

TECHNICAL REPORT 03

Updated flooding and hydrology assessment

Appendix N Assessment of local and regional flooding at Narrabri

(Part 20 of 25)

NARROMINE TO NARRABRI PROJECT



TECHNICAL REPORT 03

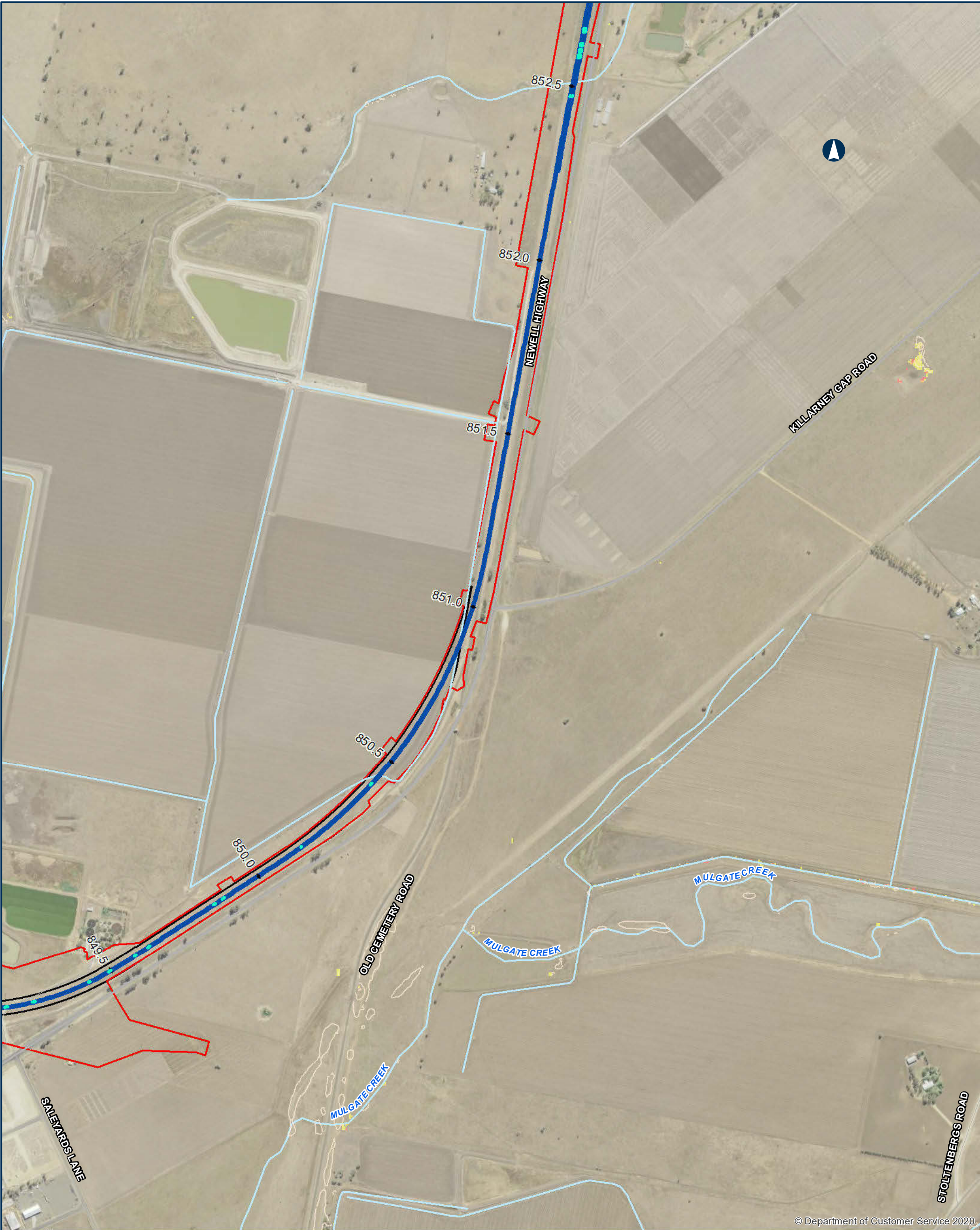
Updated flooding and hydrology assessment

Appendix B QDL compliance

Appendix B3 Narrabri local QDL compliance (scour/erosion)

NARROMINE TO NARRABRI PROJECT





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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 20% AEP -- Narrabri Local

Appendix B - Figure 2.1.1

0200400

Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 12/08/2022

Paper: A3

Author: JacobsGHD

Scale: 1:10,000

Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

Culvert

Road QDL departure

Alignment

The proposal

Rail Corridor

Design Velocity Contour (m/s)

1

2

3

<10% Increase

10% to 20% increase

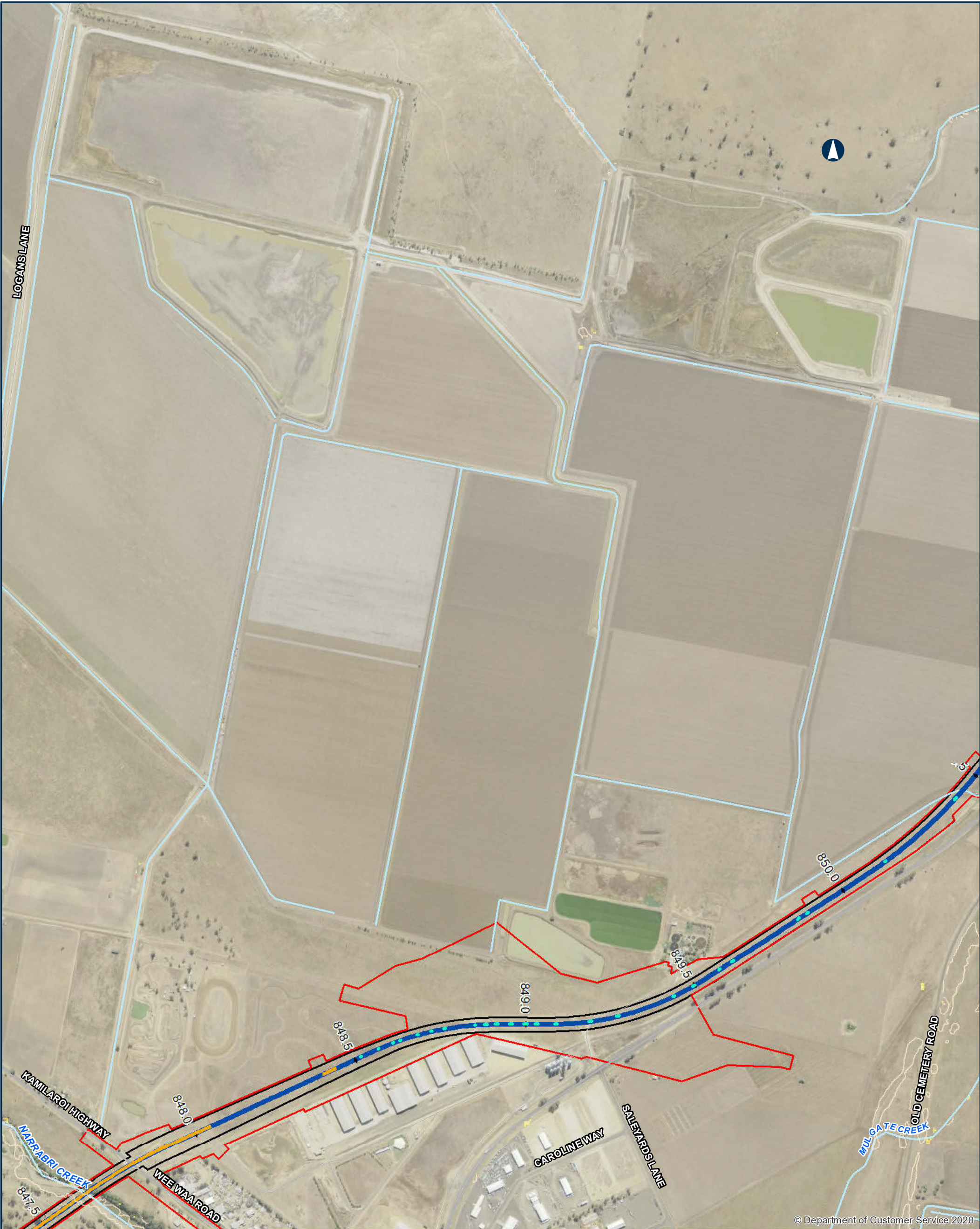
Greater than 20% increase

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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 20% AEP -- Narrabri Local

Appendix B - Figure 2.1.2

0200400Metres

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Date: 12/08/2022
Author: JacobsGHD
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

Bridge

Culvert

Road QDL departure

Alignment

The proposal

Rail Corridor

Design Velocity Contour (m/s)

1

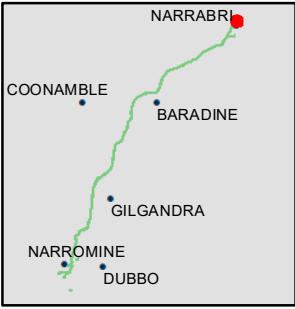
2

3

<10% Increase

10% to 20% increase

Greater than 20% increase



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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 20% AEP -- Narrabri Local Appendix B - Figure 2.1.3

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Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 12/08/2022

Paper: A3

Author: JacobsGHD

Scale: 1:10,000

Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

Bridge

Road QDL departure

Alignment

The proposal

Rail Corridor

Design Velocity Contour (m/s)

1

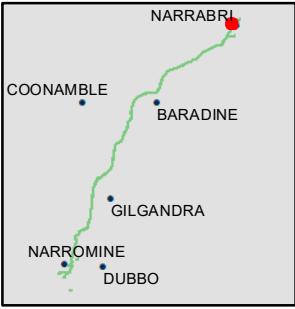
2

3

<10% Increase

10% to 20% increase

Greater than 20% increase



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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 20% AEP -- Narrabri Local Appendix B - Figure 2.1.4

0200400

Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 12/08/2022

Paper: A3

Author: JacobsGHD

Scale: 1:10,000

Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

Bridge

Road QDL departure

Alignment

The proposal

Rail Corridor

Design Velocity Contour (m/s)

1

2

3

<10% Increase

10% to 20% increase

Greater than 20% increase

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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 20% AEP -- Narrabri Local Appendix B - Figure 2.1.5

0200400

Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 12/08/2022

Paper: A3

Author: JacobsGHD

Scale: 1:10,000

Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

Bridge

Culvert

Road QDL departure

Alignment

The proposal

Rail Corridor

Design Velocity Contour (m/s)

1

2

3

4

<10% Increase

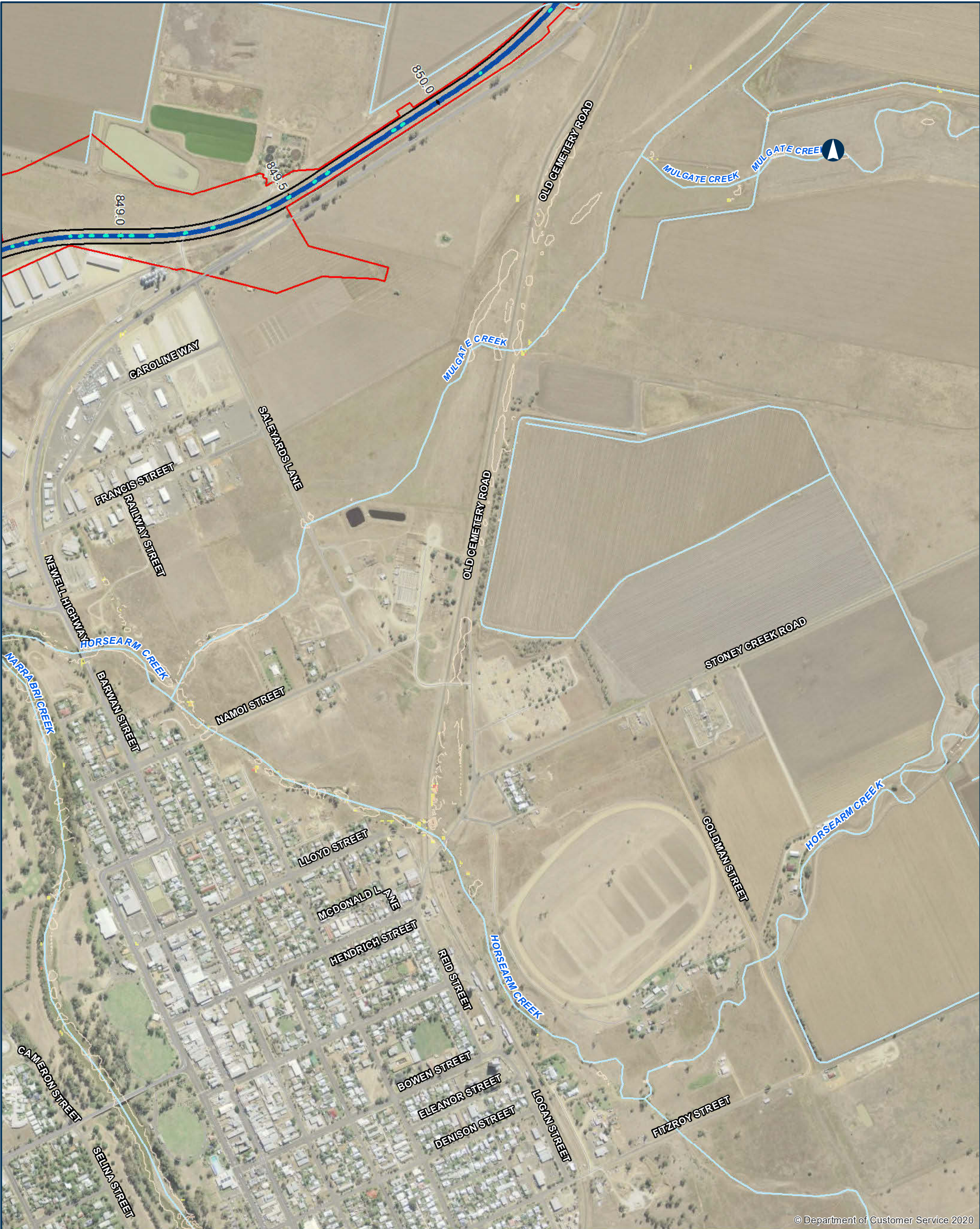
10% to 20% increase

Greater than 20% increase

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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 20% AEP -- Narrabri Local

Appendix B - Figure 2.1.6

0200400

Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 12/08/2022

Paper: A3

Author: JacobsGHD

Scale: 1:10,000

Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

Culvert

Road QDL departure

Alignment

The proposal

Rail Corridor

Design Velocity Contour (m/s)

1

2

3

4

5

<10% Increase

10% to 20% increase

Greater than 20% increase

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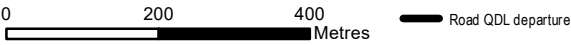
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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 20% AEP -- Narrabri Local

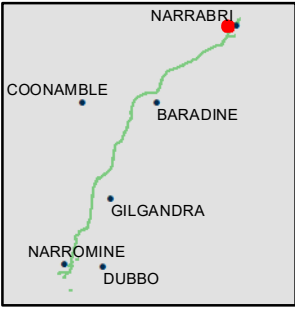
Appendix B - Figure 2.1.7



Coordinate System: GDA 1994 MGA Zone 55

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Date: 12/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD



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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 20% AEP -- Narrabri Local

