN CP 411).
20. COMPACTION OF STRUCTURAL ZONE TO ACHIEVE MINIMUM OF 95% MAXIMUM DRY DENSITY AS DETERMINED BY AS.1289 AS PER CRN CP411
21. GENERAL FILL LAYER MATERIALS TO CONFORM EARTHWORKS MATERIALS SPECIFICATION - CRN CP 411
22. ALL PLACEMENT AND COMPACTION OF RAIL FORMATION MATERIALS ARE TO CONFORM WITH EARTHWORKS MATERIALS SPECIFICATIONS - CRN CP 411
23. BATTERS ARE AS INDICATED ON THE TYPICAL SECTION DRAWINGS.
24. THE CONTRACTOR IS REQUIRED TO MAINTAIN THE SURFACE AND DRAINAGE OF ROADS IN A SOUND AND STABLE CONDITION DURING THE COURSE OF THE WORKS.

6. TRACK STRUCTURE

1. RAIL SETOUT DETAILS ARE LISTED ON THE PLAN DRAWINGS.
2. RAIL TYPE: 47kg/m CWR

   SLEEPER TYPE: STEEL SLEEPER M8.5
   130mm FFU SLEEPERS

   SLEEPER SPACING: 600mm ± 20mm

   FASTENING SYSTEM: 2 X TRAK-LOK INSULATED FASTENERS WITH LOCK IN SHOULDERS PER SLEEPER. FFU FASTENING SYSTEM IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.
3. BALLAST: BALLAST MATERIAL SHALL COMPLY WITH THE REQUIREMENTS SET OUT IN CRN CP 241
   60mm ENHANCED GRADE BALLAST
4. CAPPING: 150mm ≥CBR 50%

7. STORMWATER DRAINAGE

1. THE STORMWATER DESIGN SHOWN ON THESE DRAWINGS HAS BEEN CARRIED OUT IN ACCORDANCE WITH JOHN HOLLAND RAIL REQUIREMENTS, AUSTRALIAN RAINFALL AND RUNOFF (AR&R) GUIDELINES AND RELEVANT AUTHORITIES' GUIDELINES.
2. PROTECTION OF PIPES EXPOSED TO LOADS EXCEEDING THE W7 WHEEL LOAD OF 70kN SHALL BE THE CONTRACTOR'S RESPONSIBILITY. DAMAGE TO PIPES DUE TO CONSTRUCTION LOADING IS THE CONTRACTORS RESPONSIBILITY.
3. EXISTING STORMWATER PIPE LOCATIONS AND INVERT LEVELS TO BE CONFIRMED PRIOR TO COMMENCEMENT OF CONSTRUCTION.
4. BEDDING TYPE SHALL BE H2 IN ACCORDANCE WITH AS 3725.
5. CARE IS TO BE TAKEN WITH LEVELS OF STORMWATER LINES. GRADES SHOWN ARE NOT TO BE REDUCED WITHOUT PRIOR WRITTEN APPROVAL FROM THE DESIGN ENGINEER.
6. ALL EXISTING STORMWATER DRAINAGE LINES AND PITS THAT ARE TO REMAIN ARE TO BE INSPECTED AND CLEANED. DURING THIS PROCESS ANY PART OF THE STORMWATER DRAINAGE SYSTEM THAT WARRANTS REPAIR SHALL BE REPORTED TO THE SUPERINTENDENT AND ENGINEER FOR FURTHER DIRECTIONS.
7. THE CONTRACTOR IS TO CONFIRM THE LOCATION OF SERVICE CONDUITS WITH THE SUPERINTENDENT PRIOR TO LAYING STORMWATER DRAINAGE. ALL TRENCH EXCAVATION AND CONSTRUCTION SHALL COMPLY WITH THE REQUIREMENTS OF THE NEW SOUTH WALES WORKPLACE AND HEALTH AND SAFETY ACT.

Design accepted for use by JHR-CRN*

SIGNATURE

TITLE

DATE

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REV	BY	DATE	DESCRIPTION	APPD.
0	S.O'B	14.07.17	ISSUED FOR CONSTRUCTION	B.K.

A1 Original | *Co-ordinate System: MGA Zone 50* | *Height Datum: A.H.D.* | Scale: NTS

NSW GOVERNMENT Transport for NSW

John Holland | COUNTRY REGIONAL NETWORK

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PROJECT No. S15066

DRAWN J.B.
DRG CHECK S.W.
DESIGNED S.W.
DESIGN CHECK B.K.
APPROVED

TARAGO LOOP EXTENSION
261.280km - 263.100km
GENERAL NOTES

FILE No. S15066-DRG-C-1002	SHEET: 1 OF 1	A1
STATUS: FOR CONSTRUCTION	AWP PROJECT No. 1617-341	©
DRG No. CC000162-C-1002 0	EDMS No.	

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CONTROL LINE (MC01) - PROPOSED LOOP									
PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING	RAD/SPIRAL	A.LENGTH	DEFL.ANGLE	DESCRIPTION
IP 1	261865.490	742076.763	6116532.535	689.626	197°03'38.00"				T.O.P. TURNOUT 1
IP 2	261875.644	742073.784	6116522.828	689.576		R = 803.610	20.307	1°26'52.30"	
IP 3	261885.797	742070.561	6116513.199	689.525					K POINT TURNOUT 1
TC	261919.243	742057.348	6116482.473	689.358	203°16'06.96"				
IP 4	261948.707	742045.687	6116455.357	689.210		R = 400.000	58.928	8°26'27.07"	
CT	261978.171	742030.173	6116430.245	689.063	211°42'34.02"				
TC	262328.516	741846.027	6116132.199	687.915	211°42'34.02"				
IP 5	262347.386	741836.101	6116116.133	687.897		R = -400.000	37.741	5°24'21.57"	
CT	262366.257	741827.733	6116099.204	687.878	206°18'12.45"				
TC	262416.717	741805.373	6116053.968	687.848	206°18'12.45"				
IP 6	262435.857	741796.885	6116036.797	687.865		R = 400.000	38.281	5°28'59.83"	
CT	262454.998	741786.795	6116020.515	687.901	211°47'12.29"				
TC	262939.662	741531.493	6115608.543	688.992	211°47'12.29"				
IP 7	262955.637	741523.071	6115594.951	689.054		R = -300.000	31.949	6°06'06.45"	
CT	262971.611	741516.141	6115580.542	689.131	205°41'05.84"				
IP 8	262995.766	741505.671	6115558.774	689.210	205°41'05.84"				

CONTROL LINE (MX01) SETOUT - EXISTING MAINLINE												
PT	KILOMETRAGE	EASTING	NORTHING	HEIGHT	BEARING	RAD/SPIRAL	A.LENGTH	DEFL.ANGLE	L.TANGENT	S.TANGENT	L.TANGENT 2	S.TANGENT 2
IP 1	261280.000	742048.605	6117107.269	687.465	164°38'48.47"							
TS	261391.809	742078.209	6116999.450	688.325	164°38'48.47"							
SC	261431.809	742088.478	6116960.792	688.633	166°04'32.23"	L = 40.000			369.370	349.335	26.668	13.334
IP 2	261741.268	742176.006	6116643.262	690.202		R = 802.000	618.919	47°04'26.03"				
CS	262050.728	742002.546	6116363.265	688.700	210°17'30.74"	L = 40.000			369.370	349.335	26.668	13.334
ST	262090.728	741981.799	6116329.068	688.508	211°43'14.50"							
IP 3	263158.386	741420.447	6115420.895	689.746	211°43'14.50"							

NOTES

1. REUSE OF ELEMENTS SUBJECT TO JHR CRN CONDITION ASSESSMENT.
2. TURNOUT km REFERS TO THE TOE OF POINTS OF THE TURNOUT.
3. REFER SIGNALLING PLANS AND SFOS FOR OPERATIONAL STANDING ROOM.

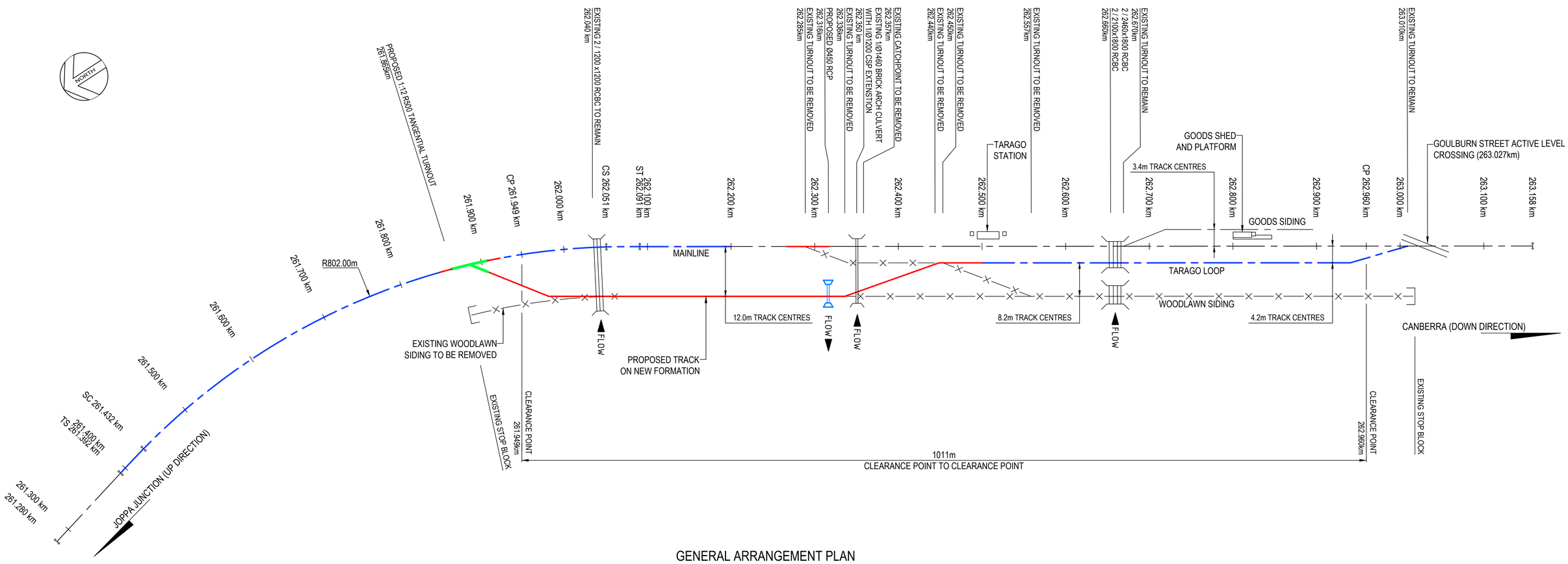
LEGEND

- PROPOSED TRACK
- PROPOSED TAMPED TRACK
- PROPOSED TURNOUT
- EXISTING TRACK
- EXISTING TRACK TO BE REMOVED
- EXISTING CULVERT
- PROPOSED CULVERT

TURNOUT DIAGRAM

1 IN 12 500 TANGENTIAL
N.T.S.

FOR DETAILED TURNOUT DIMENSIONS
REFER TO CRN CS 250



GENERAL ARRANGEMENT PLAN

N.T.S

Design accepted for use by JHR-CRN*

SIGNATURE

TITLE

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PROJECT No. S15066

BG&E

DRAWN J.B.
DRG CHECK S.W.
DESIGNED S.W.
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APPROVED

TARAGO LOOP EXTENSION

261.280km - 263.100km

GENERAL ARRANGEMENT PLAN

FILE No. S15066-DRG-C-1050	SHEET: 1 OF 1	A1
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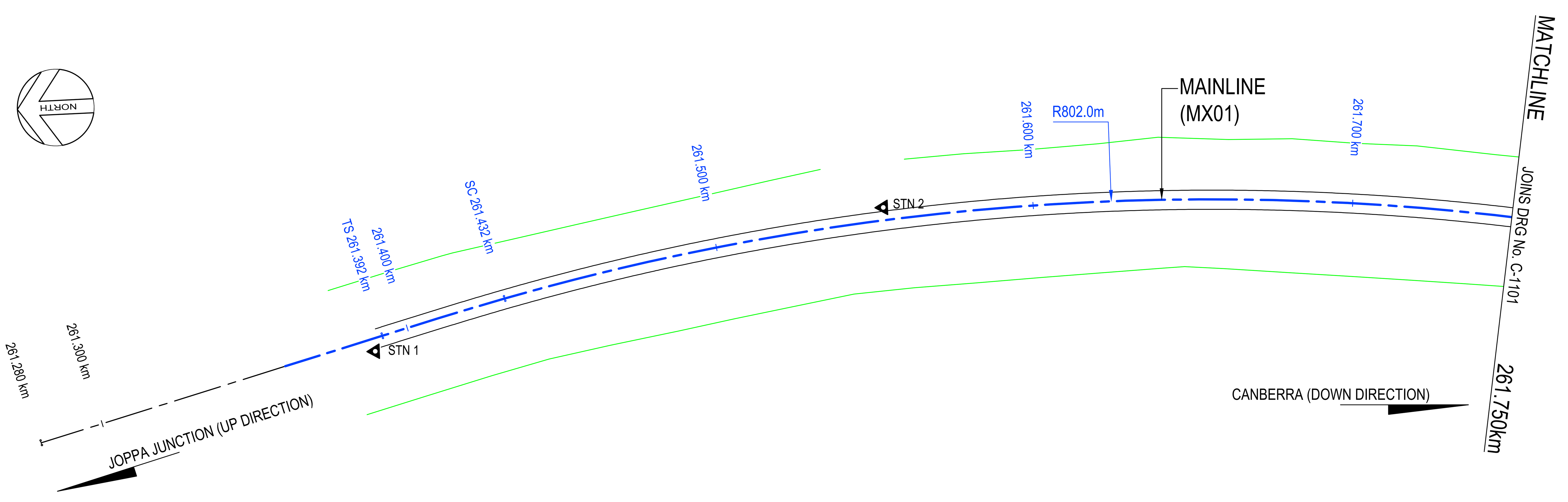
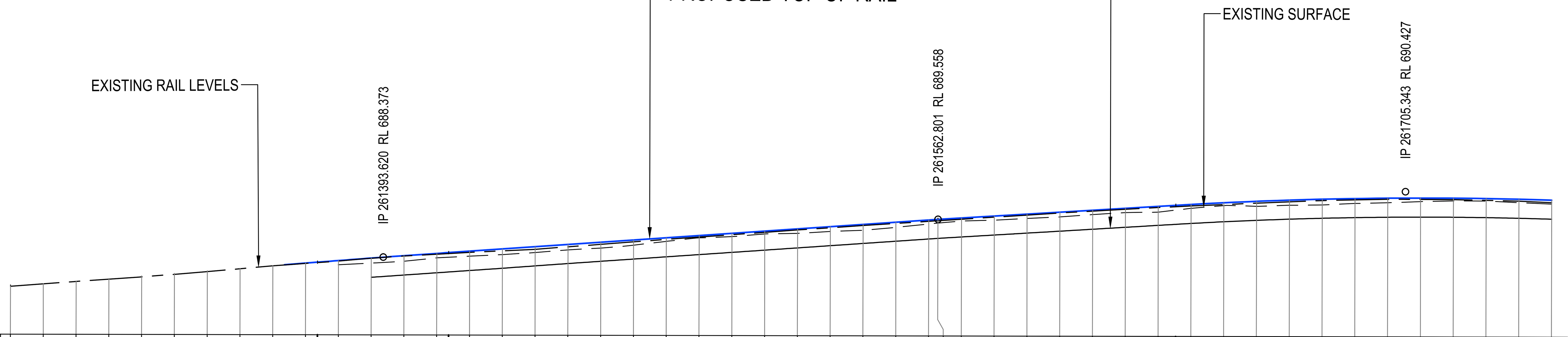


NOTES

1. REFER TO DRG No. C-1001 FOR DRAWING LIST.
2. REFER C-1300 - C-1301 FOR TYPICAL SECTIONS.
3. THIS DRAWING MUST BE READ IN CONJUNCTION WITH ALL RELEVANT CONTRACTS, SPECIFICATIONS AND DRAWINGS.
4. TURNOUT km REFERS TO TOE OF POINTS OF THE TURNOUT.
5. REUSE OF TURNOUTS, RAIL, SLEEPERS AND OTHER MATERIALS IS SUBJECT TO JHR CRN CONDITION ASSESSMENT.
6. REFER DETAIL 1 ON C-1350 FOR SCOUR PROTECTION REQUIREMENTS AT ALL PROPOSED CULVERT EXTENSIONS AND REPLACEMENTS.
7. LEVEL AND EXTENT OF TAMP SUBJECT TO APPROVAL BY SUPERINTENDENT.

LEGEND

- PROPOSED TRACK
- TAMPED TRACK
- PROPOSED CESS DRAIN
- PROPOSED CULVERT
- PROPOSED TURNOUT
- EXISTING TRACK
- EXISTING TRACK TO BE REMOVED
- EXISTING PROPERTY BOUNDARY (GIS)
- EXISTING OVERHEAD POWER LINES (OH)
- EXISTING ROAD/ACCESS TRACK
- EXISTING CULVERT
- EXISTING BENCHMARK



DATUM 686.0

GRADES: 1 in 125.691 (L =93.6210m) | V.C.40.00m (R =40002.2533) | 1 in 142.257 (L =149.1811m) | 1 in 211.094 (L =72.5421m) | V.C.140.00m (R =12612.7459)

HORIZ. CURVES: 40m | R802 618.92m

CHAINAGE	RAIL LIFT OR LOWER	EXISTING RAIL LEVELS	PROPOSED RAIL LEVELS	TOP OF CAPPING LEVELS	NATURAL SURFACE LEVELS	SUPERELEVATION
261280	0.000	687.465	687.465			
261290	0.000	687.538	687.538			
261300	0.000	687.612	687.612			
261310	0.000	687.682	687.682			
261320	0.000	687.754	687.754			
261330	0.000	687.835	687.835			
261340	0.000	687.918	687.918			
261350	0.000	688.009	688.009			
261360	0.004	688.101	688.104			
261370	0.011	688.174	688.184			
261380	0.017	688.247	688.264		688.138	0.000
261390	0.005	688.336	688.341		688.188	
261400	0.009	688.406	688.416		688.247	
261410	0.024	688.464	688.488		688.353	
261420	0.037	688.521	688.558		688.406	
261430	0.057	688.571	688.628		688.456	0.050
261440	0.078	688.621	688.698		688.520	
261450	0.071	688.697	688.768		688.603	
261460	0.064	688.774	688.838		688.661	
261470	0.056	688.852	688.908		688.752	
261480	0.048	688.930	688.978		688.870	
261490	0.044	689.004	689.048		688.978	
261500	0.041	689.077	689.118		689.018	
261510	0.037	689.151	689.188		689.100	
261520	0.033	689.225	689.258		689.120	
261530	0.033	689.295	689.328		689.181	
261540	0.034	689.364	689.398		689.220	
261550	0.038	689.430	689.468		689.311	
261560	0.042	689.496	689.538		689.417	
261562.801	0.043	689.515	689.558		689.444	
261570	0.040	689.562	689.602		689.506	
261580	0.035	689.628	689.663		689.537	
261590	0.031	689.693	689.724		689.590	
261600	0.026	689.758	689.785		689.639	
261610	0.028	689.818	689.846		689.713	
261620	0.030	689.877	689.907		689.775	
261630	0.038	689.930	689.968		689.791	
261640	0.045	689.983	690.028		689.909	
261650	0.055	690.026	690.081		689.993	
261660	0.058	690.069	690.127		689.975	
261670	0.053	690.111	690.164		690.008	
261680	0.040	690.153	690.194		690.021	
261690	0.039	690.176	690.215		690.067	
261700	0.030	690.199	690.229		690.091	
261710	0.042	690.193	690.235		690.129	
261720	0.045	690.187	690.233		690.150	
261730	0.055	690.168	690.222		690.147	
261740	0.056	690.148	690.204		690.102	
261750	0.079	690.100	690.178		690.058	0.050

* NOTE: ALL RAIL LEVELS REFER TO THE LOW RAIL.

MAINLINE (MX01)

SCALE: H 1:1000
V 1:100

BENCHMARK SCHEDULE

Mark No.	Mark Type.	Easting	Northing	Reduced Level	Kilometrage	Offset->R.F.
TS 12066	-	748,763.459	6,150,683.941	656.957		
TS 12140	-	752,796.895	6,073,875.412	659.755		
STN 1	Picket	742,073.433	6,117,001.840	687.600	261388.343	3.244 Up Rl
STN 2	Picket	742,112.666	6,116,841.397	688.911	261 553.374	3.357 Dn Rl
STN 3	Picket	742,106.441	6,116,596.398	690.669	261 796.756	11.935 Dn Rl
STN 4	Picket	742,024.230	6,116,418.152	687.781	261 991.602	6.009 Up Rl
STN 5	B.T. 5090	741,905.054	6,116,194.294	688.801	262 245.472	4.832 Dn Rl
STN 6	Nail	741,772.681	6,116,008.577	687.936	262 473.379	8.654 Up Rl
STN 7	Picket	741,619.105	6,115,783.731	689.103	262 745.953	21.063 Up Rl
STN 8	Nail	741,486.077	6,115,536.343	689.222	263 026.536	4.132 Up Rl

NOTES
1. M.G.A. CO-ORDINATES ZONE 55 A.H.D.71

0 10 20 30 40 50 60m SCALE 1:2000 AT A3 SIZE
0 10 20 30 40 50 60m SCALE 1:1000 AT A1 SIZE

Design accepted* for use by JHR-CRN

SIGNATURE
TITLE
DATE

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REV	BY	DATE	DESCRIPTION	APPD.
0	S.O'B	14.07.17	ISSUED FOR CONSTRUCTION	B.K.

A1 Original | Co-ordinate System: MGA Zone 50 | Height Datum: A.H.D. | Scale: 1:1000H 1:100V

NSW GOVERNMENT Transport for NSW
John Holland
COUNTRY REGIONAL NETWORK

Brisbane Office—
74-76 Bowen St, Spring Hill QLD 4000
P / +61 7 3167 3300
E / info@bgeeng.com
bgeeng.com—
BG&E

PROJECT No. S15066

DRAWN J.B.
DRG CHECK S.W.
DESIGNED S.W.
DESIGN CHECK B.K.
APPROVED

TARAGO LOOP EXTENSION

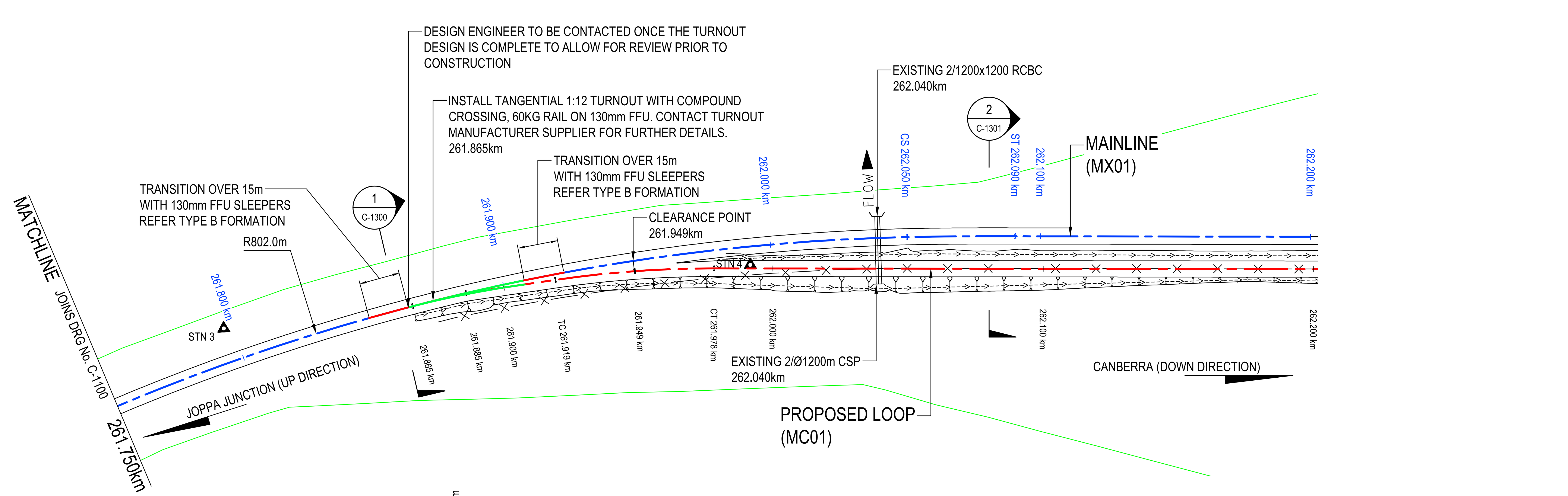
261.280km - 263.100km

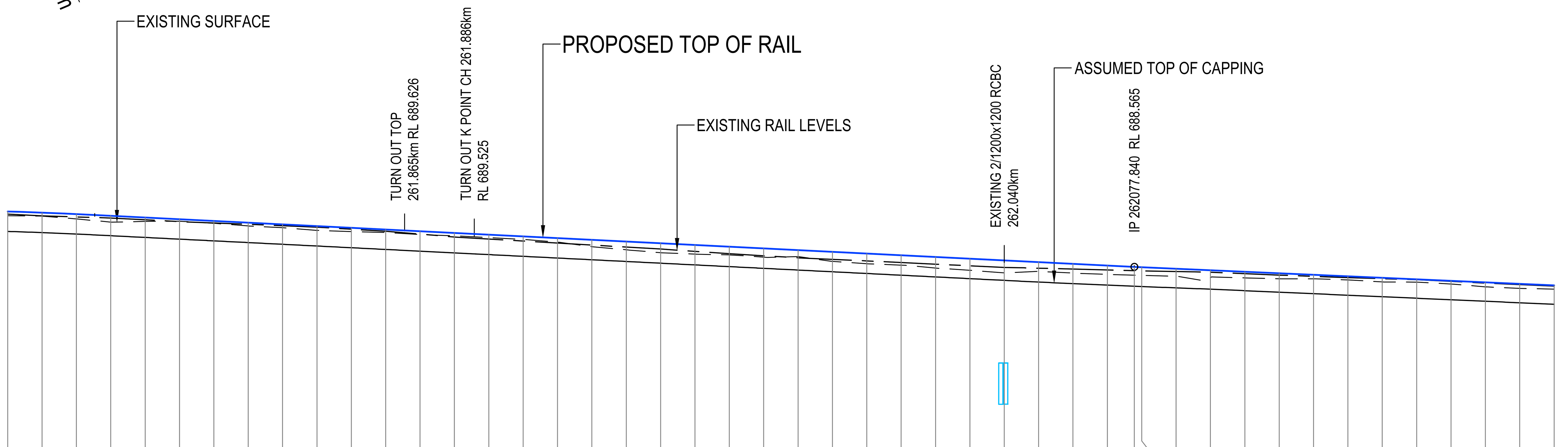
PLAN AND PROFILE (MX01)

261.280km - 261.750km

SHEET 1

FILE No. S15066-DRG-C-1100 | SHEET: 1 OF 2 | A1
STATUS: FOR CONSTRUCTION | AWP PROJECT No. 1617-341 | ©
DRG No. CC000162-C-1100 | 0 | EDMS No.





