AECOM

Inland Rail - Yelarbon to Gowrie
Australian Rail Track Corporation Limited
21-Apr-2017

Commercial-in-Confidence

Corridor Options Report

Corridor Options Report

Client: Australian Rail Track Corporation Limited

ABN: 75081455754

Prepared by

AECOM Australia Pty Ltd
Level 8, 540 Wickham Street, PO Box 1307, Fortitude Valley QLD 4006, Australia
T +61 7 3553 2000 F +61 7 3553 2050 www.aecom.com
ABN 20 093 846 925

Aurecon Australia Pty Ltd, Golders Associates, Project Support

21-Apr-2017

Job No.: 60492124

AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 AS/NZS4801 and OHSAS18001.

Printed on environmentally responsible paper.

Disclaimer

The Report and the information within it is confidential and may be privileged. If you have received the Report in error please notify AECOM immediately. You should not copy it for any purpose, or disclose its contents to any other person. The Report is qualified in its entirety by and should be considered in the light of AECOM's Terms of Engagement and the following:

1) The Report is provided solely for your use and benefit unless expressly permitted and then only in connection with the purpose in respect of which the Report is provided. Unless required by law, you shall not provide the Report to any third party without AECOM's prior written consent, which AECOM may at its discretion grant, withhold or grant subject to conditions. Possession of the Report does not carry with it the right to commercially reproduce, publish, sale, hire, lend, redistribute, abstract, excerpt or summarise the Report or to use the name of AECOM in any manner without first obtaining the prior written consent of AECOM.
2) AECOM has used its reasonable endeavours to ensure that the data contained in the Report reflects the most accurate and timely information available to it and is based on information that was current as of the date of the Report.
3) The Report is based on estimates, assumptions and other information developed by AECOM and other parties from its independent research effort, general knowledge of the industry and consultations with you, your employees and your representatives. No warranty or representation is made by AECOM that any of the projected values or results contained in the Report will actually be achieved. In addition, the Report is based upon information that was obtained on or before the date in which the Report was prepared. Circumstances and events may occur following the date on which such information was obtained that are beyond our control and which may affect the findings or projections contained in the Report. We may not be held responsible for such circumstances or events and specifically disclaim any responsibility therefore.
4) AECOM has relied on information provided by you and by third parties (Information Providers) to produce the Report and arrive at its conclusions. AECOM has not verified information provided by Information Providers (unless specifically noted otherwise) and we assume no responsibility and make no representations with respect to the adequacy, accuracy or completeness of such information. No responsibility is assumed for inaccuracies in reporting by Information Providers including, without limitation, by your employees or your representatives or for inaccuracies in any other data source whether provided in writing or orally used in preparing or presenting the Report.
5) In no event, regardless of whether AECOM's consent has been provided, shall AECOM assume any liability or responsibility to any third party to whom the Report is disclosed or otherwise made available.
6) The conclusions in the Report must be viewed in the context of the entire Report including, without limitation, any assumptions made and disclaimers provided. The conclusions in this Report must not be excised from the body of the Report under any circumstances.
7) Without the prior written consent of AECOM, the Report is not to be used in conjunction with any public or private offering of securities or other similar purpose where it might be relied upon to any degree by any person other than you.
8) All intellectual property rights (including, but not limited to copyright, database rights and trade marks rights) in the Report including any forecasts, drawings, spreadsheets, plans or other materials provided are the property of AECOM. You may use and copy such materials for your own internal use only.

Quality Information

Document	Corridor Options Report
Ref	60492124
Date	21-Apr-2017
Prepared by	Lindsay Klein
Reviewed by	Luke Smith

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
2	21-Apr-2017	For Client Issue	Robert Green Technical Director - Rail	

Appendix A

PRG Terms of Reference

Yelarbon to Gowrie
Project Reference Group

Purpose of the Group

A Project Reference Group (PRG) will be established for the Yelarbon to Gowrie section of Inland Rail. The purpose of the PRG will be to provide local, representative input in the review of alignment options for this section of the project, specifically (map attached for reference):

- current route (endorsed in 2015 by the Inland Rail Implementation Group) from Inglewood through Millmerran
- a route through Karara and Leyburn
- a route closer to Warwick.
- a route or connection to the Charlton and Wellcamp areas

The PRG's key role will be to:

- **Review and comment on the commissioned investigation work** on the alternative routes, raising any concerns or suggesting feasible enhancements to the proposed approach, method, inclusions and process – the purpose of this review is to ensure the investigations are viewed as rigorous and valid by the community and that potential gaps in approach are not identified at a later time.

- **Provide feedback on investigation findings** as they are shared, including commentary on perceived validity of the results, additional information required and any associated issues that may be raised as a result of these findings.

- **Provide local input into investigations**, particularly were anecdotal data and local knowledge will assist in enhancing investigations or shaping the process.

- **Seek feedback and input from local networks** on specific issues as requested, including taking information back to their individual networks for discussion and formal response.

- **Provide formal commentary to media through the Chair** on the progress of the review process to update the community.

- **Provide recommendations on the alignment** and endorsement of the rigor behind the comparative analysis of the various options.

The PRG will operate as a minimum for the lifespan of the alternative route analysis, but may be extended or expanded for ongoing or later use during Phase 2 (Environment and Planning Approvals).

Roles

The following key roles will support the management of the PRG:

Chair

The Chair will be appointed by the Minister for Infrastructure and Transport

The Chair will be responsible for ensuring all member issues and interests are captured on the agenda for each meeting, that full and complete discussion is facilitated in each meeting and that an open and transparent process is implemented.

The Chair will work with the Secretariat to prepare an agenda for each meeting that captures both community and project interests.

The Chair will provide a Report to the Minister on the outcomes of the PRG.

Members

Due to the short timeframe for both establishment and operation of this group, it has been open to representatives of identified local industry bodies.

Local industry bodies were identified across each alternative alignment geographic area and contacted to identify their interest in providing a representative to sit on the group. A follow up email explaining the purpose and time commitment of the group will be sent. For the purpose of this investigation, local industry groups include:

- Farming peak bodies and organisations
- Chambers of Commerce and business groups
- Environmental and conservation organisations
- Community and progress associations.

The size of the group will be subject to finalisation with the Chair.

Observers

In addition, representatives of each Council (Toowoomba, Goondiwindi, Southern Downs), each State and Federal MP, as well as TMR, DAF and DEHP, were invited to attend each meeting in the capacity of an observer. The purpose of these observers is to ensure direct transparency back to these elected representatives, to respond to any legislative or local law question as appropriate and to provide a direct line of communication for requests of information back to elected officials. It is not anticipated that the observers will participate directly in discussion of agenda items, unless specifically requested as their role is more around transparency and reporting and inputting.

Should it be desired to maintain the group longer term or to expand its membership for future use, Expressions of Interest will be taken at upcoming Community Information Sessions to enable broader community and landowner involvement post completion of this route investigation.

Terms of Reference

The Terms of Reference (TOR) will be discussed and signed off by all PRG members at the first meeting to ensure agreement to their inclusions.

Members of the PRG will undertake to participate under the following key principles:

1. **Commitment to constructive discussion** – open and honest dialogue that aims to add value and problem solve, not detract or criticise

2. **Commitment to share information as appropriate** – take update information back to member networks as a mechanism for broader community awareness of the investigations, process and findings and seek feedback from these communities as requested

3. **Commitment to a like for like determination on the alignments** – open and transparent review of information based on technical, engineering and economic principles as well as the benefits and impacts on communities.

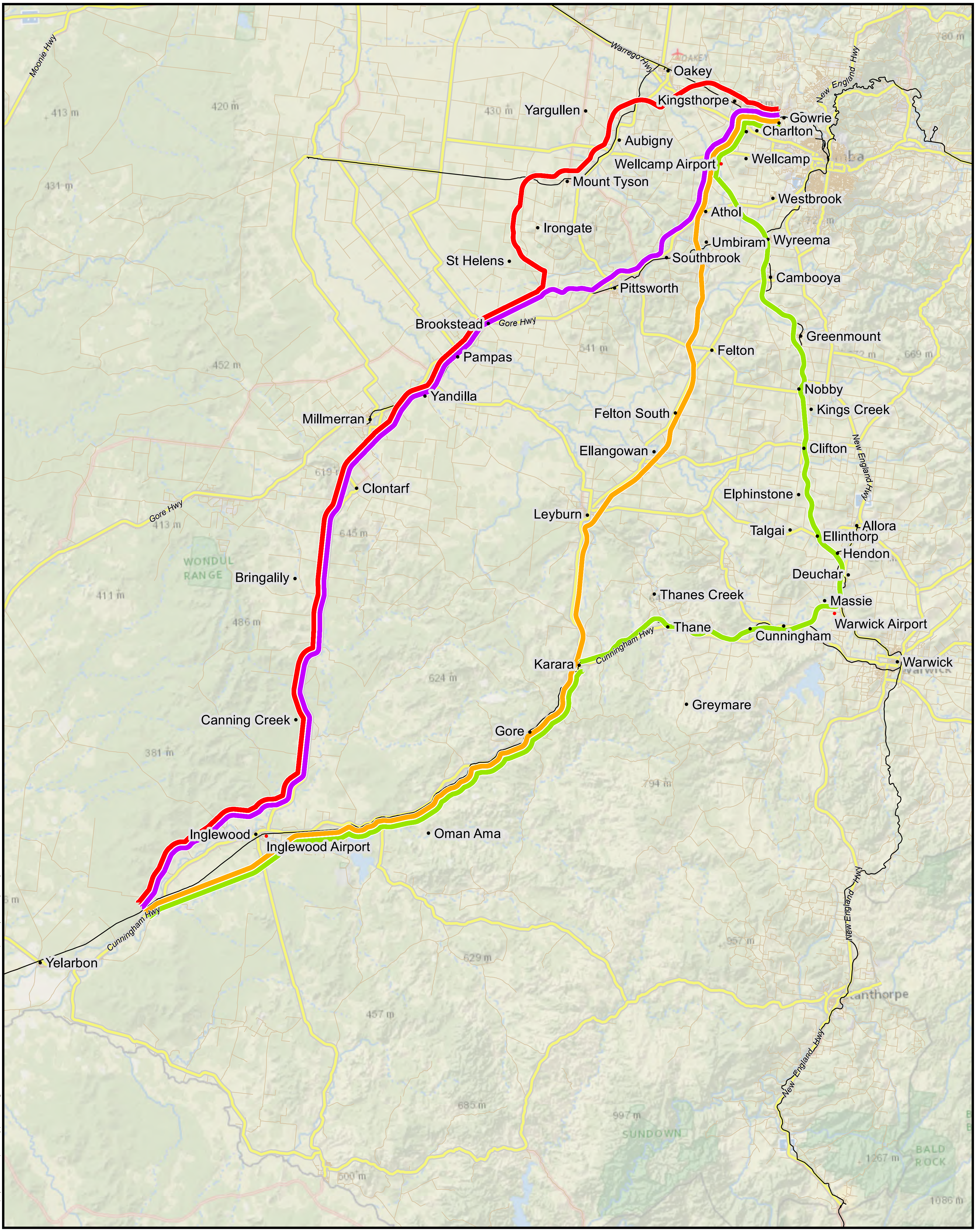
4. **Commitment to confidentiality as requested** – where information discussed has the potential to cause distress to individuals or communities (for example any detailed alignment impacts that are not yet confirmed) members may be requested to keep this confidential. This is not to reduce the openness or transparency of the meetings but to protect other community members for unnecessary angst from an impact that may not be realised due to the final route and detailed planning not yet being confirmed. Members will be advised prior to and post discussion of any confidential item; this will ensure their awareness of any confidentiality requirements.