Appendix B - Figure 2.1.8

0200400

Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 12/08/2022

Paper: A3

Author: JacobsGHD

Scale: 1:10,000

Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

Culvert

Road QDL departure

Alignment

The proposal

Rail Corridor

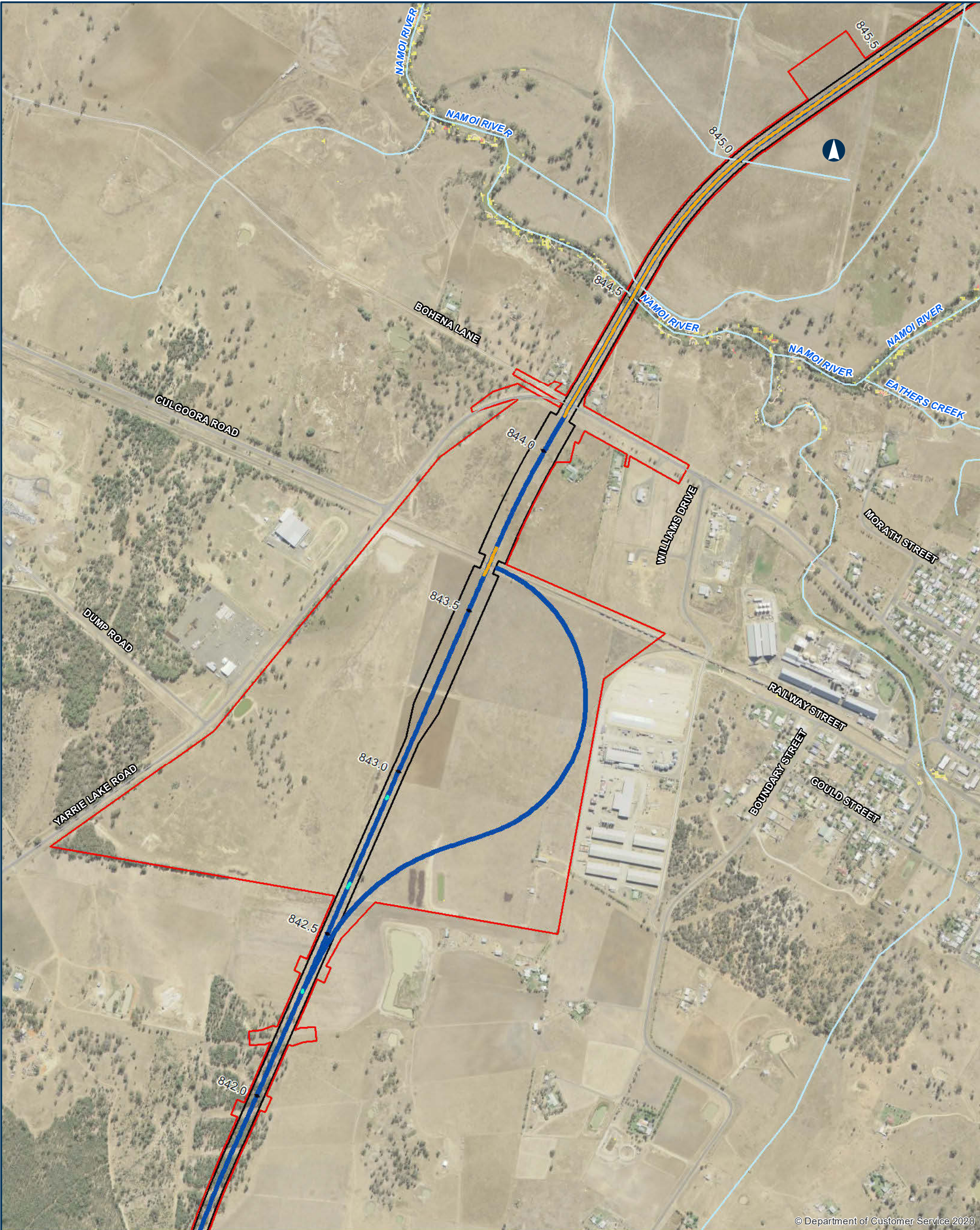
<10% Increase

10% to 20% increase

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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 20% AEP -- Narrabri Local

Appendix B - Figure 2.1.9

0200400

Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 12/08/2022

Paper: A3

Author: JacobsGHD

Scale: 1:10,000

Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

Bridge

Culvert

Road QDL departure

Alignment

The proposal

Rail Corridor

Design Velocity Contour (m/s)

1

2

3

4

<10% Increase

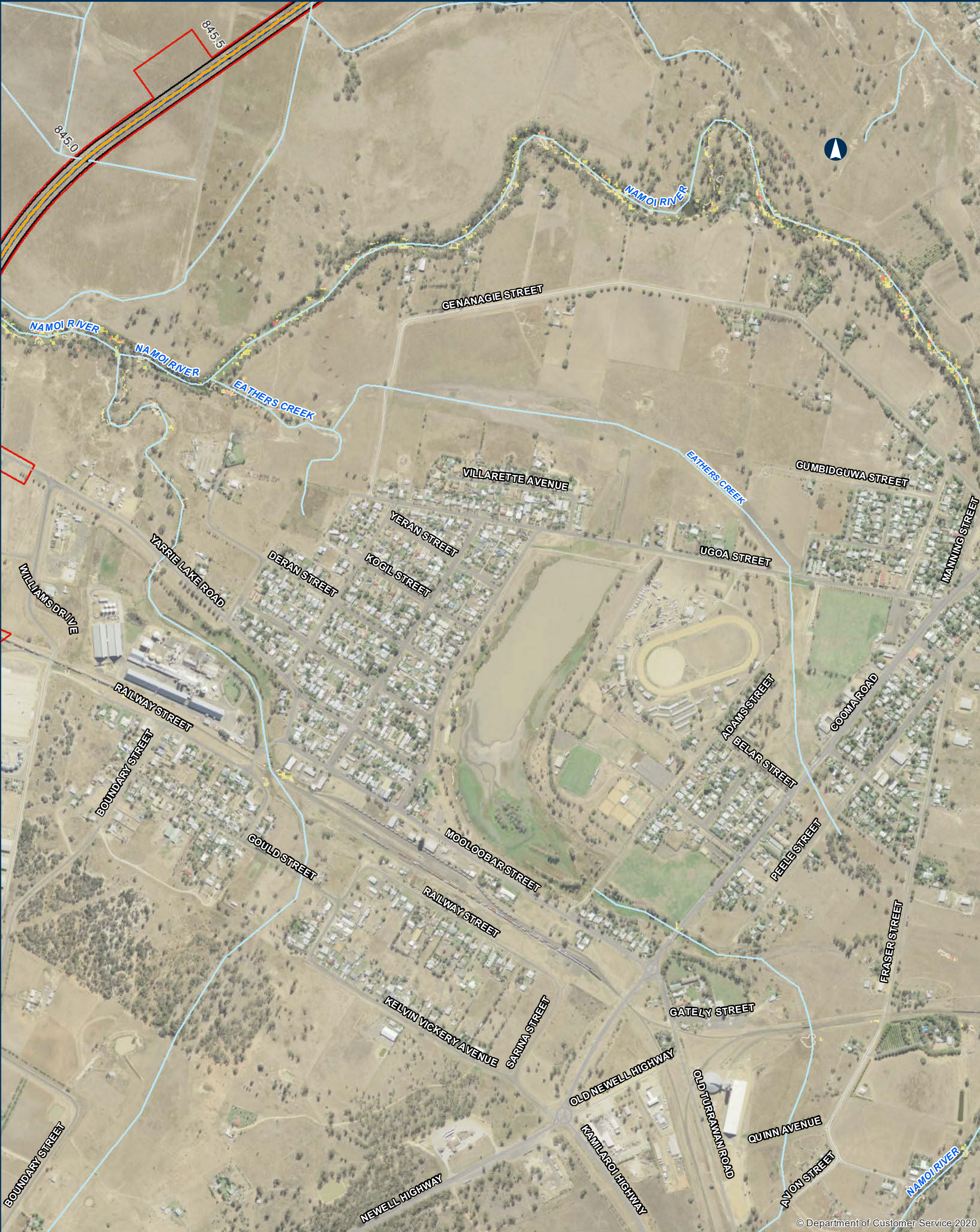
10% to 20% increase

Greater than 20% increase

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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 20% AEP -- Narrabri Local

Appendix B - Figure 2.1.10

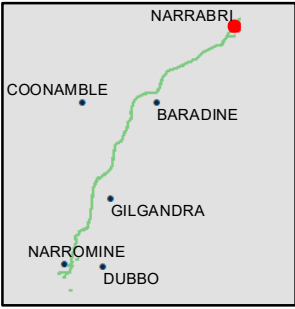
0 200 400 Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 12/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Bridge
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- Design Velocity Contour (m/s)
- 1
- 2
- 3
- 4
- <10% Increase
- 10% to 20% increase
- Greater than 20% increase



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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 20% AEP -- Narrabri Local

Appendix B - Figure 2.1.11

0200400

Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 12/08/2022

Paper: A3

Author: JacobsGHD

Scale: 1:10,000

Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

Road QDL departure

Design Velocity Contour (m/s)

1

2

3

4

5

6

7

<10% Increase

10% to 20% increase

Greater than 20% increase

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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 20% AEP -- Narrabri Local

Appendix B - Figure 2.1.12

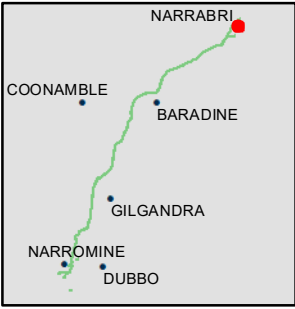
0 200 400 Metres

Coordinate System: GDA 1994 MGA Zone 55

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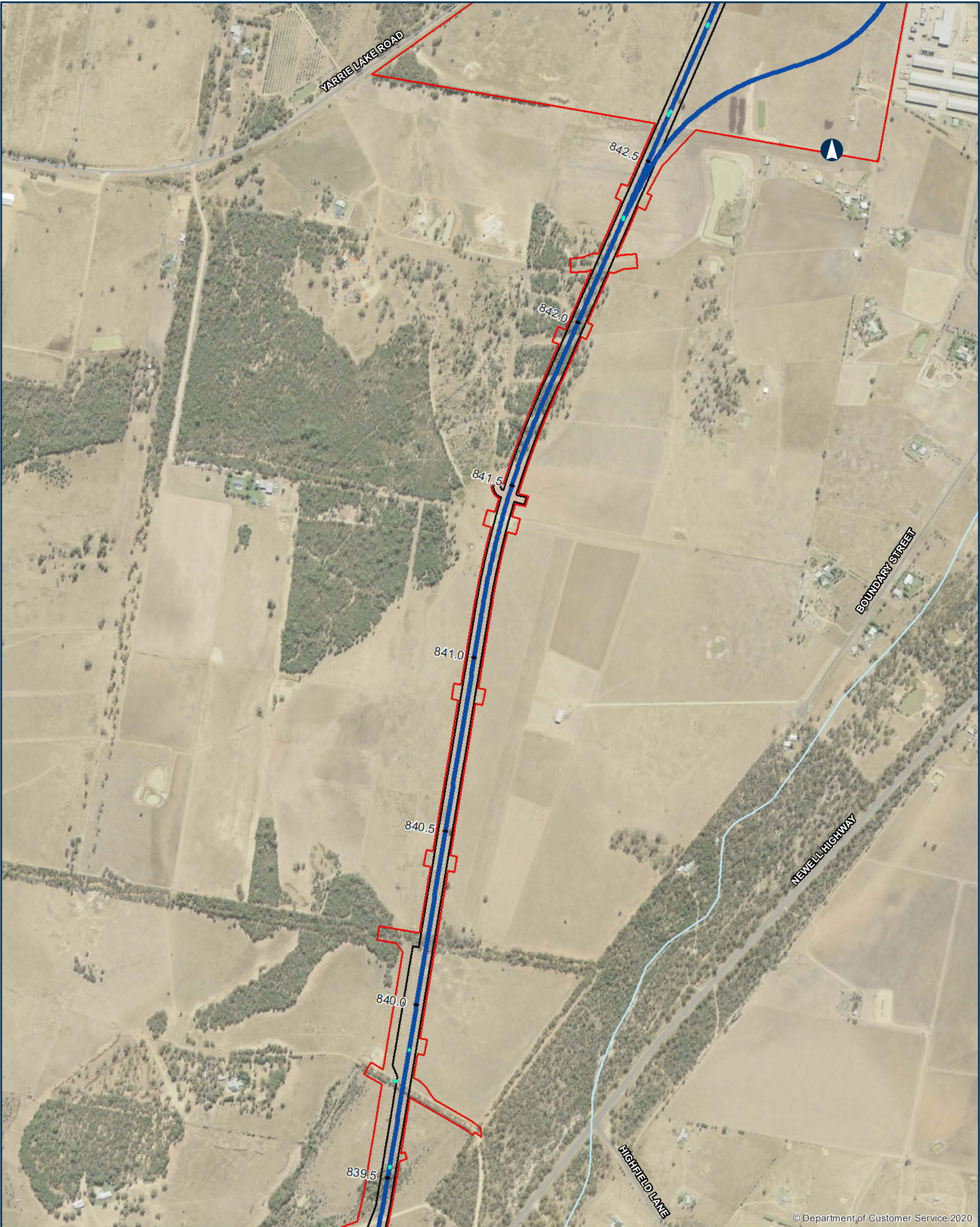
Date: 12/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Road QDL departure
- Design Velocity Contour (m/s)
- 1
 - 2
 - 3
 - 4
 - 5
 - 6
 - 7
- <10% Increase
 - 10% to 20% increase
 - Greater than 20% increase



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 20% AEP -- Narrabri Local

Appendix B - Figure 2.1.13

0200400

Metres

Coordinate System: GDA 1994 MGA Zone 55

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Culvert

Road QDL departure

Alignment

The proposal

Rail Corridor

Design Velocity Contour (m/s)

1

<10% Increase

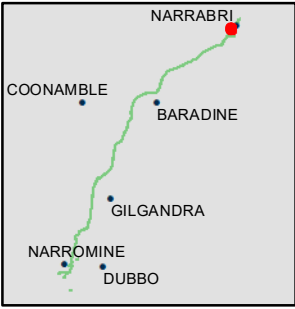
Date: 12/08/2022

Paper: A3

Author: JacobsGHD

Scale: 1:10,000

Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD



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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 20% AEP -- Narrabri Local

Appendix B - Figure 2.1.14

0200400

Metres

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Date: 12/08/2022

Paper: A3

Author: JacobsGHD

Scale: 1:10,000

Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

Culvert

Road QDL departure

Alignment

The proposal

Rail Corridor

Design Velocity Contour (m/s)

1

<10% Increase

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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 20% AEP -- Narrabri Local

Appendix B - Figure 2.1.15

0200400

Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 12/08/2022

Paper: A3

Author: JacobsGHD

Scale: 1:10,000

Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

Road QDL departure

Design Velocity Contour (m/s)

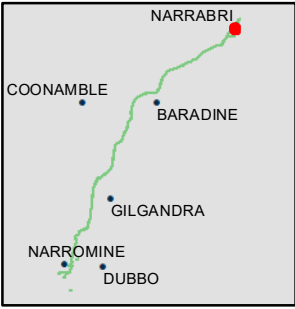
1

2

<10% Increase

10% to 20% increase

Greater than 20% increase



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 20% AEP -- Narrabri Local

Appendix B - Figure 2.1.16

0200400

Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 12/08/2022

Paper: A3

Author: JacobsGHD

Scale: 1:10,000

Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

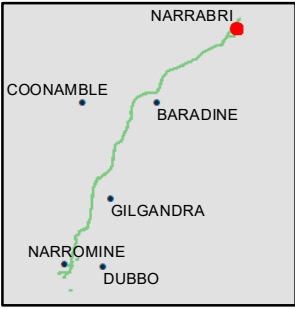
Road QDL departure

Design Velocity Contour (m/s)

Greater than 20% increase

<10% Increase

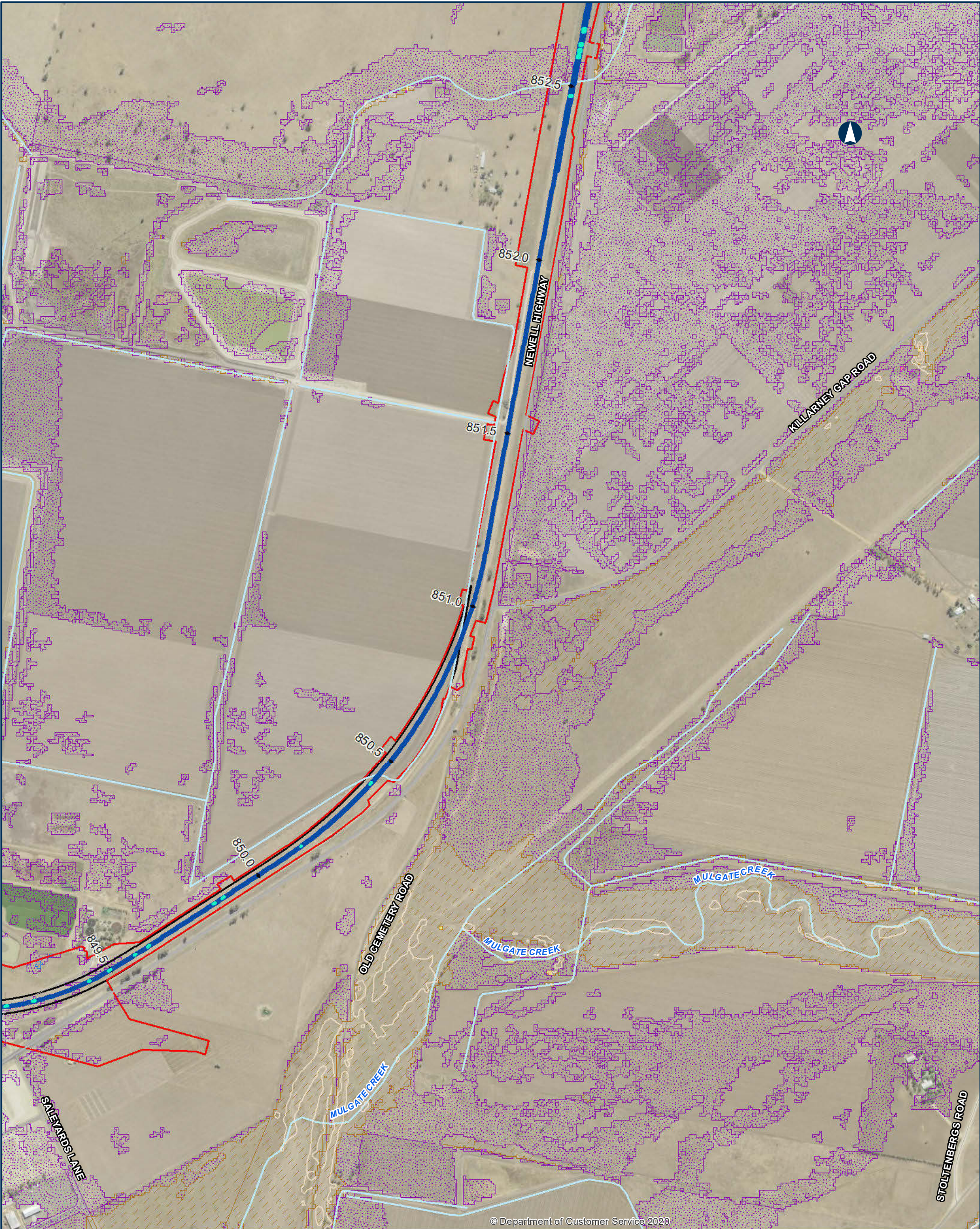
10% to 20% increase



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 5% AEP - Narrabri Local

Appendix B - Figure 2.2.1

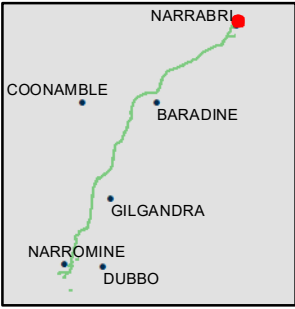
0 200 400 Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Culvert
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- Design Velocity Contour (m/s)
 - 1
 - 2
 - 3
 - 4
- Design Velocity < 0.5m/s
- Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s
- <10% Increase
- 10% to 20% increase
- Greater than 20% increase
- Unprotected Surfaces
 - Existing not flooded, design velocity > 0.5m/s
 - Existing velocity < 0.5m/s, design velocity > 0.5m/s