DATUM 683.0

GRADES: V.C.140.00m (R =12612.7459); 1 in -223.288 (L =302.4977m); 1 in -229.350 (L =171.8056m)

HORIZ. CURVES: R802 618.92m; 40m

CHAINAGE	RAIL LIFT OR LOWER	EXISTING RAIL LEVELS	PROPOSED RAIL LEVELS	TOP OF CAPPING LEVELS	NATURAL SURFACE LEVELS	SUPERELEVATION
261750	0.079	690.1	690.178		690.058	0.050
261760	0.093	690.051	690.145		690.045	
261770	0.083	690.02	690.103		689.962	
261780	0.065	689.989	690.054		689.871	
261790	0.068	689.936	690.004		689.892	
261800	0.070	689.884	689.954		689.895	
261810	0.060	689.844	689.904		689.835	
261820	0.049	689.805	689.854		689.759	
261830	0.040	689.764	689.804		689.707	
261840	0.030	689.724	689.754		689.629	
261850	0.041	689.663	689.704		689.596	
261860	0.052	689.602	689.654		689.568	
261870	0.084	689.52	689.604		689.508	
261880	0.117	689.437	689.554		689.472	
261890	0.126	689.378	689.504		689.417	
261900	0.134	689.32	689.454		689.367	
261910	0.144	689.26	689.404		689.287	
261920	0.153	689.201	689.354		689.154	
261930	0.160	689.144	689.304		689.065	
261940	0.168	689.086	689.254		688.978	
261950	0.186	689.018	689.204		688.938	
261960	0.205	688.949	689.154		688.915	
261970	0.214	688.89	689.104		688.850	
261980	0.224	688.83	689.054		688.864	
261990	0.218	688.786	689.004		688.726	
262000	0.213	688.741	688.954		688.658	
262010	0.211	688.693	688.904		688.617	
262020	0.210	688.644	688.854		688.533	
262030	0.206	688.598	688.804		688.467	
262040	0.203	688.551	688.754		688.392	
262050	0.176	688.528	688.704		688.433	0.050
262060	0.151	688.503	688.654		688.386	
262070	0.127	688.476	688.604		688.346	
262077.84	0.109	688.455	688.565		688.326	
262080	0.106	688.45	688.555		688.320	
262090	0.080	688.432	688.511		688.294	
262100	0.057	688.41	688.467		688.255	0.000
262110	0.054	688.369	688.423		688.244	
262120	0.052	688.327	688.379		688.219	
262130	0.045	688.29	688.335		688.218	
262140	0.039	688.253	688.291		688.186	
262150	0.025	688.223	688.247		688.129	
262160	0.010	688.193	688.203		688.123	
262170	0.015	688.144	688.159		688.067	
262180	0.020	688.095	688.115		687.984	
262190	0.020	688.051	688.071		687.941	
262200	0.020	688.007	688.027		687.919	

* NOTE: ALL RAIL LEVELS REFER TO THE LOW RAIL.

MAINLINE (MX01)

SCALE: H 1:1000
V 1:100

NOTES

1. REFER TO DRG No. C-1001 FOR DRAWING LIST.
2. REFER C-1300 - C-1301 FOR TYPICAL SECTIONS.
3. THIS DRAWING MUST BE READ IN CONJUNCTION WITH ALL RELEVANT CONTRACTS, SPECIFICATIONS AND DRAWINGS.
4. TURNOUT km REFERS TO TOE OF POINTS OF THE TURNOUT.
5. REUSE OF TURNOUTS, RAIL, SLEEPERS AND OTHER MATERIALS IS SUBJECT TO JHR CRN CONDITION ASSESSMENT.
6. REFER DETAIL 1 ON C-1350 FOR SCOUR PROTECTION REQUIREMENTS AT ALL PROPOSED CULVERT EXTENSIONS AND REPLACEMENTS.
7. LEVEL AND EXTENT OF TAMP SUBJECT TO APPROVAL BY SUPERINTENDENT.

LEGEND

- PROPOSED TRACK
- TAMPED TRACK
- PROPOSED CESS DRAIN
- PROPOSED CULVERT
- PROPOSED TURNOUT
- EXISTING TRACK
- EXISTING TRACK TO BE REMOVED
- EXISTING PROPERTY BOUNDARY (GIS)
- OH OH EXISTING OVERHEAD POWER LINES
- EXISTING ROAD/ACCESS TRACK
- EXISTING CULVERT
- EXISTING BENCHMARK

SCALE 1:2000 AT A3 SIZE (0 10 20 30 40 50 60m)
SCALE 1:1000 AT A1 SIZE (0 10 20 30 40 50 60m)

Design accepted for use by JHR-CRN*

SIGNATURE
TITLE
DATE

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REV	BY	DATE	DESCRIPTION	APPD.
0	S.O'B	14.07.17	ISSUED FOR CONSTRUCTION	B.K.

A1 Original | *Co-ordinate System: MGA Zone 50* | *Height Datum: A.H.D.* | Scale: 1:1000H 1:100V

NSW GOVERNMENT Transport for NSW
John Holland
COUNTRY REGIONAL NETWORK

Brisbane *Office*
74-76 Bowen St, Spring Hill QLD 4000
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E / info@bgeeng.com
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BG&E
PROJECT No. S15066

DRAWN J.B.
DRG CHECK S.W.
DESIGNED S.W.
DESIGN CHECK B.K.
APPROVED

TARAGO LOOP EXTENSION
261.280km - 263.100km
PLAN AND PROFILE (MX01)
261.750km - 262.150km
SHEET 2

FILE No. S15066-DRG-C-1101 | SHEET: 2 OF 2 | A1
STATUS: FOR CONSTRUCTION | AWP PROJECT No. 1617-341 | ©
DRG No. CC000162-C-1101 | 0 | EDMS No.

DeskSite No. 18159667 Rev 5 P:\BGE\S15\S15066\100 Drawings\102 Civil\AutoCAD\S15066-DRG-C-1100 To 1103 By: Adam Evans Plot Date: 14/07/2017 3:49 PM

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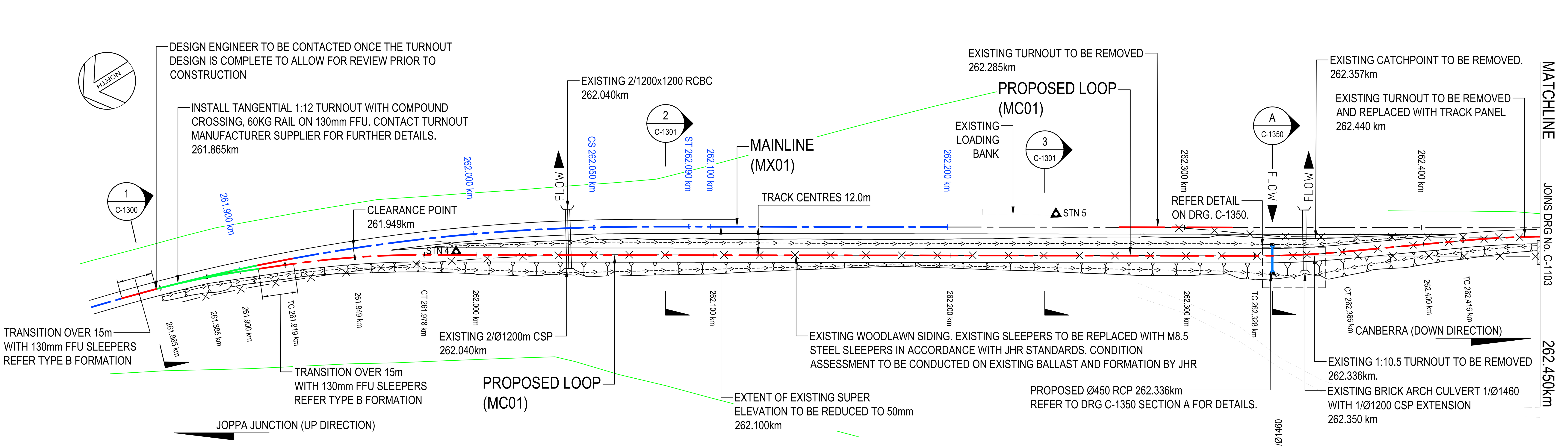
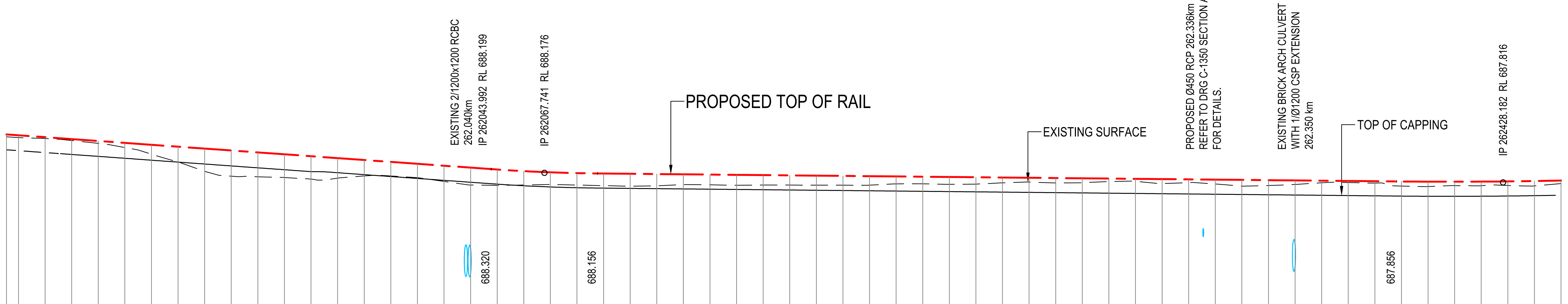


NOTES

1. REFER TO DRG No. C-1001 FOR DRAWING LIST.
2. REFER C-1300 - C-1301 FOR TYPICAL SECTIONS.
3. THIS DRAWING MUST BE READ IN CONJUNCTION WITH ALL RELEVANT CONTRACTS, SPECIFICATIONS AND DRAWINGS.
4. TURNOUT km REFERS TO TOE OF POINTS OF THE TURNOUT.
5. REUSE OF TURNOUTS, RAIL, SLEEPERS AND OTHER MATERIALS IS SUBJECT TO JHR CRN CONDITION ASSESSMENT.
6. REFER DETAIL 1 ON C-1350 FOR SCOUR PROTECTION REQUIREMENTS ON PROPOSED CULVERT EXTENSIONS AND REPLACEMENTS.
7. LEVEL AND EXTENT OF TAMP SUBJECT TO APPROVAL BY SUPERINTENDENT.

LEGEND

- PROPOSED TRACK
- TAMPED TRACK
- PROPOSED CESS DRAIN
- PROPOSED CULVERT
- PROPOSED TURNOUT
- EXISTING TRACK
- EXISTING TRACK TO BE REMOVED
- EXISTING PROPERTY BOUNDARY (GIS)
- EXISTING OVERHEAD POWER LINES
- EXISTING ROAD/ACCESS TRACK
- EXISTING CULVERT
- EXISTING BENCHMARK



DATUM 683.0

GRADES: 1 in -142.484 (L =182.2516m); V.C.40.00m (R =6482.1698); 1 in -1026.034 (L =300.4410m); V.C.80.00m (R =20000.0467)

HORIZ. CURVES: R803.61 20.31m; R400 58.93m; R-400 37.74m; R400 38.28m

CHAINAGE	RAIL LIFT OR LOWER	EXISTING RAIL LEVELS	PROPOSED RAIL LEVELS	TOP OF CAPPING LEVELS	NATURAL SURFACE LEVELS	SUPERELEVATION
261865.49			689.626	689.046	689.536	0.050
261870			689.594	689.014	689.508	
261880			689.522	688.942	689.472	
261890			689.451	688.871	689.394	
261900			689.379	688.799	689.290	
261910			689.307	688.727	689.132	
261920			689.236	688.656	688.880	
261930			689.164	688.584	688.591	
261940			689.092	688.512	688.239	
261950			689.020	688.440	688.053	0.050
261960			688.949	688.369	688.030	
261970			688.877	688.297	688.003	
261980			688.805	688.225	687.946	
261990			688.734	688.184	687.981	
262000			688.662	688.112	688.062	0.000
262010			688.590	688.040	688.061	
262020			688.519	687.969	688.000	
262030			688.447	687.897	687.856	
262040			688.375	687.825	687.721	
262050			688.304	687.754	687.707	
262060			688.243	687.693	687.722	
262070			688.198	687.648	687.743	
262080			688.169	687.619	687.719	
262090			688.154	687.604	687.698	
262100			688.144	687.594	687.677	
262110			688.134	687.584	687.690	
262120			688.124	687.574	687.735	
262130			688.114	687.564	687.730	
262140			688.104	687.554	687.712	
262150			688.094	687.544	687.719	
262160			688.084	687.534	687.721	
262170			688.074	687.524	687.714	
262180			688.064	687.514	687.714	
262190			688.054	687.504	687.716	
262200			688.044	687.494	687.765	
262210			688.034	687.484	687.766	
262220			688.024	687.474	687.747	
262230			688.014	687.464	687.754	
262240			688.004	687.454	687.803	TYPE A FORMATION
262250			687.994	687.444	687.832	
262260			687.984	687.434	687.800	
262270			687.974	687.424	687.809	
262280			687.964	687.414	687.848	
262290			687.954	687.404	687.861	
262300			687.944	687.394	687.776	
262310			687.934	687.384	687.811	
262320			687.924	687.374	687.758	
262330			687.914	687.364	687.680	
262340			687.904	687.354	687.701	
262350			687.894	687.344	687.742	
262360			687.884	687.334	687.803	
262370			687.874	687.324	687.813	
262380			687.864	687.314	687.794	
262390			687.854	687.304	687.681	
262400			687.847	687.297	687.662	
262410			687.846	687.296	687.698	
262420			687.849	687.299	687.695	
262430	0.031	687.826	687.858	687.308	687.703	
262440	0.056	687.815	687.871	687.321	687.688	
262450	0.070	687.819	687.889		687.774	

* NOTE: ALL RAIL LEVELS REFER TO THE LOW RAIL.

PROPOSED LOOP (MC01)

SCALE: H 1:1000
V 1:100

0 10 20 30 40 50 60m
SCALE 1:2000 AT A3 SIZE
0 10 20 30 40 50 60m
SCALE 1:1000 AT A1 SIZE

Design accepted* for use by JHR-CRN
SIGNATURE
TITLE
DATE
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REV	BY	DATE	DESCRIPTION	APPD.
0	S.O'B	14.07.17	ISSUED FOR CONSTRUCTION	B.K.

A1 Original | Co-ordinate System: MGA Zone 50 | Height Datum: A.H.D. | Scale: 1:1000H 1:100V

NSW GOVERNMENT | Transport for NSW
John Holland | COUNTRY REGIONAL NETWORK

Brisbane Office
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PROJECT No. S15066

BG&E

DRAWN J.B.
DRG CHECK S.W.
DESIGNED S.W.
DESIGN CHECK B.K.
APPROVED

TARAGO LOOP EXTENSION
261.280km - 263.100km
PLAN AND PROFILE (MC01)
261.850km - 262.450km
SHEET 1

FILE No. S15066-DRG-C-1102 | SHEET: 1 OF 2 | A1
STATUS: FOR CONSTRUCTION | AWP PROJECT No. 1617-341 | ©
DRG No. CC000162-C-1102 | 0 | EDMS No.

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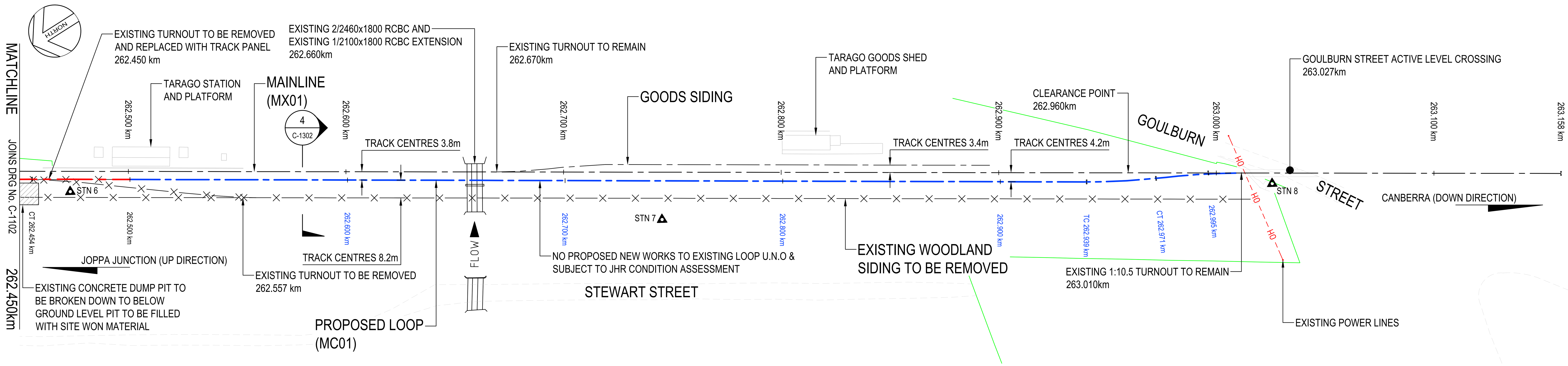

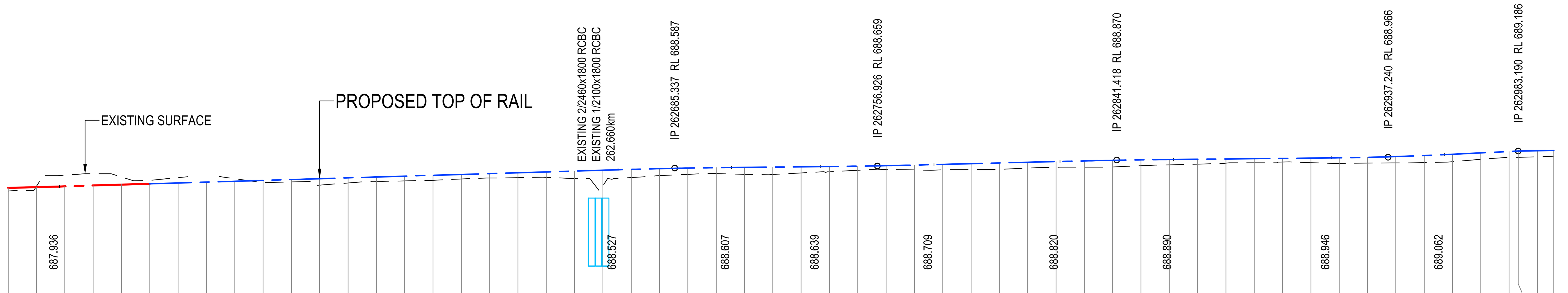

DATUM 684.0

GRADES: V.C.80.00m R =20000.0467 | 1 in 356.434 L =197.1553m | V.C.40.00m R =20000.0867 | 1 in 803.566 L =31.5885m | V.C.40.00m R =26666.7533 | 1 in 430.576 L =44.4921m | V.C.40.00m R =26666.7533 | 1 in 783.464 L =55.8219m | V.C.40.00m R =10535.4601 | 1 in 228.123 L =25.9502m | 1 in 522.636 L =12.5765m

HORIZ. CURVES: R400 38.28m | R-300 31.95m

CHAINAGE	RAIL LIFT OR LOWER	EXISTING RAIL LEVELS	PROPOSED RAIL LEVELS	TOP OF CAPPING LEVELS	NATURAL SURFACE LEVELS	SUPERELEVATION
262450	0.070	687.819	687.889		687.774	
262460	0.070	687.843	687.913		687.946	
262470	0.057	687.884	687.941		688.335	
262480	0.043	687.928	687.971		688.386	
262490	0.043	687.958	688.001		688.271	
262500	0.030	688.001	688.031		688.153	
262510	0.058	688.003	688.061		688.248	
262520	0.084	688.008	688.091			
262530	0.088	688.033	688.121		688.210	
262540	0.091	688.060	688.151		688.081	
262550	0.087	688.094	688.181		688.097	
262560	0.083	688.128	688.211		687.985	
262570	0.080	688.161	688.241		688.061	
262580	0.076	688.195	688.271		688.120	
262590	0.063	688.238	688.301		688.134	
262600	0.051	688.280	688.331		688.157	
262610	0.051	688.31	688.361		688.202	
262620	0.051	688.34	688.391		688.234	
262630	0.049	688.372	688.421		688.249	
262640	0.046	688.405	688.451		688.260	
262650	0.033	688.448	688.481		688.217	
262660	0.022	688.489	688.511		687.955	
262670	0.023	688.518	688.541		688.252	
262680	0.02	688.546	688.566		688.319	
262690	0.019	688.567	688.586		688.365	
262700	0.014	688.588	688.601		688.392	
262710	0.013	688.599	688.612		688.368	
262720	0.012	688.61	688.622		688.360	
262730	0.006	688.626	688.632		688.415	
262740	0.001	688.641	688.642		688.454	
262750	0.004	688.651	688.655		688.508	
262760	0.009	688.663	688.672		688.536	
262770	0.007	688.686	688.692		688.520	
262780	0.008	688.708	688.716		688.524	
262790	0.011	688.731	688.741		688.532	
262800	0.011	688.755	688.766		688.542	
262810	0.003	688.788	688.791		688.584	
262820	-0.003	688.82	688.816		688.616	
262830	0.003	688.837	688.840		688.620	
262840	0.008	688.852	688.860		688.627	
262850	0.026	688.85	688.876		688.669	
262860	0.038	688.851	688.889		688.701	
262870	0.030	688.868	688.899		688.728	
262880	0.023	688.886	688.909		688.760	
262890	0.016	688.903	688.919		688.773	
262900	0.010	688.919	688.929		688.800	
262910	0.009	688.929	688.939		688.779	
262920	0.010	688.938	688.949		688.753	
262930	0.025	688.942	688.966		688.761	
262940	0.045	688.948	688.993		688.767	
262950	0.055	688.975	689.030		688.779	
262960	0.062	689.013	689.075		688.812	
262970	0.026	689.097	689.123		688.896	
262980	-0.010	689.181	689.171		688.960	
262983.19	-0.009	689.195	689.186		688.967	
262990	0.019	689.181	689.199		688.984	
262995.766	0.000	689.21	689.210		689.005	

* NOTE: ALL RAIL LEVELS REFER TO THE LOW RAIL.

PROPOSED LOOP (MC01)

SCALE: H 1:1000
V 1:100

NOTES

1. REFER TO DRG No. C-1001 FOR DRAWING LIST.
2. REFER C-1300 - C-1301 FOR TYPICAL SECTIONS.
3. THIS DRAWING MUST BE READ IN CONJUNCTION WITH ALL RELEVANT CONTRACTS, SPECIFICATIONS AND DRAWINGS.
4. TURNOUT km REFERS TO TOE OF POINTS OF THE TURNOUT.
5. REUSE OF TURNOUTS, RAIL, SLEEPERS AND OTHER MATERIALS IS SUBJECT TO JHR CRN CONDITION ASSESSMENT.
6. REFER DETAIL 1 ON C-1350 FOR SCOUR PROTECTION REQUIREMENTS AT ALL PROPOSED CULVERT EXTENSIONS AND REPLACEMENTS.
7. LEVEL AND EXTENT OF TAMP SUBJECT TO APPROVAL BY SUPERINTENDENT.

LEGEND

- PROPOSED TRACK
- TAMPED TRACK
- PROPOSED CESS DRAIN
- PROPOSED CULVERT
- PROPOSED TURNOUT
- EXISTING TRACK
- EXISTING TRACK TO BE REMOVED
- EXISTING PROPERTY BOUNDARY (GIS)
- EXISTING OVERHEAD POWER LINES
- EXISTING ROAD/ACCESS TRACK
- EXISTING CULVERT
- EXISTING BENCHMARK

0 10 20 30 40 50 60m
SCALE 1:2000 AT A3 SIZE

0 10 20 30 40 50 60m
SCALE 1:1000 AT A1 SIZE

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TITLE

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REV	BY	DATE	DESCRIPTION	APPD.
0	S.O'B	14.07.17	ISSUED FOR CONSTRUCTION	B.K.