5. **Review, feedback and information gathering body** – the role of the PRG is to review, challenge, collect and share data and input community views.

6. **Commitment to delivering a final report through the Chair** with recommendations on the review of the alignments and endorsement of the comparative analysis behind these recommendations. The final Inland Rail alignment will be a decision of the Commonwealth Government.

Appendix B

Corridor Maps



AECOM shall bear no responsibility or liability for any errors, faults, defects, or omissions in the information. AECOM does not warrant the accuracy or completeness of information displayed in this map and any person using it does so at their own risk.

AECOM
www.aecom.com

N

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator

0 5 10 20
Kilometres
1:500,000 (when printed at A3)

LEGEND

- Place_names_gazetteer
- Base Case Modified
- Wellcamp-Charlton
- Karara-Leyburn
- Warwick
- Existing Railway
- Main Roads

PRELIMINARY. NOT FOR CONSTRUCTION.
FOR INFORMATION PURPOSES ONLY.
ROUTES ARE APPROXIMATE ONLY.

Data sources: © State of Queensland (Department of Natural Resources and Mines) 2016
StreetPro © 2014. Pitney Bowes Software Pty Ltd.
All rights reserved.

ARTC

PROJECT OVERVIEW
CONCEPTUAL CORRIDOR ROUTES

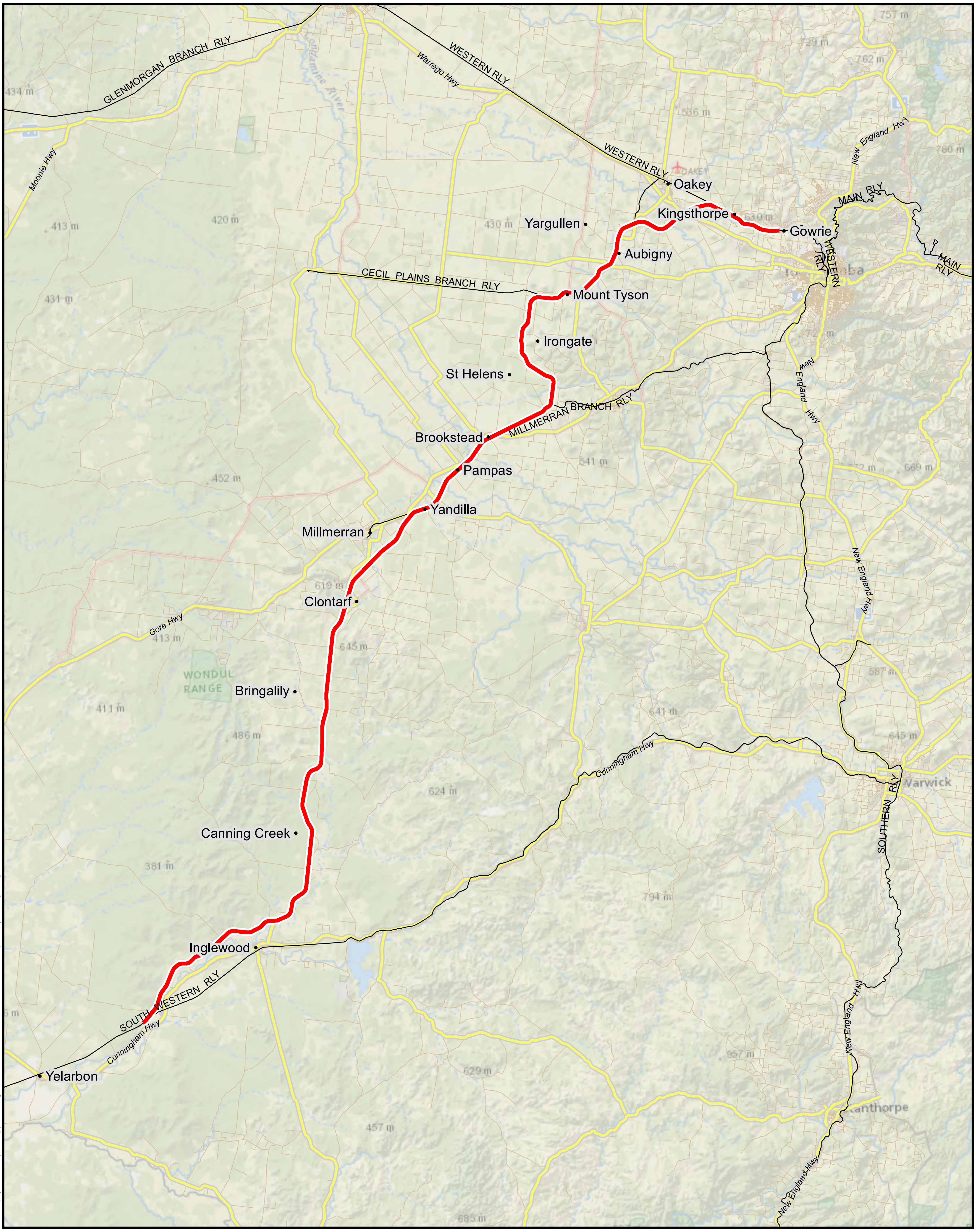
Yelarbon to Gowrie (Y2G) Project

PROJECT ID	60492124
CREATED BY	MF
LAST MODIFIED	frym - 29/03/2017
VERSION:	2

Map
1

Filename: P:\604X\60492124\4. Tech Work Area\4.99 GIS\02_MXDs\20161020_Environment\G011_60492124_ARTC_Overview.mxd

A3 size



AECOM

www.aecom.com

N

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator

0 5 10 20
Kilometres
1:500,000 (when printed at A3)