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 5% AEP - Narrabri Local

Appendix B - Figure 2.2.2

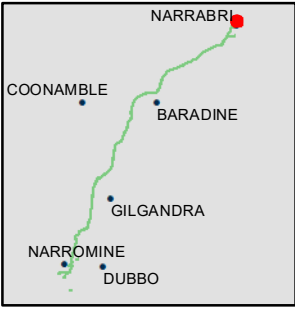
0 200 400 Metres

Coordinate System: GDA 1994 MGA Zone 55

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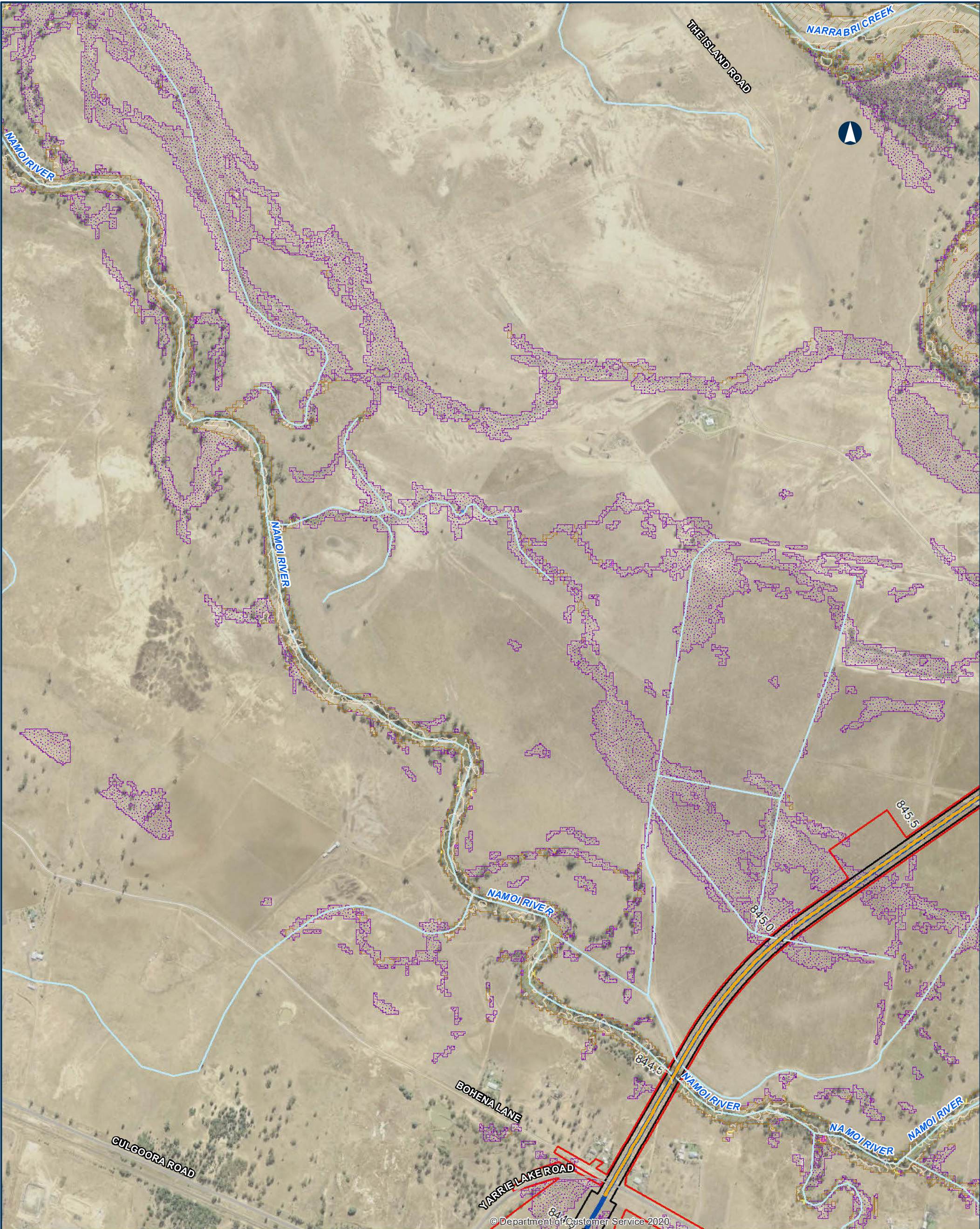
Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Bridge
- Culvert
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- Design Velocity Contour (m/s)
 - 1
 - 2
 - 3
- Design Velocity < 0.5m/s
- Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s
- <10% Increase
- 10% to 20% increase
- Greater than 20% increase
- Unprotected Surfaces
 - Existing not flooded, design velocity > 0.5m/s
 - Existing velocity < 0.5m/s, design velocity > 0.5m/s



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 5% AEP - Narrabri Local

Appendix B - Figure 2.2.3

0200400Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022

Paper: A3

Author: JacobsGHD

Scale: 1:10,000

Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

Bridge

Road QDL departure

Alignment

The proposal

Rail Corridor

Design Velocity Contour (m/s)

1

2

3

Design Velocity < 0.5m/s

Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s

<10% Increase

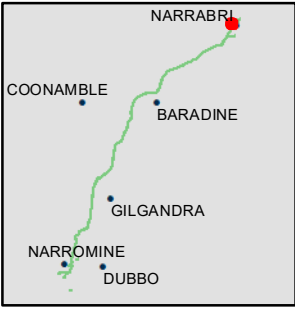
10% to 20% increase

Greater than 20% increase

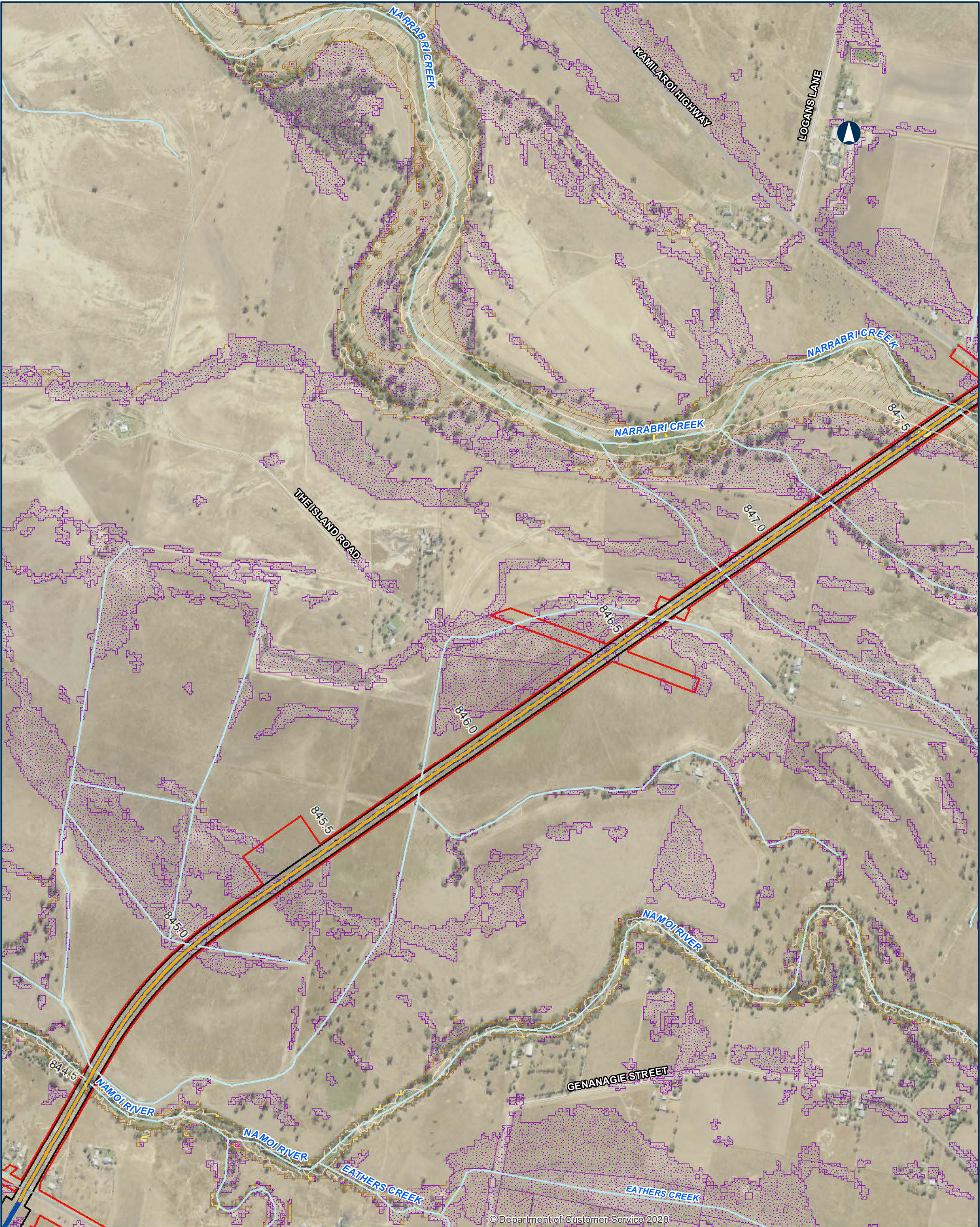
Unprotected Surfaces

Existing not flooded, design velocity > 0.5m/s

Existing velocity < 0.5m/s, design velocity > 0.5m/s



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 5% AEP - Narrabri Local

Appendix B - Figure 2.2.4

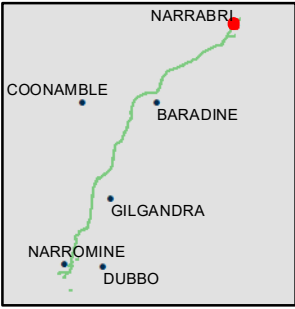
0 200 400 Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Bridge
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- Design Velocity Contour (m/s)
 - 1
 - 2
- Design Velocity < 0.5m/s
- Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s
- <10% Increase
- 10% to 20% increase
- Greater than 20% increase
- Unprotected Surfaces
 - Existing velocity < 0.5m/s, design velocity > 0.5m/s



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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 5% AEP - Narrabri Local

Appendix B - Figure 2.2.5

0 200 400 Metres

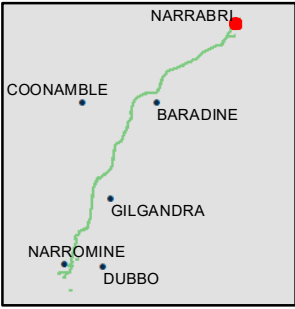
Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

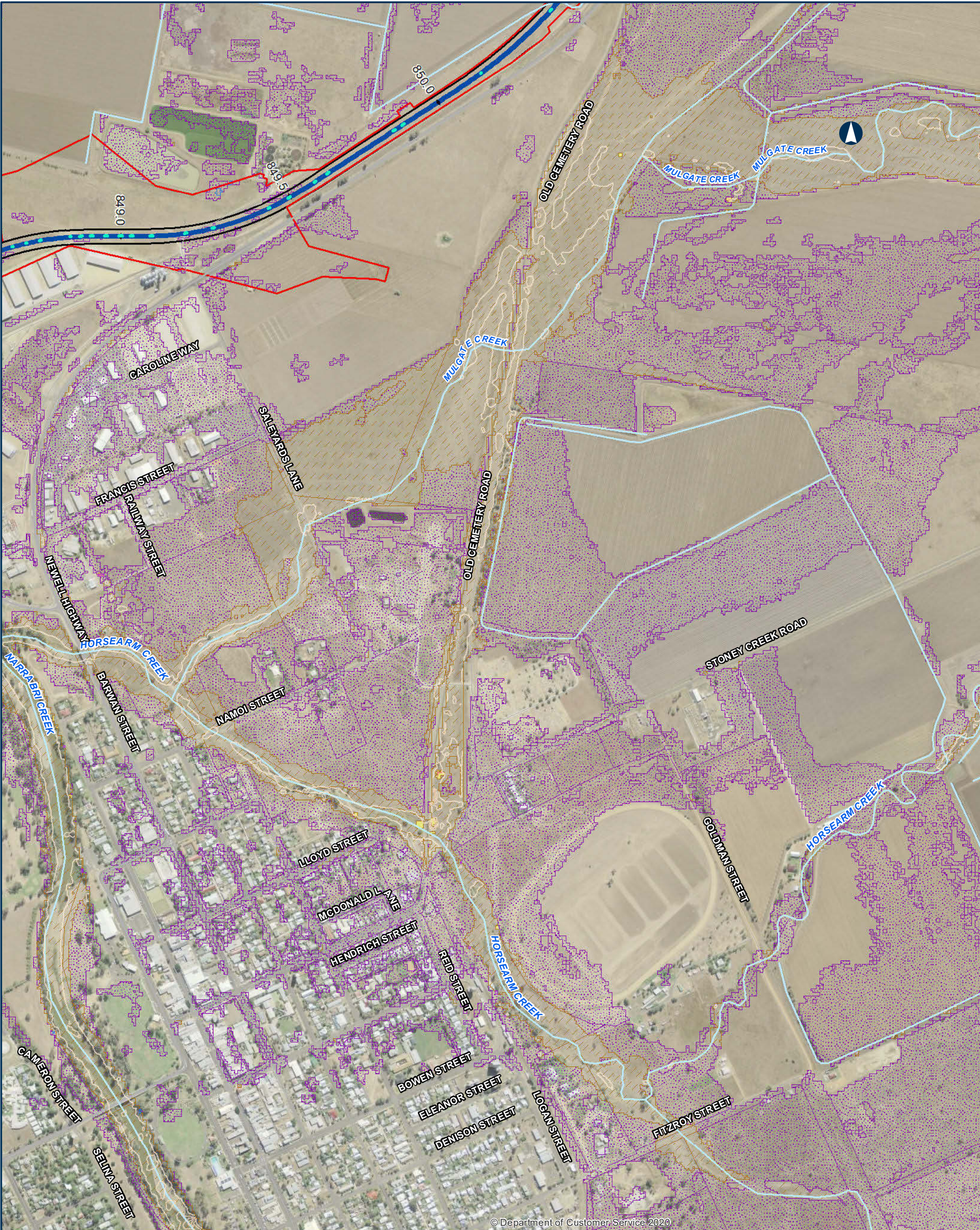
- Bridge
- Culvert
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- Design Velocity Contour (m/s)
 - 1
 - 2
- 3
- 4
- Design Velocity < 0.5m/s
- Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s
- <10% Increase
- 10% to 20% increase
- Greater than 20% increase

- Unprotected Surfaces
- Existing not flooded, design velocity > 0.5m/s
 - Existing velocity < 0.5m/s, design velocity > 0.5m/s



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 5% AEP - Narrabri Local

Appendix B - Figure 2.2.6

0200400Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022
Author: JacobsGHD
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

Paper: A3
Scale: 1:10,000
all other layers: JacobsGHD

Culvert

Road QDL departure

Alignment

The proposal

Rail Corridor

Design Velocity Contour (m/s)

1

2

3

4

5

Design Velocity < 0.5m/s

Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s

<10% Increase

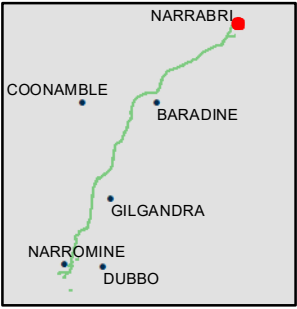
10% to 20% increase

Greater than 20% increase

Unprotected Surfaces

Existing not flooded, design velocity > 0.5m/s

Existing velocity < 0.5m/s, design velocity > 0.5m/s



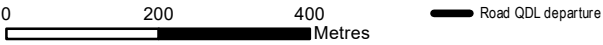
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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 5% AEP - Narrabri Local

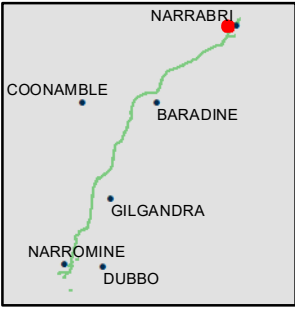
Appendix B - Figure 2.2.7



Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 5% AEP - Narrabri Local

Appendix B - Figure 2.2.8

0 200 400 Metres

Coordinate System: GDA 1994 MGA Zone 55

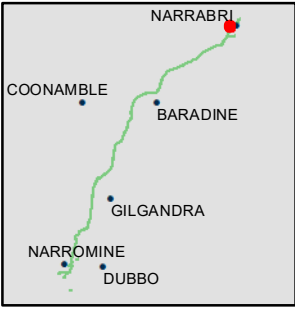
ARTC makes no representation or warranty and assumes no duty of care or other responsibility to any party as to the completeness, accuracy or suitability of the information contained in this GIS map. The GIS map has been prepared from material provided to ARTC by an external source and ARTC has not taken any steps to verify the completeness, accuracy or suitability of that material. ARTC will not be responsible for any loss or damage suffered as a result of any person whatsoever placing reliance upon the information contained within this GIS map.

Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Culvert
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- Design Velocity < 0.5m/s
- Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s
- <10% Increase
- 10% to 20% increase

Unprotected Surfaces

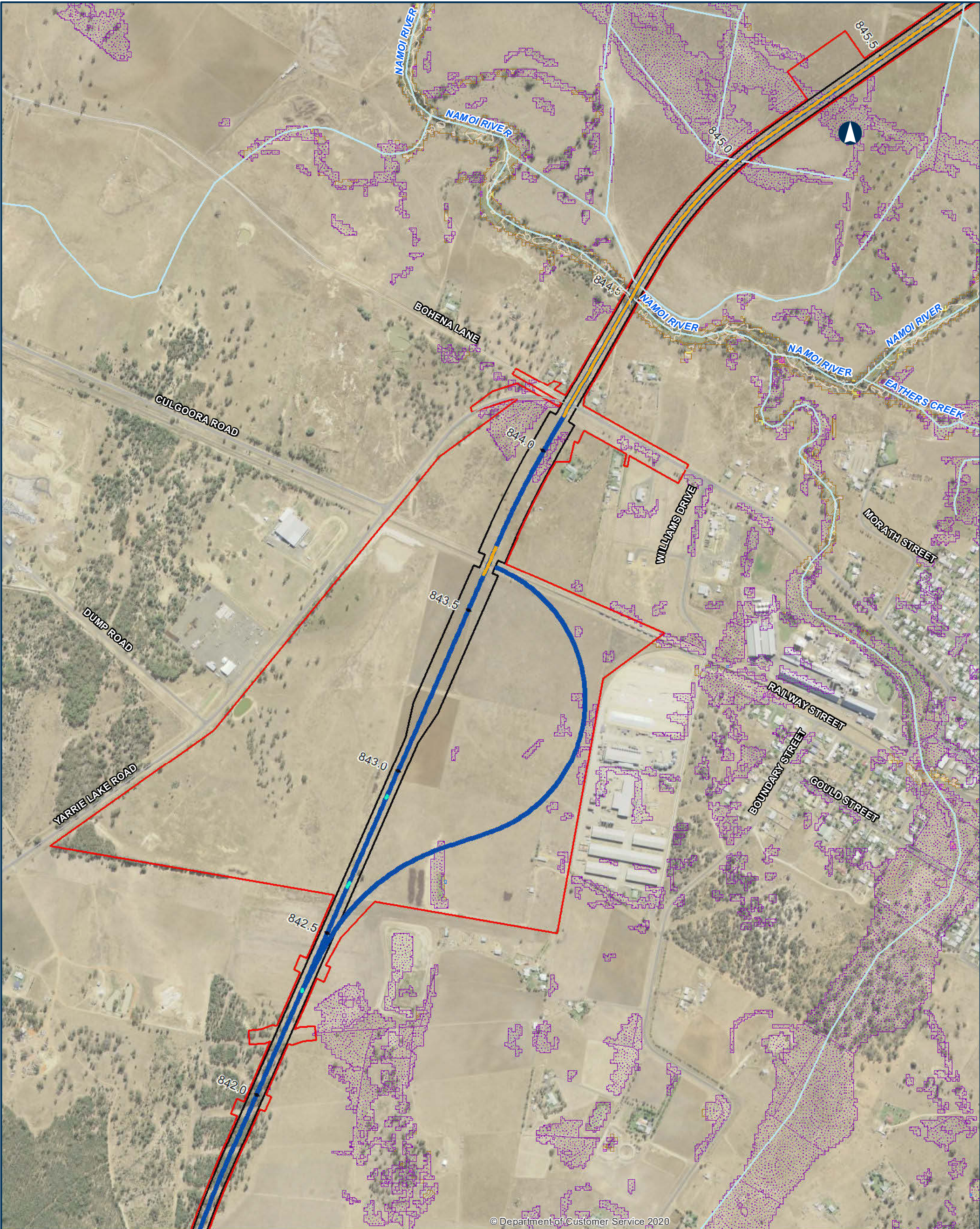
Existing velocity < 0.5m/s, design velocity > 0.5m/s



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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 5% AEP - Narrabri Local

Appendix B - Figure 2.2.9

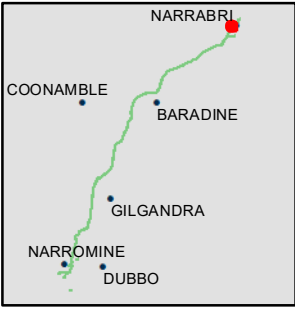
0 200 400 Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Bridge
- Culvert
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- Design Velocity Contour (m/s)
 - 1
 - 2
 - 3
 - 4
- 5
- Design Velocity < 0.5m/s
- Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s
- <10% Increase
- 10% to 20% increase
- Greater than 20% increase
- Unprotected Surfaces
 - Existing not flooded, design velocity > 0.5m/s
 - Existing velocity < 0.5m/s, design velocity > 0.5m/s



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 5% AEP - Narrabri Local

Appendix B - Figure 2.2.10

0 200 400 Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

Bridge

Road QDL departure

Alignment

The proposal

Rail Corridor

Design Velocity Contour (m/s)

1

2

3

4

5

Design Velocity < 0.5m/s

Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s

<10% Increase

10% to 20% increase

Greater than 20% increase

Unprotected Surfaces

Existing not flooded, design velocity > 0.5m/s

Existing velocity < 0.5m/s, design velocity > 0.5m/s

NARRABRI

COONAMBLE

BARADINE

GILGANDRA

NARROMINE

DUBBO

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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 5% AEP - Narrabri Local

Appendix B - Figure 2.2.11

0 200 400 Metres

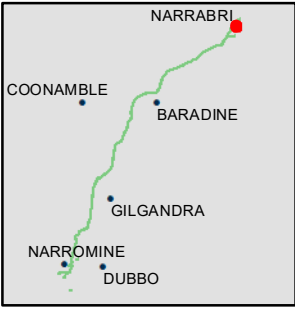
Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

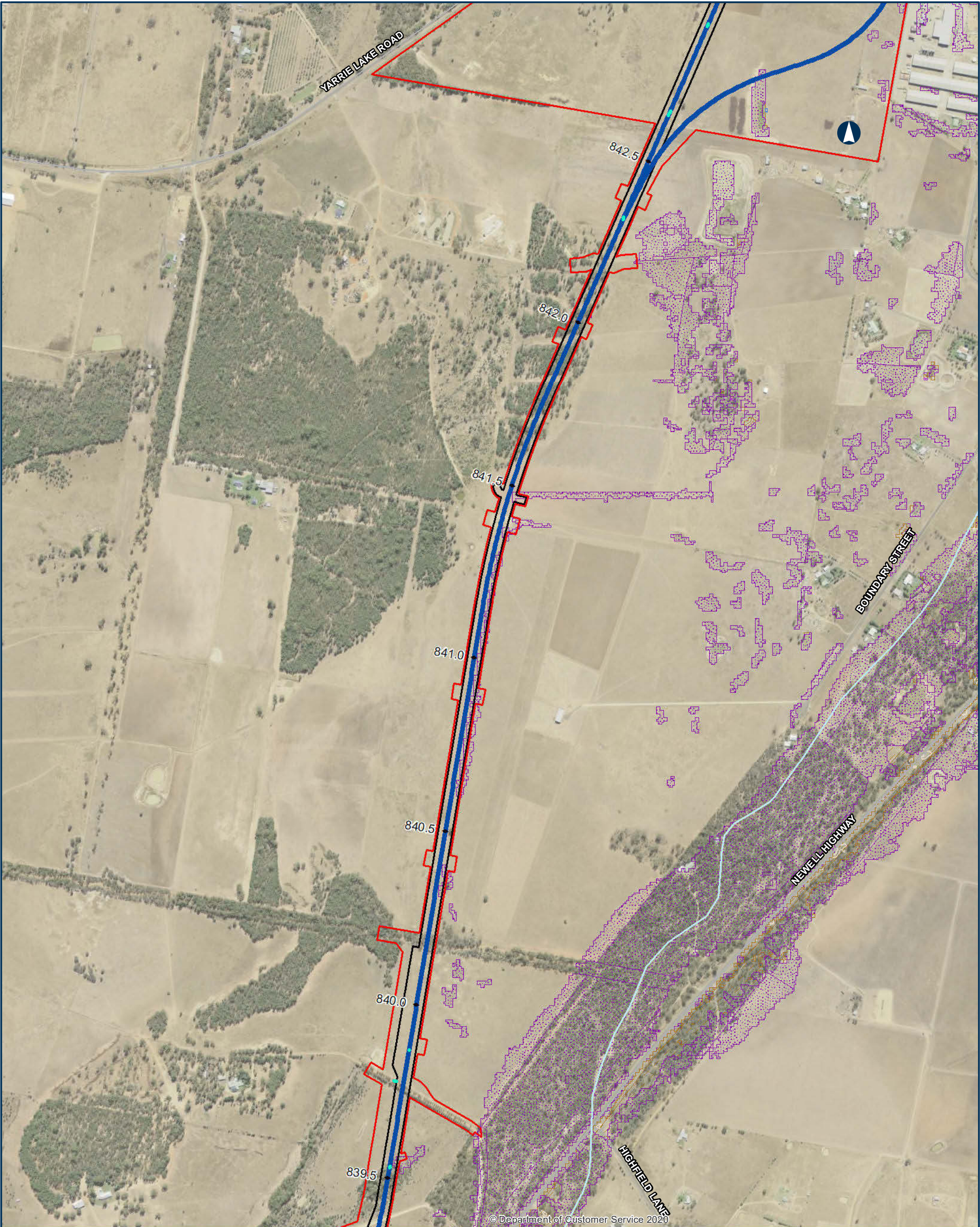
- Road QDL departure
- Design Velocity Contour (m/s)
- 1
 - 2
 - 3
 - 4
 - 5
- Design Velocity < 0.5m/s
- Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s

- <10% Increase
- 10% to 20% increase
- Unprotected Surfaces
- Existing not flooded, design velocity > 0.5m/s
 - Existing velocity < 0.5m/s, design velocity > 0.5m/s



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 5% AEP - Narrabri Local

Appendix B - Figure 2.2.13

0 200 400 Metres

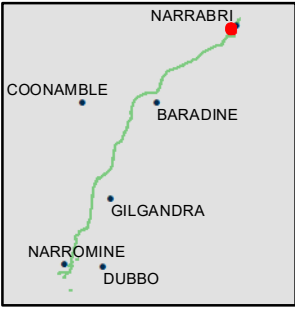
Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Culvert
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- Design Velocity Contour (m/s)
 - 1
 - Design Velocity < 0.5m/s
 - Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s

- <10% Increase
- Unprotected Surfaces
 - Existing not flooded, design velocity > 0.5m/s
 - Existing velocity < 0.5m/s, design velocity > 0.5m/s



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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 5% AEP - Narrabri Local

Appendix B - Figure 2.2.14

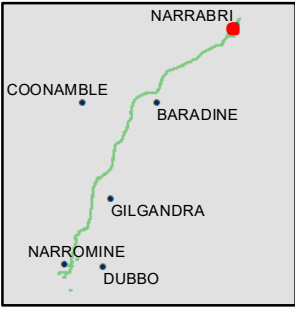
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Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Culvert
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- Design Velocity Contour (m/s)
 - 1
 - Design Velocity < 0.5m/s
 - Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s
- <10% Increase
- 10% to 20% increase
- Greater than 20% increase
- Unprotected Surfaces
 - Existing not flooded, design velocity > 0.5m/s
 - Existing velocity < 0.5m/s, design velocity > 0.5m/s



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 5% AEP - Narrabri Local

Appendix B - Figure 2.2.15

0 200 400 Metres

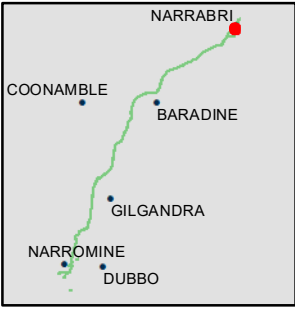
Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Road QDL departure
- Design Velocity Contour (m/s)
- 1
 - 2
- Design Velocity < 0.5m/s
- Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s
- <10% Increase
 - 10% to 20% increase
 - Greater than 20% increase

- Unprotected Surfaces
- Existing not flooded, design velocity > 0.5m/s
 - Existing velocity < 0.5m/s, design velocity > 0.5m/s



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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 5% AEP - Narrabri Local Appendix B - Figure 2.2.16

0 200 400 Metres

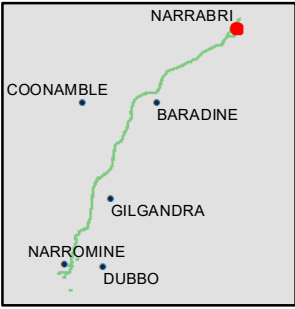
Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

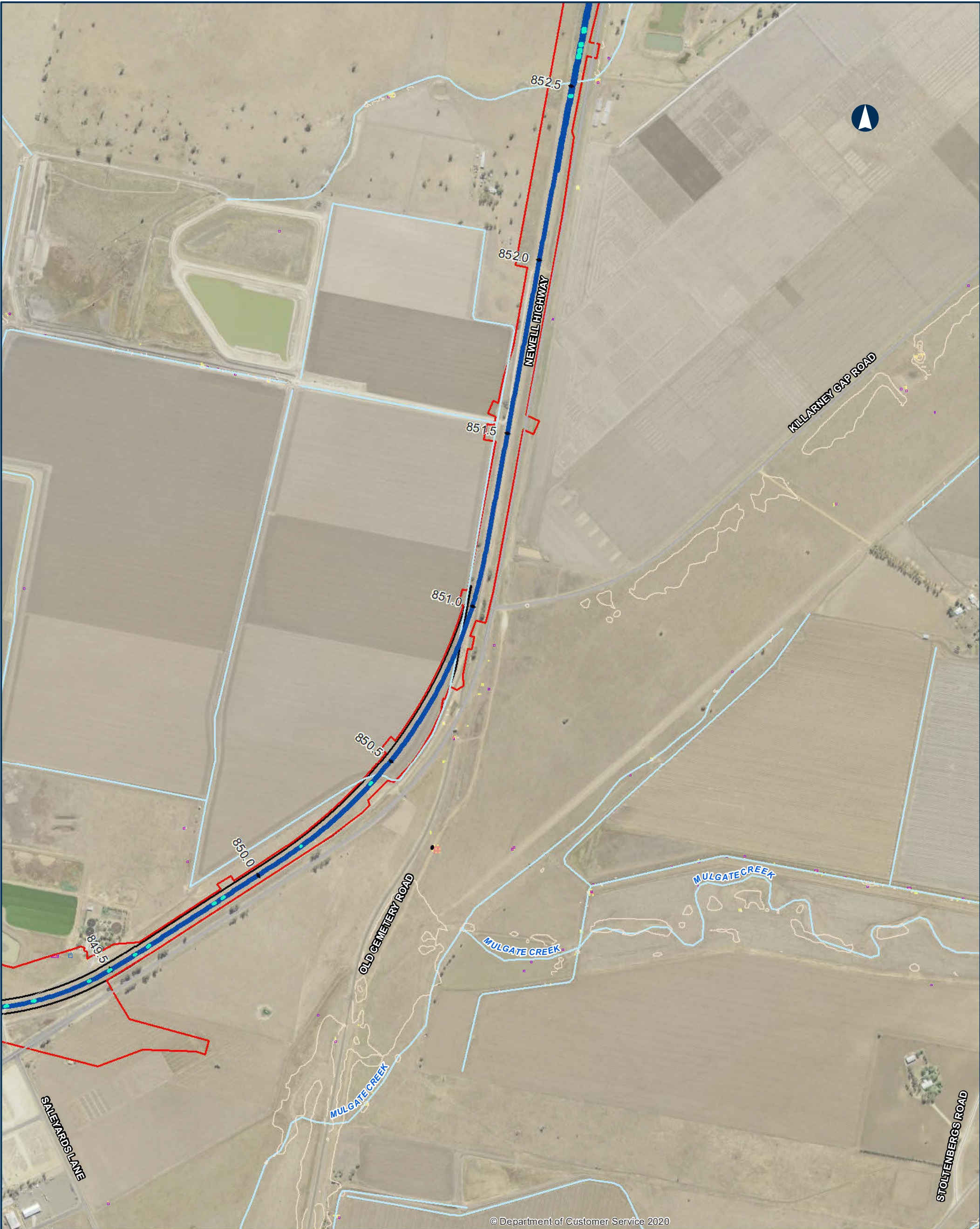
- Road QDL departure
- Design Velocity Contour (m/s)
- 1
 - 2
 - 3
 - 4
 - 5
- Design Velocity < 0.5m/s
- Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s