A1 Original | Co-ordinate System: MGA Zone 50 | Height Datum: A.H.D. | Scale: 1:1000H 1:100V

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PROJECT No. S15066

DRAWN J.B.
DRG CHECK S.W.
DESIGNED S.W.
DESIGN CHECK B.K.
APPROVED

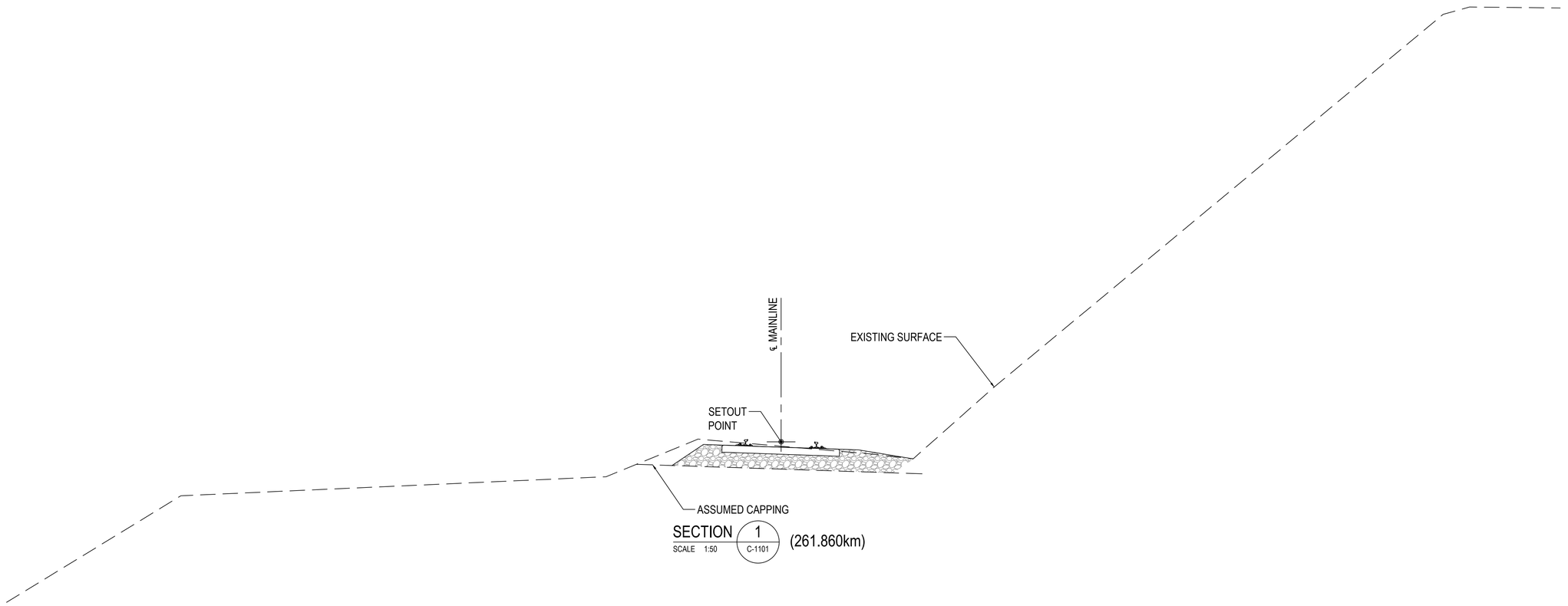
TARAGO LOOP EXTENSION

261.280km - 263.100km

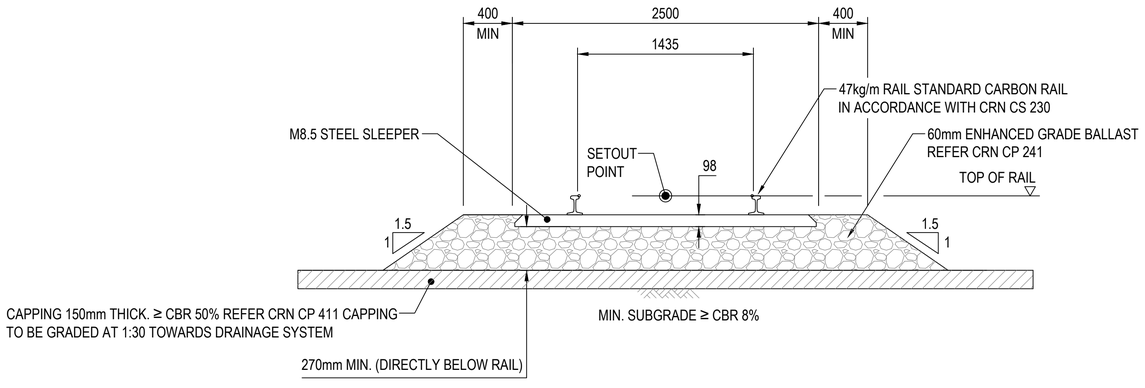
PLAN AND PROFILE (MC01)
262.450km - 263.100km
SHEET 2

FILE No. S15066-DRG-C-1103 | SHEET: 2 OF 2 | A1
STATUS: FOR CONSTRUCTION | AWP PROJECT No. 1617-341 | ©
DRG No. CC000162-C-1103 | 0 | EDMS No.

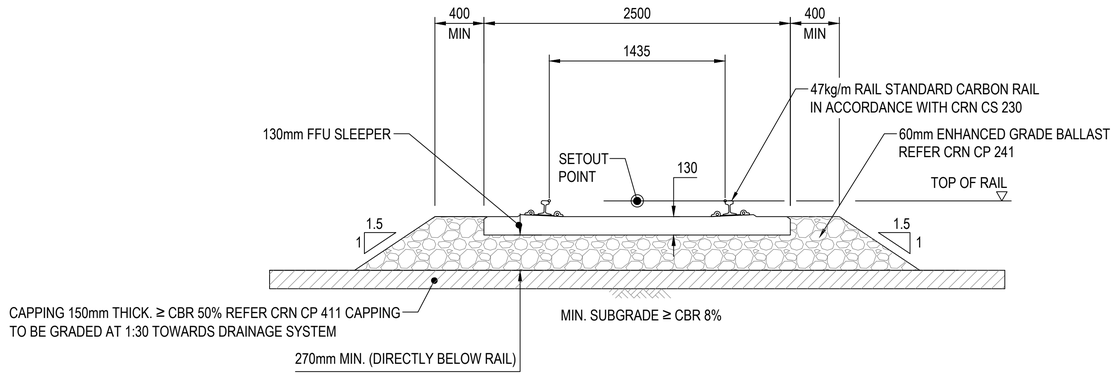
NOTE:
1. FOR GEOTECHNICAL REQUIREMENTS, REFER TO SECTION 5 OF GENERAL NOTES ON DRAWING C-1002.



SECTION 1 / C-1101 (261.860km)
SCALE 1:50



TYPICAL SECTION - TYPE A FORMATION - PROPOSED LOOP EXTENSION
SCALE N.T.S.



TYPICAL SECTION - TYPE B FORMATION - TRANSITION ZONES
SCALE N.T.S.

0 0.5 1.0 1.5 2.0 2.5 3.0m
SCALE 1:100 AT A3 SIZE
0 0.5 1.0 1.5 2.0 2.5 3.0m
SCALE 1:50 AT A1 SIZE

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A1 Original | Co-ordinate System: MGA Zone 50 | Height Datum: A.H.D. | Scale: 1:50

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PROJECT No. S15066

DRAWN J.B.
DRG CHECK S.W.
DESIGNED S.W.
DESIGN CHECK B.K.
APPROVED

TARAGO LOOP EXTENSION
261.280km - 263.100km
TYPICAL SECTION
SHEET 1

FILE No. S15066-DRG-C-1300		SHEET: 1 OF 3	A1
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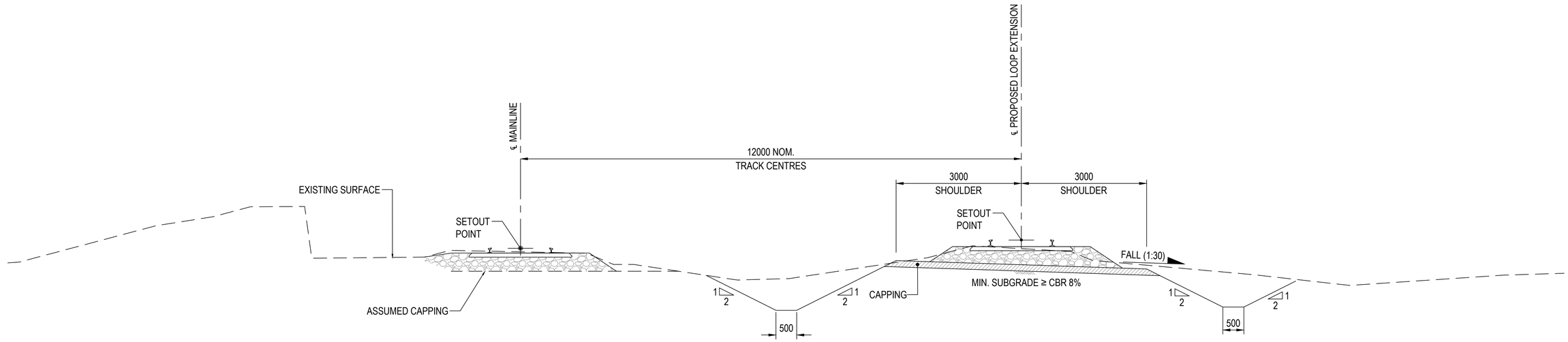
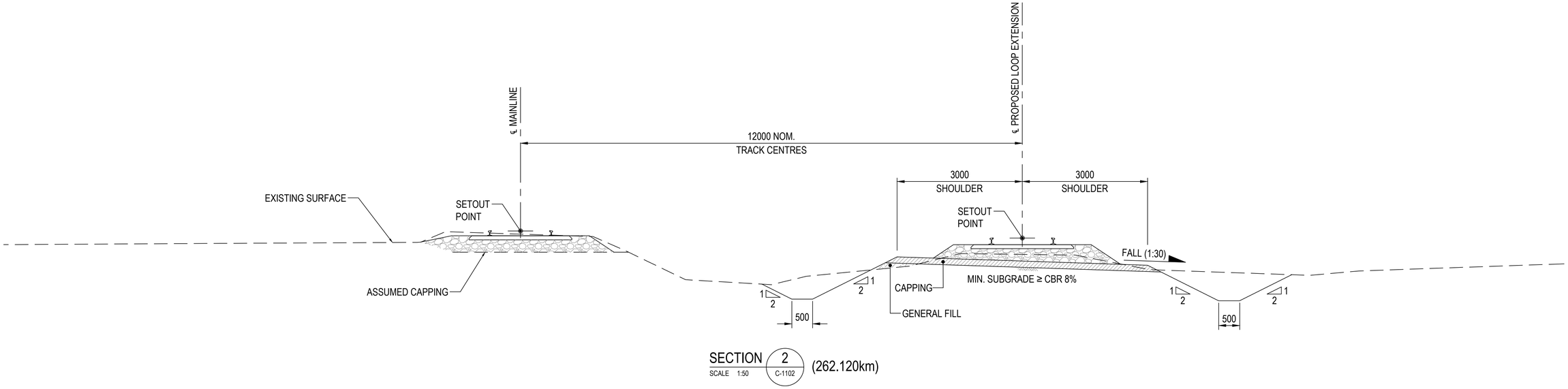
DRG No. CC000162-C-1300	0	EDMS No.	

DeskSite No. 18159067 Rev 5 P:\BGE\CVD\S15066\180 Drawings\182 Civil\Mu\nc\ADI\S15066-DRC-C-1300 To 1302 By: Adam Evans Plot Date: 14/7/2017 3:49 PM

NOTE:
1. FOR GEOTECHNICAL REQUIREMENTS, REFER TO SECTION 5 OF GENERAL NOTES ON DRAWING C-1002.



SECTION 3 (262.240km)
SCALE 1:50 C-1102



SECTION 2 (262.120km)
SCALE 1:50 C-1102

0 0.5 1.0 1.5 2.0 2.5 3.0m
SCALE 1:100 AT A3 SIZE
0 0.5 1.0 1.5 2.0 2.5 3.0m
SCALE 1:50 AT A1 SIZE

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A1 Original | Co-ordinate System: MGA Zone 50 | Height Datum: A.H.D. | Scale: 1:50

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DESIGNED S.W.
DESIGN CHECK B.K.
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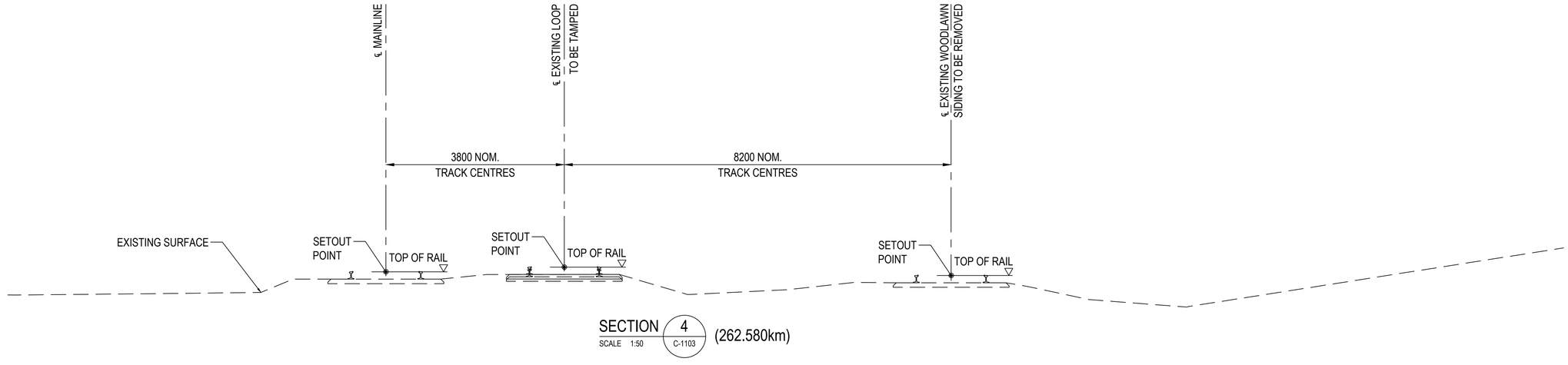
TARAGO LOOP EXTENSION
261.280km - 263.100km
TYPICAL SECTION
SHEET 2

FILE No. S15066-DRG-C-1301	SHEET: 2 OF 3	A1
STATUS: FOR CONSTRUCTION	AWP PROJECT No. 1617-341	©
DRG No. CC000162-C-1301 0	EDMS No.	

DeskSite No. 1615967 Rev 5 P:\BGE\S15\S15066\100 Drawings\102 Civil\AutoCAD\S15066-DRG-C-1302 To 1302 By: Adam Evans Plot Date: 14/7/2017 3:4:9 PM

NOTE:
1. FOR GEOTECHNICAL REQUIREMENTS, REFER TO SECTION 5 OF GENERAL NOTES ON DRAWING C-1002.



SECTION 4 / C-1103 (262.580km)
SCALE 1:50

0 0.5 1.0 1.5 2.0 2.5 3.0m
SCALE 1:100 AT A3 SIZE
0 0.5 1.0 1.5 2.0 2.5 3.0m
SCALE 1:50 AT A1 SIZE

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TITLE

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A1 Original | Co-ordinate System: MGA Zone 50 | Height Datum: A.H.D. | Scale: 1:50

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PROJECT No. S15066

DRAWN J.B.
DRG CHECK S.W.
DESIGNED S.W.
DESIGN CHECK B.K.
APPROVED

TARAGO LOOP EXTENSION
261.280km - 263.100km
TYPICAL SECTION
SHEET 3

FILE No. S15066-DRG-C-1302	SHEET: 3 OF 3	A1
STATUS: FOR CONSTRUCTION	AWP PROJECT No. 1617-341	©
DRG No. CC000162-C-1302 0	EDMS No.	

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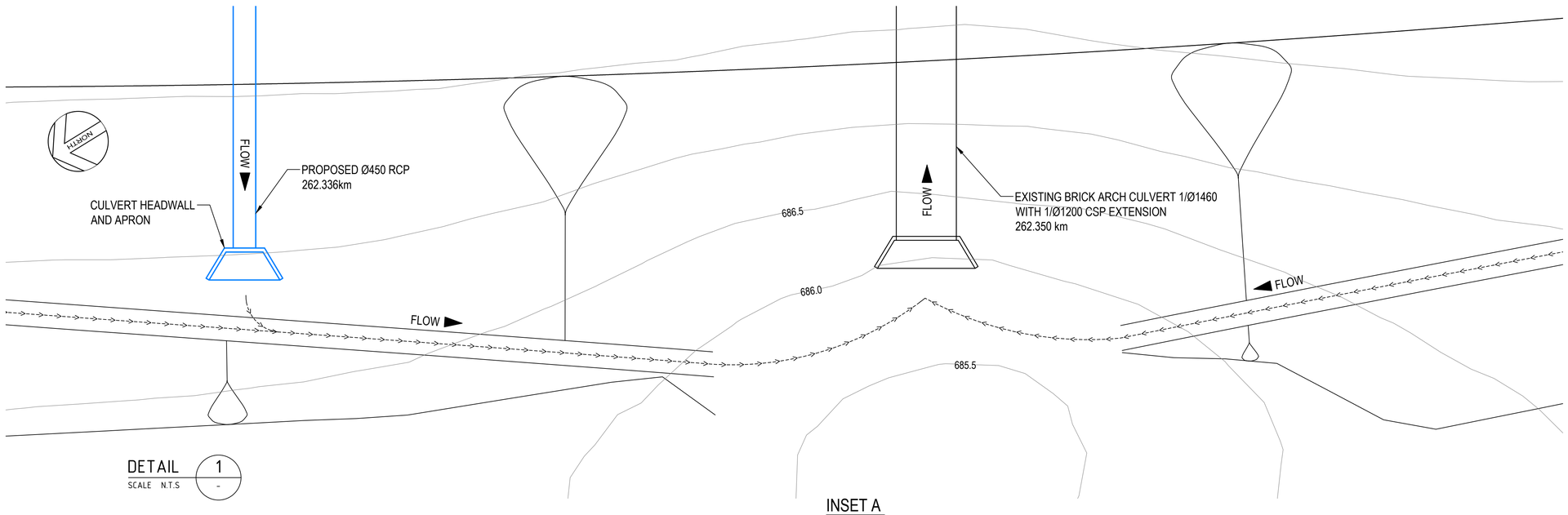
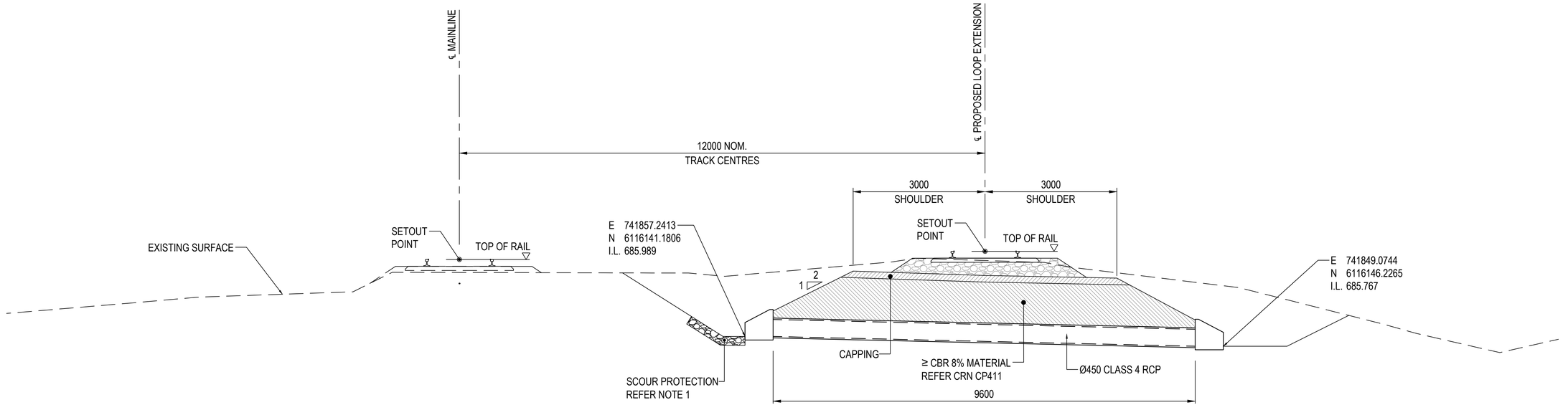


DETAIL 1
SCALE N.T.S

INSET A
SCALE 1:50

NOTE:
1. SCOUR PROTECTION, AS REQUIRED DESIGNED IN ACCORDANCE WITH CRN CM 301 - STRUCTURES GENERAL. THE DESIGN AND PROVISION OF SCOUR PROTECTION MAY BE ALTERED AT THE DISCRETION OF THE SUPERINTENDENT, REFER DETAIL 1.



CULVERT SECTION A (262.336km)
SCALE 1:50

0 0.5 1.0 1.5 2.0 2.5 3.0m
SCALE 1:100 AT A3 SIZE
0 0.5 1.0 1.5 2.0 2.5 3.0m
SCALE 1:50 AT A1 SIZE

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A1 Original | Co-ordinate System: MGA Zone 50 | Height Datum: A.H.D. | Scale: 1:50

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PROJECT No. S15066

DRAWN J.B.
DRG CHECK S.W.
DESIGNED S.W.
DESIGN CHECK B.K.
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TARAGO LOOP EXTENSION
261.280km - 263.100km
CULVERT DETAIL - SECTION A

FILE No. S15066-DRG-C-1350	SHEET: 1 OF 1	A1
STATUS: FOR CONSTRUCTION	AWP PROJECT No. 1617-341	©
DRG No. CC000162-C-1350 0	EDMS No.	

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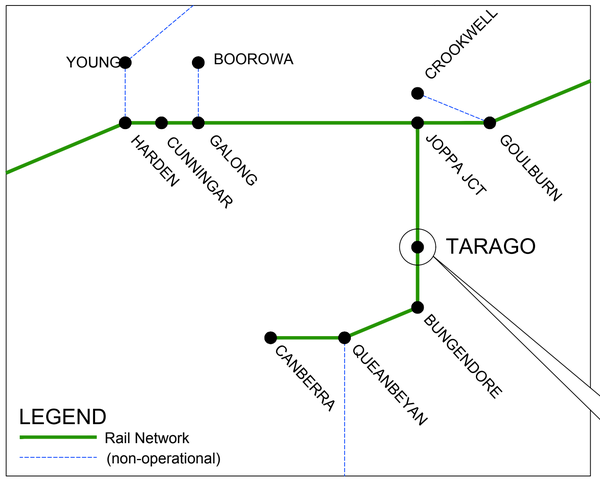
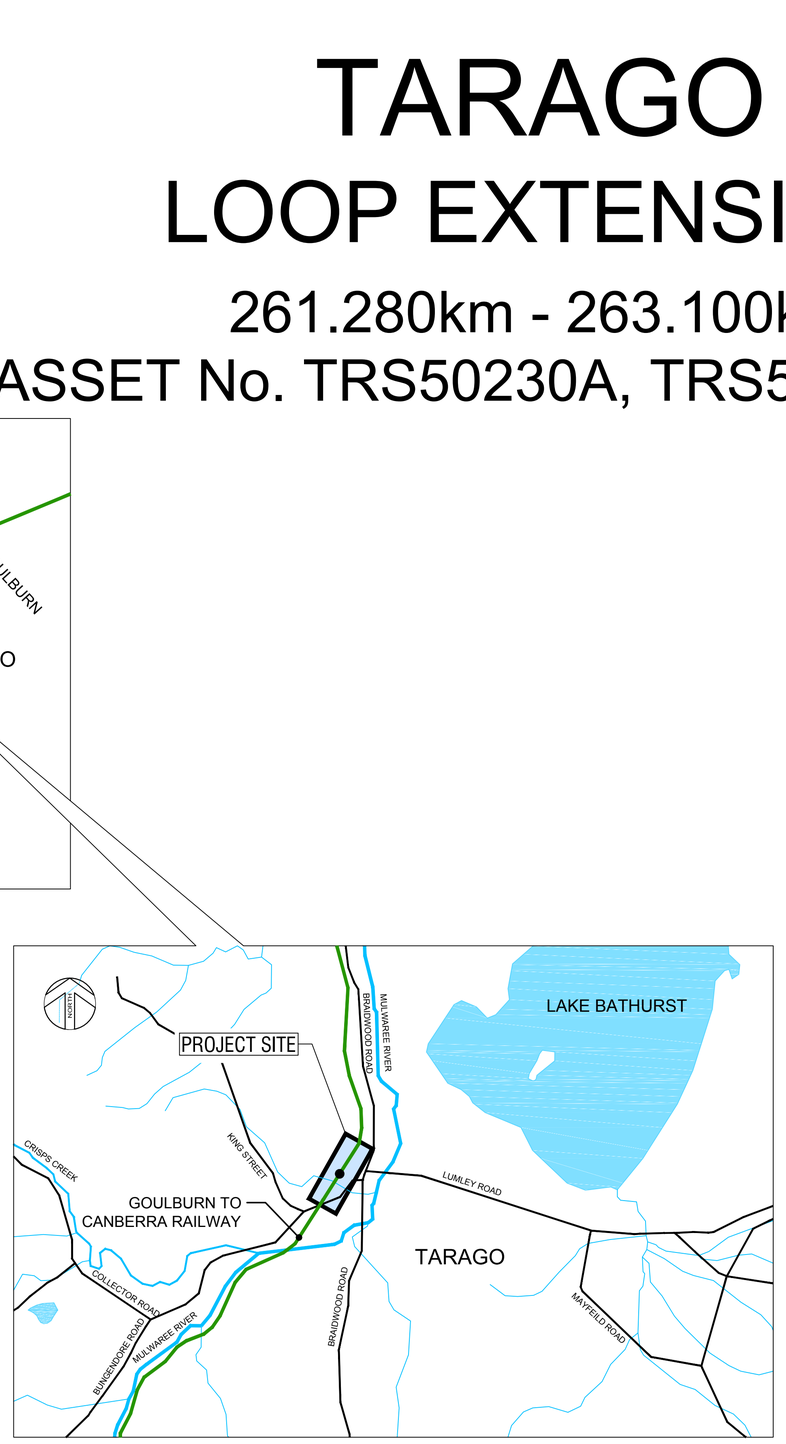
TARAGO
LOOP EXTENSION
261.280km - 263.100km
JHR CRN ASSET No. TRS50230A, TRS502626B, TRS50262A





TARAGO - OPTION 2	
DRAWING NUMBER	DRAWING TITLE
CC000162-C-2001	DRAWING INDEX AND LOCALITY PLAN
CC000162-C-2002	GENERAL NOTES
CC000162-C-2050	GENERAL ARRANGEMENT PLAN
CC000162-C-2100	PLAN AND PROFILE (MX01) 261.280km - 261.750km SHEET 1
CC000162-C-2101	PLAN AND PROFILE (MX01) 261.750km - 262.150km SHEET 2
CC000162-C-2102	PLAN AND PROFILE (MC11) 261.850km - 262.450km SHEET 1
CC000162-C-2103	PLAN AND PROFILE (MC11) 262.450km - 263.100km SHEET 2
CC000162-C-2300	TYPICAL SECTION SHEET 1
CC000162-C-2301	TYPICAL SECTION SHEET 2
CC000162-C-2302	TYPICAL SECTION SHEET 3
CC000162-C-2350	CULVERT DETAIL - SECTION A

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A1 Original | Co-ordinate System: MGA Zone 50 | Height Datum: A.H.D. | Scale: NTS

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PROJECT No. S15066

DRAWN J.B.
DRG CHECK S.W.
DESIGNED S.W.
DESIGN CHECK B.K.
APPROVED

TARAGO LOOP EXTENSION
261.280km - 263.100km
DRAWING INDEX AND LOCALITY PLAN

FILE No. S15066 | SHEET: 1 OF 1 | A1
STATUS: FOR CONSTRUCTION | AWP PROJECT No. 1617-341 | ©
DRG No. CC000162-C-2001 | 0 | EDMS No.