Legend

- Base Case Modified
- Existing Railway
- Main Roads

ARTC

BASE CASE MODIFIED ALIGNMENT CONCEPTUAL CORRIDOR ROUTE

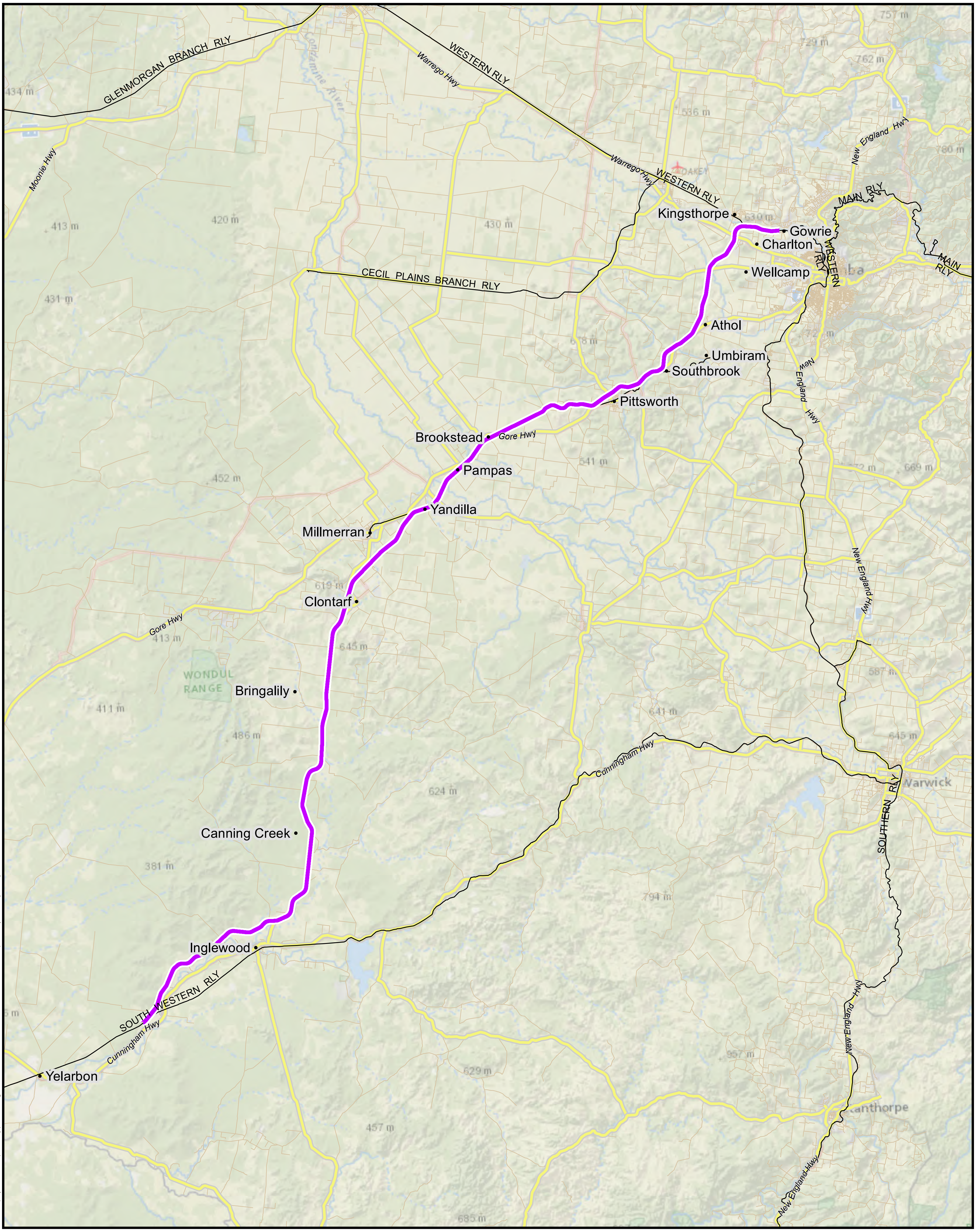
Yelarbon to Gowrie (Y2G) Project

PROJECT ID	60492124
CREATED BY	MF
LAST MODIFIED	FryM - 31/03/2017
VERSION:	1

Map 2

A3 size

Filename: P:\604X\60492124\4. Tech Work Area\4.99 GIS\02_MXDs\CorridorOptionsAssessment\Civil\CIV-02_60492124_ARTC_Overview_BaseCase.mxd



AECOM
www.aecom.com

N

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator

0 5 10 20
Kilometres
1:500,000 (when printed at A3)

Legend

- Wellcamp-Charlton
- Existing Railway
- Main Roads

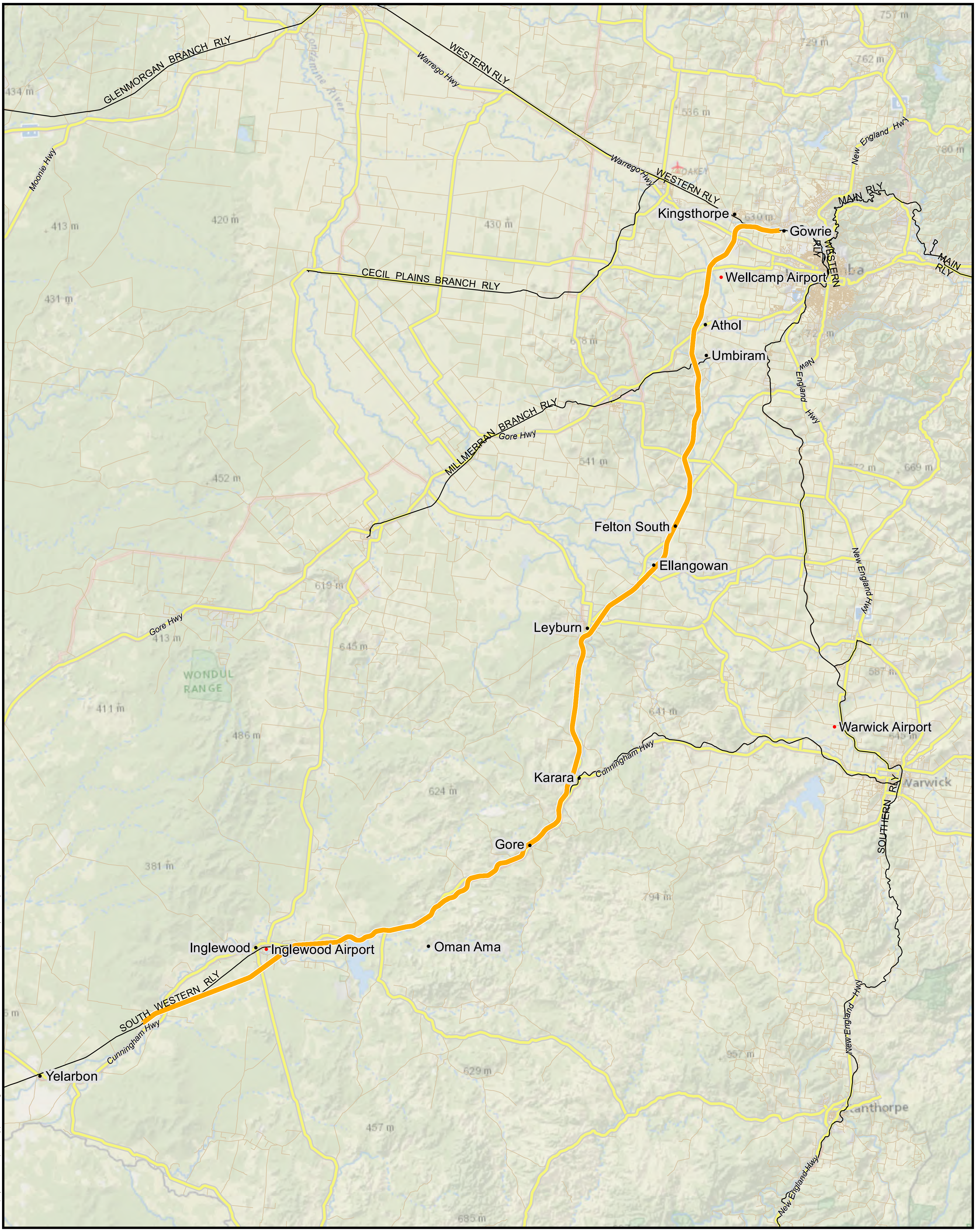
ARTC

WELLCAMP-CHARLTON ALIGNMENT CONCEPTUAL CORRIDOR ROUTE

Yelarbon to Gowrie (Y2G) Project

PROJECT ID	60492124
CREATED BY	MF
LAST MODIFIED	FryM - 31/03/2017
VERSION:	1

Map **3**



N

AECOM
www.aecom.com

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator

0 5 10 20
Kilometres
1:500,000 (when printed at A3)

Legend

- Karara-Leyburn
- Existing Railway
- Main Roads

ARTC

KARARA-LEYBURN ALIGNMENT CONCEPTUAL CORRIDOR ROUTE

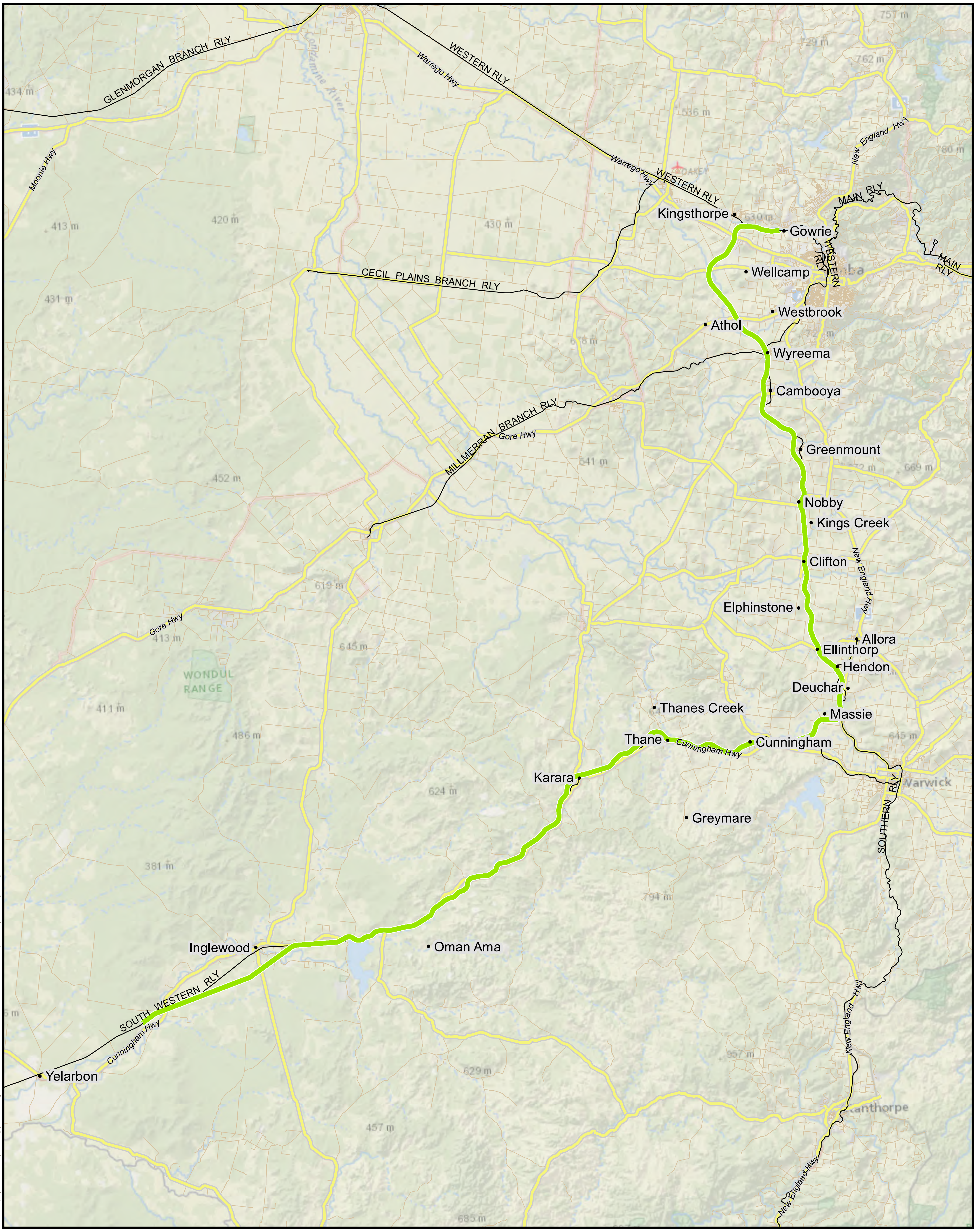
Yelarbon to Gowrie (Y2G) Project

PROJECT ID	60492124
CREATED BY	MF
LAST MODIFIED	FryM - 31/03/2017
VERSION:	1

Map **4**

Filename: P:\604X\60492124\4. Tech Work Area\4.99 GIS\02_MXDs\CorridorOptionsAssessment\Civil\CIV-04_60492124_ARTC_Overview_KararaLeyburn.mxd

A3 size



AECOM does not warrant the accuracy or completeness of information displayed in this map and any person using it does so at their own risk. AECOM shall bear no responsibility or liability for any errors, faults, defects, or omissions in the information.