- <10% Increase
- Unprotected Surfaces
- Existing not flooded, design velocity > 0.5m/s
 - Existing velocity < 0.5m/s, design velocity > 0.5m/s



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 2% AEP - Narrabri Local

Appendix B - Figure 2.3.1

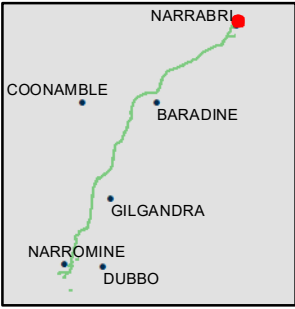
0 200 400 Metres

Coordinate System: GDA 1994 MGA Zone 55

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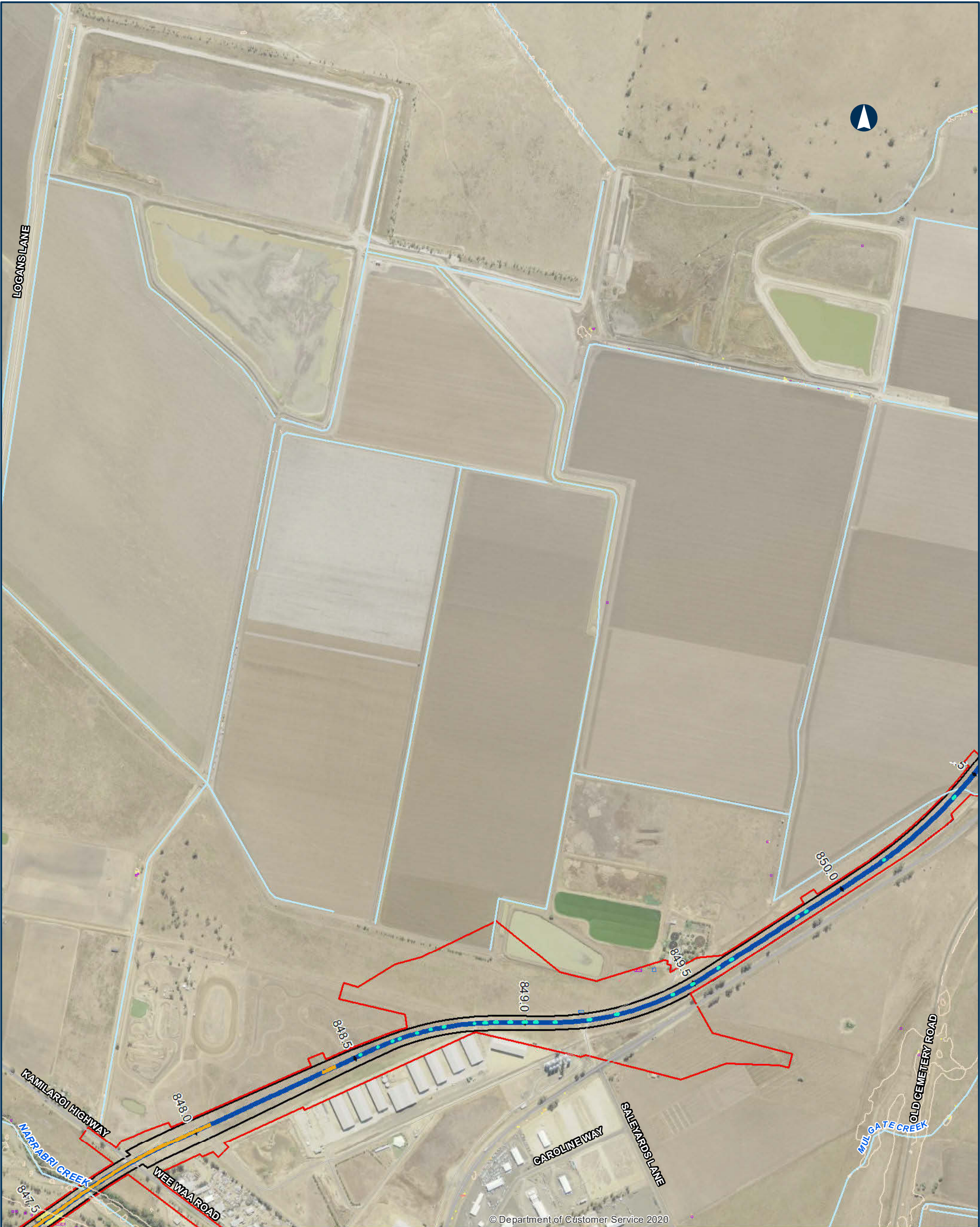
Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Culvert
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- Design Velocity Contour (m/s)
 - 1
 - 2
 - 3
 - 4
- <10% Increase
- 10% to 20% increase
- Greater than 20% increase
- Unprotected Surfaces
 - Existing not flooded, design velocity > 0.5m/s
 - Existing velocity < 0.5m/s, design velocity > 0.5m/s



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 2% AEP - Narrabri Local

Appendix B - Figure 2.3.2

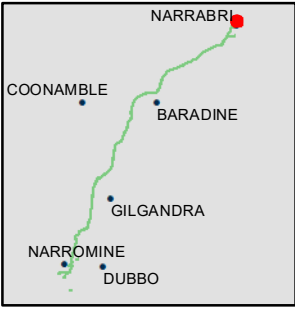
0 200 400 Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Bridge
- Culvert
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- Design Velocity Contour (m/s)
 - 1
 - 2
 - 3
- <10% Increase
- 10% to 20% increase
- Greater than 20% increase
- Unprotected Surfaces
 - Existing not flooded, design velocity > 0.5m/s
 - Existing velocity < 0.5m/s, design velocity > 0.5m/s



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 2% AEP - Narrabri Local

Appendix B - Figure 2.3.3

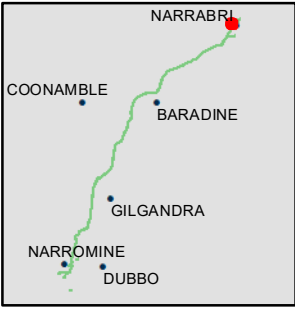
0 200 400 Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Bridge
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- Design Velocity Contour (m/s)
- 1
- 2
- 3
- <10% increase
- 10% to 20% increase
- Greater than 20% increase
- Unprotected Surfaces
- Existing velocity < 0.5m/s, design velocity > 0.5m/s



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 2% AEP - Narrabri Local

Appendix B - Figure 2.3.4

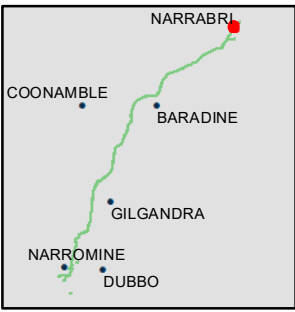
0 200 400 Metres

Coordinate System: GDA 1994 MGA Zone 55

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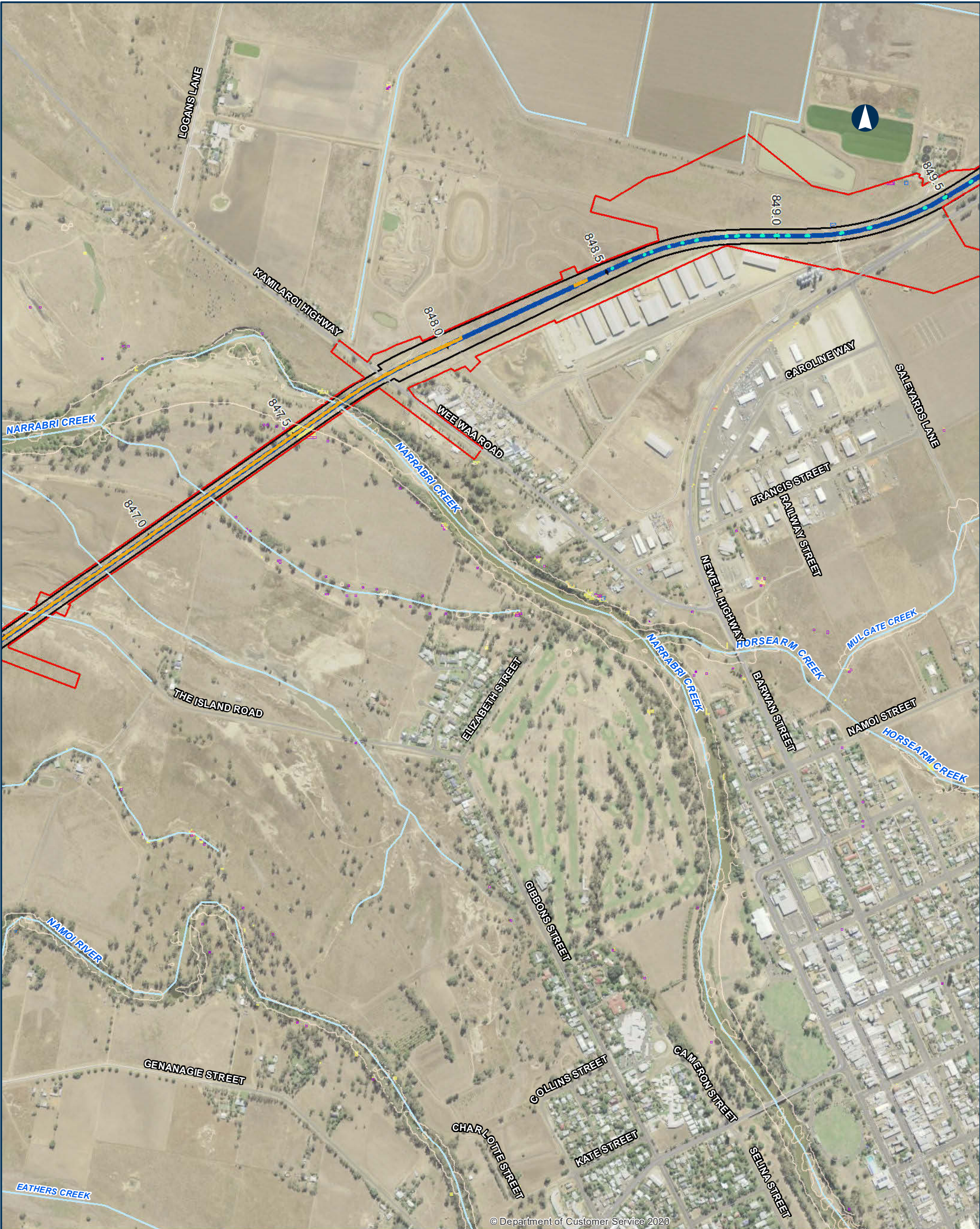
Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Bridge
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- Design Velocity Contour (m/s)
 - 1
 - 2
 - <10% Increase
 - 10% to 20% increase
- Greater than 20% increase
- Unprotected Surfaces
 - Existing not flooded, design velocity > 0.5m/s
 - Existing velocity < 0.5m/s, design velocity > 0.5m/s



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 2% AEP - Narrabri Local

Appendix B - Figure 2.3.5

0 200 400 Metres

Coordinate System: GDA 1994 MGA Zone 55

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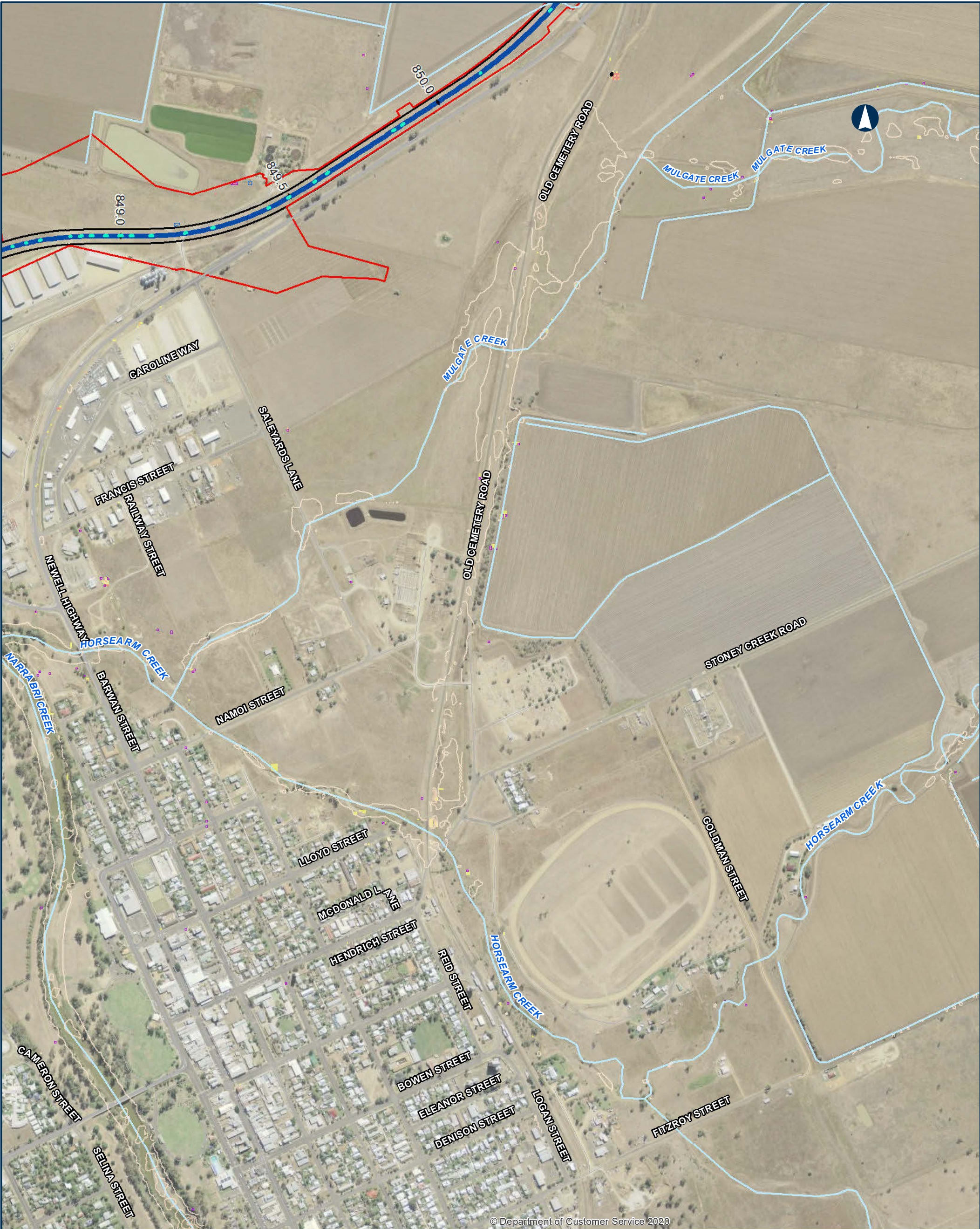
Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Bridge
- Culvert
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- Design Velocity Contour (m/s)
- 1
- 2
- 3
- 4
- <10% Increase
- 10% to 20% increase
- Greater than 20% increase
- Unprotected Surfaces
- Existing not flooded, design velocity > 0.5m/s
- Existing velocity < 0.5m/s, design velocity > 0.5m/s