DeskSite No. 18159067 Rev 5 P:\BGE\CVD\S15066\180 Drawings\180_Civil\Mu\nc\401S15066-DRC-C-2001 By: Adam Evans Plot Date: 14/7/2017 3:50 PM

1. GENERAL

1. REFER TO ALL NOTES ON THESE DRAWINGS AND PREVIOUSLY MENTIONED DOCUMENTATION BEFORE BEGINNING CIVIL WORKS.
2. JOHN HOLLAND RAIL STANDARDS AND SPECIFICATIONS TAKE PRECEDENCE OVER ALL OTHER STANDARDS AND SPECIFICATIONS
3. TECHNICAL SPECIFICATIONS OR SPECIFIC INSTRUCTIONS ON DRAWINGS TAKE PRECEDENCE OVER THESE NOTES.
4. DO NOT DEPART FROM THE DESIGN UNLESS AUTHORISED IN WRITING BY THE DESIGN ENGINEER.
5. SPECIFICATIONS FROM JOHN HOLLAND RAIL SPECIFICALLY
   - CRN CP 201 - MEASURING GAUGES
   - CRN CP 202 - TRACK TOOLS
   - CRN CP 203 - TRACK DESIGN
   - CRN CP 204 - PRODUCT APPROVAL
   - CRN CP 205 - FIELD TESTING
   - CRN CP 206 - TRACK CONSTRUCTION
   - CRN CP 211 - SURVEY
   - CRN CP 212 - CONTRACT SURVEY
   - CRN CP 213 - TRACKSIDE SIGNS
   - CRN CP 221 - INSULATED JOINTS
   - CRN CP 222 - RAIL FLAW DETECTION
   - CRN CP 231 - TIMBER SLEEPERS AND BEARERS
   - CRN CP 232 - CONCRETE SLEEPERS
   - CRN CP 233 - STEEL SLEEPERS
   - CRN CP 237 - RESILIENT BASEPLATES
   - CRN CP 241 - BALLAST
   - CRN CP 251 - TURNOUTS
   - CRN CP 411 - EARTHWORKS MATERIALS
   - CRN CP 512 - WORKSITE DEMARCATION FENCES
5. THESE DRAWINGS SHALL BE READ IN CONJUNCTION WITH ALL OTHER CONSULTANT'S DRAWINGS AND SPECIFICATIONS AND WITH ANY OTHER WRITTEN INSTRUCTIONS THAT MAY BE ISSUED DURING THE COURSE OF THE CONTRACT. ANY DISCREPANCY SHALL BE REFERRED TO THE DESIGN ENGINEER BEFORE PROCEEDING WITH THE WORK. CONSTRUCTION FROM THESE DRAWINGS, AND THEIR ASSOCIATED CONSULTANT'S DRAWINGS, IS NOT TO COMMENCE UNTIL APPROVED BY THE RELEVANT AUTHORITIES.
6. JOHN HOLLAND RAIL OCCUPATIONAL HEALTH AND SAFETY PRACTICES MUST BE COMPLIED WITH.
7. ALL DIMENSIONS AND LEVELS SHOWN ON THE DRAWINGS SHALL BE VERIFIED BY THE CONTRACTOR ON SITE. CIVIL DRAWINGS SHALL NOT BE SCALED FOR DIMENSIONS. THE DESIGN ENGINEER SHALL BE NOTIFIED OF ANY DISCREPANCIES PRIOR TO CONSTRUCTION.
8. ALL DIMENSIONS ARE IN METRES (m) AND ALL LEVELS ARE IN METRES (m) TO AUSTRALIAN HEIGHT DATUM (AHD) U.N.O
9. IF THERE IS DOUBT REGARDING THE CIVIL DESIGN, CONTACT THE DESIGN ENGINEER FOR CLARIFICATION.
10. ALL ABBREVIATIONS ARE AS FOLLOWS:

EGL	EXISTING GROUND LEVEL
RL	REDUCED LEVEL
E	EASTING COORDINATE
N	NORTHING COORDINATE
AHD	AUSTRALIAN HEIGHT DATUM
U.N.O	UNLESS NOTED OTHERWISE
uPVC	UNPLASTICISED POLYVINYL CHLORIDE
PE	POLYETHYLENE
RCP	REINFORCED CONCRETE PIPE
RCBC	REINFORCED CONCRETE BOX CULVERT
VCP	VITRIFIED CLAY PIPE
FFU	FIBRE REINFORCED FOAMED URETHANE
FRC	FIBRE REINFORCED COMPOSITE
FSL	FINISHED SURFACE LEVEL
IL	INVERT LEVEL
GD	GRATED DRAIN
TWL	TOP WATER LEVEL
IJ	ISOLATION JOINT
DEJ	DOWELLED EXPANSION JOINT
SJ	SAWN JOINT
KJ	KEYED JOINT
WPJ	TROWELED WEAKENED PLANE JOINT
EJ	EXPANSION JOINT
TOTP	TURNOUT TANGENT POINT
TOEP	TURNOUT END POINT
THEO. PT.	CROSSING THEORETICAL POINT
POINTS	TOE OR TIP OF SWITCHRAIL
TOP	TOE OF POINTS
TOS	TOE OF SWITCH

2. SURVEY

1. THE EXISTING SITE CONDITIONS SHOWN ON THE FOLLOWING DRAWINGS HAVE BEEN DERIVED FROM SURVEY INFORMATION SUPPLIED BY ONTRACK SURVEY AND DESIGN.
2. SHOULD DISCREPANCIES BE ENCOUNTERED DURING CONSTRUCTION BETWEEN THE SURVEY DATA AND ACTUAL FIELD DATA, CONTACT THE DESIGN ENGINEER.
3. THE CONTRACTOR SHALL ARRANGE ALL SURVEY SETOUT TO BE CARRIED OUT BY A SURVEYOR, APPROVED BY JOHN HOLLAND RAIL.
4. BENCH MARK, SURVEY PEGS, LEVEL PEGS OR SUPPLEMENTARY REFERENCE MARKS SHALL NOT BE ADJUSTED OR MOVED WITHOUT WRITTEN APPROVAL FROM THE SUPERINTENDENT. THE CONTRACTOR SHALL TRANSFER ANY PEGS AFFECTED BY THE PROPOSED WORKS TO SIDE POSITIONS CLEAR OF OPERATIONS AND SHALL NOTE THE EXTENT OF THE MOVEMENT IN DISTANCE AND LEVEL.
5. VERTICAL DATUM IS AHD 71. HORIZONTAL DATUM IS MGA ZONE 55 BASED ON THE STATIC ADJUSTED CONTROL USING GPS AND CONTROL POINT COORDINATES.
6. EXISTING SURFACE LEVELS ARE APPROXIMATE.

3. EXISTING SERVICES AND FEATURES

1. THE CONTRACTOR MUST CONFIRM THE EXACT LOCATION AND EXTENT OF EXISTING SERVICES PRIOR TO CONSTRUCTION AND NOTIFY ANY CONFLICT WITH THE DRAWINGS IMMEDIATELY TO THE ENGINEER/SUPERINTENDENT.
2. EXISTING SERVICES, UNLESS SHOWN ON SURVEY PLAN, HAVE BEEN PLOTTED FROM DBYD SERVICES SEARCH PLANS AND, AS SUCH, THEIR ACCURACY CANNOT BE GUARANTEED.
3. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO COMPLETE A DYBD SEARCH AND TO ESTABLISH THE LOCATION AND LEVELS OF ALL EXISTING SERVICES PRIOR TO THE COMMENCEMENT OF ANY WORK. ANY DISCREPANCIES SHALL BE REPORTED TO THE ENGINEER/SUPERINTENDENT. CLEARANCES SHALL BE OBTAINED FROM THE RELEVANT SERVICE AUTHORITY. SEARCH RESULTS ARE TO BE KEPT ON SITE AT ALL TIMES.
4. THE CONTRACTOR HAS A DUTY OF CARE WHEN EXCAVATING NEAR SERVICES. DO NOT ASSUME DEPTHS OR ALIGNMENTS OF CABLES OR PLANT AS THESE MAY VARY SIGNIFICANTLY. THE CONTRACTOR MUST ACCEPT ALL RESPONSIBILITY FOR DAMAGE TO EXISTING SERVICES AS SERVICE AUTHORITIES MAY SEEK COMPENSATION FOR DAMAGE CAUSED TO THEIR PROPERTY AND SUBSEQUENT LOSSES.
5. THE CONTRACTOR SHALL ALLOW FOR THE PROTECTION, EXCAVATION AND REMOVAL OR RELOCATION (IF REQUIRED) TO RELEVANT AUTHORITIES GUIDELINES OF ALL EXISTING SERVICES IN AREAS AFFECTED BY WORKS WITHIN THE WORK AREA OR AS SHOWN ON THE DRAWINGS UNLESS DIRECTED OTHERWISE BY THE ENGINEER/SUPERINTENDENT.
6. INTERRUPTION TO SUPPLY OF EXISTING SERVICES SHALL BE DONE SO AS NOT TO CAUSE ANY INCONVENIENCE TO RAIL TRAFFIC. CONTRACTOR TO GAIN APPROVAL FROM JOHN HOLLAND RAIL FOR TIME OF INTERRUPTION.
7. IF EXISTING SERVICE UTILITY COVERS AND GRATES OR SURROUNDING SURFACE LEVELS ARE TO BE LOWERED, THE CONTRACTOR IS TO MAKE CERTAIN THAT MINIMUM COVERS (IN ACCORDANCE WITH RELEVANT SERVICE AUTHORITY GUIDELINES) TO SERVICES ARE MAINTAINED. IF MINIMUM COVERS AREN'T MAINTAINED, THE CONTRACTOR IS TO LOWER OR PROTECT SERVICES TO THE SATISFACTION OF THE RELEVANT SERVICE AUTHORITY/SUPERINTENDENT.

4. SEDIMENT AND EROSION CONTROL

1. EROSION AND SEDIMENT CONTROL IS THE RESPONSIBILITY OF THE CONTRACTOR.
2. ALL SEDIMENT TRAPPING STRUCTURES AND DEVICES ARE TO BE INSPECTED AFTER STORMS FOR STRUCTURAL DAMAGE OR CLOGGING. DAMAGED SEDIMENT TRAPPING STRUCTURES ARE TO BE REPAIRED AND ANY TRAPPED MATERIAL IS TO BE REMOVED TO AN APPROPRIATE LOCATION.
3. ALL TOPSOIL IS TO BE STOCKPILED ON SITE (AWAY FROM TREES AND DRAINAGE LINES) AS ADVISED BY JHR AND IN ACCORDANCE WITH RELEVANT GUIDELINES. MEASURES SHALL BE APPLIED TO PREVENT EROSION OF THE STOCKPILES.
4. ALL EARTHWORK AREAS SHALL BE ROLLED EACH EVENING TO SEAL THE EARTHWORKS. DUST SUPPRESSION SHALL BE CARRIED OUT IN ACCORDANCE WITH RELEVANT GUIDELINES.
5. UPON COMPLETION OF ALL EARTHWORKS OR AS DIRECTED BY RELEVANT AUTHORITY, SOIL CONSERVATION TREATMENTS SHALL BE APPLIED SO AS TO RENDER AREAS THAT HAVE BEEN DISTURBED EROSION PROOF WITHIN 14 DAYS.
6. EROSION AND SILT PROTECTION MEASURES ARE TO BE MAINTAINED AT ALL TIMES.
7. ALL VEHICLES LEAVING THE SITE SHALL BE CLEANED AND INSPECTED BEFORE LEAVING SITE TO LIMIT SEDIMENT TRACKING TO ROADWAYS.

5. RAIL FORMATION AND EARTHWORKS

1. REFER TO 'EXISTING SERVICES AND FEATURES' NOTES BEFORE COMMENCING BULK EARTHWORKS.
2. TECHNICAL SPECIFICATIONS OR SPECIFIC INSTRUCTIONS CONTAINED IN THE GEOTECHNICAL REPORT TAKE PRECEDENCE OVER THESE NOTES.
3. ALL TOPSOIL, ORGANIC MATTER AND FILL MATERIAL SHALL BE REMOVED FROM ALL AREAS UNDER PROPOSED WORK LOCATIONS TO A DEPTH OF 100 mm AND TO THE SATISFACTION OF THE GEOTECHNICAL ENGINEER. AREAS TO BE FULLY STRIPPED OF DARK BROWN UPPER ORGANIC ALLUVIUM.
4. CONTRACTOR SHALL PLACE SAFETY BARRIERS AROUND EXCAVATIONS IN ACCORDANCE WITH JOHN HOLLAND RAIL SAFETY REGULATIONS.
5. REFER AS.3798 AND JOHN HOLLAND RAIL SPECIFICATIONS FOR BULK EARTHWORKS TESTING REQUIREMENTS.
6. ALL GENERAL BACKFILL TO BE COMPACTED TO NOT LESS THAN 95% OF THE STANDARD MAX. DRY DENSITY TO AS.1289 IN MAXIMUM 150mm LAYERS, U.N.O.
7. ANY EXCAVATION THAT IS 3.0m FROM THE NEAREST RAIL OF THE EXISTING OPERATING TRACK THAT HAS A SLOPE GREATER THAN 1 IN 1 IS TO BE SHORED IN A MANNER APPROVED BY JOHN HOLLAND RAIL.
8. AT NO TIME IS EXCAVATION ADJACENT TO EXISTING TRACK TO BE CLOSER THAN 3.0m FROM THE NEAREST EXISTING RAIL WITHOUT TRACK POSSESSION.
9. ANY EXCAVATION WITHIN 3.0m OF THE NEAREST RAIL OF THE EXISTING OPERATING TRACK, WHICH EXCEEDS 300mm DEPTH BELOW FORMATION LEVEL SHALL BE BACKFILLED THE SAME DAY AND NOT REMAIN AS AN OPEN EXCAVATION OVERNIGHT. THE CONTRACTOR'S WORK METHOD AND PROGRAMMING SHALL FULLY COMPLY WITH THIS REQUIREMENT.
10. ITP'S ARE TO BE COMPLETED BY THE CONTRACTOR AND RECEIVED BY THE DESIGN ENGINEER AND JOHN HOLLAND RAIL.

RAIL FORMATION AND EARTHWORKS (cont.)

11. EXISTING STRUCTURES TO BE ABANDONED WITHIN 3.0m FROM THE NEAREST RAIL OF A NEW OR EXISTING OPERATIONAL TRACK ARE TO BE DEMOLISHED BELOW FORMATION TO A DEPTH APPROVED BY JOHN HOLLAND RAIL.
12. CONSTRUCTION OF EARTHWORKS TO BE IN ACCORDANCE WITH JOHN HOLLAND RAIL SPECIFICATIONS PARTICULARLY NOTING CRN CM 411.
13. THE CAPPING LAYER SHALL BE SPREAD IN UNIFORM LAYERS TO ACHIEVE THE SPECIFIED COMPACTED THICKNESS FOR THE FULL WIDTH OF THE CAPPING LAYER. THE METHOD EMPLOYED SHALL ENSURE THERE IS NO RUTTING, THE COMPACTED LAYER IS NOT DISTURBED AND SEGREGATION DOES NOT OCCUR.
14. COMPACTION OF CAPPING LAYER SHALL ACHIEVE THE MINIMUM RELATIVE COMPACTION OF 95% MAXIMUM DRY DENSITY OBTAINED BY AS.1289 5.2.1 AND WITH 9Kg SURCHARGE AS DETAILED IN CRN CP 411 TABLE 12.
15. THE CAPPING MATERIAL SHALL BE WELL MIXED THROUGHOUT THE LAYER SO THAT ALL VOIDS ARE FILLED. THE TOP OF THE FINAL LAYER SHALL BE GRADED AND TRIMMED AS NECESSARY.
16. CAPPING AND PAVEMENT DESIGN HAS BEEN COMPLETED BY GOLDER ASSOCIATES.
17. BULK EARTHWORK MATERIALS ARE TO CONFORM WITH EARTHWORKS MATERIALS SPECIFICATIONS - CRN CP 411
18. CAPPING LAYER MATERIALS ARE TO CONFORM WITH THE REQUIREMENTS OF JOHN HOLLAND RAIL AND IN ACCORDANCE WITH EARTHWORKS MATERIALS SPECIFICATIONS - CRN CP 411
19. STRUCTURAL ZONE MATERIALS ARE TO CONFORM WITH THE REQUIREMENTS OF JOHN HOLLAND RAIL AND BE IN ACCORDANCE WITH EARTHWORKS MATERIALS SPECIFICATION (CRN CP 411).
20. COMPACTION OF STRUCTURAL ZONE TO ACHIEVE MINIMUM OF 95% MAXIMUM DRY DENSITY AS DETERMINED BY AS.1289 AS PER CRN CP411
21. GENERAL FILL LAYER MATERIALS TO CONFORM EARTHWORKS MATERIALS SPECIFICATION - CRN CP 411
22. ALL PLACEMENT AND COMPACTION OF RAIL FORMATION MATERIALS ARE TO CONFORM WITH EARTHWORKS MATERIALS SPECIFICATIONS - CRN CP 411
23. BATTERS ARE AS INDICATED ON THE TYPICAL SECTION DRAWINGS.
24. THE CONTRACTOR IS REQUIRED TO MAINTAIN THE SURFACE AND DRAINAGE OF ROADS IN A SOUND AND STABLE CONDITION DURING THE COURSE OF THE WORKS.

6. TRACK STRUCTURE

1. RAIL SETOUT DETAILS ARE LISTED ON THE PLAN DRAWINGS.
2. RAIL TYPE: 47kg/m CWR
   SLEEPER TYPE: STEEL SLEEPER M8.5
   130mm FFU SLEEPERS
   SLEEPER SPACING: 600mm ± 20mm
   FASTENING SYSTEM: 2 X TRAK-LOK INSULATED FASTENERS WITH LOCK IN SHOULDERS PER SLEEPER. FFU FASTENING SYSTEM IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.
3. BALLAST: BALLAST MATERIAL SHALL COMPLY WITH THE REQUIREMENTS SET OUT IN CRN CP 241
   60mm ENHANCED GRADE BALLAST
4. CAPPING: 150mm ≥CBR 50%

7. STORMWATER DRAINAGE

1. THE STORMWATER DESIGN SHOWN ON THESE DRAWINGS HAS BEEN CARRIED OUT IN ACCORDANCE WITH JOHN HOLLAND RAIL REQUIREMENTS, AUSTRALIAN RAINFALL AND RUNOFF (AR&R) GUIDELINES AND RELEVANT AUTHORITIES' GUIDELINES.
2. PROTECTION OF PIPES EXPOSED TO LOADS EXCEEDING THE W7 WHEEL LOAD OF 70kN SHALL BE THE CONTRACTOR'S RESPONSIBILITY. DAMAGE TO PIPES DUE TO CONSTRUCTION LOADING IS THE CONTRACTORS RESPONSIBILITY.
3. EXISTING STORMWATER PIPE LOCATIONS AND INVERT LEVELS TO BE CONFIRMED PRIOR TO COMMENCEMENT OF CONSTRUCTION.
4. BEDDING TYPE SHALL BE H2 IN ACCORDANCE WITH AS 3725.
5. CARE IS TO BE TAKEN WITH LEVELS OF STORMWATER LINES. GRADES SHOWN ARE NOT TO BE REDUCED WITHOUT PRIOR WRITTEN APPROVAL FROM THE DESIGN ENGINEER.
6. ALL EXISTING STORMWATER DRAINAGE LINES AND PITS THAT ARE TO REMAIN ARE TO BE INSPECTED AND CLEANED. DURING THIS PROCESS ANY PART OF THE STORMWATER DRAINAGE SYSTEM THAT WARRANTS REPAIR SHALL BE REPORTED TO THE SUPERINTENDENT AND ENGINEER FOR FURTHER DIRECTIONS.
7. THE CONTRACTOR IS TO CONFIRM THE LOCATION OF SERVICE CONDUITS WITH THE SUPERINTENDENT PRIOR TO LAYING STORMWATER DRAINAGE. ALL TRENCH EXCAVATION AND CONSTRUCTION SHALL COMPLY WITH THE REQUIREMENTS OF THE NEW SOUTH WALES WORKPLACE AND HEALTH AND SAFETY ACT.

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SIGNATURE

TITLE

DATE

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REV	BY	DATE	DESCRIPTION	APPD.
0	S.O'B	14.07.17	ISSUED FOR CONSTRUCTION	B.K.

A1 Original | *Co-ordinate System: MGA Zone 50* | *Height Datum: A.H.D.* | Scale: NTS

NSW GOVERNMENT Transport for NSW

John Holland | COUNTRY REGIONAL NETWORK

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bgeeng.com—

PROJECT No. S15066

DRAWN J.B.
DRG CHECK S.W.
DESIGNED S.W.
DESIGN CHECK B.K.
APPROVED

TARAGO LOOP EXTENSION
261.280km - 263.100km
GENERAL NOTES

FILE No. S15066	SHEET: 1 OF 1	A1
STATUS: FOR CONSTRUCTION	AWP PROJECT No. 1617-341	©
DRG No. CC000162-C-2002 0	EDMS No.	

DesiSGN No. 1815967 Rev 5 P:\BGE\S15066\190 Drawings\192 Civil\Mxd\C015066-DRG-C-2002 By: Adam Evans Plot Date: 14/7/2017 3:50 PM

CONTROL LINE (MC11) - PROPOSED LOOP									
PT	CHAINAGE	EASTING	NORTHING	HEIGHT	BEARING	RAD/SPIRAL	A.LENGTH	DEFL.ANGLE	DESCRIPTION
IP 1	261875.170	742073.868	6116523.299	689.578	197°45'26.03"				T.O.P. TURNOUT 1
IP 2	261880.484	742072.247	6116518.238	689.552		R = 813.519	10.628	0°44'54.69"	
IP 3	261885.798	742070.561	6116513.199	689.525					K POINT TURNOUT 1
TC	261920.336	742056.540	6116481.634	689.352	203°56'58.09"				
IP 4	261954.195	742042.775	6116450.643	689.183		R = 500.000	67.719	7°45'35.94"	
CT	261988.055	742024.951	6116421.794	680.014	211°42'34.02"				
TC	262328.465	741846.027	6116132.199	687.915	211°42'34.02"				
IP 5	262347.335	741836.101	6116116.133	687.896		R = -400.000	37.741	5°24'21.57"	
CT	262366.206	741827.733	6116099.204	687.877	206°18'12.45"				
TC	262416.666	741805.373	6116053.968	687.848	206°18'12.45"				
IP 6	262435.806	741796.885	6116036.797	687.865		R = 400.000	38.281	5°28'59.83"	
CT	262454.947	741786.795	6116020.515	687.902	211°47'12.29"				
TC	262939.611	741531.493	6115608.543	688.993	211°47'12.29"				
IP 7	262955.586	741523.071	6115594.951	689.056		R = -300.000	31.949	6°06'06.45"	
CT	262971.560	741516.141	6115580.542	689.133	205°41'05.84"				
IP 8	262995.715	741505.671	6115558.774	689.211	205°41'05.84"				

CONTROL LINE (MX01) SETOUT - EXISTING MAINLINE												
PT	KILOMETRAGE	EASTING	NORTHING	HEIGHT	BEARING	RAD/SPIRAL	A.LENGTH	DEFL.ANGLE	L.TANGENT	S.TANGENT	L.TANGENT 2	S.TANGENT 2
IP 1	261280.000	742048.605	6117107.269	687.465	164°38'48.47"							
TS	261391.809	742078.209	6116999.450	688.325	164°38'48.47"							
SC	261431.809	742088.478	6116960.792	688.633	166°04'32.23"	L = 40.000			369.370	349.335	26.668	13.334
IP 2	261741.268	742176.006	6116643.262	690.202		R = 802.000	618.919	47°04'26.03"				
CS	262050.728	742002.546	6116363.265	688.700	210°17'30.74"	L = 40.000			369.370	349.335	26.668	13.334
ST	262090.728	741981.799	6116329.068	688.508	211°43'14.50"							
IP 3	263158.386	741420.447	6115420.895	689.746	211°43'14.50"							

NOTES

1. REUSE OF ELEMENTS SUBJECT TO JHR CRN CONDITION ASSESSMENT.
2. TURNOUT km REFERS TO THE TOE OF POINTS OF THE TURNOUT.
3. REFER SIGNALLING PLANS AND SFOS FOR OPERATIONAL STANDING ROOM.