AECOM
www.aecom.com

N

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator

0 5 10 20
Kilometres
1:500,000 (when printed at A3)

Legend
- Warwick
- Existing Railway
- Main Roads

Data sources: © State of Queensland (Department of Natural Resources and Mines) 2016
StreetPro © 2014. Pitney Bowes Software Pty Ltd.
All rights reserved.

ARTC

WARWICK ALIGNMENT CONCEPTUAL CORRIDOR ROUTE

Yelarbon to Gowrie (Y2G) Project

PROJECT ID	60492124
CREATED BY	MF
LAST MODIFIED	FryM - 31/03/2017
VERSION:	1

Map
5

Filename: P:\604X\60492124\4. Tech Work Area\4.99 GIS\02_MXDs\CorridorOptionsAssessment\Civil\CIV-05_60492124_ARTC_Overview_Warwick.mxd

A3 size

Appendix C

PRG Inputs

Information Received from PRG

Submitted By	Information	Date
Millmerran Rail Group	Guided tour of Condamine River floodplain	18-Jan-17
Millmerran Rail Group	Evaluation of flood and waterway impacts	30-Jan-17
Millmerran Farmers Group	Hydrology data package	6-Feb-17
Condamine Alliance	2 x Summary of environmental and planning data sets	8-Feb-17
Paul and Cate Cousen	Video and photos of Walingford Rd flooding	8-Feb-17
Millwood Landholders	Submission re: option assessment and MCA process	8-Feb-17
Friends of Felton	Submission re: option assessment process	10-Feb-17
Millmerran Rail Group	Submission re: option assessment and MCA process	10-Feb-17
Millwood Farmers Group: Wayne Saal	Submission re: community and property impacts, MCA workshop, drop in sessions and PRG 2 presentation	11-Feb-17
Heavy Vehicle Transport Association: Ross Fraser	Submission re: option assessment process	14-Feb-17
Warwick Chamber of Commerce: Gary Hayes	Submission re: property access	16-Feb-17
Queensland Murray-Darling Committee Inc	Submission re: route mapping and natural assets	17-Feb-17
Warwick Chamber of Commerce: Gary Hayes	Hardcopy sketch of alternative Warwick bypass route	20-Feb-17
Millwood Farmers Group: Wayne Saal	Question post-PRG 3 regarding the source of land use data	28-Feb-17
Millmerran Rail Group	Photos of flooding around Doug Hall Poultry	9-Mar-17
Friends of Felton	Submission re: Rating of Karara-Leyburn-Felton (KLF) Y2G Alignment Relative to Base Case and Several Criteria Critical to KLF Community	14-Mar-17
Post Drop-In Session submissions to DIRD		
Gary Cousen	Letter re: Inland Rail Brookstead to Mt Tyson	16-Mar-17
Vicki Green	Feedback Form: Offer to host farm visit to Ellangowan	17-Mar-17
Lisa and Daniel Cavanagh	Letter re: Letter of Concern regarding inland rail Yelarbon to Gowrie Project Reference Group	17-Mar-17
Ian and Karen Kronk	Letter re: Inland Rail Project – Proposed Brookstead to Mt Tyson Section	17-Mar-17

Appendix D

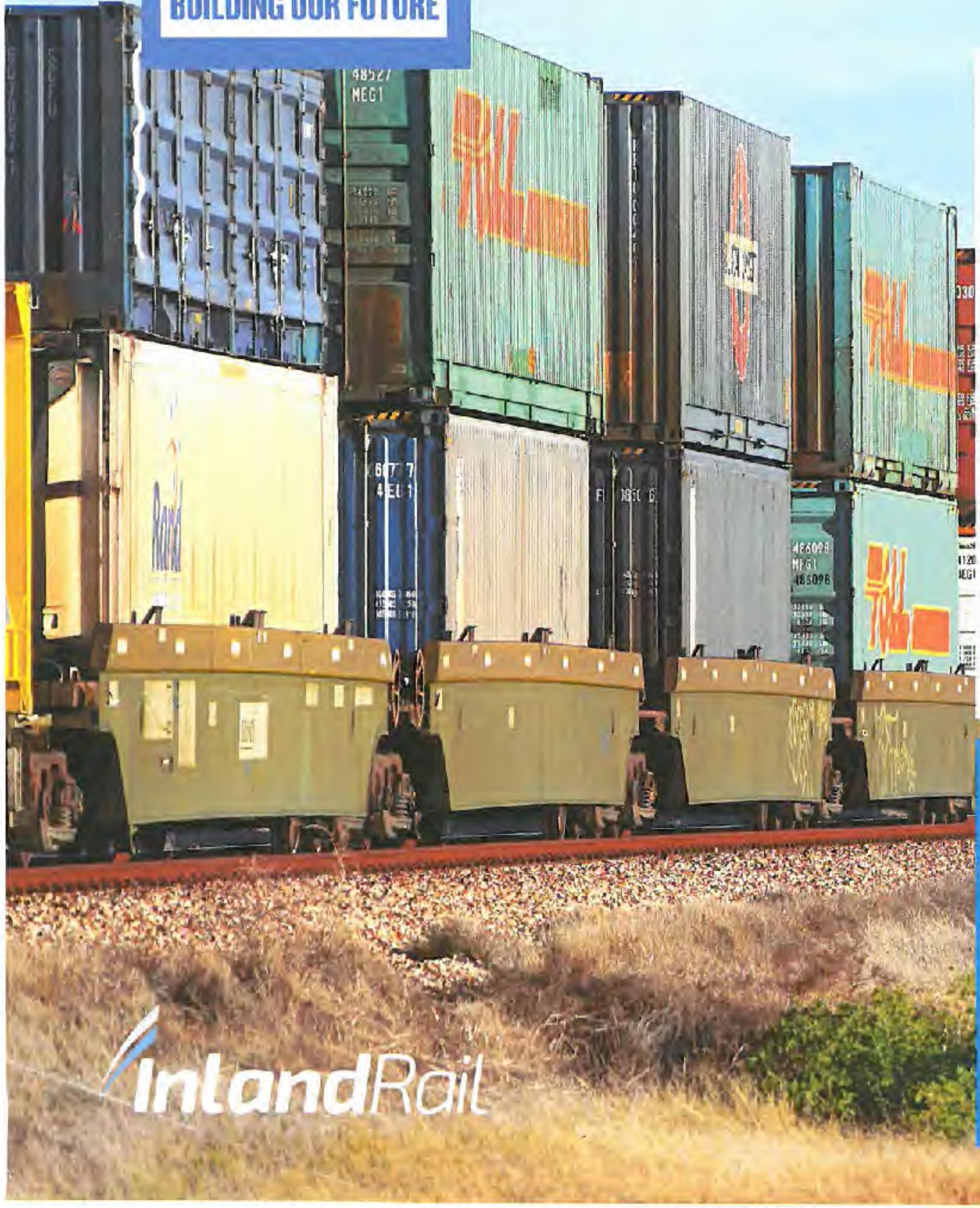
Drop-In Sessions Advertisement

Australian Government

BUILDING OUR FUTURE

INLAND RAIL - YELARBON TO GOWRIE

Community Drop-In Sessions



Inland Rail is a new 1700km freight rail connection between Melbourne and Brisbane, via regional Victoria, New South Wales and Queensland.

The Inland Rail Queensland Community Advisor, Mr Bruce Wilson AM, invites you to attend a community drop-in session about the Inland Rail alignment review between Yelarbon and Gowrie.

Mr Wilson will give an update on the current status of the review and answer your questions.