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 2% AEP - Narrabri Local

Appendix B - Figure 2.3.6

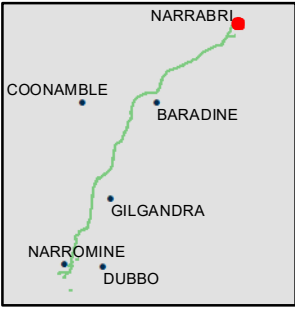
0 200 400 Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Culvert
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- Design Velocity Contour (m/s)
 - 1
 - 2
 - 3
 - 4
- 5
- <10% Increase
- 10% to 20% increase
- Greater than 20% increase
- Unprotected Surfaces
 - Existing not flooded, design velocity > 0.5m/s
 - Existing velocity < 0.5m/s, design velocity > 0.5m/s



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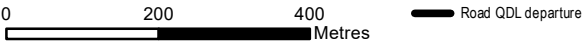


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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 2% AEP - Narrabri Local

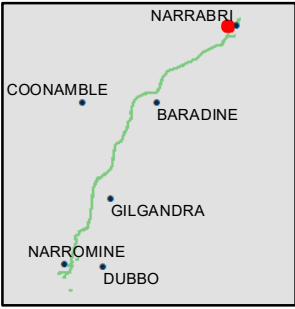
Appendix B - Figure 2.3.7



Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 2% AEP - Narrabri Local

Appendix B - Figure 2.3.8

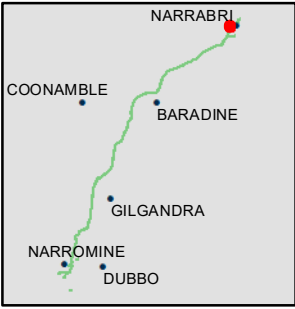
0 200 400 Metres

Coordinate System: GDA 1994 MGA Zone 55

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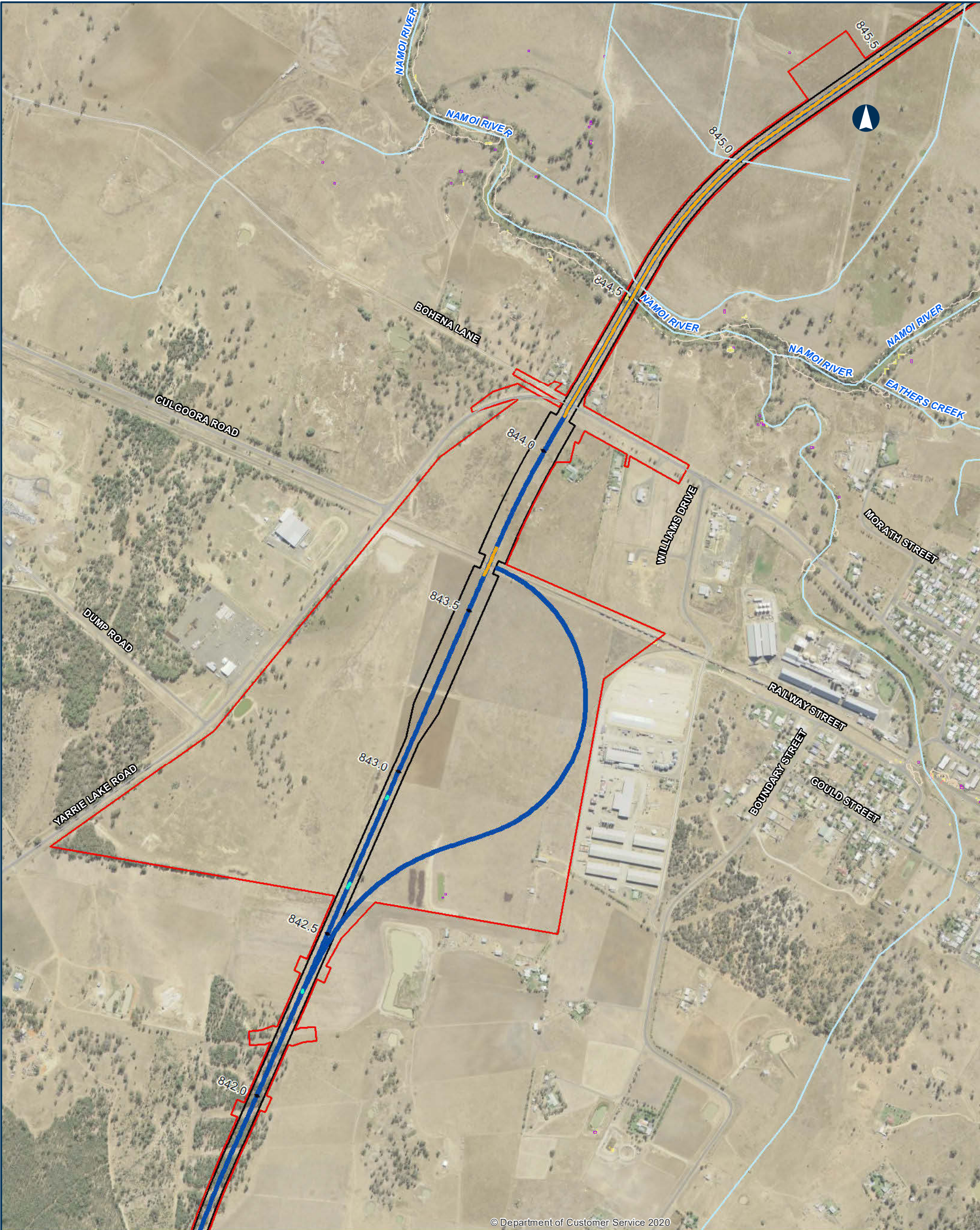
Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Culvert
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- <10% Increase
- Unprotected Surfaces
 - Existing velocity < 0.5m/s, design velocity > 0.5m/s



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 2% AEP - Narrabri Local

Appendix B - Figure 2.3.9

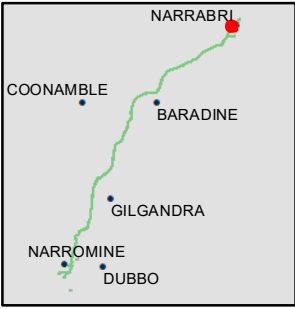
0 200 400 Metres

Coordinate System: GDA 1994 MGA Zone 55

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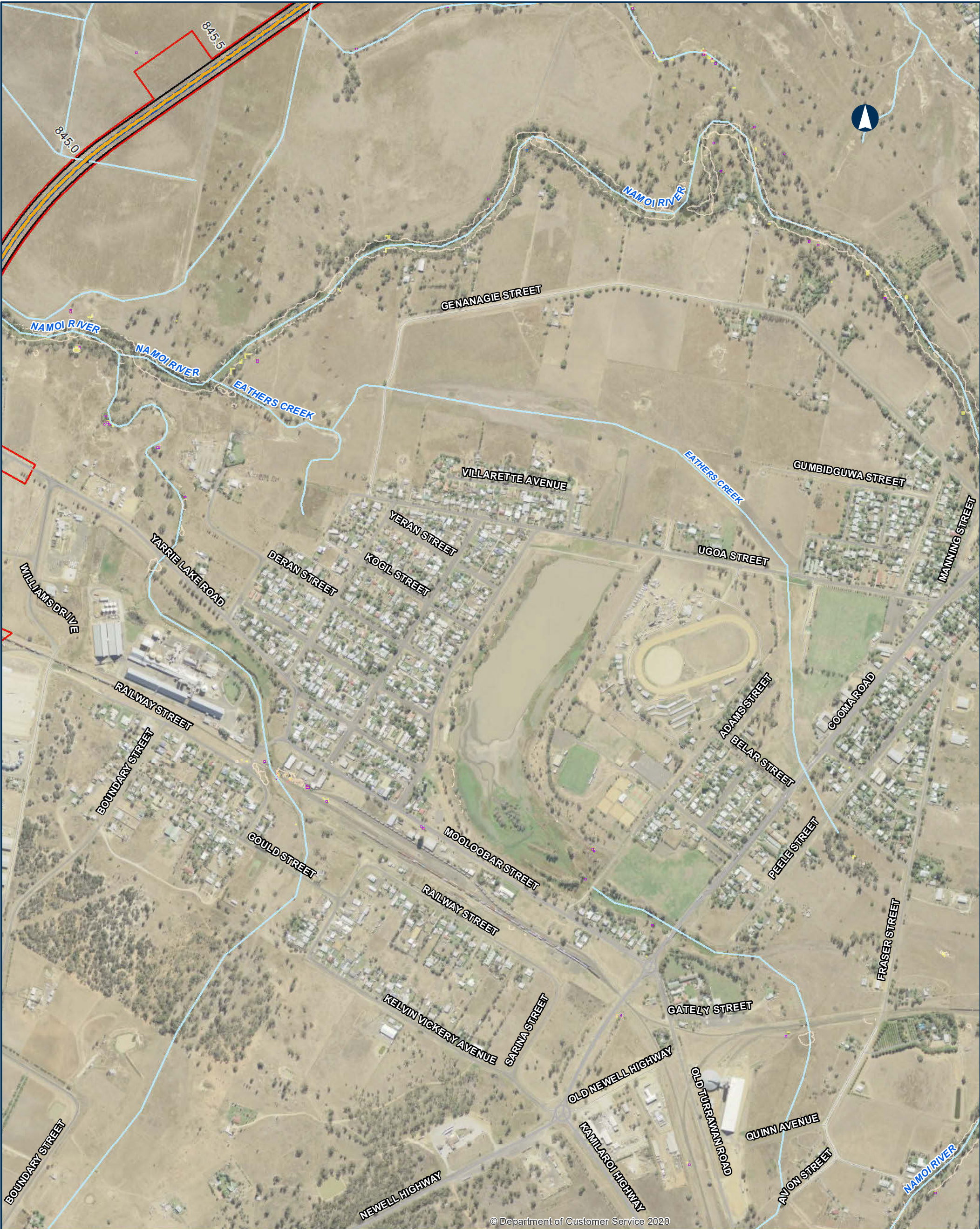
Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Bridge
- Culvert
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- Design Velocity Contour (m/s)
 - 1
 - 2
 - 3
- 4
- <10% Increase
- 10% to 20% increase
- Greater than 20% increase
- Unprotected Surfaces
 - Existing velocity < 0.5m/s, design velocity > 0.5m/s



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 2% AEP - Narrabri Local

Appendix B - Figure 2.3.10

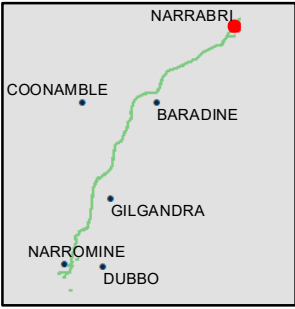
0 200 400 Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Bridge
 - Road QDL departure
 - Alignment
 - The proposal
 - Rail Corridor
 - Design Velocity Contour (m/s)
 - 1
 - 2
 - 3
 - 4
- Unprotected Surfaces**
- Existing not flooded, design velocity > 0.5m/s
 - Existing velocity < 0.5m/s, design velocity > 0.5m/s
- Scour / Erosion - 2% AEP**
- <10% Increase
 - 10% to 20% increase
 - Greater than 20% increase



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 2% AEP - Narrabri Local

Appendix B - Figure 2.3.11

0 200 400 Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Road QDL departure

Design Velocity Contour (m/s)

1

2

3

4

5

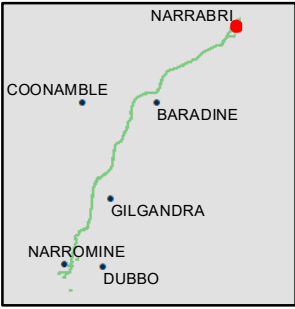
6

<10% Increase
- 10% to 20% increase

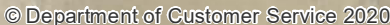
Greater than 20% increase

Unprotected Surfaces

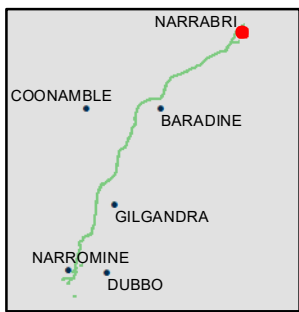
Existing velocity < 0.5m/s, design velocity > 0.5m/s



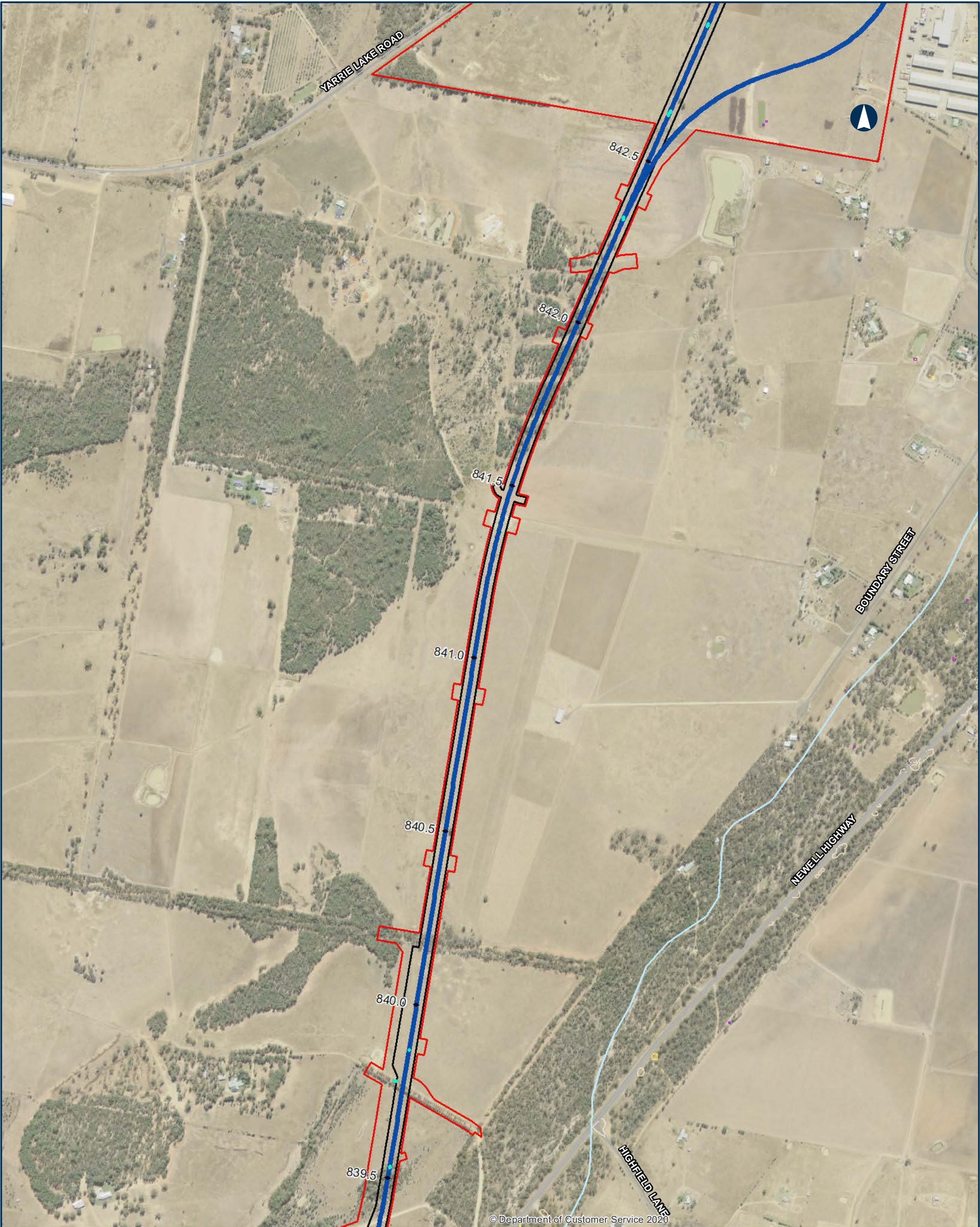
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Appendix B - Figure 2.3.12



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 2% AEP - Narrabri Local

Appendix B - Figure 2.3.13

0 200 400 Metres

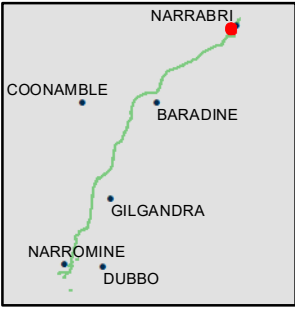
Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Culvert
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- Design Velocity Contour (m/s)
 - 1
 - <10% Increase
 - 10% to 20% increase

- Unprotected Surfaces
- Existing velocity < 0.5m/s, design velocity > 0.5m/s



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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 2% AEP - Narrabri Local

Appendix B - Figure 2.3.14

0 200 400 Metres

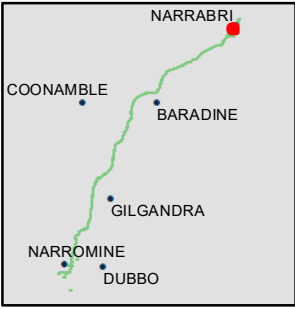
Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Culvert
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- Design Velocity Contour (m/s)
 - 1
 - <10% Increase
 - 10% to 20% increase
 - Greater than 20% increase