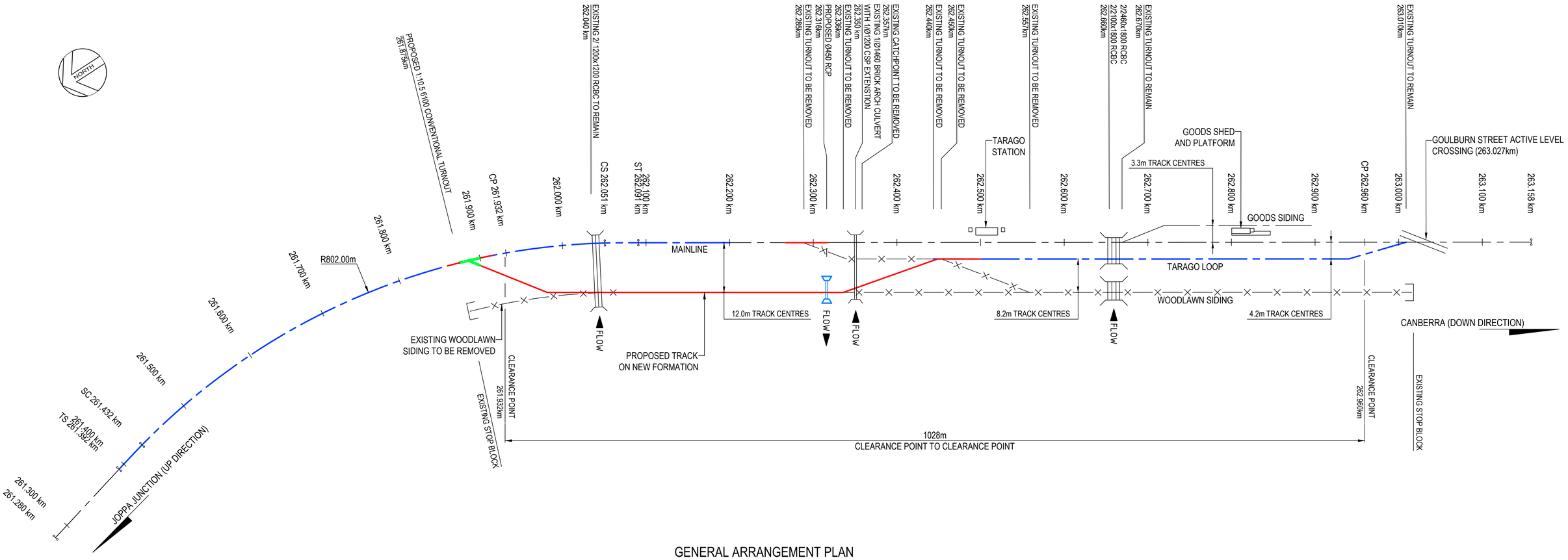
LEGEND

- PROPOSED TRACK
- PROPOSED TAMPED TRACK
- PROPOSED TURNOUT
- EXISTING TRACK
- EXISTING TRACK TO BE REMOVED
- EXISTING CULVERT
- PROPOSED CULVERT

TURNOUT DIAGRAM

1 IN 10 500 CONVENTIONAL
N.T.S.

FOR DETAILED TURNOUT DIMENSIONS
REFER TO CRN CS 250



GENERAL ARRANGEMENT PLAN

N.T.S

Design accepted for use by JHR-CRN*

SIGNATURE

TITLE

DATE

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A1 Original | Co-ordinate System: MGA Zone 50 | Height Datum: A.H.D. | Scale: NTS

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PROJECT No. S15066

BG&E

DRAWN J.B.
DRG CHECK S.W.
DESIGNED S.W.
DESIGN CHECK B.K.
APPROVED

TARAGO LOOP EXTENSION

261.280km - 263.100km

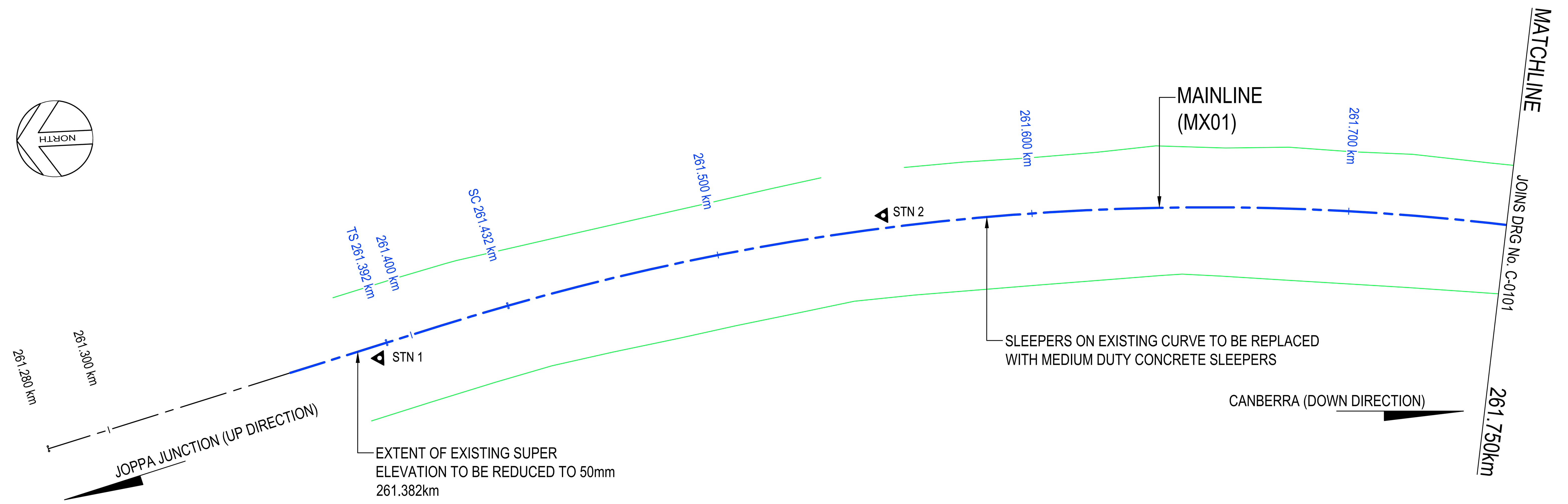
GENERAL ARRANGEMENT PLAN

FILE No. S15066	SHEET: 1 OF 1	A1
STATUS: FOR CONSTRUCTION	AWP PROJECT No. 1617-341	©
DRG No. CC000162-C-2050	0	EDMS No.

DeskSite No. 15150967 Rev 5 P:\BGE\S15\S15066\100 Drawings\102 Civil\AutoCAD\S15066-DRG-C-2050 By: Adam Evans Print Date: 14/7/2017 3:59 PM

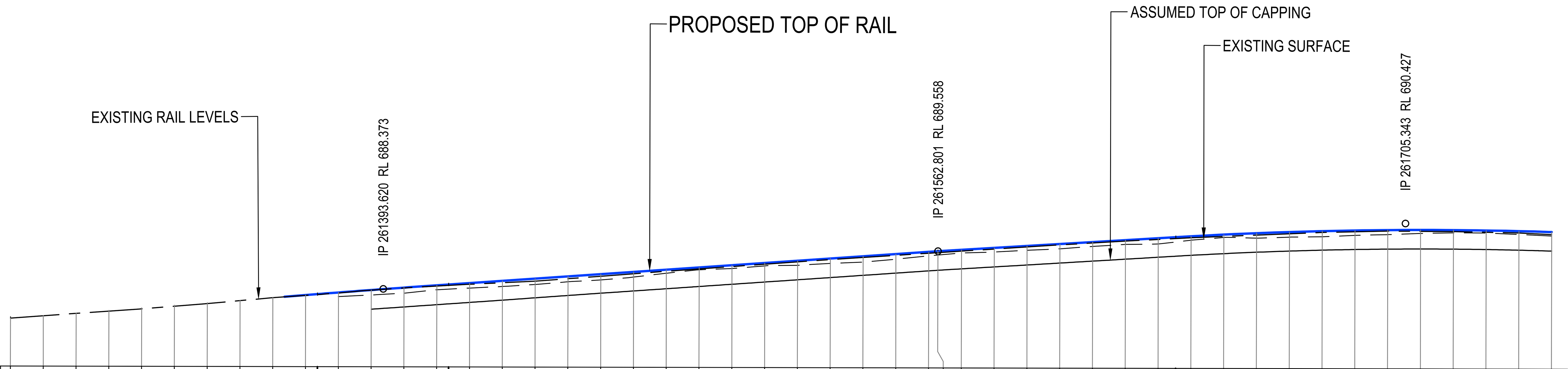
NOTES

1. REFER TO DRG No. C-2001 FOR DRAWING LIST.
2. REFER C-2300 - C-2301 FOR TYPICAL SECTIONS.
3. THIS DRAWING MUST BE READ IN CONJUNCTION WITH ALL RELEVANT CONTRACTS, SPECIFICATIONS AND DRAWINGS.
4. TURNOUT km REFERS TO TOE OF POINTS OF THE TURNOUT.
5. REUSE OF TURNOUTS, RAIL, SLEEPERS AND OTHER MATERIALS IS SUBJECT TO JHR CRN CONDITION ASSESSMENT.
6. REFER DETAIL 1 ON C-2350 FOR SCOUR PROTECTION REQUIREMENTS AT ALL PROPOSED CULVERT EXTENSIONS AND REPLACEMENTS.
7. LEVEL AND EXTENT OF TAMP SUBJECT TO APPROVAL BY SUPERINTENDENT.



LEGEND

- PROPOSED TRACK
- TAMPED TRACK
- PROPOSED CESS DRAIN
- PROPOSED CULVERT
- PROPOSED TURNOUT
- EXISTING TRACK
- EXISTING TRACK TO BE REMOVED
- EXISTING PROPERTY BOUNDARY (GIS)
- EXISTING OVERHEAD POWER LINES (OH)
- EXISTING ROAD/ACCESS TRACK
- EXISTING CULVERT
- EXISTING BENCHMARK



DATUM 686.0

GRADES: 1 in 125.691 (L =93.6210m); V.C.40.00m (R =40002.2533); 1 in 142.257 (L =149.1811m); 1 in 211.094 (L =72.5421m); V.C.140.00m (R =12612.7459)

HORIZ. CURVES: 40m; R802 618.92m

CHAINAGE	RAIL LIFT OR LOWER	EXISTING RAIL LEVELS	PROPOSED RAIL LEVELS	TOP OF CAPPING LEVELS	NATURAL SURFACE LEVELS	SUPERELEVATION
261280	0.000	687.465	687.465			
261290	0.000	687.538	687.538			
261300	0.000	687.612	687.612			
261310	0.000	687.682	687.682			
261320	0.000	687.754	687.754			
261330	0.000	687.835	687.835			
261340	0.000	687.918	687.918			
261350	0.000	688.009	688.009			
261360	0.004	688.101	688.104			
261370	0.011	688.174	688.184			
261380	0.017	688.247	688.264		688.138	0.000
261390	0.005	688.336	688.341		688.188	
261400	0.009	688.406	688.416		688.247	
261410	0.024	688.464	688.488		688.353	
261420	0.037	688.521	688.558		688.406	
261430	0.057	688.571	688.628		688.456	0.050
261440	0.078	688.621	688.698		688.520	
261450	0.071	688.697	688.768		688.603	
261460	0.064	688.774	688.838		688.661	
261470	0.056	688.852	688.908		688.752	
261480	0.048	688.930	688.978		688.870	
261490	0.044	689.004	689.048		688.978	
261500	0.041	689.077	689.118		689.018	
261510	0.037	689.151	689.188		689.100	
261520	0.033	689.225	689.258		689.120	
261530	0.033	689.295	689.328		689.181	
261540	0.034	689.364	689.398		689.220	
261550	0.038	689.430	689.468		689.311	
261560	0.042	689.496	689.538		689.417	
261562.801	0.043	689.515	689.558		689.444	
261570	0.040	689.562	689.602		689.506	
261580	0.035	689.628	689.663		689.537	
261590	0.031	689.693	689.724		689.590	
261600	0.026	689.758	689.785		689.639	
261610	0.028	689.818	689.846		689.713	
261620	0.030	689.877	689.907		689.775	
261630	0.038	689.930	689.968		689.791	
261640	0.045	689.983	690.028		689.909	
261650	0.055	690.026	690.081		689.993	
261660	0.058	690.069	690.127		689.975	
261670	0.053	690.111	690.164		690.008	
261680	0.040	690.153	690.194		690.021	
261690	0.039	690.176	690.215		690.067	
261700	0.030	690.199	690.229		690.091	
261710	0.042	690.193	690.235		690.129	
261720	0.045	690.187	690.233		690.150	
261730	0.055	690.168	690.222		690.147	
261740	0.056	690.148	690.204		690.102	
261750	0.079	690.100	690.178		690.058	0.050

* NOTE: ALL RAIL LEVELS REFER TO THE LOW RAIL.

MAINLINE (MX01)

SCALE: H 1:1000
V 1:100

BENCHMARK SCHEDULE

Mark No.	Mark Type.	Easting	Northing	Reduced Level	Kilometrage	Offset->R.F.
TS 12066	-	748,763.459	6,150,683.941	656.957		
TS 12140	-	752,796.895	6,073,875.412	659.755		
STN 1	Picket	742,073.433	6,117,001.840	687.600	261388.343	3.244 Up Rl
STN 2	Picket	742,112.666	6,116,841.397	688.911	261 553.374	3.357 Dn Rl
STN 3	Picket	742,106.441	6,116,596.398	690.669	261 796.756	11.935 Dn Rl
STN 4	Picket	742,024.230	6,116,418.152	687.781	261 991.602	6.009 Up Rl
STN 5	B.T. 5090	741,905.054	6,116,194.294	688.801	262 245.472	4.832 Dn Rl
STN 6	Nail	741,772.681	6,116,008.577	687.936	262 473.379	8.654 Up Rl
STN 7	Picket	741,619.105	6,115,783.731	689.103	262 745.953	21.063 Up Rl
STN 8	Nail	741,486.077	6,115,536.343	689.222	263 026.536	4.132 Up Rl

NOTES
1. M.G.A. CO-ORDINATES ZONE 55 A.H.D.71

SCALE 1:2000 AT A3 SIZE (0 10 20 30 40 50 60m)
SCALE 1:1000 AT A1 SIZE (0 10 20 30 40 50 60m)

Design accepted for use by JHR-CRN*

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A1 Original | *Co-ordinate System: MGA Zone 50* | *Height Datum: A.H.D.* | Scale: 1:1000H 1:100V

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PROJECT No. S15066

BG&E

DRAWN J.B.
DRG CHECK S.W.
DESIGNED S.W.
DESIGN CHECK B.K.
APPROVED

TARAGO LOOP EXTENSION

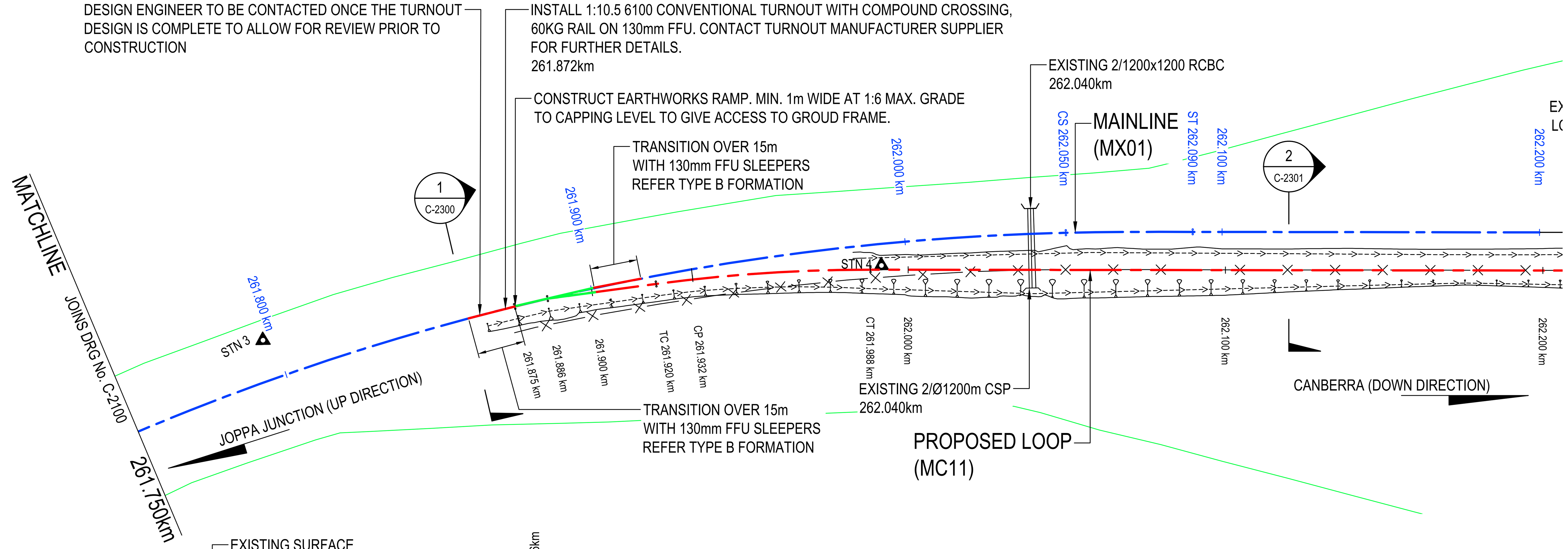
261.280km - 263.100km

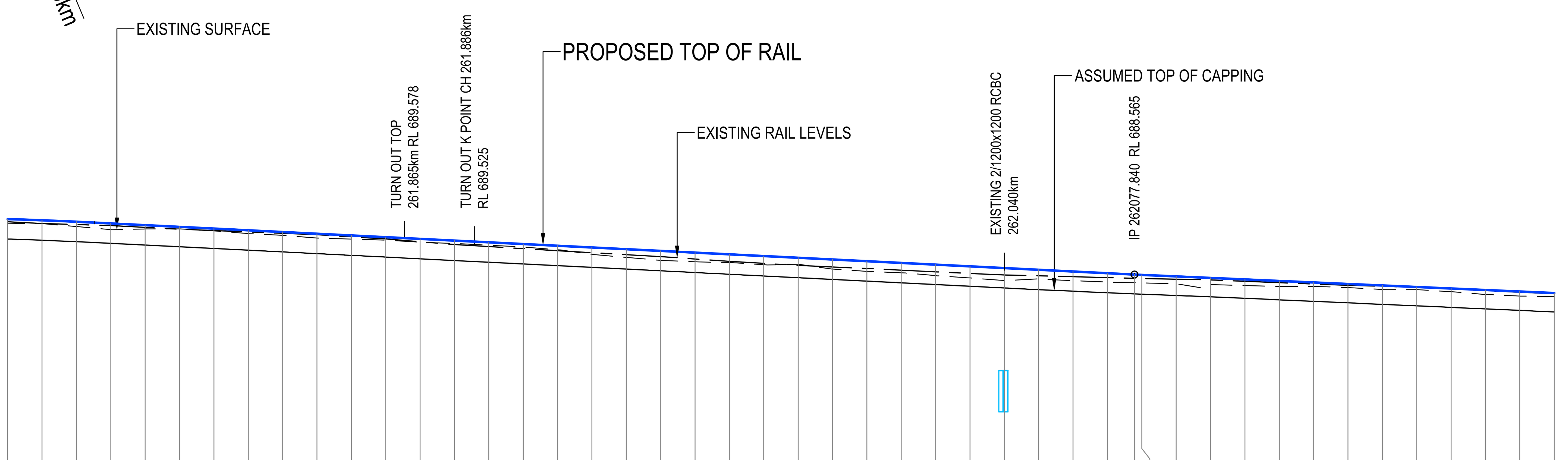
PLAN AND PROFILE (MX01)

261.280km - 261.750km

SHEET 1

FILE No. S15066		SHEET: 1 OF 2	A1
STATUS: FOR CONSTRUCTION		AWP PROJECT No. 1617-341	©
DRG No. CC000162-C-2100	0	EDMS No.	





DATUM 683.0

GRADES: V.C.140.00m (R =12612.7459); 1 in -223.288 (L =302.4977m); 1 in -229.350 (L =171.8056m)

HORIZ. CURVES: R802 618.92m; 40m

CHAINAGE	RAIL LIFT OR LOWER	EXISTING RAIL LEVELS	PROPOSED RAIL LEVELS	TOP OF CAPPING LEVELS	NATURAL SURFACE LEVELS	SUPERELEVATION
261750	0.079	690.1	690.178		690.058	0.050
261760	0.093	690.051	690.145		690.045	
261770	0.083	690.02	690.103		689.962	
261780	0.065	689.989	690.054		689.871	
261790	0.068	689.936	690.004		689.892	
261800	0.070	689.884	689.954		689.895	
261810	0.060	689.844	689.904		689.835	
261820	0.049	689.805	689.854		689.759	
261830	0.040	689.764	689.804		689.707	
261840	0.030	689.724	689.754		689.629	
261850	0.041	689.663	689.704		689.596	
261860	0.052	689.602	689.654		689.568	
261870	0.084	689.52	689.604		689.508	
261880	0.117	689.437	689.554		689.472	
261890	0.126	689.378	689.504		689.417	
261900	0.134	689.32	689.454		689.367	
261910	0.144	689.26	689.404		689.287	
261920	0.153	689.201	689.354		689.154	
261930	0.160	689.144	689.304		689.065	
261940	0.168	689.086	689.254		688.978	
261950	0.186	689.018	689.204		688.938	
261960	0.205	688.949	689.154		688.915	
261970	0.214	688.89	689.104		688.850	
261980	0.224	688.83	689.054		688.864	
261990	0.218	688.786	689.004		688.726	
262000	0.213	688.741	688.954		688.658	
262010	0.211	688.693	688.904		688.617	
262020	0.210	688.644	688.854		688.533	
262030	0.206	688.598	688.804		688.467	
262040	0.203	688.551	688.754		688.392	
262050	0.176	688.528	688.704		688.433	0.050
262060	0.151	688.503	688.654		688.386	
262070	0.127	688.476	688.604		688.346	
262077.84	0.109	688.455	688.565		688.326	
262080	0.106	688.45	688.555		688.320	
262090	0.080	688.432	688.511		688.294	
262100	0.057	688.41	688.467		688.255	0.000
262110	0.054	688.369	688.423		688.244	
262120	0.052	688.327	688.379		688.219	
262130	0.045	688.29	688.335		688.218	
262140	0.039	688.253	688.291		688.186	
262150	0.025	688.223	688.247		688.129	
262160	0.010	688.193	688.203		688.123	
262170	0.015	688.144	688.159		688.067	
262180	0.020	688.095	688.115		687.984	
262190	0.020	688.051	688.071		687.941	
262200	0.020	688.007	688.027		687.919	

* NOTE: ALL RAIL LEVELS REFER TO THE LOW RAIL.

MAINLINE (MX01)

SCALE: H 1:1000
V 1:100

NOTES

1. REFER TO DRG No. C-2001 FOR DRAWING LIST.
2. REFER C-2300 - C-2301 FOR TYPICAL SECTIONS.
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5. REUSE OF TURNOUTS, RAIL, SLEEPERS AND OTHER MATERIALS IS SUBJECT TO JHR CRN CONDITION ASSESSMENT.
6. REFER DETAIL 1 ON C-2350 FOR SCOUR PROTECTION REQUIREMENTS AT ALL PROPOSED CULVERT EXTENSIONS AND REPLACEMENTS.
7. LEVEL AND EXTENT OF TAMP SUBJECT TO APPROVAL BY SUPERINTENDENT.

LEGEND

- PROPOSED TRACK
- TAMPED TRACK
- PROPOSED CESS DRAIN
- PROPOSED CULVERT
- PROPOSED TURNOUT
- EXISTING TRACK
- EXISTING TRACK TO BE REMOVED
- EXISTING PROPERTY BOUNDARY (GIS)
- OH OH EXISTING OVERHEAD POWER LINES
- EXISTING ROAD/ACCESS TRACK
- EXISTING CULVERT
- EXISTING BENCHMARK

SCALE 1:2000 AT A3 SIZE (0 10 20 30 40 50 60m)
SCALE 1:1000 AT A1 SIZE (0 10 20 30 40 50 60m)

Design accepted for use by JHR-CRN*

SIGNATURE
TITLE
DATE

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REV	BY	DATE	DESCRIPTION	APPD.
0	S.O'B	14.07.17	ISSUED FOR CONSTRUCTION	B.K.