For more information about Inland Rail, visit www.inlandrail.com.au

COMMUNITY DROP-IN SESSIONS

Time: 1-4pm, Wednesday 8 March 2017
Venue: Millwood Hall, Millmerran Inglewood Road, Millwood

Time: 10am-1pm, Thursday 9 March 2017
Venue: Brookstead Hall, Madelaine Street, Brookstead

Time: 5-8pm, Thursday 9 March 2017
Venue: Felton Hall, 2775 Toowoomba-Karara Road, Felton

InlandRail

Appendix E

Project Risk Register

Ref #	Source	R = Risk O = Opportunity	Status Open or Closed	Risk Location	Risk Category	Project Section	Discipline	Design Life Cycle Stage	Safety in Design Hazard/Issue	Cause	Consequences	Responsibility	Existing Controls (Implementation Commenced or Complete)	Existing Control Owner	Safety	Assets	Environmental	Max Current Consequence	Current Likelihood	Current Level of Risk	Planned Future Controls (Planned but implementation not yet commenced)	Action Owner	By When	Residual Consequence	Residual Likelihood	Residual Level of Risk	Comments
		R	Open			NSW/QLD border to Gowrie	Signals	Set-up	Train collisions	Issues with operations and signals at the: • Interface with existing operational narrow gauge line which has different operation safe working systems. • Interface with shared / common space with Queensland Rail which has different operational requirements. • Interface with proposed multimodal terminal.	Single fatality	Rail Infrastructure Manager (RIM)	Safe working procedures. Train Orders. ATMS.		Major			Major	Unlikely	R M-4D		RIM	Phase 3			NA	
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Construction	Collision with train and construction plant	Construction in live corridor	Serious injury occurs	Principal Contractor	Safe working procedures. Possession and construction planning. Construct offline. Speed restrictions during construction. Delineation of work areas. Construction management plan.		Moderate			Moderate	Unlikely	R L-3D						NA	
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Construction	Collision with train and construction person	Construction in live corridor	Single fatality	Principal Contractor	Safe working procedures. Possession and construction planning. Construct offline. Speed restrictions during construction. Delineation of work areas. Construction management plan.		Major			Major	Unlikely	R M-4D						NA	
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Construction	Collision with train and plant	Occupational crossing. Existing line 1-2 trains per week (seasonal). Future 15 trains per day.	Serious injury occurs	Rail Infrastructure Manager (RIM)	Safe working procedures. Speed restrictions during construction. Ensure correct signage and sighting distance. Education. ALCAM assessment.		Moderate			Moderate	Unlikely	R L-3D						NA	
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Operations	Collision with train and plant	Public level crossing. Existing line 1-2 trains per week (seasonal). Future 15 trains per day.	Serious injury occurs	Rail Infrastructure Manager (RIM)	Ensure correct signage and sighting distance. ALCAM assessment. Educate plant operators and public. Design crossings to suit plant.		Moderate			Moderate	Unlikely	R L-3D							
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Operations	Collision with train and vehicle on level crossing	Sighting distance of trains can not be achieved	Single fatality	Rail Infrastructure Manager (RIM)	Ensure correct signage and sighting distance. ALCAM assessment. Educate landowners and public. Design crossings to suit vehicles.		Major			Major	Unlikely	R M-4D							
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Operations	Collision with train and stock	Stock crossings. Occupational Crossings. Level crossings. Brocken fences.	Serious injury occurs	Rail Infrastructure Manager (RIM)	Ensure correct signage and sighting distance. Ensure correct fencing type and maintain fencing. Use underpasses where possible in the design.		Moderate			Moderate	Unlikely	R L-3D						NA	
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Operations	Collison with train and farm equipment	Bifurcation of existing farms. Severance of existing crossings.	Serious injury occurs	Rail Infrastructure Manager (RIM)	Ensure correct signage and sighting distance. Discuss crossing requirements with landowners. Design crossings to suit requirements. Educate the crossing users.		Moderate			Moderate	Unlikely	R L-3D						NA	
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Operations	Collision with road traffic and farm equipment	Farm equipment required to travel on road network	Serious injury occurs	Rail Infrastructure Manager (RIM)	No existing control		Moderate			Moderate	Unlikely	R L-3D						NA	
		R	Open			NSW/QLD border to Gowrie		Construction	Increased traffic collisions on public roads	Increased traffic due to construction including heavy construction vehicles	Serious injury occurs	Principal Contractor	Construction traffic management plan to include access strategy to site. Use of public roads to be considered in strategy.		Moderate			Moderate	Unlikely	R L-3D							
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Construction	Traffic collisions on corridor access roads	Access roads are not suitable for construction vehicles. Limited room for turning movements. limited room for passing. Increased traffic on access roads during construction.	Serious injury occurs	Rail Infrastructure Manager (RIM)	Construction traffic management plan to include access strategy to site. Temporary upgrade of maintenance access road as assed and required.		Moderate			Moderate	Unlikely	R L-3D							
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Construction	Oversize vehicle deliveries	Impact on existing infrastructure, damage to public roads and maintenance road causing accident.	Serious injury occurs	Principal Contractor	Construction traffic management plan to include access strategy to site. Temporary upgrade of maintenance access road as assed and required		Moderate			Moderate	Unlikely	R L-3D							
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Operations	Rail and road collisions from driver glare	Glare obstructs driver view	Serious injury occurs	Rail Infrastructure Manager (RIM)	No existing control		Moderate			Moderate	Unlikely	R L-3D							
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Operations	Lights of vehicles on internal maintenance road	Train driver perceives vehicle lights as oncoming train, applies emergency brakes, causing injury to train driver and maintenance staff.	Serious injury occurs	Rail Infrastructure Manager (RIM)	No existing control. Maintenance at night in this location would be reactive situation, not planned.		Moderate			Moderate	Unlikely	R L-3D							
		R	Open			NSW/QLD border to Gowrie	Bridges and Structures	Construction	Construction workers and equipment in close proximity to existing operational bridge.	Construction of new bridge adjacent to existing operation rail bridge. Potential collision between train and construction workers or equipment.	Single fatality	Principal Contractor	Safe working procedures		Major			major	Unlikely	R M-4D							
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Construction	Insufficient safe working standards and systems during construction and operations	Potential three tracks in tight corridor	Multiple fatalities	Principal Contractor	Safe working procedures		Extreme			Extreme	Possible	R H-5C							
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Construction	Restricted area available for construction	Rail corridor bounded by roads either side. Existing brown field corridor of insufficient width for construction.	Serious injury occurs	Principal Contractor	Safe working procedures		Moderate			Moderate	Possible	R M-3C							
		R	Open			NSW/QLD border to Gowrie	Bridges and Structures	Construction	Work at height	Remote site works requiring complex construction. Fall from height resulting in injury or death.	Single fatality	Principal Contractor	Use of modular construction techniques Assess need for temporary fencing to be put in place for maintenance activities and provide Safe work method statements.		Major			Major	Possible	R H-4C						NA	
		R	Open			NSW/QLD border to Gowrie		Construction	Fatigue/Exposure to weather	Remote site works requiring intensive onsite labour	Lost Time Injury (LTI) Results OR Medical Treatment Required	Principal Contractor	Safe working procedures. Construction management plan and induction to ensure work is conducted in an appropriate and safe manner.		Minor			Minor	likely	R M-2B						NA	
		R	Open			NSW/QLD border to Gowrie		Construction	Limited time available for undertaking works during closures	Injuries due to accelerated pace of works.	Lost Time Injury (LTI) Results OR Medical Treatment Required	Principal Contractor	Safe working procedures. Construction management plan and induction to ensure work is conducted in an appropriate and safe manner.		Minor			Minor	likely	R M-2B							
		R	Open			NSW/QLD border to Gowrie		Construction	Slips and vehicle accidents due to surface conditions	Rain event	Lost Time Injury (LTI) Results OR Medical Treatment Required	Principal Contractor	Safe working procedures. Construction management plan and induction to ensure work is conducted in an appropriate and safe manner.		Minor			Minor	likely	R M-2B							
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Construction	Flooding of construction site causing injuries	Flood event	Serious injury occurs	Principal Contractor	Safe working procedures. Personal assessment of flood waters. Construction management plan and induction to ensure work is conducted in an appropriate and safe manner.		moderate			moderate	Possible	R M-3C							
		R	Open			NSW/QLD border to Gowrie		Design	Inadequate Design	Scope requirements unclear. Designer unfamiliar with rail requirements. Design program to short. Failure of review and verification process.	Single fatality	Designer	Checking and verification process		Major			major	Unlikely	R M-4D						NA	
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Design	Initial design does not allow safe future expansion	Inadequate future proofing in design stage	Single fatality	Designer	Checking and verification process		Major			Major	Possible	R H-4C							
		R	Open			NSW/QLD border to Gowrie		Design	Use of inappropriate existing infrastructure	Adequacy of existing infrastructure not assessed correctly	Single fatality	Designer	Checking and verification process		Major			major	Unlikely	R M-4D						NA	
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Operations	Failure of embankment / cut slope	Flooding. Poor soils. Culvert Blockage	Serious injury occurs	Rail Infrastructure Manager (RIM)	Soil Testing. Stability assessment after a flood event. Perform blockage assessment and hydrologically model with blockage included. Add deflectors to upstream side of embankment. Maintain culverts before and after events.		moderate			moderate	Possible	R M-3C							
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Operations	Erosion of embankment adjacent to creek	Flooding. Poor soils. Increased velocities resulting in erosion	Serious injury occurs	Rail Infrastructure Manager (RIM)	Soil Testing. Stability assessment after a flood event. Consider design with sealed access road below embankment to assist with return to natural flows. Provide sufficient rock matress to slow velocities and spread flows.		moderate			moderate	Possible	R M-3C							
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Construction	Shear or slip failure of embankment due to construction vehicles on embankment	Unsuitable ground conditions for construction vehicles.	Serious injury occurs	Principal Contractor	Safe Working Procedures. Use of appropriate vehicle type for rail corridor conditions. Construction Management Plan. On site assessment of conditions. Temporary support works. Constructability Review and actions captured in design. Stability assessment.		moderate			moderate	Unlikely	R L-3D							
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Construction	Construction temporarily changes known flooding areas causing injury to personal during a new flood event.	Existing drainage channels changed during construction.	Serious injury occurs	Principal Contractor	Drainage design to ensure velocity of water is maintained at existing levels. Provide rail vehicle / safety notices / procedures to rail vehicle crew and maintenance crew advising of potential conditions of location.		moderate			moderate	Possible	R M-3C							
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Construction	Derailment of rail vehicle due to destabilisation of existing track and formation	Excavation of material adjacent to operating track. Limited time to undertake works resulting in formation failure. Unstable material.	Serious injury occurs	Principal Contractor	Construction management plan. On site assessment of conditions. Temporary support works. Constructability review and actions captured in design. Stability assessment.		moderate			moderate	Unlikely	R L-3D							
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Operations	Flooding overtopping rail formation. Track washout. Track under water. Failure of formation resulting in rail vehicle derailment.	Flood event	Serious injury occurs	Rail Infrastructure Manager (RIM)	Personal assessment of flood waters. Provide rail vehicle / safety notices / procedures to rail vehicle crew and maintenance crew advising of potential conditions of location.		moderate			moderate	Unlikely	R L-3D							