- Unprotected Surfaces
- Existing velocity < 0.5m/s, design velocity > 0.5m/s



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 2% AEP - Narrabri Local

Appendix B - Figure 2.3.15

0200400

Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022

Paper: A3

Author: JacobsGHD

Scale: 1:10,000

Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

Road QDL departure

Design Velocity Contour (m/s)

1

2

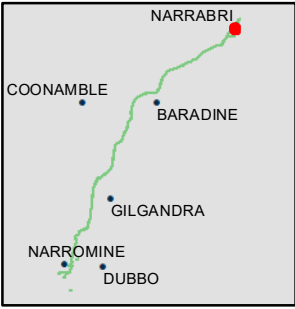
<10% Increase

10% to 20% increase

Greater than 20% increase

Unprotected Surfaces

Existing velocity < 0.5m/s, design velocity > 0.5m/s



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 2% AEP - Narrabri Local

Appendix B - Figure 2.3.16

0200400

Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022

Paper: A3

Author: JacobsGHD

Scale: 1:10,000

Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

Road QDL departure

Design Velocity Contour (m/s)

1

2

3

4

5

<10% Increase

10% to 20% increase

Unprotected Surfaces

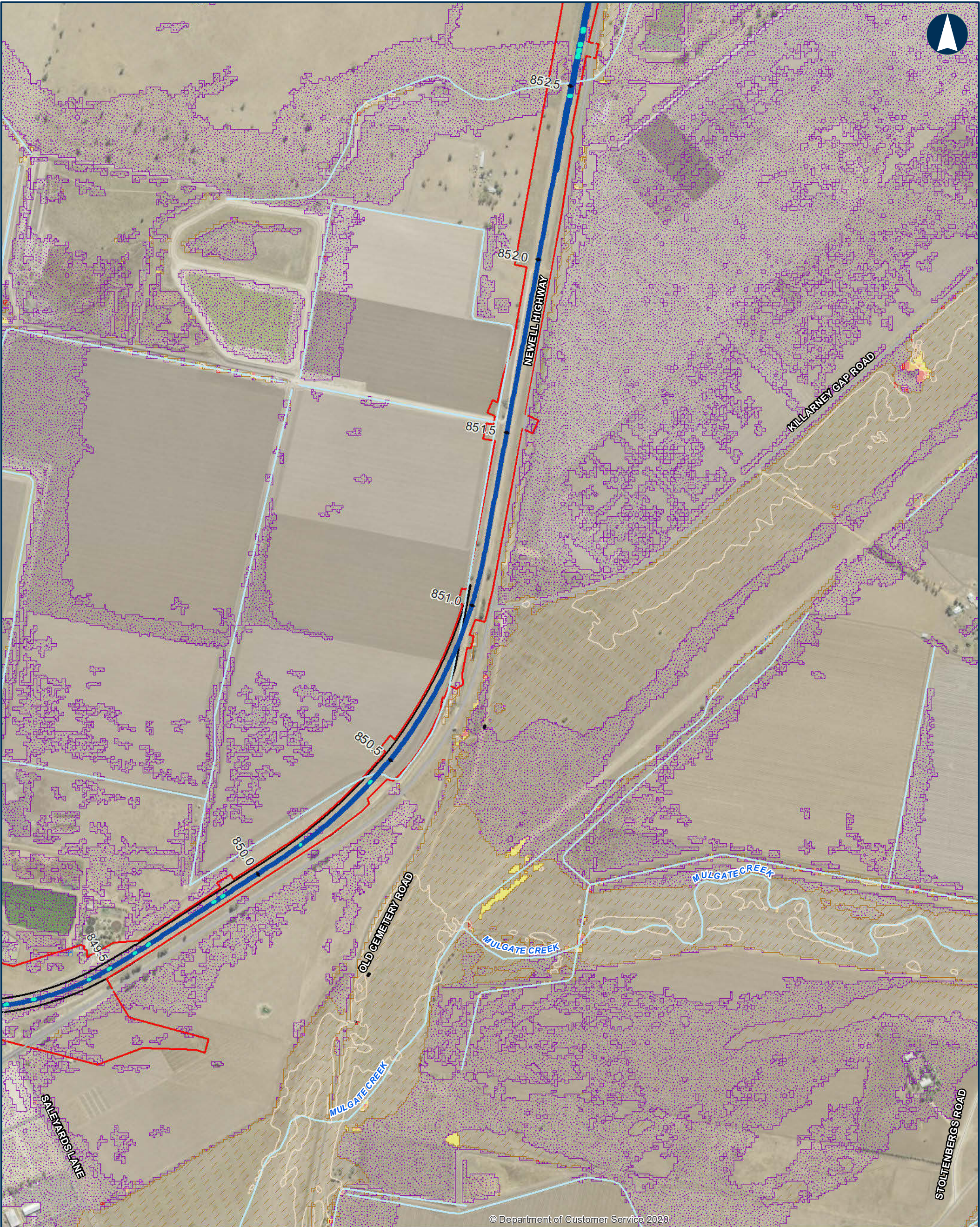
Existing not flooded, design velocity > 0.5m/s

Existing velocity < 0.5m/s, design velocity > 0.5m/s

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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 1% AEP with blockage - Narrabri Local

Appendix B - Figure 2.4.1

0 200 400 Metres

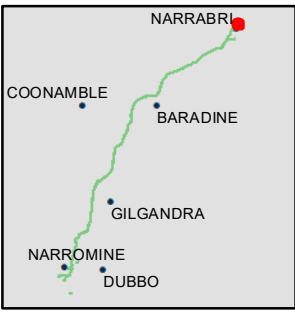
Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Culvert
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- Design Velocity Contour (m/s)
 - 1
 - 2
 - 3
 - 4
- Design Velocity < 0.5m/s
- Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s
- <10% Increase
- 10% to 20% increase
- Greater than 20% increase

- Unprotected Surfaces
- Existing not flooded, design velocity > 0.5m/s limited to 0.025m/s
 - Existing velocity < 0.5m/s, design velocity > 0.5m/s
 - Existing velocity > 0.5m/s, velocity change > 10%



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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 1% AEP with blockage - Narrabri Local

Appendix B - Figure 2.4.2

0 200 400 Metres

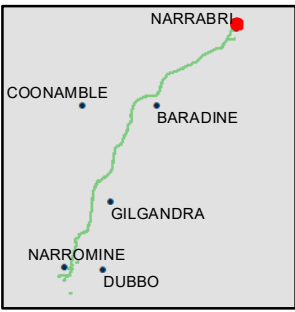
Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Bridge
- Culvert
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- Design Velocity Contour (m/s)
 - 1
 - 2
 - 3
- Design Velocity < 0.5m/s
- Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s
- <10% Increase
- 10% to 20% increase
- Greater than 20% increase

- Unprotected Surfaces
- Existing not flooded, design velocity > 0.5m/s limited to 0.025m/s
 - Existing velocity < 0.5m/s, design velocity > 0.5m/s
 - Existing velocity > 0.5m/s, velocity change > 10%



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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 1% AEP with blockage - Narrabri Local

Appendix B - Figure 2.4.3

0

200

400

Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022

Paper: A3

Author: JacobsGHD

Scale: 1:10,000

Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

Bridge

Road QDL departure

Alignment

The proposal

Rail Corridor

Design Velocity Contour (m/s)

1

2

Design Velocity < 0.5m/s

Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s

<10% Increase

10% to 20% increase

Greater than 20% increase

Unprotected Surfaces

Existing not flooded, design velocity > 0.5m/s limited to 0.025m/s

Existing velocity < 0.5m/s, design velocity > 0.5m/s

Existing velocity > 0.5m/s, velocity change > 10%

NARRABRI

COONAMBLE

BARADINE

GILGANDRA

NARROMINE

DUBBO

INLAND RAIL

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N:\AU\Newcastle\Projects\22\19593\GIS\GIS_2500_N2N_v2\Maps\Deliverables_SPIR\EIS\Flooding_Hydrology\Appendices\2500_EISFWAPP112_QDL_Local_ScourErosion_1pcBlockage_revA.mxd



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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 1% AEP with blockage - Narrabri Local

Appendix B - Figure 2.4.4

0 200 400 Metres

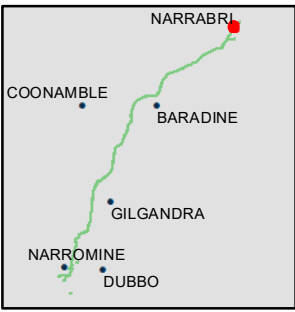
Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

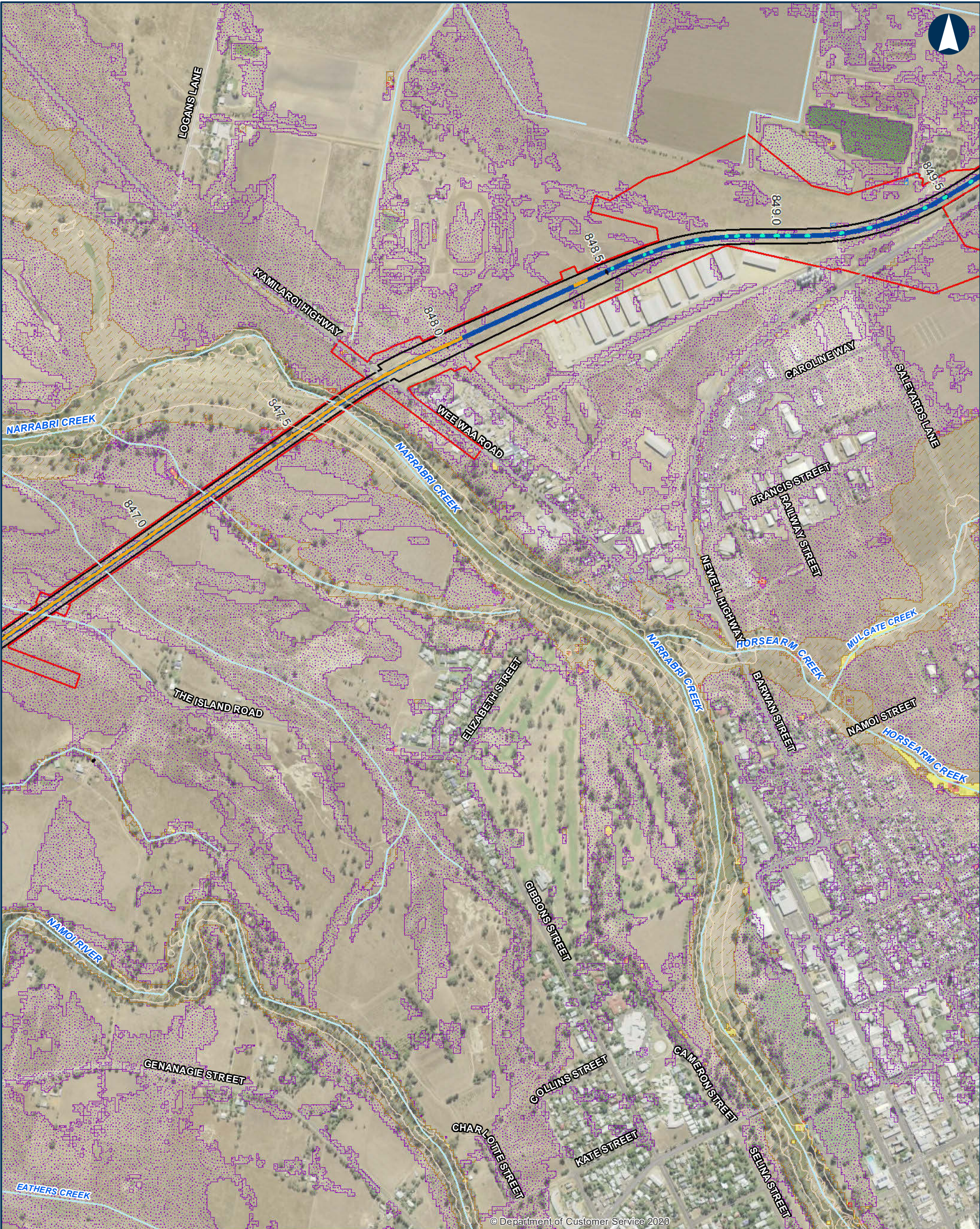
- Bridge
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- Design Velocity Contour (m/s)
 - 1
 - 2
- Design Velocity < 0.5m/s
- Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s
- <10% Increase
- 10% to 20% increase
- Greater than 20% increase

- Unprotected Surfaces
- Existing not flooded, design velocity > 0.5m/s limited to 0.025m/s
 - Existing velocity < 0.5m/s, design velocity > 0.5m/s
 - Existing velocity > 0.5m/s, velocity change > 10%



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 1% AEP with blockage - Narrabri Local

Appendix B - Figure 2.4.5

0 200 400 Metres

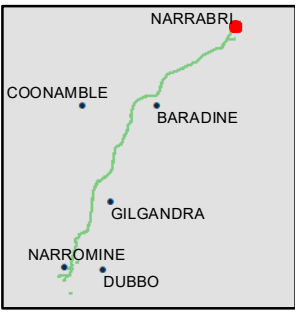
Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

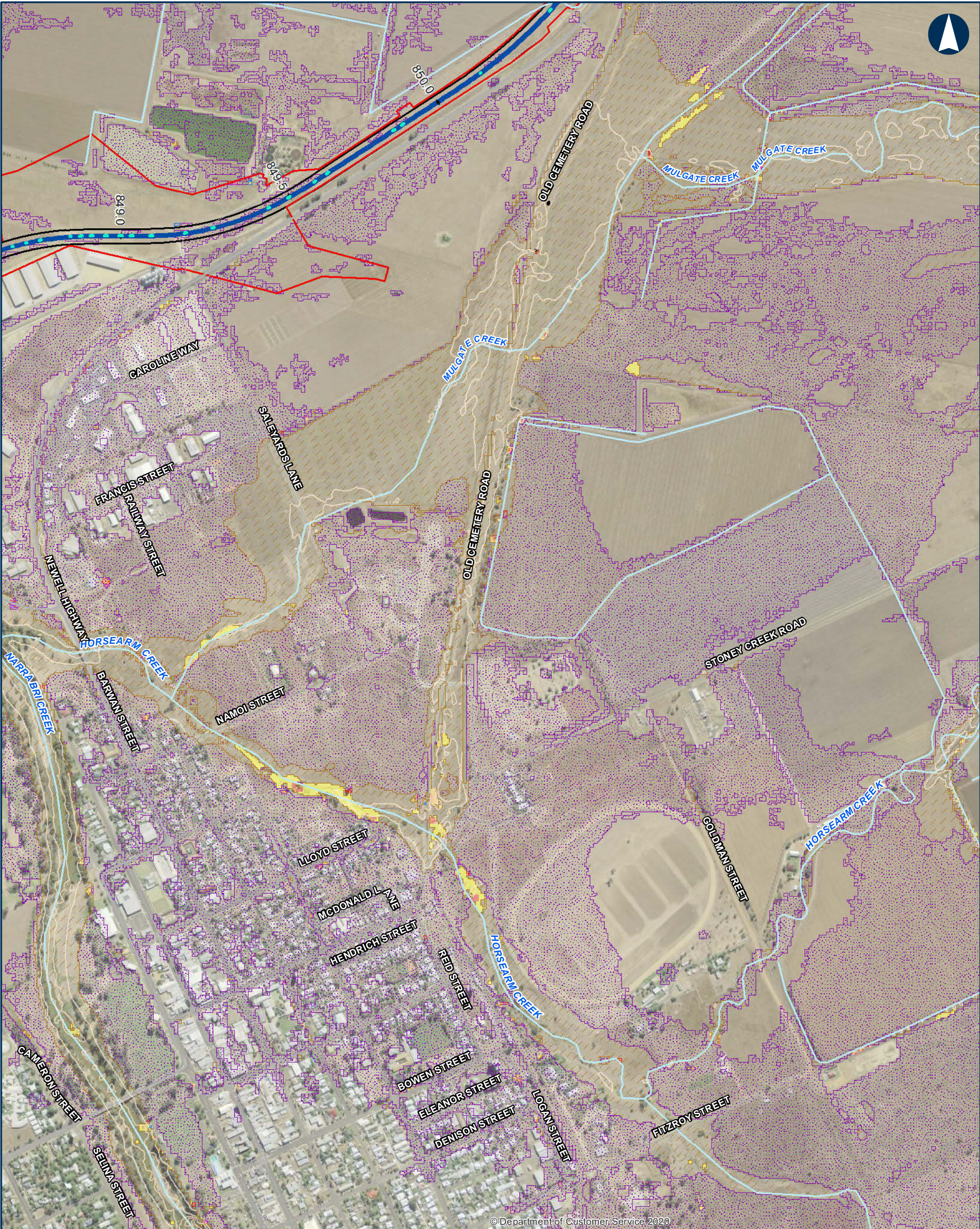
- Bridge
 - Culvert
 - Road QDL departure
 - Alignment
 - The proposal
 - Rail Corridor
- Design Velocity Contour (m/s)
- 1
 - 2
 - 3
 - 4
- Design Velocity < 0.5m/s
- Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s
- <10% Increase
 - 10% to 20% increase
 - Greater than 20% increase