A1 Original | Co-ordinate System: MGA Zone 50 | Height Datum: A.H.D. | Scale: 1:1000H 1:100V

NSW GOVERNMENT Transport for NSW
John Holland
COUNTRY REGIONAL NETWORK

Brisbane Office—
74-76 Bowen St, Spring Hill QLD 4000
P / +61 7 3167 3300
E / info@bgeeng.com
bgeeng.com—

PROJECT No. S15066

BG&E

DRAWN J.B.
DRG CHECK S.W.
DESIGNED S.W.
DESIGN CHECK B.K.
APPROVED

TARAGO LOOP EXTENSION

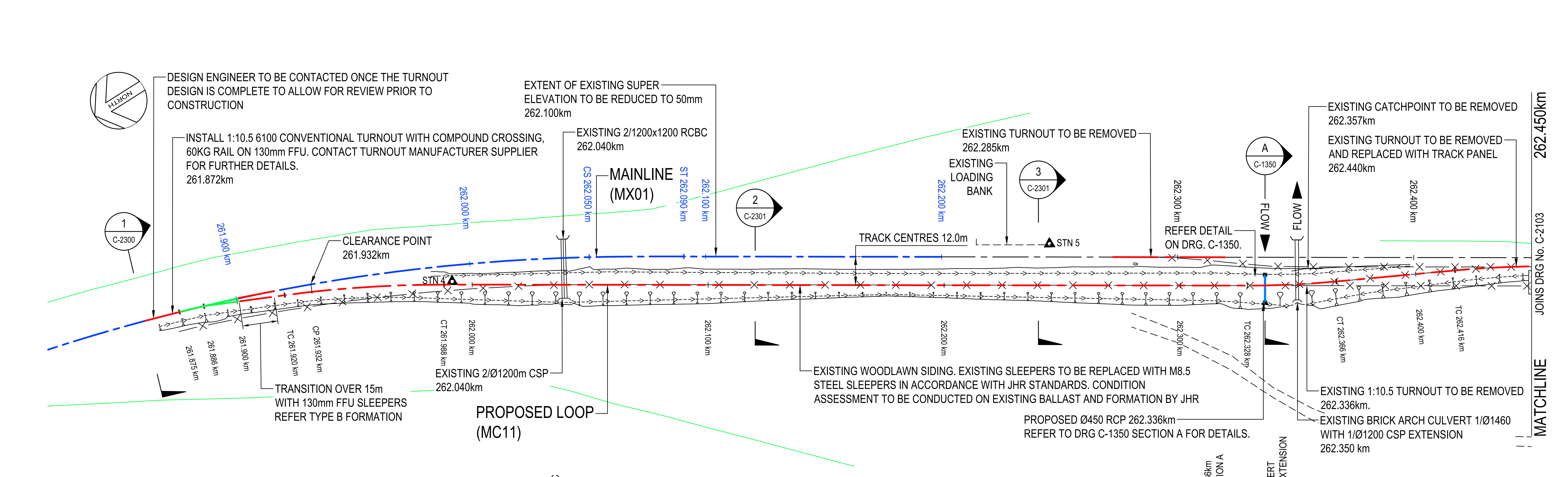
261.280km - 263.100km

PLAN AND PROFILE (MX01)

261.750km - 262.150km

SHEET 2

FILE No. S15066
STATUS: FOR CONSTRUCTION
SHEET: 2 OF 2
A1
AWP PROJECT No. 1617-341
DRG No. CC000162-C-2101 | 0
EDMS No.



NOTES

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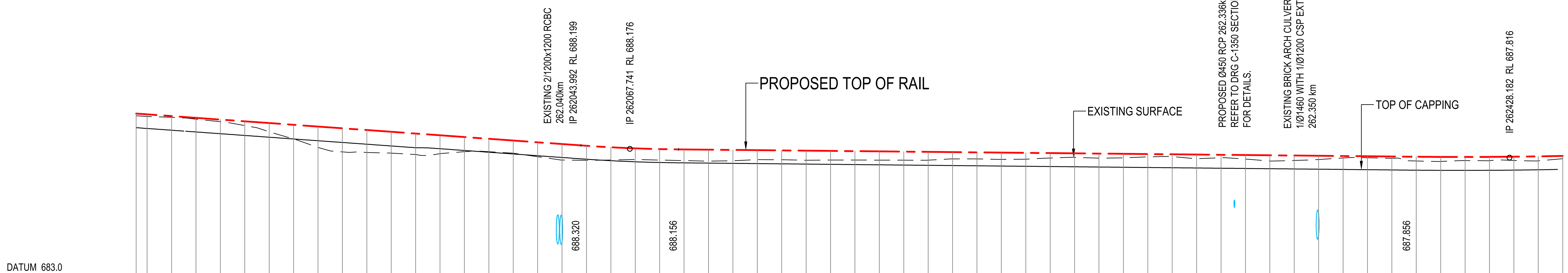
- EXISTING ROAD/ACCESS TRACK
- EXISTING CULVERT
- EXISTING BENCHMARK



GRADES: 1 in -142.484 (L =182.2516m); V.C.40.00m (R =6482.1698); 1 in -1026.034 (L =300.4410m); V.C.80.00m (R =20000.0467)

HORIZ. CURVES: R803.61 20.31m; R400 58.93m; R-400 37.74m; R400 38.28m

CHAINAGE	RAIL LIFT OR LOWER	EXISTING RAIL LEVELS	PROPOSED RAIL LEVELS	TOP OF CAPPING LEVELS	NATURAL SURFACE LEVELS	SUPERELEVATION
261865.49			689.626	689.046	689.536	0.050
261870			689.594	689.014	689.508	
261880			689.522	688.942	689.472	
261890			689.451	688.871	689.394	
261900			689.379	688.799	689.290	
261910			689.307	688.727	689.132	
261920			689.236	688.656	688.880	
261930			689.164	688.584	688.591	
261940			689.092	688.512	688.239	
261950			689.020	688.440	688.053	0.050
261960			688.949	688.369	688.030	
261970			688.877	688.297	688.003	
261980			688.805	688.225	687.946	
261990			688.734	688.184	687.981	
262000			688.662	688.112	688.062	0.000
262010			688.590	688.040	688.061	
262020			688.519	687.969	688.000	
262030			688.447	687.897	687.856	
262040			688.375	687.825	687.721	
262050			688.304	687.754	687.707	
262060			688.243	687.693	687.722	
262070			688.198	687.648	687.743	
262080			688.169	687.619	687.719	
262090			688.154	687.604	687.698	
262100			688.144	687.594	687.677	
262110			688.134	687.584	687.690	
262120			688.124	687.574	687.735	
262130			688.114	687.564	687.730	
262140			688.104	687.554	687.712	
262150			688.094	687.544	687.719	
262160			688.084	687.534	687.721	
262170			688.074	687.524	687.714	
262180			688.064	687.514	687.714	
262190			688.054	687.504	687.716	
262200			688.044	687.494	687.765	
262210			688.034	687.484	687.766	
262220			688.024	687.474	687.747	
262230			688.014	687.464	687.754	
262240			688.004	687.454	687.803	
262250			687.994	687.444	687.832	
262260			687.984	687.434	687.800	TYPE A FORMATION
262270			687.974	687.424	687.809	
262280			687.964	687.414	687.848	
262290			687.954	687.404	687.861	
262300			687.944	687.394	687.776	
262310			687.934	687.384	687.811	
262320			687.924	687.374	687.758	
262330			687.914	687.364	687.680	
262340			687.904	687.354	687.701	
262350			687.894	687.344	687.742	
262360			687.884	687.334	687.803	
262370			687.874	687.324	687.813	
262380			687.864	687.314	687.794	
262390			687.854	687.304	687.681	
262400			687.847	687.297	687.662	
262410			687.846	687.296	687.698	
262420			687.849	687.299	687.695	
262430	0.031	687.826	687.858	687.308	687.703	
262440	0.056	687.815	687.871	687.321	687.688	
262450	0.070	687.819	687.889		687.774	

* NOTE: ALL RAIL LEVELS REFER TO THE LOW RAIL.

PROPOSED LOOP (MC01)

SCALE: H 1:1000

SCALE 1:2000 AT A3 SIZE — 0 10 20 30 40 50 60m
SCALE 1:1000 AT A1 SIZE — 0 10 20 30 40 50 60m

Design accepted for use by JHR-CRN*

SIGNATURE ____
TITLE ____
DATE ____

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NSW GOVERNMENT — Transport for NSW
John Holland — COUNTRY REGIONAL NETWORK

Brisbane Office—
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bgeeng.com—

PROJECT No. S15066

BG&E

DRAWN — J.B.
DRG CHECK — S.W.
DESIGNED — S.W.
DESIGN CHECK — B.K.
APPROVED —

TARAGO LOOP EXTENSION

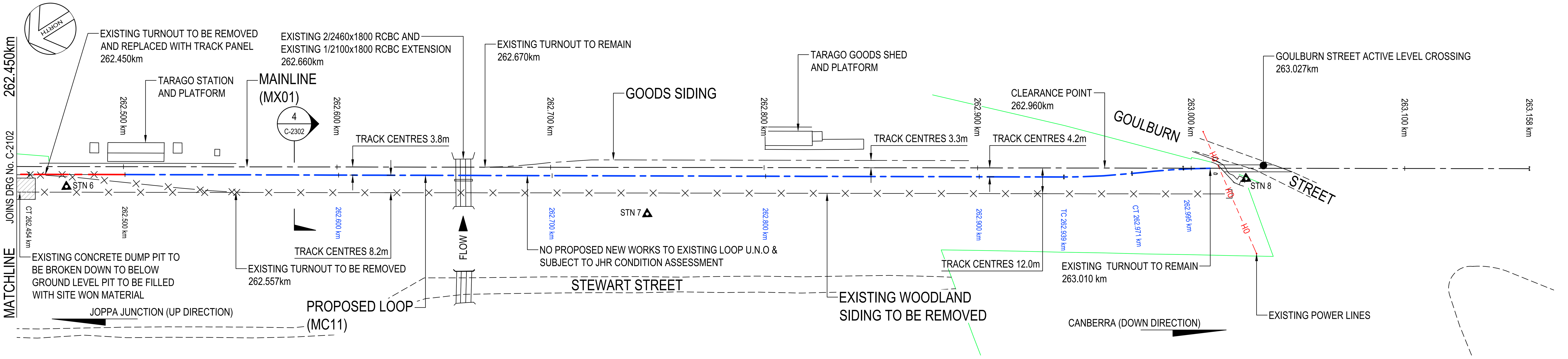
261.280km - 263.100km

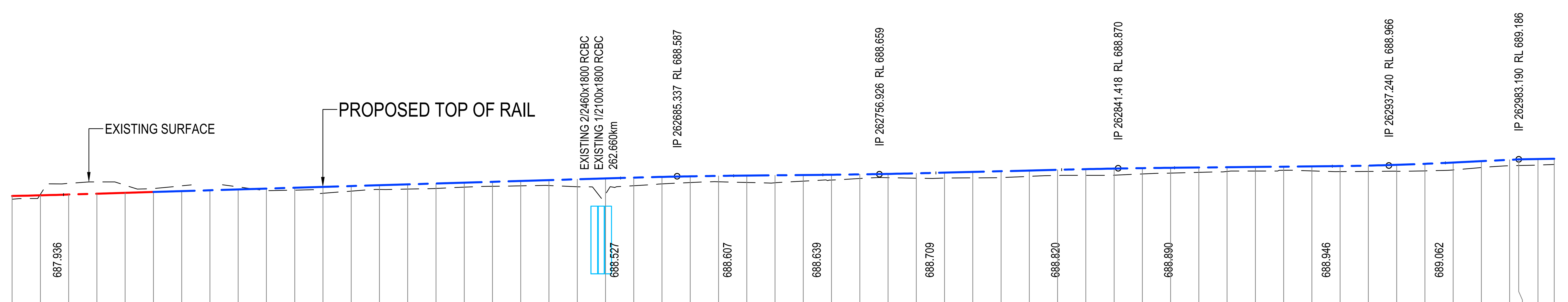
PLAN AND PROFILE (MC11)

261.850km - 262.450km

SHEET 1

FILE No. S15066 | SHEET: 1 OF 2 | A1
STATUS: FOR CONSTRUCTION | AWP PROJECT No. 1617-341 | ©
DRG No. CC000162-C-2102 | 0 | EDMS No.





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- PROPOSED TURNOUT
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- OH — OH EXISTING OVERHEAD POWER LINES
- EXISTING ROAD/ACCESS TRACK
- EXISTING CULVERT
- EXISTING BENCHMARK

DATUM 684.0

GRADES

V.C.80.00m R =20000.0467	1 in 356.434 L =197.1553m	V.C.40.00m R =20000.0867	1 in 803.566 L =31.5885m	V.C.40.00m R =26666.7533	1 in 430.576 L =44.4921m	V.C.40.00m R =26666.7533	1 in 783.464 L =55.8219m	V.C.40.00m R =10535.4601	1 in 228.1231 L =25.9502m	1 in 522.636 L =12.5765m

HORIZ. CURVES: R400 38.28m; R-300 31.95m

CHAINAGE	RAIL LIFT OR LOWER	EXISTING RAIL LEVELS	PROPOSED RAIL LEVELS	TOP OF CAPPING LEVELS	NATURAL SURFACE LEVELS	SUPERELEVATION
262450	0.070	687.819	687.889		687.774	
262460	0.070	687.843	687.913		687.946	
262470	0.057	687.884	687.941		688.335	
262480	0.043	687.928	687.971		688.386	
262490	0.043	687.958	688.001		688.271	
262500	0.030	688.001	688.031		688.153	
262510	0.058	688.003	688.061		688.248	
262520	0.084	688.008	688.091			
262530	0.088	688.033	688.121		688.210	
262540	0.091	688.060	688.151		688.081	
262550	0.087	688.094	688.181		688.097	
262560	0.083	688.128	688.211		687.985	
262570	0.080	688.161	688.241		688.061	
262580	0.076	688.195	688.271		688.120	
262590	0.063	688.238	688.301		688.134	
262600	0.051	688.280	688.331		688.157	
262610	0.051	688.31	688.361		688.202	
262620	0.051	688.34	688.391		688.234	
262630	0.049	688.372	688.421		688.249	
262640	0.046	688.405	688.451		688.260	
262650	0.033	688.448	688.481		688.217	
262660	0.022	688.489	688.511		687.955	
262670	0.023	688.518	688.541		688.252	
262680	0.02	688.546	688.566		688.319	
262690	0.019	688.567	688.586		688.365	
262700	0.014	688.588	688.601		688.392	
262710	0.013	688.599	688.612		688.368	
262720	0.012	688.61	688.622		688.360	
262730	0.006	688.626	688.632		688.415	
262740	0.001	688.641	688.642		688.454	
262750	0.004	688.651	688.655		688.508	
262760	0.009	688.663	688.672		688.536	
262770	0.007	688.686	688.692		688.520	
262780	0.008	688.708	688.716		688.524	
262790	0.011	688.731	688.741		688.532	
262800	0.011	688.755	688.766		688.542	
262810	0.003	688.788	688.791		688.584	
262820	-0.003	688.82	688.816		688.616	
262830	0.003	688.837	688.840		688.620	
262840	0.008	688.852	688.860		688.627	
262850	0.026	688.85	688.876		688.669	
262860	0.038	688.851	688.889		688.701	
262870	0.030	688.868	688.899		688.728	
262880	0.023	688.886	688.909		688.760	
262890	0.016	688.903	688.919		688.773	
262900	0.010	688.919	688.929		688.800	
262910	0.009	688.929	688.939		688.779	
262920	0.010	688.938	688.949		688.753	
262930	0.025	688.942	688.966		688.761	
262940	0.045	688.948	688.993		688.767	
262950	0.055	688.975	689.030		688.779	
262960	0.062	689.013	689.075		688.812	
262970	0.026	689.097	689.123		688.896	
262980	-0.010	689.181	689.171		688.960	
262983.19	-0.009	689.195	689.186		688.967	
262990	0.019	689.181	689.199		688.984	
262995.766	0.000	689.21	689.210		689.005	

* NOTE: ALL RAIL LEVELS REFER TO THE LOW RAIL.

PROPOSED LOOP (MC01)

SCALE: H 1:1000
V 1:100

SCALE 1:2000 AT A3 SIZE
SCALE 1:1000 AT A1 SIZE

Design accepted for use by JHR-CRN*

SIGNATURE

TITLE

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Transport for NSW
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bgeeng.com—
BG&E

PROJECT No. S15066

DRAWN J.B.
DRG CHECK S.W.
DESIGNED S.W.
DESIGN CHECK B.K.
APPROVED

TARAGO LOOP EXTENSION

261.280km - 263.100km

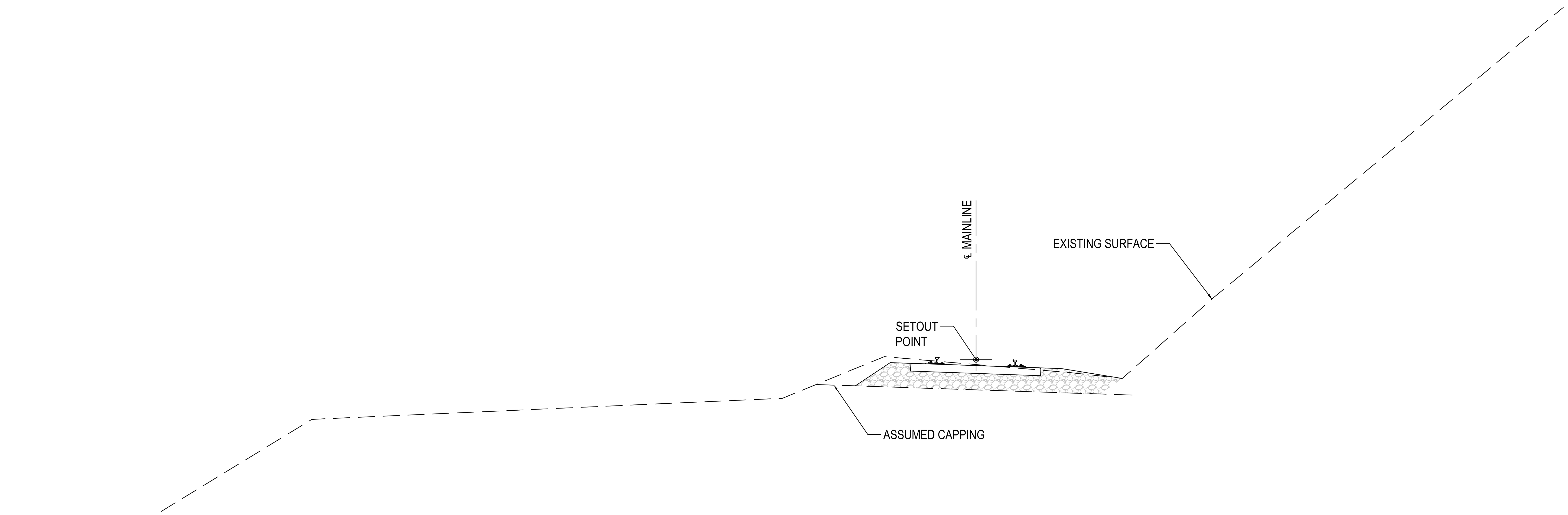
PLAN AND PROFILE (MC11)

262.450km - 263.100km

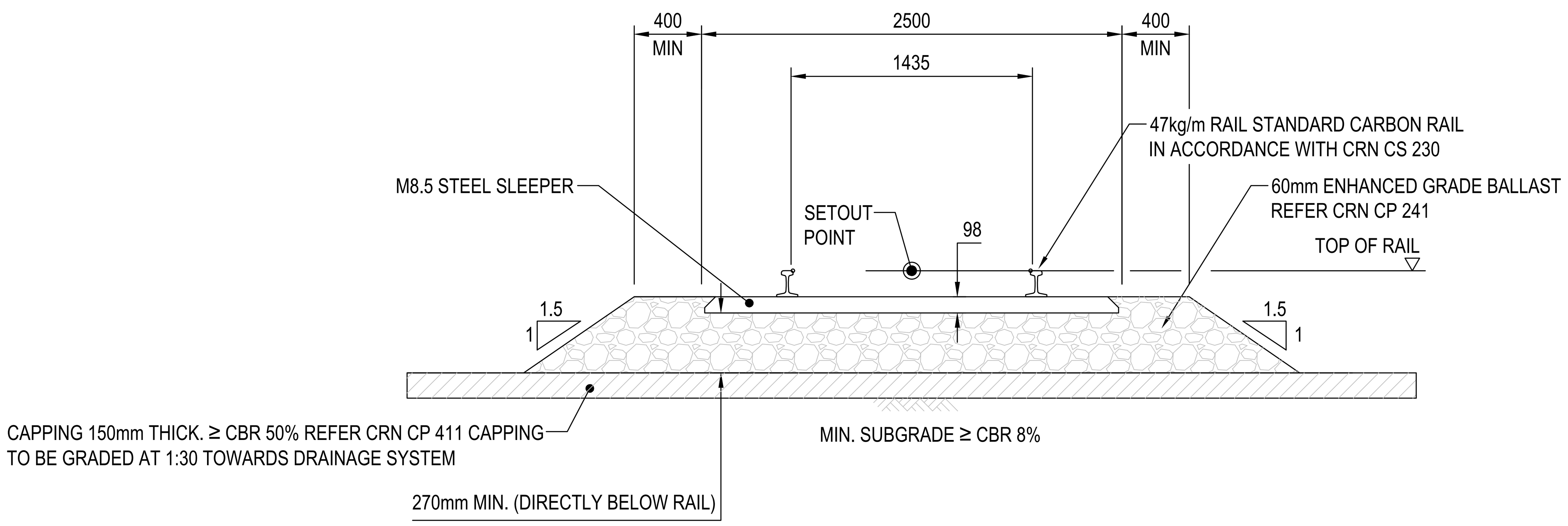
SHEET 2

FILE No. S15066
STATUS: FOR CONSTRUCTION
DRG No. CC000162-C-2103 | 0
SHEET: 2 OF 2 | A1
AWP PROJECT No. 1617-341 | ©
EDMS No.

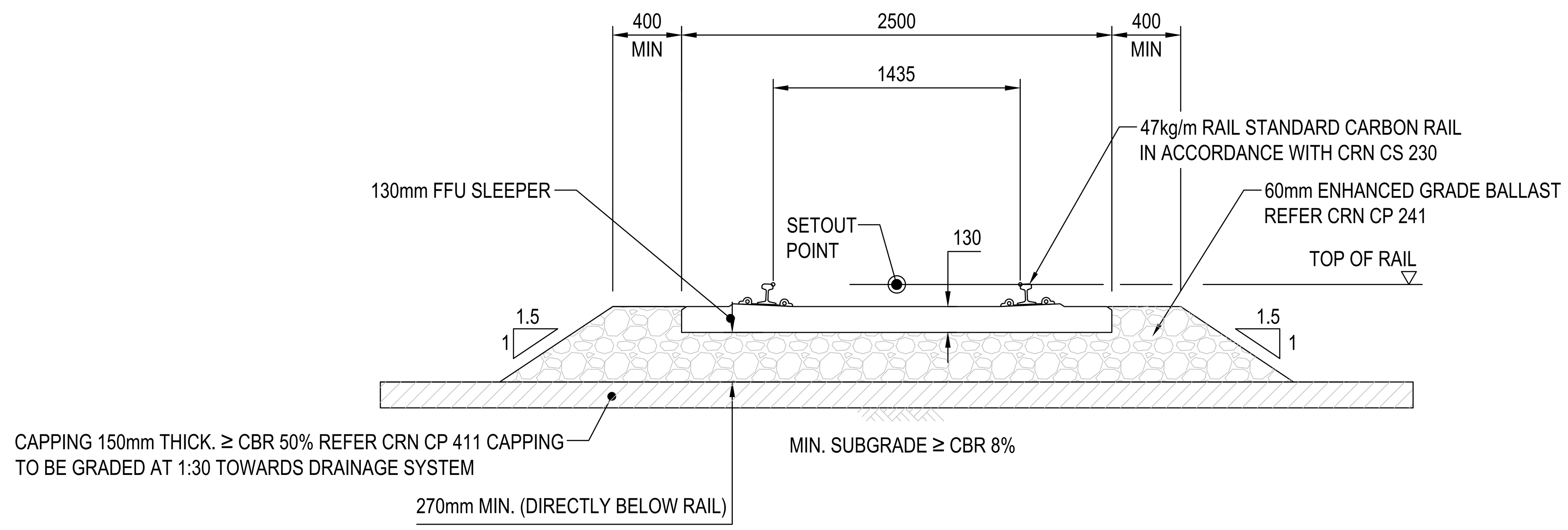
NOTE:
1. FOR GEOTECHNICAL REQUIREMENTS, REFER TO SECTION 5 OF GENERAL NOTES ON DRAWING C-2002.



SECTION 1 (261.860km)
SCALE 1:50 C-2100



TYPICAL SECTION - TYPE A FORMATION - PROPOSED LOOP EXTENSION
SCALE N.T.S.



TYPICAL SECTION - TYPE B FORMATION - TRANSITION ZONES
SCALE N.T.S.