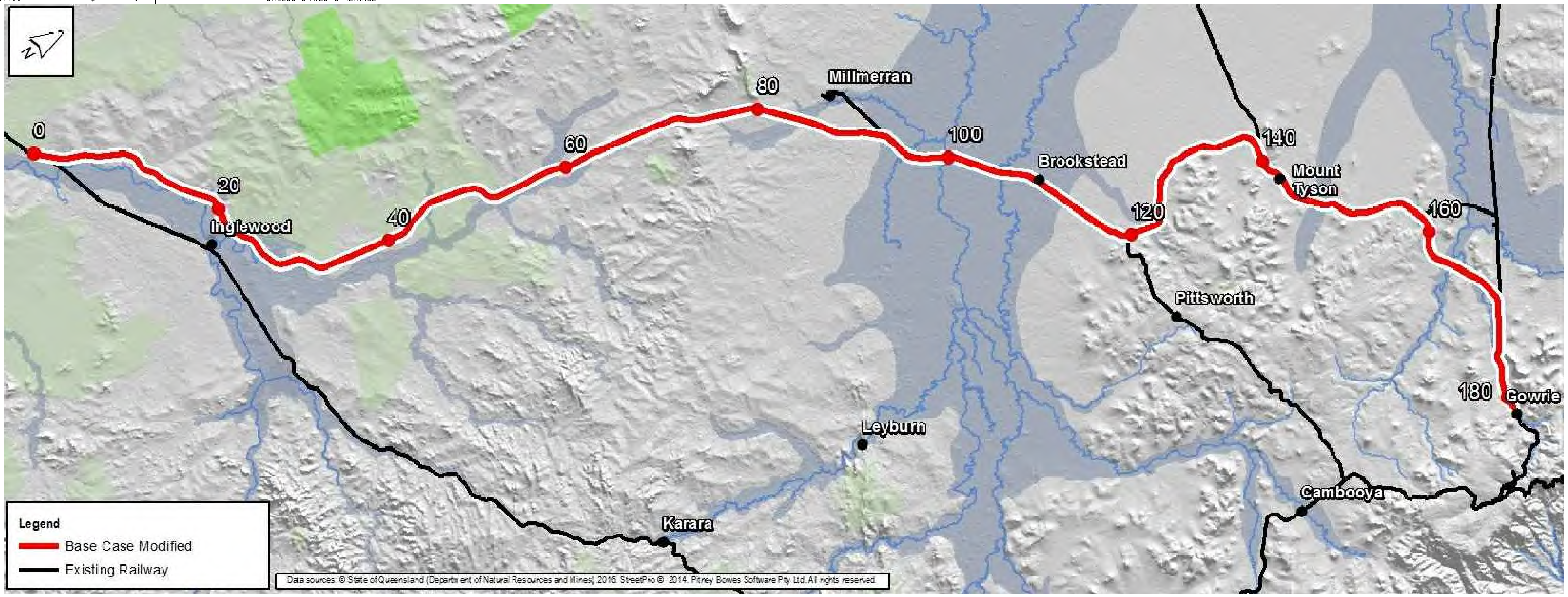
Ref #	Source	R = Risk O = Opportunity	Status Open or Closed	Risk Location	Risk Category	Project Section	Discipline	Design Life Cycle Stage	Safety in Design Hazard/Issue	Cause	Consequences	Responsibility	Existing Controls (Implementation Commenced or Complete)	Existing Control Owner	Safety	Assets	Environmental	Max Current Consequence	Current Likelihood	Current Level of Risk	Planned Future Controls (Planned but implementation not yet commenced)	Action Owner	By When	Residual Consequence	Residual Likelihood	Residual Level of Risk	Comments
		R	Open			NSW/QLD border to Gowrie	Bridges and Structures	Operations	High flow velocities around culverts and near walls. Scour under wall leading to potential failure	Flood event	Serious injury occurs	Rail Infrastructure Manager (RIM)	Drainage design to ensure velocity of water is maintained at existing levels. Scour protection designed where suitable. Low angle batter slopes for the embankment. Use of deflectors to channelise flows to culverts.		moderate			moderate	Unlikely	R L-3D							
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Operations	Lack of emergency access to rail corridor in the event of flood.	During regional flood events local roads with a nominal 1:5 immunity may be blocked off while rail with a 1:100 immunity is still operational.	Serious injury occurs	Rail Infrastructure Manager (RIM)	No existing control. Map access points for emergency services. Discuss emergency access routes with local landowners.		moderate			Moderate	Possible	R M-3C							
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Operations	Delay to incident / emergency response	Incident in remote area	Serious injury occurs	Rail Infrastructure Manager (RIM)	No existing control Check radio coverage.		Moderate			Moderate	Possible	R M-3C							
		R	Open			NSW/QLD border to Gowrie		Operations	Bush Fire	Electrical fault. Lightning. Arson. Train Debris.	Multiple fatalities	Rail Infrastructure Manager (RIM)	No existing control Maintain the corridor as reduce fire fuel load.		Extreme			Extreme	Possible	R H-5C							
		R	Open			NSW/QLD border to Gowrie		Operations	Unauthorised person entering rail corridor resulting in person being struck by rail traffic	Rail corridor fencing not suitable	Single fatality	Rail Infrastructure Manager (RIM)	Fencing to be installed on all private property boundaries and at access points along rail corridor.		Major			Major	Possible	R H-4C							
		R	Open			NSW/QLD border to Gowrie		Operations	Vandalism causing damage to rail corridor infrastructure	Rail corridor fencing not suitable	Serious injury occurs	Rail Infrastructure Manager (RIM)	Fencing to be installed on all private property boundaries and at access points along rail corridor.		moderate			Moderate	Possible	R M-3C							
		R	Open			NSW/QLD border to Gowrie		Construction	Unauthorised person entering construction site	Construction site fencing not suitable	Serious injury occurs	Principal Contractor	Construction safety management plans to provide construction signage and site delineation		moderate			moderate	Possible	R M-3C							
		R	Open			NSW/QLD border to Gowrie		Construction	Proximity of local community	Potential for serious injury if rail corridor and construction areas are not adequately fenced off.	Serious injury occurs	Principal Contractor	Construction safety management plans to provide construction signage and site delineation. Fencing to be installed on all private property boundaries and at access points along rail corridor. Bypass communities where appropriate.		moderate			moderate	Possible	R M-3C							
		R	Open			NSW/QLD border to Gowrie		Construction	Proximity of school	Large number of children in close proximity to rail corridor and construction areas. Potential for serious injury if areas are not adequately fenced off.	Serious injury occurs	Principal Contractor	Construction safety management plans to provide construction signage and site delineation. Fencing to be installed on all private property boundaries and at access points along rail corridor. Education strategy.		moderate			moderate	Possible	R M-3C							
		R	Open			Brookstead, Yandilla & Aubingy	Track and Civil	Operations	Proximity of local industry. Existing brownfield corridor has grain silos in close proximity to line at Brookstead, Yandilla & Aubingy.	Collision with rail vehicles	Single fatality	Rail Infrastructure Manager (RIM)	No existing control. Investigate brown fieild infrastructure and consider in design. Consider bypass in design.		Major			Major	Possible	R H-4C							
		R	Open			NSW/QLD border to Gowrie		Construction	Damage to existing gas crossing	Construction traffic and/or excavation equipment damages gas crossing	Single fatality	Principal Contractor	Drawings and documentation note DBYD and location of underground series to be undertaken prior to construction works. Constructor to be aware of existing gas crossings. Ensure drawings and documentation note adequate protection of gas pipelines.		Major			Major	Unlikely	R M-4D							
		R	Open			NSW/QLD border to Gowrie	Signals	Construction	Damage to existing signalling infrastructure within corridor (cable routes, pits, etc.)	Construction traffic and/or excavation equipment damages underground conduits, resulting in failure of SER/CER and signalling / communication system, causing rail vehicle incident.	Serious injury occurs	Principal Contractor	Drawings and documentation note DBYD and location of underground series to be undertaken prior to construction works. Constructor to implement procedures to maintain existing services during construction.		Moderate			Moderate	Possible	R M-3C							
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Design	Noise barriers	Lack of sighting distance at level crossings resulting in train collision	Single fatality	Designer	Ensure acceptable sight distance at level crossing is maintained in the design stage. Checking and verification process.		Major			Major	Unlikely	R M-4D							
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Construction	Exposure to contaminated land	Contaminated land not identified. Appropriate PPE not worn.	Serious injury occurs	Principal Contractor	Soil testing prior to commencement of construction and maintenance.		Moderate			Moderate	Possible	R M-3C							
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Operations	Loose load/damaged wagon	Lack of drag detection	Serious injury occurs	Rail Infrastructure Manager (RIM)	No existing control		Moderate			Moderate	Possible	R M-3C							
		R	Open			NSW/QLD border to Gowrie	Track and Civil	Construction	Potential for explosives in proximity to community or operational train	Incorrect use of explosives in quarry during construction	Single fatality	Principal Contractor	Safe working procedures		Major			Major	Unlikely	R M-4D							
		R	Open			Commodore Mine	Track and Civil	Operations	Commodore Mine - Collision with heavy haul mine vehicle at mine interface	Heavy haul mine vehicle (non-road registered) crosses railway and strikes train resulting in derailment.	Multiple fatalities	Rail Infrastructure Manager (RIM)	Mine operator to provide a vehicle operations plan. Level crossing agreement to be developed outlining the requirement for non-registered vehicles		Extreme			Extreme	Possible	R H-5C							
		R	Open			Commodore Mine	Track and Civil	Operations	Commodore Mine - Damage to pavement/ level crossing at mine interface	Over-rated heavy haul vehicle traverses pavement/level crossing resulting in failure of road. May result in trapped vehicle across rail crossing.	Serious injury occurs	Rail Infrastructure Manager (RIM)	Mine operator to provide a vehicle operations plan. Level crossing agreement to be developed outlining the requirement for non-registered vehicles. Haul road pavement design for nominal vehicle load		Moderate			Moderate	Possible	R M-3C							
		R	Open			Commodore Mine	Track and Civil	Operations	Commodore Mine - Explosives and blasting in proximity of rail	Use of explosives at Commodore Mine	Single fatality	Rail Infrastructure Manager (RIM)	No existing control		Major			Major	Unlikely	R M-4D							
		R	Open			Inglewood	Track and Civil	Operations	Inglewood Airport - Collision with plane and train	Rail in close proximity to airport	Multiple fatalities	Rail Infrastructure Manager (RIM)	No existing control. Discuss safety strategy with airport authorities.		Extreme			Extreme	Unlikely	R M-5D							
		R	Open			Condamine river environment	Track and Civil	Construction	Safety hazards involved with complex construction environments	Construction in the Condamine river environment	Serious injury occurs	Principal Contractor	Safe working procedures. Construction management plan and induction to ensure work is conducted in an appropriate and safe manner.		Moderate			Moderate	Possible	R M-3C							
		R	Open			Warrego Highway	Track and Civil	Operations	Increased flooding on Warrego Highway	Increased flooding as a result of earthworks and inadequate drainage design	Serious injury occurs	Designer	Checking and verification process. Liaise with TMR and TRC for road upgrade plans that could impact design.		Moderate			Moderate	Possible	R M-3C							
		R	Open			Condamine and Warrego	Bridges and Structures	Construction	Potential for long viaduct type structure at Condamine and Warrego	Working at heights and working along the viaduct walkway which is in close proximity to an operational line. Potential fall or collision between train and construction worker.	Single fatality	Principal Contractor	Safe working procedures. Ensure safe walkways along viaduct structure. Construction management plan and induction to ensure work is conducted in an appropriate and safe manner.		Major			Major	Unlikely	R M-4D							
		R	Open			NSW/QLD border to Gowrie	Signals	Operations	Train collisions due to telecommunication system failure	Reliability on 3rd party telecommunications	Single fatality	Rail Infrastructure Manager (RIM)	No existing control		Major			Major	Unlikely	R M-4D							
		R	Open			NSW/QLD border to Gowrie		Construction	Camps / remote construction sites	Remote locations, travel to site along rail corridor and fatigue driving back at the end of a shift resulting in traffic collsions.	Single fatality	Principal Contractor	Safe working procedures. Construction management plan and induction to ensure work is conducted in an appropriate and safe manner.		Major			Major	Unlikely	R M-4D							
If additional rows are required, then insert them above the bottom row of the current table and copy the formula and formatting into the new row(s) by copying an existing blank row.																				NA							
																				NA						NA	