- Unprotected Surfaces
- Existing not flooded, design velocity > 0.5m/s limited to 0.025m/s
 - Existing velocity < 0.5m/s, design velocity > 0.5m/s
 - Existing velocity > 0.5m/s, velocity change > 10%



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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 1% AEP with blockage - Narrabri Local

Appendix B - Figure 2.4.6

0 200 400 Metres

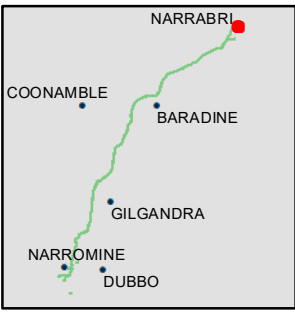
Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Culvert
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- Design Velocity Contour (m/s)
 - 1
 - 2
 - 3
 - 4
 - 5
- Design Velocity < 0.5m/s
- Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s
- <10% Increase
- 10% to 20% increase
- Greater than 20% increase

- Unprotected Surfaces
- Existing not flooded, design velocity > 0.5m/s limited to 0.025m/s
 - Existing velocity < 0.5m/s, design velocity > 0.5m/s
 - Existing velocity > 0.5m/s, velocity change > 10%



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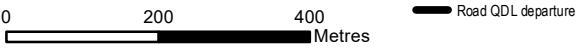
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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 1% AEP with blockage - Narrabri Local

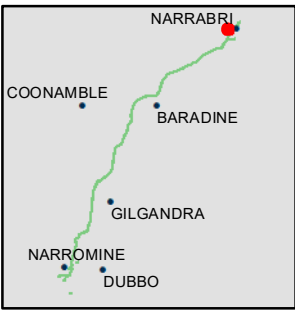
Appendix B - Figure 2.4.7



Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
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NARROMINE TO NARRABRI

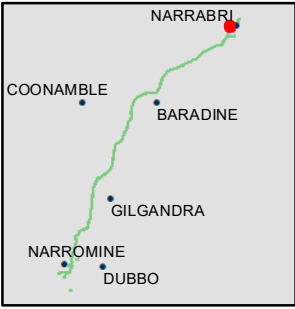
QDL departures - Scour / Erosion - 1% AEP with blockage - Narrabri Local

Appendix B - Figure 2.4.8

0 200 400 Metres
Coordinate System: GDA 1994 MGA Zone 55
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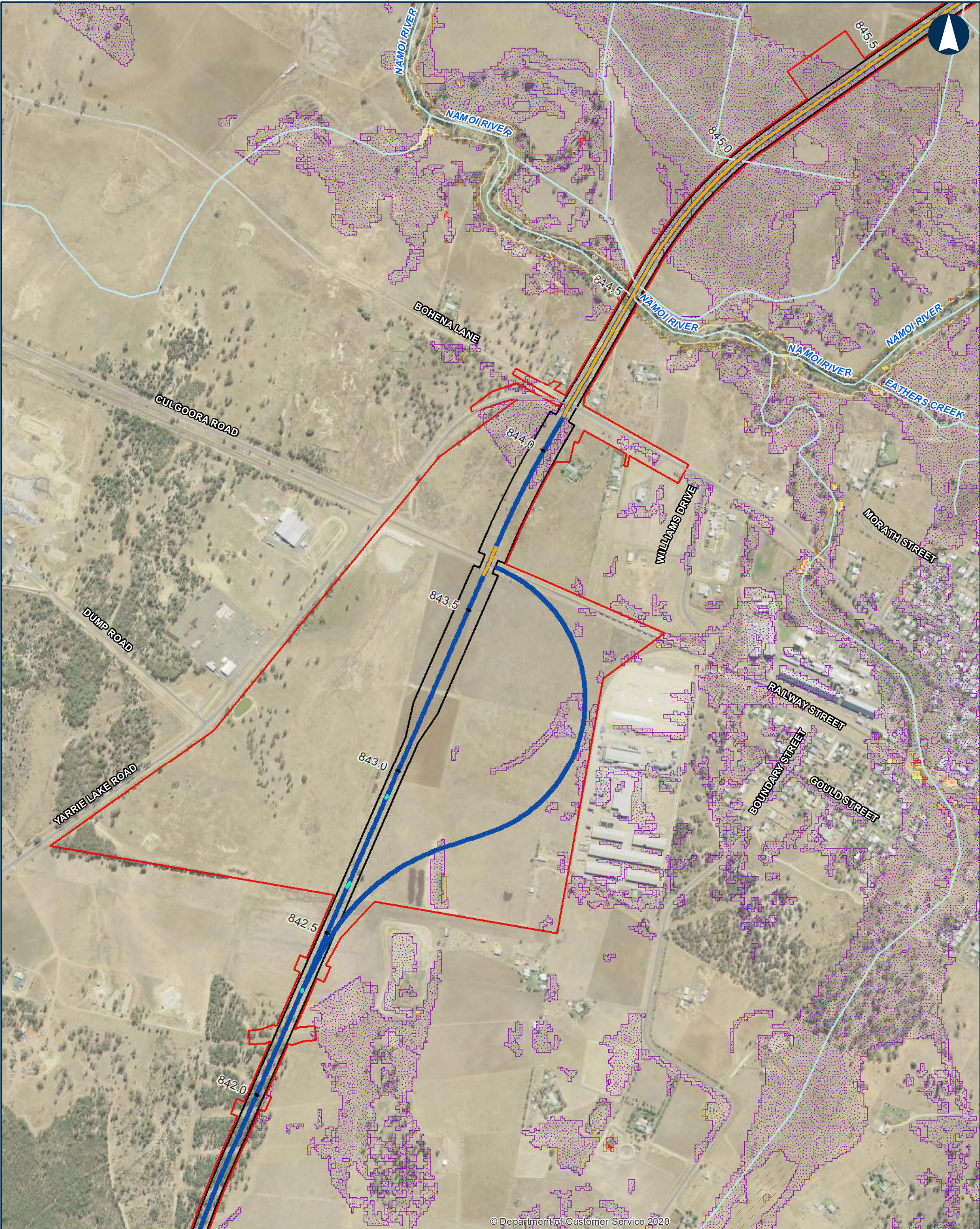
Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Culvert
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- Design Velocity < 0.5m/s
- Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s
- 10% to 20% increase
- Unprotected Surfaces
- Existing velocity < 0.5m/s, design velocity > 0.5m/s



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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 1% AEP with blockage - Narrabri Local

Appendix B - Figure 2.4.9

0 200 400 Metres

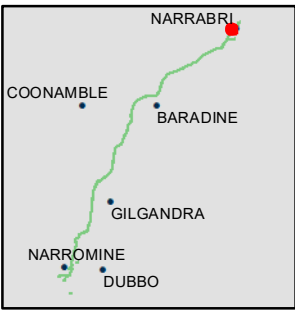
Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Bridge
- Culvert
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- Design Velocity Contour (m/s)
 - 1
 - 2
 - 3
 - 4
- Design Velocity < 0.5m/s
- Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s
- <10% Increase
- 10% to 20% increase
- Greater than 20% increase

- Unprotected Surfaces
- Existing not flooded, design velocity > 0.5m/s limited to 0.025m/s
 - Existing velocity < 0.5m/s, design velocity > 0.5m/s
 - Existing velocity > 0.5m/s, velocity change > 10%



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NARROMINE TO NARRABRI

QDL departures - Scour / Erosion - 1% AEP with blockage - Narrabri Local

Appendix B - Figure 2.4.10

0 200 400 Metres

Coordinate System: GDA 1994 MGA Zone 55

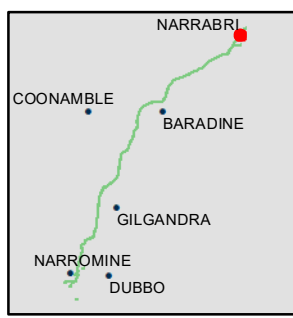
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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Bridge
- Road QDL departure
- Alignment
- The proposal
- Rail Corridor
- Design Velocity Contour (m/s)
- 1
- 2
- 3
- 4

- Design Velocity < 0.5m/s
- Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s
- <10% Increase
- 10% to 20% increase
- Greater than 20% increase

- Unprotected Surfaces
- Existing not flooded, design velocity > 0.5m/s limited to 0.025m/s
- Existing velocity < 0.5m/s, design velocity > 0.5m/s
- Existing velocity > 0.5m/s, velocity change > 10%



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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 1% AEP with blockage - Narrabri Local

Appendix B - Figure 2.4.11

0 200 400 Metres

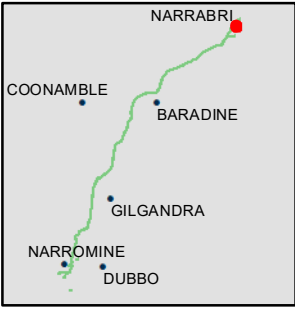
Coordinate System: GDA 1994 MGA Zone 55

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Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

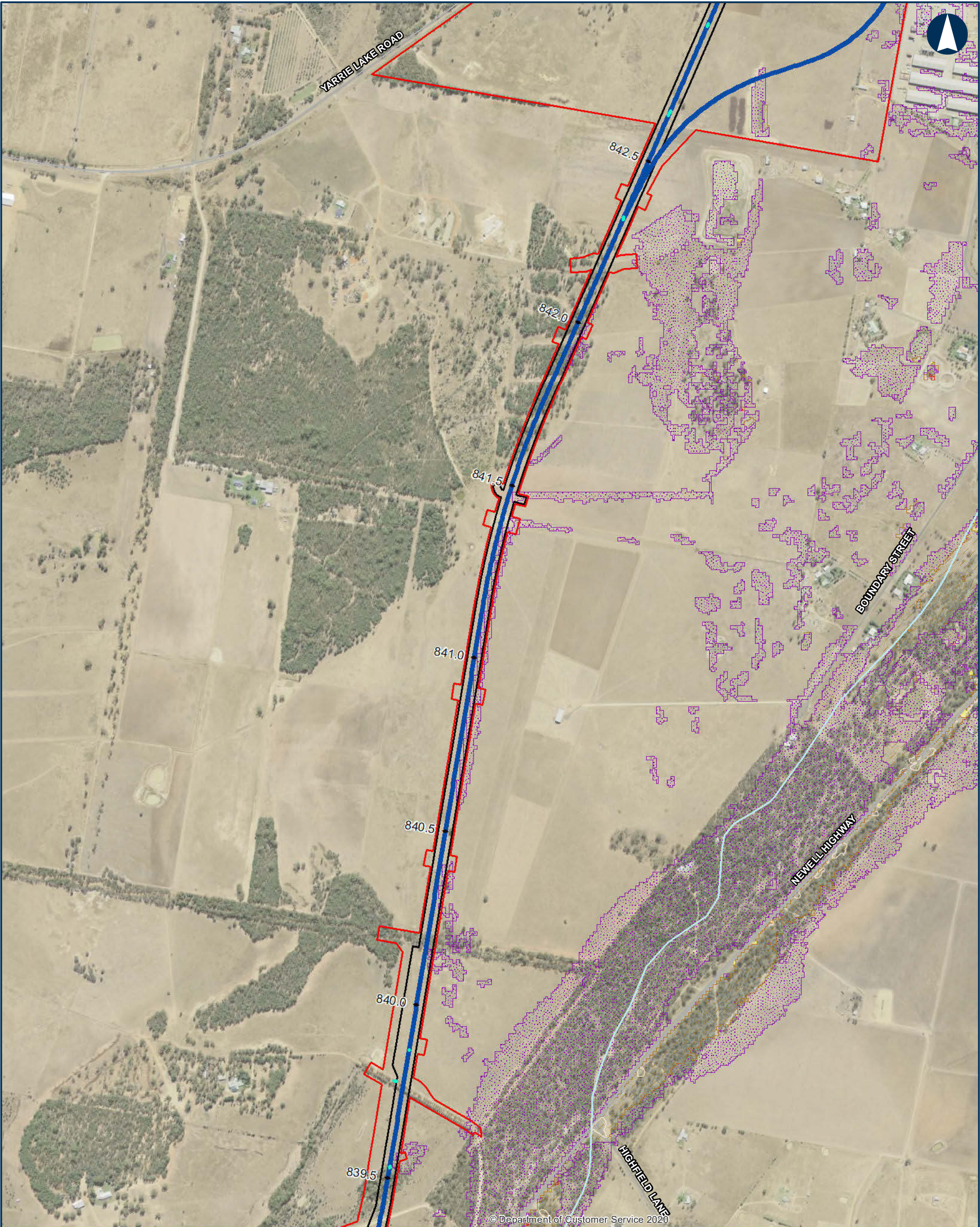
- Road QDL departure
- Design Velocity Contour (m/s)
- 1
 - 2
 - 3
 - 4
 - 5
- Design Velocity < 0.5m/s
- Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s
- <10% Increase
 - 10% to 20% increase
 - Greater than 20% increase

- Unprotected Surfaces
- Existing not flooded, design velocity > 0.5m/s limited to 0.025m/s
 - Existing velocity < 0.5m/s, design velocity > 0.5m/s
 - Existing velocity > 0.5m/s, velocity change > 10%



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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 1% AEP with blockage - Narrabri Local Appendix B - Figure 2.4.13

0 200 400 Metres

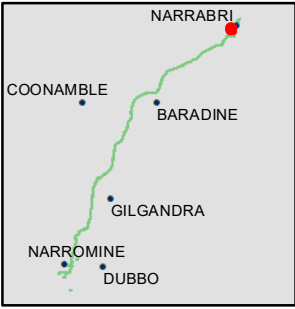
Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Culvert
 - Road QDL departure
 - Alignment
 - The proposal
 - Rail Corridor
 - Design Velocity Contour (m/s)
 - 1
- Design Velocity < 0.5m/s
 - Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s
 - <10% Increase
 - 10% to 20% increase
 - Greater than 20% increase

- Unprotected Surfaces
- Existing velocity < 0.5m/s, design velocity > 0.5m/s
 - Existing velocity > 0.5m/s, velocity change > 10%



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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 1% AEP with blockage - Narrabri Local

Appendix B - Figure 2.4.14

0 200 400 Metres

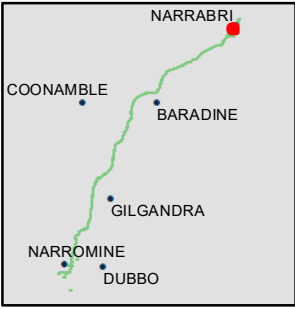
Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Culvert
 - Road QDL departure
 - Alignment
 - The proposal
 - Rail Corridor
 - Design Velocity Contour (m/s)
 - 1
- Design Velocity < 0.5m/s
 - Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s
 - <10% Increase
 - 10% to 20% increase
 - Greater than 20% increase

- Unprotected Surfaces
- Existing velocity < 0.5m/s, design velocity > 0.5m/s
 - Existing velocity > 0.5m/s, velocity change > 10%



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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 1% AEP with blockage - Narrabri Local

Appendix B - Figure 2.4.15

0200400

Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022

Paper: A3

Author: JacobsGHD

Scale: 1:10,000

Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

—

 Road QDL departure

—

 Design Velocity Contour (m/s)

1

2

•••••

 Design Velocity < 0.5m/s

—

 Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s

—

 <10% Increase

—

 10% to 20% increase

—

 Greater than 20% increase

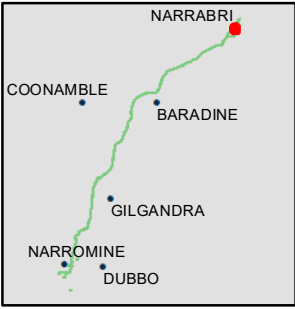
Unprotected Surfaces

—

 Existing velocity < 0.5m/s, design velocity > 0.5m/s

—

 Existing velocity > 0.5m/s, velocity change > 10%



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NARROMINE TO NARRABRI QDL departures - Scour / Erosion - 1% AEP with blockage - Narrabri Local

Appendix B - Figure 2.4.16

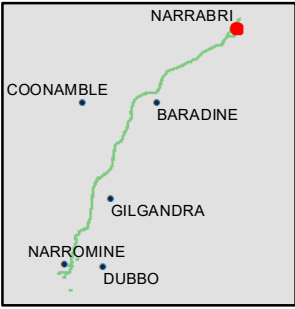
0 200 400 Metres

Coordinate System: GDA 1994 MGA Zone 55

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Date: 10/08/2022 Paper: A3
Author: JacobsGHD Scale: 1:10,000
Data Sources: Basemap layers: NSWSS; all other layers: JacobsGHD

- Design Velocity Contour (m/s)**
- 1
 - 2
 - 3
 - 4
 - 5
- Design Velocity < 0.5m/s**
- Design Velocity > 0.5m/s, Velocity increase limited to 0.025m/s
 - <10% Increase
 - 10% to 20% increase
 - Greater than 20% increase
- Unprotected Surfaces**
- Existing velocity < 0.5m/s, design velocity > 0.5m/s
 - Existing velocity > 0.5m/s, velocity change > 10%



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