0 0.5 1.0 1.5 2.0 2.5 3.0m
SCALE 1:100 AT A3 SIZE

0 0.5 1.0 1.5 2.0 2.5 3.0m
SCALE 1:50 AT A1 SIZE

DeskSite No. 1815967 Rev 5 P:\BGE\SYD\S15066\100 Drawings\102 Civil\AutoCAD\S15066-DRG-C-2300 To 2302 By: Adam Evans Plot Date: 14/7/2017 3:51 PM

Design accepted* for use by JHR-CRN

SIGNATURE

TITLE

DATE

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A1 Original | Co-ordinate System: MGA Zone 50 | Height Datum: A.H.D. | Scale: 1:50

NSW GOVERNMENT Transport for NSW

John Holland

COUNTRY REGIONAL NETWORK

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PROJECT No. S15066

BG&E

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DRG CHECK S.W.
DESIGNED S.W.
DESIGN CHECK B.K.
APPROVED

TARAGO LOOP EXTENSION
261.280km - 263.100km
TYPICAL SECTION
SHEET 1

FILE No. S15066		SHEET: 1 OF 3	A1
STATUS: FOR CONSTRUCTION		AWP PROJECT No. 1617-341	©
DRG No. CC000162-C-2300	0	EDMS No.	

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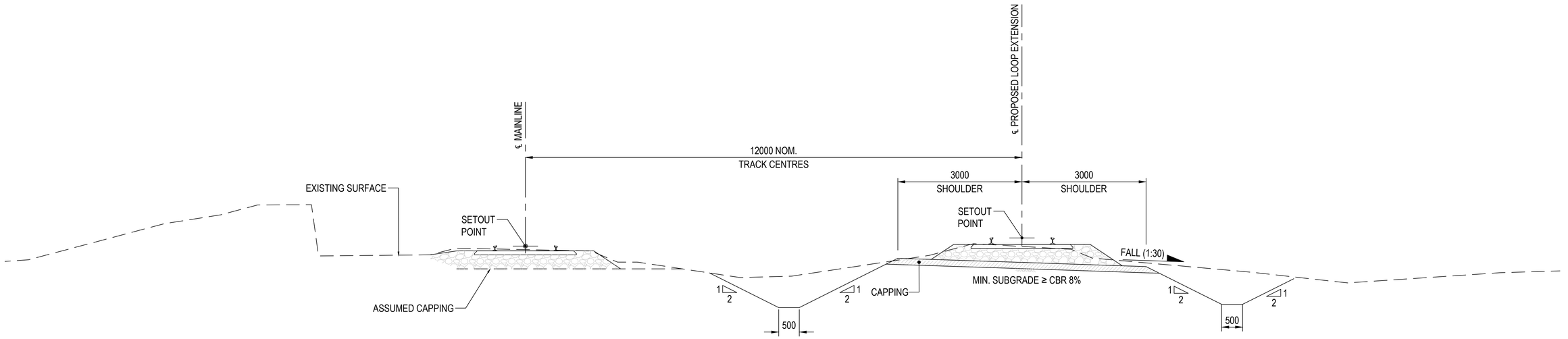
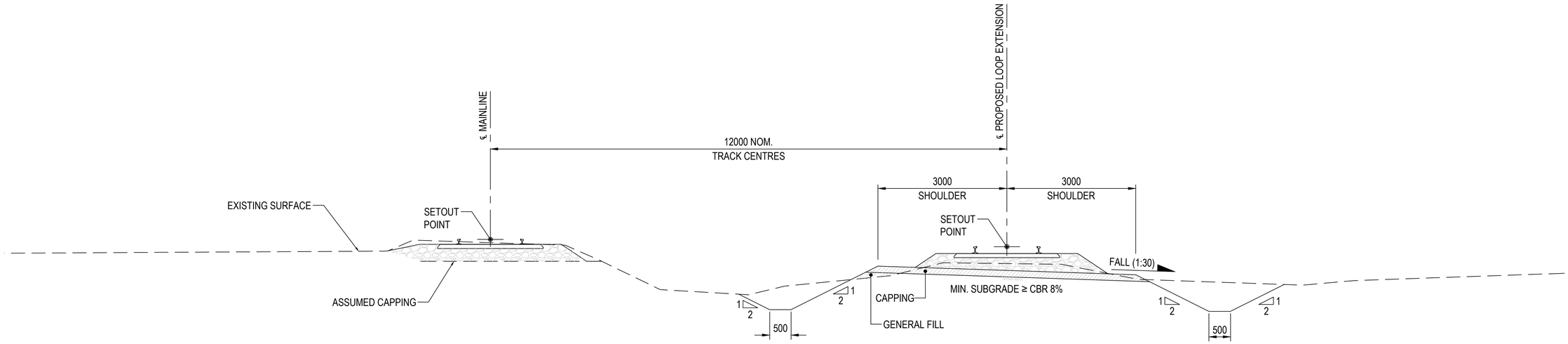


SECTION 3 (262.240km)
SCALE 1:50 C-2102



SECTION 2 (262.120km)
SCALE 1:50 C-2102

0 0.5 1.0 1.5 2.0 2.5 3.0m
SCALE 1:100 AT A3 SIZE
0 0.5 1.0 1.5 2.0 2.5 3.0m
SCALE 1:50 AT A1 SIZE

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APPROVED

TARAGO LOOP EXTENSION
261.280km - 263.100km
TYPICAL SECTION
SHEET 2

FILE No. S15066	SHEET: 2 OF 3	A1
STATUS: FOR CONSTRUCTION	AWP PROJECT No. 1617-341	©
DRG No. CC000162-C-2301 0	EDMS No.	

DeskSite No. 16159671 Rev 5 P:\BGE\S15\S15066\WP Drawings\402 Civil Auto\CAD\S15066-DRG-C-2301 To 2302 By: Adam Evans Plot Date: 14/7/2017 3:51 PM

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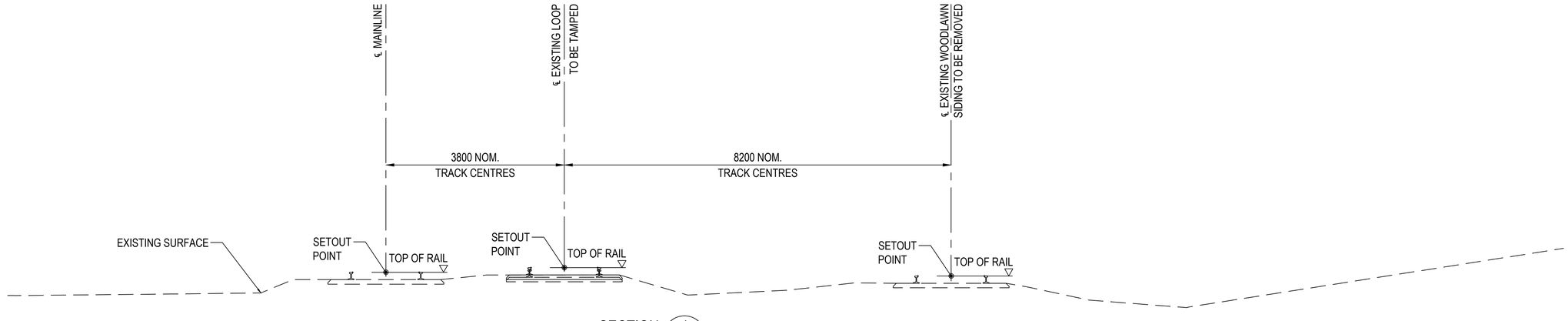

SECTION 4 / C-2103 (262.580km)
SCALE 1:50

0 0.5 1.0 1.5 2.0 2.5 3.0m
SCALE 1:100 AT A3 SIZE
0 0.5 1.0 1.5 2.0 2.5 3.0m
SCALE 1:50 AT A1 SIZE

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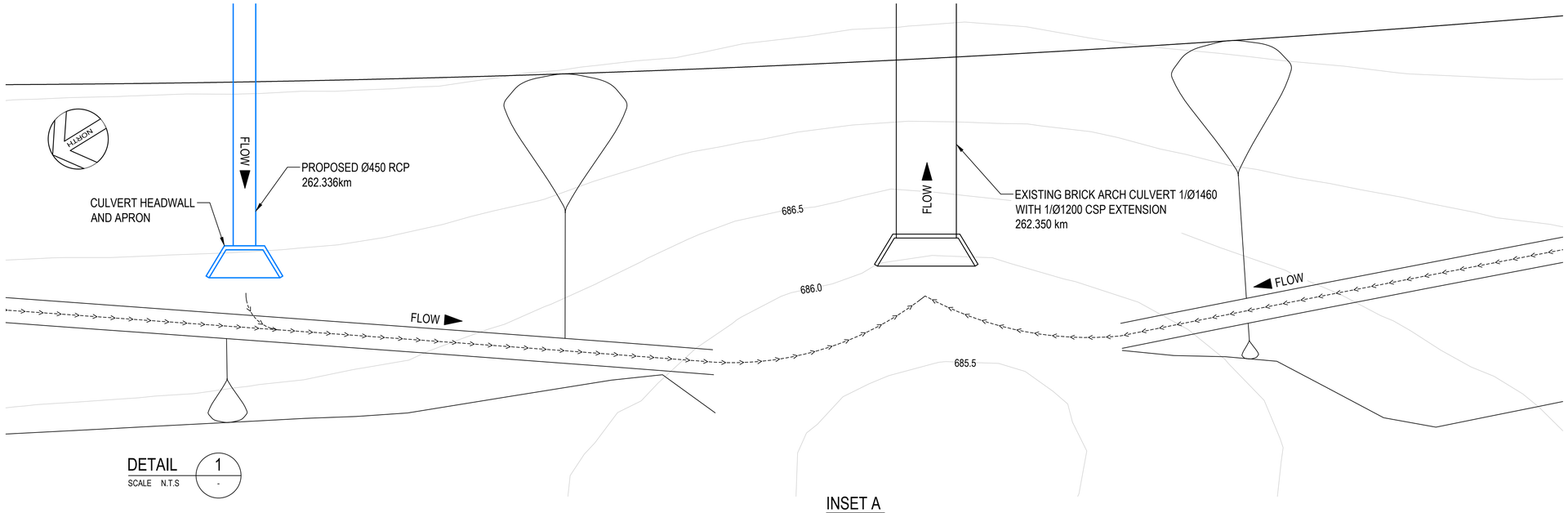
TARAGO LOOP EXTENSION
261.280km - 263.100km
TYPICAL SECTION
SHEET 3

FILE No. S15066	SHEET: 3 OF 3	A1
STATUS: FOR CONSTRUCTION	AWP PROJECT No. 1617-341	©
DRG No. CC000162-C-2302 0	EDMS No.	

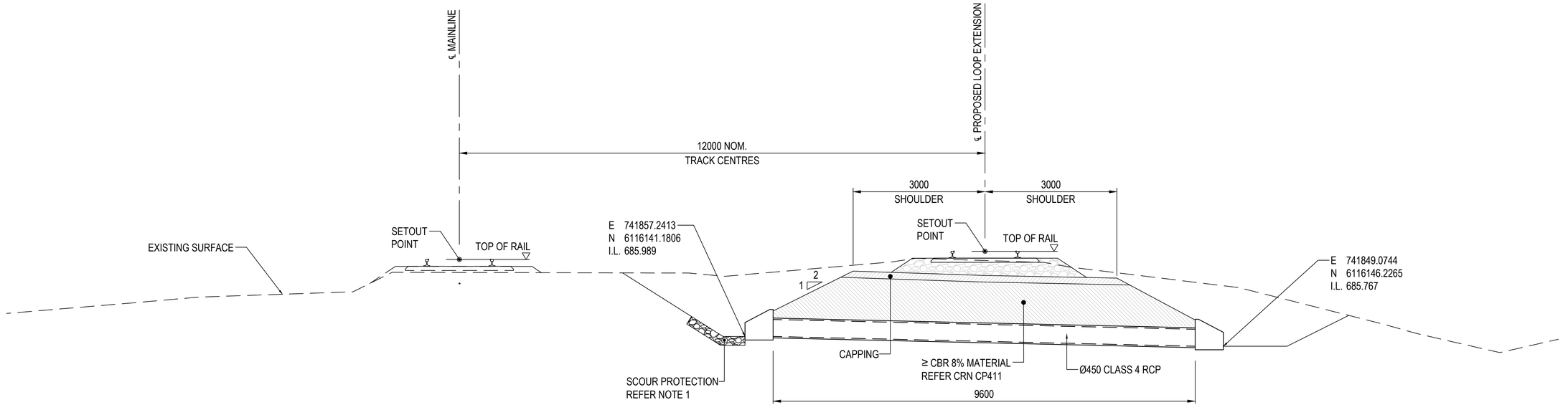
DeskSite No. 18159067 Rev 5 P:\BGE\CVD\S15066\180 Drawings\182 Civil\Auto\dgn\S15066-CC-2300 To 2307 By: Adam Evans Plot Date: 14/7/2017 3:51 PM



DETAIL 1
SCALE N.T.S -

INSET A
SCALE 1:50

NOTE:
1. SCOUR PROTECTION, AS REQUIRED DESIGNED IN ACCORDANCE WITH CRN CM 301 - STRUCTURES GENERAL. THE DESIGN AND PROVISION OF SCOUR PROTECTION MAY BE ALTERED AT THE DISCRETION OF THE SUPERINTENDENT, REFER DETAIL 1.



CULVERT SECTION A (262.336km)
SCALE 1:50

0 0.5 1.0 1.5 2.0 2.5 3.0m
SCALE 1:100 AT A3 SIZE
0 0.5 1.0 1.5 2.0 2.5 3.0m
SCALE 1:50 AT A1 SIZE

Design accepted for use by JHR-CRN*

SIGNATURE

TITLE

DATE

**JHR-CRN signatures on this drawing do not signify acceptance of responsibility for the design. Responsibility for integrity, safety and dimensional accuracy of the design remains with the approving authority.*

REV	BY	DATE	DESCRIPTION	APPD.
0	S.O'B	14.07.17	ISSUED FOR CONSTRUCTION	B.K.

A1 Original | Co-ordinate System: MGA Zone 50 | Height Datum: A.H.D. | Scale: 1:50

NSW GOVERNMENT Transport for NSW
John Holland | COUNTRY REGIONAL NETWORK

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PROJECT No. S15066

DRAWN J.B.
DRG CHECK S.W.
DESIGNED S.W.
DESIGN CHECK B.K.
APPROVED

TARAGO LOOP EXTENSION
261.280km - 263.100km
CULVERT DETAIL - SECTION A

FILE No. S15066 | SHEET: 1 OF 1 | A1
STATUS: FOR CONSTRUCTION | AWP PROJECT No. 1617-341 | ©
DRG No. CC000162-C-2350 | 0 | EDMS No.

DeskSite No. 1815967 Rev 5 P:\BGE\S15\S15066\100 Drawings\102 Civil\Autocad\S15066-DRG-C-2350 By: Adam Evans Plot Date: 14/12/2017 4:48 PM

ARCADIS Design & Consultancy for natural and built assets

TARAGO LOOP EXTENSION – OPTION 1 MOTORISED OPTION

SIGNALLING FUNCTIONAL OPERATIONAL SPECIFICATION

11 OCTOBER 2017

Incorporating Hyder

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JHR CRN
TARAGO LOOP EXTENSION – OPTION 1 MOTORISED OPTION

SIGNALLING FUNCTIONAL OPERATIONAL SPECIFICATION

Author	Mark Fergus	
Checker	Matt Nelson	
Approver	Peter Hyde	

Report No	A0001-AA00-AAZ-02
Date	11/10/2017
Revision	3.4

REVISIONS

Revision	Date	Description	Prepared by	Approved by
0.1	20/03/2017	Initial draft for internal comment	Mark Fergus	Peter Hyde
0.2	03/05/2017	Initial draft production after project halt.	Mark Fergus	Peter Hyde
0.3	05/05/2017	Review updates	Mark Fergus	Peter Hyde
1.0	08/05/2017	Updated For external release	Matt Nelson	Peter Hyde
1.1	19/05/2017	Updated to stakeholder comments	Matt Nelson	Peter Hyde
2.0	22/05/2017	Updated to review Comments and external release	Matt Nelson	Peter Hyde
2.1	13/07/2017	Addition of TMaCS Remote Control	Mark Fergus	Peter Hyde
2.2	17/07/2017	Updated to internal review	Mark Fergus	Peter Hyde
3.0	24/07/2017	Update for External Release	Mark Fergus	Peter Hyde
3.1	18/08/2017	Updated to CRC review comments	Matt Nelson	Peter Hyde
3.2	25/08/2017	Updated to internal review comments	Matt Nelson	Peter Hyde
3.3	15/09/2017	Updated to Stake Holder comments	Matt Nelson	Peter Hyde
3.4	11/10/2017	Updated to TMACS changes	Matt Nelson	Peter Hyde

CONTENTS

APPENDICES

1 SIGNALLING FUNCTIONAL OPERATIONAL SPECIFICATION – CLIENT ACCEPTANCE

Tarago Loop Extension

JHR CRN Approvals	Signature
Mitch Scealy Fixing Country Rail – Program Manager	
Rodney Masman Track Manager	
Ben Hope Operations Manager	
Jason Leonard Signal Manager	
Stewart Rendell Principal Signal Engineer	

CRC Approvals	Signature
Michael Sanders Operations Manager	
Mark Mills Engineering Manager	

2 GLOSSARY

Abbreviation	Term
CBI	Computer Based Interlocking
GIJ	Glued Insulated Joints
I/O	Input and Output
JHR-CRN	John Holland Rail Country Regional Network
PSTN	Public Switched Telephone Network
RVD	Rail Vehicle Detection
TfNSW	Transport for New South Wales
TMaCS	Train Management and Control System
TOC	Train Operating Conditions
UPS	Uninterruptable Power Supply

3 REFERENCES

The following documents were referenced in the development of this SFOS.

1. JHR CRN – Tarago Loop Extension – Scope of Works (Signalling) – Version 3 – 20-Dec-2016
2. JHR CRN – Network Rules CNSY 502 – Train Order System – Version 4.0 – 3/7/2015
3. BG&E – Tarago Loop Extension – Design Report – S15066-DES-REP-001 REV/A – 20/08/2015
4. JHR CRN – Signalling Design Principles – Train Order Working CRN SD 019 – Version 2.1 – November 2016
5. BG&E – Tarago Loop Extension CC000162 IFC - Option 1 (signed) – 01/08/2017

4 INTRODUCTION

4.1 Background

Tarago loop and Crisps Creek sidings are located in southern NSW on the Canberra line, between Joppa Junction and Canberra terminus. The loop line at Tarago has been identified as an issue due to its insufficient length of 526m, which cannot accommodate the trains using the line. The current functionality requires the trains to be broken up and spread across multiple sidings in order to allow another train to pass.

The intention of JHR CRN is to partially reuse the existing Woodlawn siding to extend the loop towards Sydney to accommodate longer trains. The Woodlawn siding is currently booked out of use. The reuse of the Woodlawn siding formation combined with the Bungendore Road level crossing which is located 40m country side of the loop, means that ideally the Sydney side of the loop will be extended.

Tarago and Crisps Creek utilises Train Order Working as its method of safe working operation. With Bungendore Rd level crossing adjacent to the loop, the location implements Main Line Indicators to operate the crossing and improve train movement efficiency.

4.1.1 Tarago

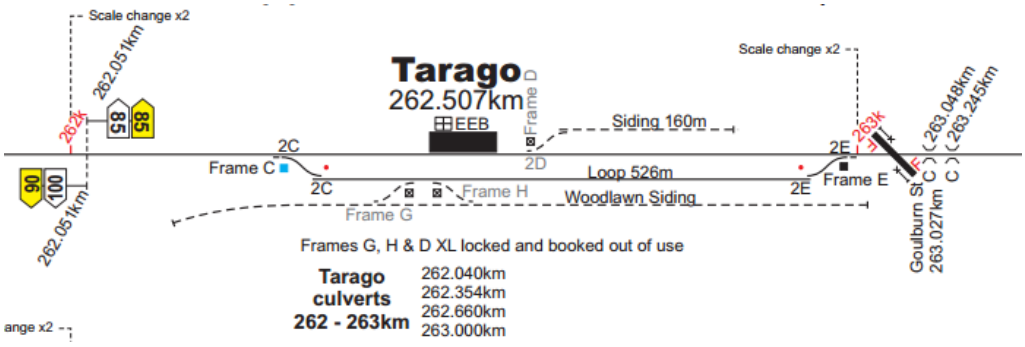

Figure 1 - Existing Tarago location – JHR CRN TOC Manual – Southern Section pages

There are currently 3 MLIs in place that at Tarago, Y and E are adjacent to Bungendore Rd level crossing and C is on the down approach to the loop on the main line at 262.330km. There are pushbuttons for the Y and E location nearby the MLI whilst Y can also be set for a train stationed at the platform.

4.1.2 Crisps Creek

Crisps Creek currently has 2 MLIs, A and B, located at either end of the siding and indicate for the current position of the ground frames, Frame A and Frame B. These MLIs are independent of Tarago MLIs, however the scope has been increased to link these two locations such that trains can be given advanced warning of the aspects into the yards.

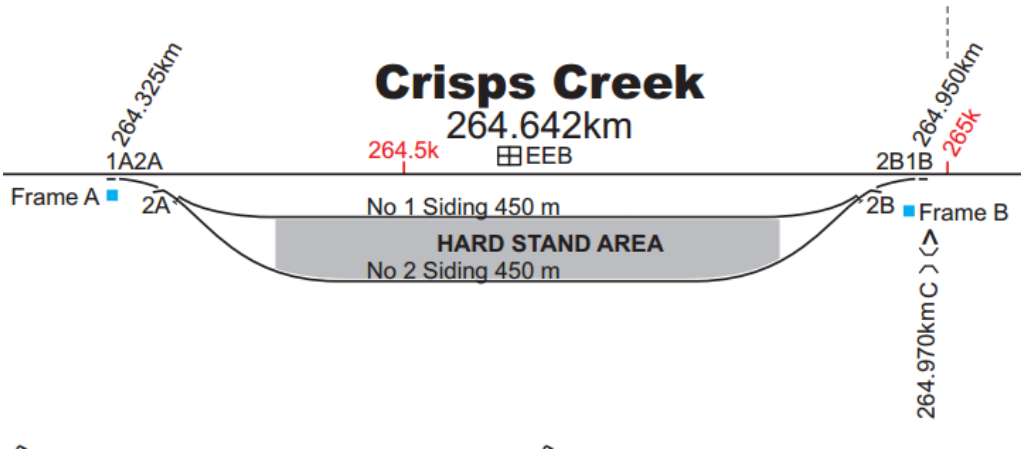

Figure 2 - Existing Crisps Creek Location - JHR CRN TOC Manual Southern Section pages

The existing layout of the signalling system for the arrangement at Tarago and Crisps Creek can be found in Appendix A.

4.2 Project Business Case

Veolia have secured a contract to increase the amount of waste they are processing and in turn increase the volume of waste transported from Sydney to Crisps Creek Intermodal Terminal. Pacific National and Veolia have indicated to Transport for NSW (TfNSW) to extend the loop at Tarago to increase the standing room to enable them to increase the waste processing.

The loop extension will enable Pacific National to completely store one train off the mainline without the current requirement of sectioning the train across multiple sidings. The increase in train movements through the location as well as a proposed increase to the length of the trains means that the lengthened standing room of the loop will improve the efficiency through the area.

4.3 Purpose

The purpose of this Signal Functional Operational Specification is to provide JHR CRN and its stakeholders with the requirements for the signalling infrastructure that is to be designed and installed at Tarago. It is also to provide sufficient understanding of the existing and proposed site and infrastructure conditions to enable stakeholders to become familiar with the project. It will also detail the operational usage of the extended loop line.

4.4 Project Scope

The overall objective of the project is to provide an extension to the loop line located at Tarago (TRS50230A, TRS50262B, TRS50262A) and to provide following aspects between Crisps Creek and Tarago. The line speed at Tarago will also be increased from 85km/hr to 100km/hr that will require Tarago Bungendore Rd level crossing to be upgraded to include boom gates. To achieve the full operational benefits of motorising the loop line points, the interlocking will also be remote controlled from TMACS that will allow the system to set the points for the loop depending on the current train order.

The proposed detailed signal design for the extension of the loop line at Tarago and connection to Crisps Creek requires the following operational aspects to be delivered in order to meet stakeholder needs, expectations and project design phase objectives;

4.4.1 Design Deliverables

- Signalling Functional & Operational Specifications report (this document)
- Signalling Plans
- Track Insulation Plans
- Signal Sighting Documents
- Drivers Diagrams
- Control Tables
- Circuits
- Microlok Data
- Modem Configuration Files
- Design Integrity Test Plan
- Principles Testing
- Safe Notice

5 OPERATIONAL REQUIREMENTS

5.1 Tarago

Topic	Requirement
Line Speeds (Existing)	• 85km/hr mainline speed in both up and down direction. • 25km/hr speed for the turnouts in the up and down ends, at frame C and frame E.
Line Speeds (new)	• 100km/hr mainline speed in both up and down direction. • 40km/hr turnout speed in the up direction at new 51 points.
Loop Length	• Ability to cross up to a 1000m train standing in loop
Level Crossing	• Approaches to be increased to 30 secs @ 100km/hr • Half width frangible boom barriers to be added to new level crossing standards
Braking Curve	• GW-16
Motorised points	• Points to auto-normalise within the Tarago loop to the main line.
Mainline Indicators (MLIs)	• Aspect sequence to be connected with Crisps Creek

5.2 Crisps Creek

Topic	Requirement
Line Speeds	65km/hr mainline speed in both up and down direction (As existing) 70km/hr mainline speed in both up and down direction for XPT (As existing) 25km/hr speed for the turnouts in the up and down ends, at frame A and frame B.
Braking Curve	GW-16
Mainline Indicators (MLIs)	Aspect sequence to be connected with Tarago

6 EXISTING SIGNALLING EQUIPMENT

The following identifies the signalling equipment located at the existing sites of Tarago and Crisps Creek.