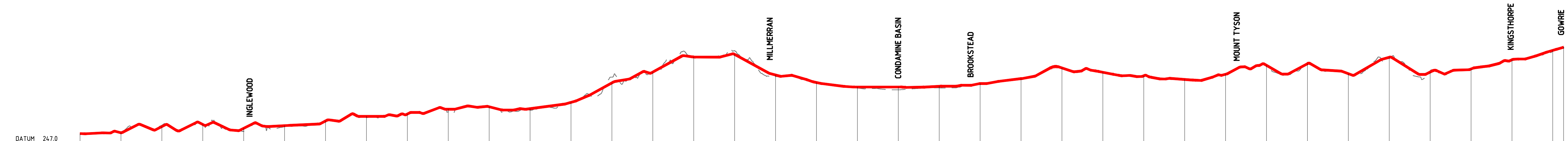
Appendix F

Alignment Plan and Profiles

1	2	3	4	5	6	7	8

DRAWN TO AS1100 | DO NOT SCALE | ALL DIMENSIONS IN m UNLESS STATED OTHERWISE





DATUM 247.0

EXISTING SURFACE LEVELS	267.753	269.939	288.111	292.729	273.478	284.752	301.229	306.844	314.008	320.796
DEPTH FILL+ / CUT -	0.000	-0.107	-3.208	-2.496	7.148	2.474	-2.705	3.106	1.737	6.654
DESIGN FORMATION LEVELS	267.753	269.833	284.903	290.233	280.625	287.226	298.524	309.950	315.745	327.450
KILOMETRAGE	00km	5km	10km	15km	20km	25km	30km	35km	40km	45km

EXISTING SURFACE LEVELS	331.249	325.054	345.636	405.960	417.827	455.529	470.437	407.297	392.958	379.210
DEPTH FILL+ / CUT -	2.144	3.831	-1.415	-14.230	0.571	-0.360	-8.688	3.805	-0.166	2.490
DESIGN FORMATION LEVELS	333.393	328.885	344.220	391.730	418.398	455.169	461.749	411.102	392.792	381.700
KILOMETRAGE	50km	55km	60km	65km	70km	75km	80km	85km	90km	95km

EXISTING SURFACE LEVELS	375.026	379.646	390.050	402.007	426.935	416.824	409.349	399.739	413.506	435.214
DEPTH FILL+ / CUT -	6.674	3.921	0.206	0.206	1.505	1.123	-0.260	0.542	-0.587	-0.315
DESIGN FORMATION LEVELS	381.700	383.567	390.256	402.213	428.441	417.947	409.089	400.281	412.919	434.898
KILOMETRAGE	100km	105km	110km	115km	120km	125km	130km	135km	140km	145km

EXISTING SURFACE LEVELS	437.591	411.763	454.612	420.763	424.974	447.099	469.468	478.543
DEPTH FILL+ / CUT -	1.150	2.630	-0.223	-2.511	0.886	1.358	2.029	0.650
DESIGN FORMATION LEVELS	438.742	414.393	454.389	418.252	425.860	448.457	471.496	479.193
KILOMETRAGE	150km	155km	160km	165km	170km	175km	180km	181.3km

PRELIMINARY ISSUE
NOT FOR CONSTRUCTION

Drawing standard in accordance with EGP-04-01 & EGP-04-02

Used on / Next higher assembly:

Filename: SK-3100_LONGSEC.dwg

Alternate DMS number:

Rev	Date	Revision Description	Designed	Checked	Ind. Rev.	Approv.
01	22.03.17	ISSUED FOR CONCEPT REPORT	T.C			

Designing Company: AECOM aurecon

Designed	T.C.	22.03.17
Checked		
Ind.Rev. Company	Ind.Rev. Name	
Review Signature		

ARTC ACCEPTANCE Accepted By
Signed:
Acceptance Date

ARTC

01

SK-3100-LS-01

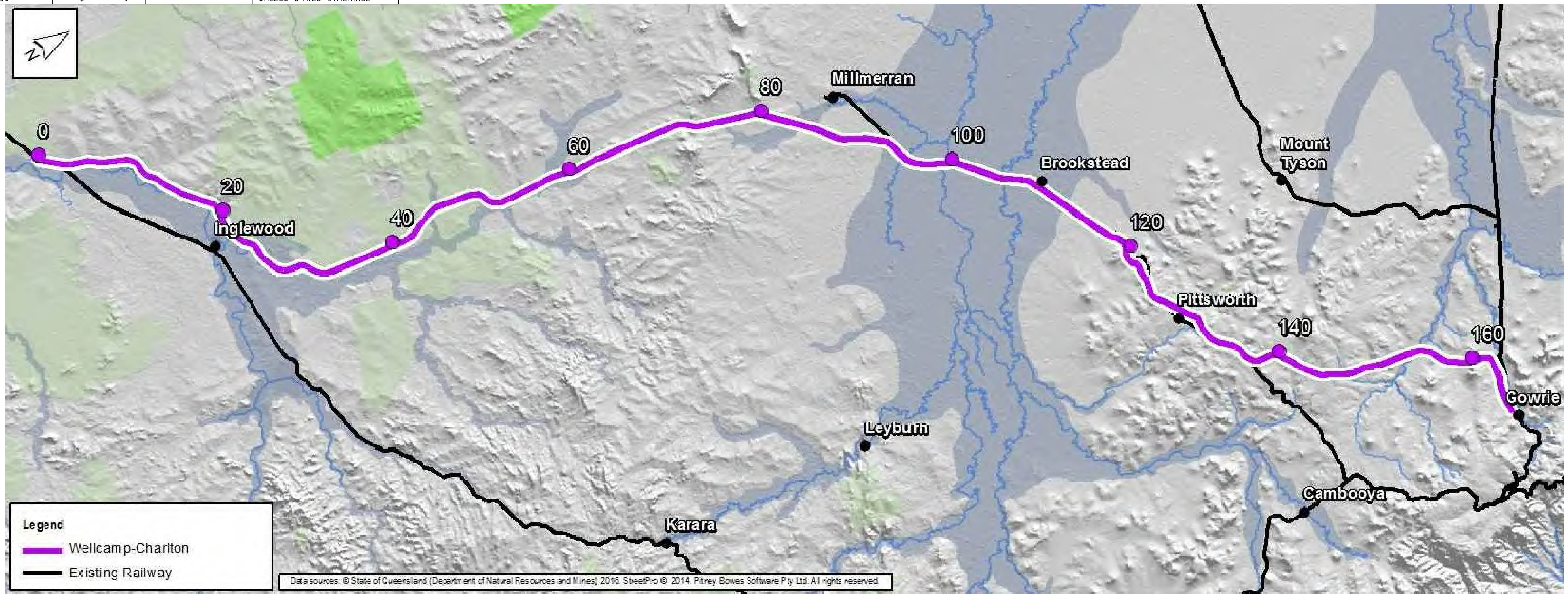
Sheet No.