6.1 Control System

The method of safe working that is in use at Tarago and Crisps Creek is Train Order Working or TOW. The train orders authorise train movements between train order locations and Train Management and Control System (TMaCS) to maintain the integrity of the TOW safe working system.

6.2 Line Side Signalling Infrastructure

The Signalling Infrastructure installed at Tarago consists of the following;

- Location boards to identify the location as well as the braking point for approaching trains.
- Landmarks to identify the braking point for approaching trains.
- Yard limit boards which identify the limits of the yard.
- Shunt Limit boards which identify the boundaries of the yard in which shunting is permitted.
- Ground frames which are used to operate the mechanical points are released by operator's keys. Tarago has three 2 lever ground frames on the Sydney side of the Bungendore Rd level crossing. Crisps Creek has two 2 lever ground frames at either end of the sidings.
- Main line indicators to indicate that the infrastructure conditions beyond the MLI are acceptable for a train to proceed.

6.3 Crisps Creek Siding

The Crisps Creek siding located on the country side of the Tarago loop, although it is within the Tarago Yard Limits, it is not electrically connected to Tarago. Therefore, the MLIs located at Crisps Creek do not repeat aspects of Tarago and similarly, Tarago MLIs do not repeat the aspects of Crisps Creek.

To ensure that the signalling system is compliant with JHR CRN standards, the MLIs between Tarago and Crisps Creek are provided with landmarks to ensure that an approaching train is aware of the braking point required to safely stop if the MLI is displaying a red aspect.

6.4 Bungendore Rd Level Crossing

Bungendore Rd level crossing is situated 40m country side of Tarago loop. It is an active 'F' type relay operated level crossing with lights and bells only. The adjacent MLIs provide an indication the crossing with pushbuttons provided. Shunters pushbuttons are also provided on both sides of the road for manual operation during shunting moves.

7 PROPOSED SIGNALLING WORK

7.1 Introduction

The signalling arrangement that will be completed through the design process will provide 1000m of standing room within the loop line. The layout of the area will see the Sydney side end of the loop line extended 403m to accommodate for the new standing room.

Additionally, Tarago and Crisps Creek will be electrically connected to provide repeating aspects to the aspect sequence between the two locations. This will involve linking A location in Crisps Creek to Bungendore Rd Crossing location at Tarago with a copper multicore signalling cable. This will carry the signal control functions for the upgraded aspects in X MLI, Y MLI and B MLI.

The line speed through Tarago is to be increased from 85km/hr to 100km/hr, this will require the level crossing to have booms installed on new crossing standards.

The proposed concept for the signalling arrangement at Tarago is in Appendix A.

The design will refurbish both ends of the Tarago loop to improve efficiency through the location. The turnouts will be motorised to eliminate the need to manually operate the points via a ground frame. This will require new Jeumont Schneider track circuits to be installed over the turnouts.

Main line indicators will be positioned throughout the yard to provide the driver with an aspect indicating the current position of the points and level crossing health. Adjacent to each signal will be pushbuttons for setting the desired route as well as operating Bungendore Rd level crossing where required.

The location will implement two Microlok II computer based interlockings also known as CBIs to operate motor points and MLIs within the Tarago yard. The safeworking operation will remain as Train Order Working, however the movements through Tarago will be automated using motorised points and driver pushbuttons for MLI's with controls from a Microlok and TMaCS interface.

7.2 Locality and Naming conventions

The location name of Tarago will not change nor will the specified locality of Tarago as being 262.544km. The existing infrastructure will be mostly be removed and replaced with new points, MLI's, and location enclosures. The naming convention of this new equipment will be in accordance with JHR CRN standards.

Crisps Creek's locality and name will remain as it is. The existing equipment and infrastructure will retain the previous naming conventions.

7.3 Interlocking Equipment

The signalling interlocking equipment used at all locations will be of Microlok II type using the new type of CPU cards with ethernet connectivity.

All walk-in locations containing Microlok equipment will be provided with air conditioning.

Lamp driver cards shall not be used for this project.

Discrete vital disconnection facilities will not be provided for individual signal routes and points due to the ability to disconnect local control relays.

7.3.1 Telemetry

A Kingfisher RTU telemetry system will be provided at Bungendore Road crossing location to transfer non-vital controls and indications between the Tarago Interlocking and the TMaCS at Mayfield. The non-vital TCS link will consists of a Telstra 4G modem and a PSTN line as a diverse link.

The Kingfisher will be housed in the Bungendore Rd level crossing hut and will be connected via a serial link to Port 4 on the B.RD Microlok. The Mayfield Network Control Centre will require the TMaCS system be updated to accept the remote control. This will be completed independently of the signalling works. The principles testing will require a stripped-out version of the TMaCS without any non-vital locking along with the final version to prove the operation.

7.4 Train control system

The TMaCS database will require updating for the relocated infrastructure to be implemented as part of this project. This will be the responsibility of JHR CRN to ensure these changes are made to the TMaCS database.

To improve the efficiency, remote setting of train paths in and out of the loop as well as main line movements will be provided. This will allow approaching trains to enter the loop without the need to stop and manually operate driver's pushbuttons. Also, assuming the remote setting has been performed before the arrival of the train, the 2 minute approach timing will not be observed by the train.

The quiescent state of the loop will be all points normal and MLI's set for main line movements.

The TMaCS system will give a train order to enter the main or loop line at Tarago. Upon the train order becoming current, a command will be delivered to the CBI through a Kingfisher interface for the desired train movement. The points will be set according to the route request and the MLIs will display the appropriate indication after the approach locking time of 120 seconds has expired.

Local pushbuttons will also be provided on site to allow train crews to set and move around the yard with the use of an operator's key

The interlocking will receive one of eight different routes dependent on the desired train movement. These will be:

- Down Main Entry
- Down Loop Entry
- Up Main Depart
- Up Loop Depart
- Up Main Entry
- Up Loop Entry
- Down Main Depart
- Down Loop Depart

After the train has completed the move with the points reverse, the points at each end of the loop will auto-normalise and the quiescent state of the interlocking will be restored. A train order route cancel bit will also be provided to initiate the auto-normalisation of the points should circumstances dictate.

MLI's for the mainline will automatically re-clear after a passage of a train and will have a 120 second approach locking timer if cancelled that will lock the points in the current position until this time has elapsed. To negate this timer, the MLI's on the mainline will not automatically re-clear instantly after the passage of a mainline train. This will create a window of opportunity to allow setting of the MLI's without incurring the 120 second cancelling delay. The suppression of the mainline re-clearing after the passage of a mainline train will be set to match the section running time. This will

reduce the time delay of train departing from the loop after the passage of a train down the mainline in either a crossing or passing move.

Shunt orders from TMaCS will not operate the points remotely and the train crew will be required to set train movements through the driver's pushbuttons. The local track circuit occupation will allow the approach locking to quick release and shunting to be performed efficiently.

7.4.1 Remote Monitoring

The following indications and alarms will be remotely monitored by the 4Tel Alarm Management System to enable shorter MTTR or Mean Time To Recovery:

- Track circuits
- Point position and status
- Power supply warning and alarm indications (refer to Section 5.6.5)
- Communication equipment warning and alarm indications e.g. Ethernet switch

The indications will be monitored via the CBI system interfacing with the Kingfisher. New alarms generated at 51 PTS and Bungendore Rd crossing shall be communicated back to the SIGWAN via a Kingfisher with a Telstra Next G connection.

7.5 Signage

The existing boards at the Sydney end of the yard will be required to be relocated as discussed below. The location of the new boards for Tarago shown on the preliminary layout are subject to a signal sighting committee and may be required to be moved to suit the site conditions.

7.5.1 Up Shunt Limit

The existing up shunt limit board located at 261.150km will be relocated to 260.000km and will provide a shunt limit of 1865m on the Sydney side of 51 points for the loop line. The proposed location for the TOP for 51 points is 261.865km.

7.5.2 Down Yard Limit

The existing down yard limit board located at 260.650km will be relocated to 500m on the Sydney side of the new up shunt limit board at a new location of 259.500km. This board's location is in close proximity to 3 Private level crossings that provide access to farm land. A train standing at the new down yard limit could impede the level crossing depending on the selected location after the signal sighting. Consideration should be given to these roads during the signal sighting.

7.5.3 Down Location Board

The existing down location board located at 258.650km will be relocated to 2100m on the Sydney side of the down yard limit at a new location of 257.400km.

7.6 Level Crossings

7.6.1 Bungendore Road

Bungendore Rd level crossing approaches will be reconfigured for an increase to a speed of 100km/hr. A risk assessment concluded that due to the speed increase, booms will be required at the level crossing. The hut will be replaced by a larger hut which will house the Microlok, point controls and other signalling equipment.

7.6.1.1 Level crossing hut

The Bungendore Rd level crossing hut will be removed and a new hut installed with a larger capacity and named B.RD. The level crossing controls will be output from the new Microlok II installed within the B.RD hut. The existing track circuits used for operating the crossing will be input into the Microlok II and used internally for the crossing controls as well as MLI operating functions.

7.6.1.2 Level crossing controls

The level crossing will also be provided with a recovery path in the event of a Microlok failure. If the track circuits are not occupied at the time of failure the level crossing will not continuously operate.

7.6.1.3 Level crossing approaches

Bungendore Rd level crossing approach is configured for an 85km/hr approach on both sides of the level crossing. The existing warning time is configured for a 25 secs approach as boom motors are not installed.

The level crossing approaches are to be increased in time to cater for the road offset width calculation and minimum time required for a crossing with booms.

7.6.2 Private crossings

There are also 3 passive private level crossings on the Sydney side of the yard that could be affected by the relocation of the shunt and Yard limit boards. Trains standing at the down yard board waiting for yard entry may block the road. Consideration will need to be given during the signal sighting.

7.7 Points

The ground frames C and E will be removed and replaced with motorised turnouts. The proposed machines are Siemens M3A MKII. The motorising of the turnouts will alleviate the need to manually operate the ground frame. The operation of the points will be through the setting of the MLIs via push buttons and via remote control from Mayfield. The Microlok II CBI will output the control relays. Clawlock mechanisms are not to be used on this project.

The points will also have an auto normalising feature where the points after being used in the reverse position will operate to the normal positon for a through train. This feature will be controlled via track circuit occupation. The auto normalising feature will be will be contained within the Microlok II logic and not at Mayfield.

A caution label shall be applied to the point motor case for maintenance purposes stating “CAUTION – AUTO NORMALISING”. This will serve as a reminder that when working with the points in the reverse position, the points may drive after time if not properly isolated.

The catchpoints within the Loop at Tarago will be removed and physical clearance posts will be installed to convert the siding to a TOW loop location.

7.8 Main Line Indicators

Main line indicators will be installed on both the up and down approaches to the loop, and also on the main line and loop line when exiting the loop from either direction. In total Tarago will implement the 5 new MLI's as well as a replacement head for E MLI.

MLI	Status	Location	Destination	Profile
A MLI	EXISTING	LOC A	Down Shunt Limit	2 aspect head
B MLI	UPGRADED	LOC B	E MLI	Replaced 2 aspect head with 3 aspect head
E MLI	NEW	B.RD	T MLI or W MLI	3 aspect head with band of lights to the left
T MLI	NEW	51 PTS	Up Shunt Limit	2 aspect head
W MLI	NEW	51 PTS	Up Shunt Limit	2 aspect head
X MLI	NEW	B.RD	A MLI	3 aspect head
Y MLI	NEW	B.RD	A MLI	3 aspect head
Z MLI	NEW	51 PTS	X MLI or Y MLI	3 aspect head with band of lights to the right. 5m signal post.

Z MLI will be required to be on at least a 5m post to allow the signal to be sighted over the cutting at the Sydney end of the yard.

All signals shall be driven by 120VAC LEDs via a relay interface.

The MLIs will also be proved to be functioning correctly via lamp proving modules. These modules will be output to the Microlok and fed back to the JHR CRN alarm management system. Signals will step down in aspect when LED modules have failed.

7.9 Train Detection

Jeumont Schneider track circuits shall be used over turnouts, with twin receivers to provide maximum broken rail and train detection.

The down approach and crossing track at Bungendore Rd level crossing will be fed from the new level crossing hut. The track circuits shall be DC Store 72.

The up approach to Bungendore Rd crossing will be a DC solar fed track circuit.

The opportunity to reuse Glued Insulated Joints or GIJs will be taken advantage of to reduce costs.

7.10 Power Arrangements

7.10.1 240VAC Domestic Supplies

The council supply connection will be provided to the new Bungendore Rd Xing hut from the adjacent existing connection point.

The 240VAC mains shall be sized accordingly to carry the signalling system load and domestic load (air conditioning, lighting etc.). The mains cables are to be double insulated and be installed in a separate buried conduit. The scope of the 240VAC design is not included in this document and requires an electrical level 2 service provider.

7.10.2 Generators

A new 240V AC air cooled motor generator with a capacity of 8KVA will be located adjacent to the new Bungendore Rd Xing hut. The generator will not provide a backup supply for the air conditioning or other 240V AC equipment. The generator will provide power to operate the motor points during mains failure.

The Generator alarms are to be interfaced via cables and relays from the generator to Bungendore Rd Xing location.

7.10.3 Uninterruptable Power Supplies

Powerware UPS's shall be used to provide a no-break supply to cover the changeover period in the event of a mains power supply failure. This will ensure a consistent but temporary supply to all vital equipment, excluding motor points at 51 PTS, until such time that the main failure is rectified or the motor generator comes online.

7.10.4 DC Power Supplies

The Microlok II system shall utilise Powernet ADC5000 series power supplies for the 12V DC supply to power the Microlok II system and also to charge the battery back-up bank. The power supplies are to be configured in an "N+1" arrangement.

Due to limited external inputs, there shall be no segregation of external and internal inputs. However, all external inputs circuits shall be fully arrested on the outgoing and filtered on the incoming. The 50V DC power supplies shall be 12-50V DC Powerbox PBIH series and configured in an "N+1" arrangement.

New 50V DC power supplies will be installed at A and B locations at Crisps Creek. These power supplies will be used to replace the existing non-preferred 120V AC ground frame detection for frames A, and B.

7.10.5 Reticulation

Reticulation of the signalling supply from Bungendore Rd Xing hut to 51PTS location shall be via a single 415V AC isolated signalling feed via the existing and new underground cable route. The 415V AC at 51 PTS location will be supplied from a guaranteed 120V AC supply at 52 PTS location.

7.10.6 Earth Leakage Detection

Detection of earth leakage current will be detected by MRD type earth leakage detectors. The preferred detector will be the MRD Earth Logger which is IP connection capable and able to monitor up to 4 buses at once.

7.11 Communications

7.11.1 Local Communications

A secure vital communication link shall be provided at Tarago for localised communications. The vital communication link shall consist of two 12-core single-mode fibre optic cables run between 51PTS and Bungendore Rd level crossing locations.

The redundancy path of the communication ring will be served by a fibre pair on a separate fibre cable.

The Microloks shall be connected to the fibre optic cable via RuggedCom RS400 modems. The RS400 shall automatically control the diversity ring. All communication between the Microloks shall be vital using the Microlok Peer-Peer protocol.

A separate port through the RS400 modem will allow local access for maintenance personnel to safely conduct activities without causing operational concern to the system. The diagnostic tools will be accessible via a connection to port 5 of the MLK CPU card.

7.11.2 Remote Communications

New alarms generated at 51 PTS and B.RD locations shall be communicated back to the SIGWAN via a Kingfisher with a Telstra next G connection. This will allow remote monitoring of signalling equipment to enable shorter MTTR or Mean Time To Recovery.

The Microlok will communicate with the Mayfield control centre via a Kingfisher connected via a 4G modem and PSTN line as a secondary connection. The remote I/O will be displayed and generated by the TMaCS control board in Mayfield. The indications will be confirmed by 4Tel, however the typical RVD style indications will be provided to allow the design of the panel.

All IP addresses to be provided by JHR CRN.

7.12 General Signalling Cables and Routes

The final cable route arrangement is to be determined in consultation with JHR-CRN as part of the DSS and Site Agreement project walk through. All cable routes shall be designed in accordance with standard CRN SC 021.

An opportunity exists to utilise the existing pit and piping around the Bungendore Rd location with the relocation of the hut. The multicore and power feeding D location may be able to be pulled back and re-terminated in the new location hut.

A new 8 pair cable will be run from the existing D location to the new Bungendore Rd level crossing hut. This will carry the functions for frame D back to the Microlok.

Bungendore Rd Crossing location will be connected to A location via a 12pr multicore signalling cable. This will connect Tarago and Crisps Creek electrically and allow the two locations to send the respective frame detection and higher aspects for use in the MLI aspects.

A new 12pr multicore signalling cable will be installed between A and B locations at Crisps Creek to carry the new aspect controls.

7.13 Maintainability

Equipment installed as part of this project shall be installed in such a way that, where possible and within reason, ready and safe access is provided for testing, commissioning and maintenance personnel with minimum exposure to the operational railway.

7.14 Reliability and Availability

The main interlocking equipment proposed for this project is Microlok II Computer Based Interlocking (CBI) system. The system will ensure that the Signalling System has a high level of reliability and availability and will ensure that the level of reactive maintenance required by the Signalling System is minimised.

7.15 Commissioning Strategy

Commissioning for Tarago and Crisps Creek can be conducted on a single weekend possession with the last day having at least 12hrs wheels free for testing.

Prior to the commissioning, all stand alone equipment and systems shall be fully set to work and function tested where possible. This shall be achieved no more than 2 weeks prior to the commissioning date. The equipment includes;

- Microlok II systems
- Rugged Comm Network
- 415VAC Power Distribution
- 120VAC power
- 240VAC Mains power and Generator with UPS configuration
- 12VDC/50VDC power supplies
- Signal aspects set to work with pre-stood signals excluding those existing signals to be modified
- Point motors and detection if possible
- Train Order Working signage
- Track circuits outside of level crossing approach.
- Kingfisher and the TMaCS remote control system

8 TRAIN OPERATIONS

The following is overview of the operational requirements and proposed usage of Tarago Loop Line.

8.1 Train Types

The Clyde train currently using the loop has a length of 58 wagons / 900m and there is no proposed alteration to this train length. A Banksmeadow train is proposed for operation, this will commence with a length of 26 wagons / 405m with the potential to increase the consist to 58 wagons / 900m as per the Clyde train.

8.2 Loop Length and Clearance Points

Refer to the detailed civil design for the location of the clearance points and length of the proposed loop.

8.3 Emergency Equipment box

There is an existing emergency equipment box located at the Tarago platform at 262.544km. There is no change anticipated for this equipment.

8.4 Loop and Siding Access

Access to the Tarago Loop Line will be via the points 51 and 52. The points can be moved by the MLI pushbuttons adjacent to each MLI. The driver can set either the main or loop path from these pushbuttons, the points will operate in accordance, and the MLI aspects will clear when the train can move through.

8.5 Storage

Trains entering the loop line will have 1000m of standing room between the clearance points at each end. The stabling of trains within the Tarago loop will not be permitted as the Tarago loop will be configured in the TMaCS as a crossing location. This will be also indicated by the presence of clearance point markers.

8.6 Train Movements

8.6.1 Through Trains

Through trains will receive a train order which will extend up to the next TOW location or beyond. Upon the train order becoming current the train control system will send a route setting bit and the interlocking will action the points if required. The following sequence will occur:

1. Train movements on the Main Line will proceed through 51 and 52 points in the normal position. The drivers will observe the MLIs normally cleared, which will be a pulsating white indication when the points are set and detected in the normal position and the points deadlocking track circuit is unoccupied. A yellow aspect will be displayed when the MLI ahead displays a stop indication due to track occupation or lack of point detection.
2. On the rare event the points are not set for main line or the route request has not been received, the train crew will set the MLI for the Main Line movement, which will be done via the drivers pushbuttons. The process will be as follows:

a. The Train Crew will insert the Operator's key and depress the 'Cancel' button for 2 seconds. This will place the protecting MLIs to Red and the Main Line MLI in rear at yellow.
b. The 'Points Free' light will flash green until the points become free after 2 minutes
c. When a steady green 'Points Free' light is illuminated, the 'Main' button can be depressed.
d. Providing the points are set and detected normal, the points deadlocking track circuit is unoccupied and the following MLI is clear, the MLI will display pulsating White Aspect.

Note[1]: Setting the MLI for a main line movement will also set the other end points and MLIs for a main line movement.

Note[2]: If the MLIs are displaying a red aspect for the corresponding lye of the points, the local operation via pushbuttons will occur without delay.

8.6.2 Crossing of Trains - Remote

When two trains are to be crossed, the first train will receive a train order for the loop, calling the points reverse and clearing the MLI for the loop. The following sequence will occur:

1. The first train movement into the loop as follows:
    a. Reception of the loop entry route from TMaCS will set the MLIs back to stop and commence the 120 second approach locking timer. (This assumes that the points are set for the main line and MLIs are clear)
    b. The loop entry set of points will commence movement once the approach locking has timed off, the interlocking will set the points reverse whilst the opposite end points will remain normal.
    c. Upon detection of the points the MLI will display a band of lights into the loop.
    d. When the train arrives at the location it will progress into the loop, finalising at the loop exit MLI which will display a red until the departure route is set.
    e. Once the train has cleared the points track circuit, the points will commence auto-normalisation.
    f. When in the loop and clear of the mainline, the fulfilment of the train order is received by TMaCS and the order no longer remains current.
2. The second train can then receive a main line train order up to the next TOW section or beyond and follow a standard through train movement.
3. Train movements out of the loop will require a train order calling a loop departure route. If this order has been received within nominal headway time period, the train can depart without delay as the auto-normalising function will be suppressed. After the nominal headway time period has expired, the main line MLIs will re-clear for main line moves, if a train order is received at this point, it will require the MLIs to be cancelled and approach timers to be timed off.

Note[1]: *Nominal Headway Time Period* – the time in which the interlocking will hold the MLIs at stop to allow the instantaneous setting of points. This will ensure that crossing trains will not have to wait for the approach locking to be released on the mainline MLIs.

8.6.3 Crossing of Trains – Local

When two trains are to be crossed, the first train will receive a train order for the loop. The following sequence will occur:

1. The first train movements into the Loop will require the train crew to set the MLI for the Loop Line movement, which will be done via the Drivers pushbuttons. The process will be as follows:
    a. The Train Crew will insert the Operator's key and depress the 'Cancel' button for 2 seconds. This will place the protecting MLIs to Red.
    b. The 'Points Free' light will flash green until the points become free after 2 minutes.
    c. When a steady green 'Points Free' light is illuminated, the 'Loop' button can be depressed.
    d. Providing the points are set and detected reverse and the points deadlocking track circuit is unoccupied, the MLI will display a Yellow Aspect with Steady Band of White Lights in the direction of turnout indicated.
2. Once the first train is in the loop, the second train will receive a train order up to the next TOW location or beyond.
3. After the second train has cleared the Tarago Yard Limits, the first train will receive a new train order which will extend up to the next TOW location or beyond.
4. Train movements out of the Loop will require the MLI to be set for the Main Line movement, which will be done via the Drivers pushbuttons. The process will be as follows:
    a. The Train Crew will insert the Operator's key and depress the 'Cancel' button for 2 seconds. This will place the protecting MLIs to Red.
    b. The 'Points Free' light will flash green until the points become free after 2 minutes.
    c. When a steady green 'Points Free' light is illuminated, the 'Loop' button can be depressed.
    d. Providing the points are set and detected reverse and the points deadlocking track circuit is unoccupied, the MLI will display a pulsating white indication.
5. Automatic point normalising will be provided on train departure.

An aspect sequence chart is provided in appendix B.

9 PROPOSED SIGNALLING EQUIPMENT

Alternative comparable and compatible devices to those specified below may be considered subject to the approval of the JHR-CRN Standards Engineer and JHR-CRN Signal Maintenance Engineer. Alternative equipment is to be type approved by JHR-CRN. If a new non-approved item is put forward for use, it will be the responsibility of the contractor to gain approval. The following new equipment is proposed for installation:

Equipment	Type
Rail Vehicle Detection	Level Crossing - DC Track Store 72 Up Level Crossing Approach – Solar DC Feed Points - Jeumont Schneider
Signals	Siemens LED 120V AC long range and medium range (to be identified on signal sighting)
Motor Points	Siemens M3A MKII with mechanical back drives *
Relays	Q type relays to be used from an approved manufacturer.
DC Power Supply's	Powernet 12V ADC5000 series. Powerbox 12-50V DC Powerbox
Motor Generator	Kenshaw with Deep Sea Controller and IP interface module. (Note: IP address to be allocated by 4Tel)
Interlocking	Microlok II with PTC Upgradable CPU cards with Ethernet ports, Part Number N17067601.
Input cards	Vital Input 50V DC - N17061003. Non Vital input 12VDC – N17063701
Output Cards	Vital Output 12V DC - N1706050.
ELD	MRD Earth Loggers
UPS	Eaton Powerware 9120 Series.
Surge Protection Equipment	ERICO
Vital Communication	RuggedCom RS400
Internal Non-vital Alarm	Westermo SDW-550
Interlocking TCS Connection	Primary – Telstra NextG – Cybertec 2250W (note) – This will only be for alarm and maintenance purposes only. It will also allow the system to be configured for the future upgrade of the interlocking to interface with TMaCS.
	*To be advised by turnout manufacture to the type and number of thrust points. Not to use a clawlock arrangement.

APPENDIX A

Proposed signalling arrangement at Tarago

Legend

Red= New Work

Green = Removed Work

Black = Existing unchanged.

APPENDIX B

Aspect sequence Chart

APPENDIX C

Communications Architecture

ARCADIS Design & Consultancy for natural and built assets