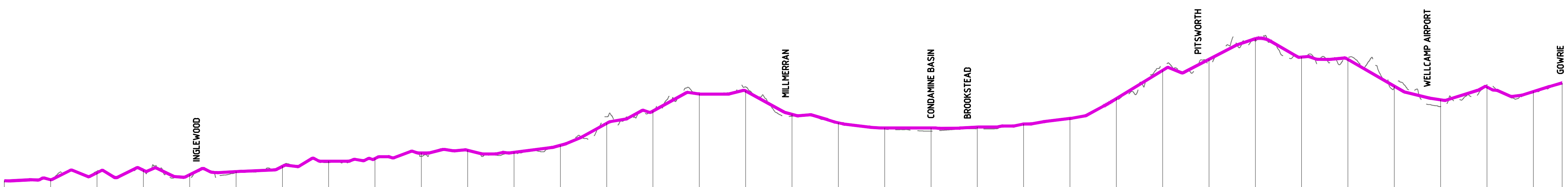
Scale: N.T.S

SHEET SIZE A1

MELBOURNE-BRISBANE INLAND RAIL
YELARBON TO GOWRIE
BASE CASE MODIFIED - PLAN AND LONGITUDINAL SECTION

DRAWN TO AS1100		DO NOT SCALE	ALL DIMENSIONS IN m UNLESS STATED OTHERWISE





EXISTING SURFACE LEVELS	267.753	269.939	288.111	292.729	273.478	284.752	301.229	306.844	314.008	320.796	331.249	325.054
DEPTH FILL+ / CUT -	0.000	-0.107	-3.208	-2.496	7.148	2.474	-2.705	3.106	1.737	6.654	2.144	3.831
DESIGN FORMATION LEVELS	267.753	269.833	284.903	290.233	280.625	287.226	298.524	309.950	315.745	327.450	333.393	328.885
KILOMETRAGE	00km	5km	10km	15km	20km	25km	30km	35km	40km	45km	50km	55km

EXISTING SURFACE LEVELS	345.636	405.960	417.827	455.529	470.437	407.297	392.958	379.210	375.026	379.646	390.050	402.007
DEPTH FILL+ / CUT -	-1.415	-14.230	0.571	-0.360	-8.688	3.805	-0.166	2.490	6.674	3.921	0.206	0.206
DESIGN FORMATION LEVELS	344.220	391.730	418.398	455.169	461.749	411.102	392.792	381.700	381.700	383.567	390.256	402.213
KILOMETRAGE	60km	65km	70km	75km	80km	85km	90km	95km	100km	105km	110km	115km

EXISTING SURFACE LEVELS	442.480	517.546	519.200	569.643	535.009	535.251	468.847	427.970	475.007	460.000	478.543
DEPTH FILL+ / CUT -	2.594	-11.370	10.897	4.947	0.142	-5.279	3.124	14.527	-4.623	0.359	0.637
DESIGN FORMATION LEVELS	445.074	506.176	530.097	574.591	535.151	529.971	471.971	442.497	470.384	460.359	479.180
KILOMETRAGE	120km	125km	130km	135km	140km	145km	150km	155km	160km	165km	168.1km

PRELIMINARY ISSUE
NOT FOR CONSTRUCTION

Drawing standard in accordance with EGP-04-01 & EGP-04-02

Used on / Next higher assembly:

Filename: SK-2201_LONGSEC.dwg

Alternate DMS number:

Rev	Date	Revision Description	Designed	Checked	Ind. Rev.	Approv.
01	22.03.17	ISSUED FOR CONCEPT REPORT	T.C			

Designing Company: AECOM aurecon

Designed T.C. 22.03.17

Checked

Ind.Rev. Company | Ind.Rev. Name

Review Signature

ARTC ACCEPTANCE Accepted By

Signed:

Acceptance Date

ARTC

01

SK-2201-LS-01

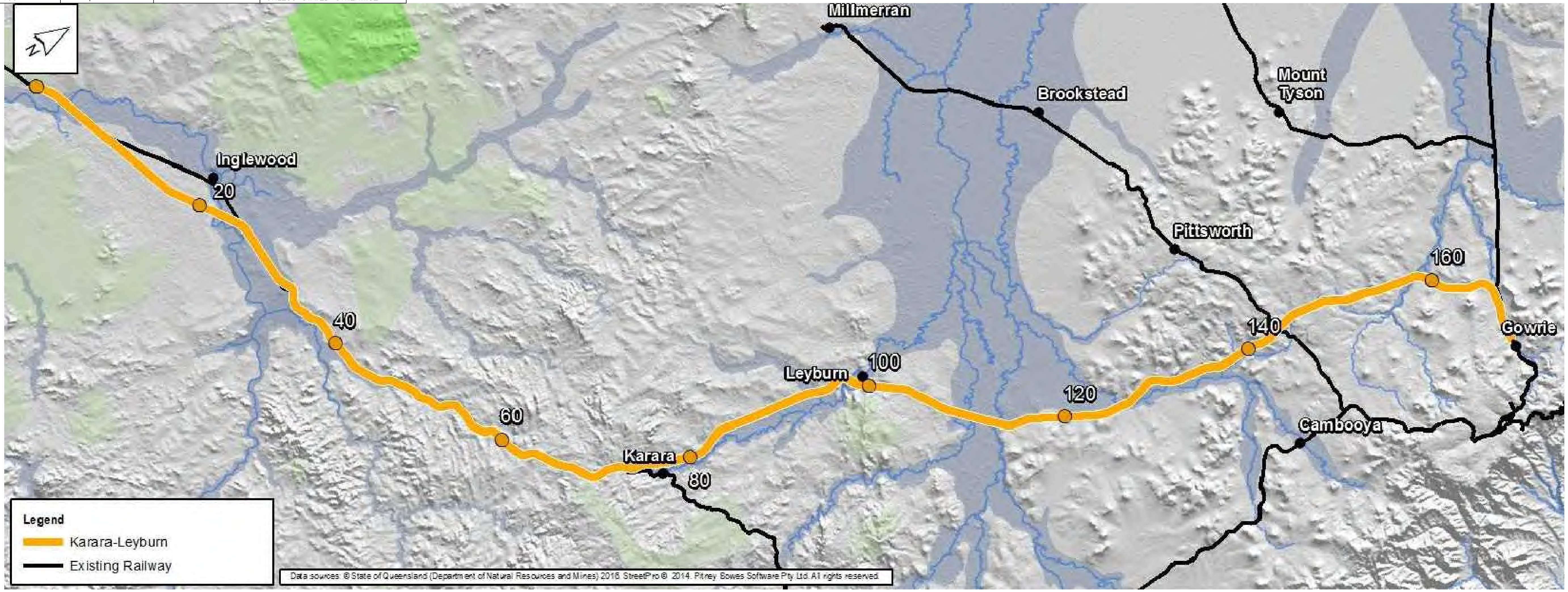
Sheet No.

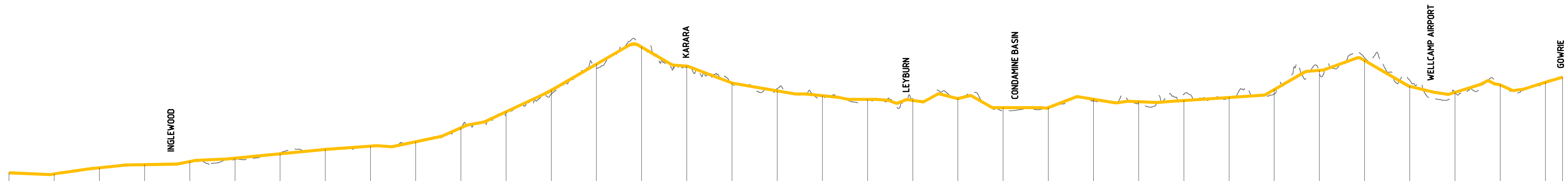
Scale: N.T.S

SHEET SIZE A1

MELBOURNE-BRISBANE INLAND RAIL
YELARBON TO GOWRIE
WELLCAMP-CHARLTON - PLAN AND LONGITUDINAL SECTION

DRAWN TO AS1100		DO NOT SCALE	ALL DIMENSIONS IN m UNLESS STATED OTHERWISE





DATUM 243.0

EXISTING SURFACE LEVELS	267.753	264.468	277.623	283.806	293.239	297.454	311.955	320.459	326.171	335.606
DEPTH FILL+ / CUT -	0.000	0.714	1.167	1.822	-0.670	2.464	-2.323	-1.113	0.500	0.637
DESIGN FORMATION LEVELS	267.753	265.182	278.790	285.628	292.569	299.918	309.632	319.346	326.671	336.243
KILOMETRAGE	00km	5km	10km	15km	20km	25km	30km	35km	40km	45km

EXISTING SURFACE LEVELS	366.661	391.035	442.009	499.149	546.633	507.156	465.933	453.416	433.599	430.964
DEPTH FILL+ / CUT -	0.708	11.518	8.116	8.742	-0.670	-3.477	0.554	-4.525	4.675	-0.964
DESIGN FORMATION LEVELS	367.368	402.553	450.125	507.891	545.963	503.679	466.487	448.890	438.274	430.000
KILOMETRAGE	50km	55km	60km	65km	70km	75km	80km	85km	90km	95km

EXISTING SURFACE LEVELS	431.593	431.565	404.962	411.546	426.403	420.148	441.346	433.921	442.163	485.298
DEPTH FILL+ / CUT -	-3.690	0.555	7.038	0.362	4.101	4.896	-13.702	0.446	9.658	8.905
DESIGN FORMATION LEVELS	427.903	432.120	412.000	411.907	430.503	425.044	427.643	434.366	451.821	494.204
KILOMETRAGE	100km	105km	110km	115km	120km	125km	130km	135km	140km	145km

EXISTING SURFACE LEVELS	522.034	472.297	444.598	461.948	469.177	478.543
DEPTH FILL+ / CUT -	-5.966	-13.169	1.033	0.324	-1.315	0.640
DESIGN FORMATION LEVELS	516.067	459.128	445.631	462.272	467.862	479.183
KILOMETRAGE	150km	155km	160km	165km	170km	171.9km

PRELIMINARY ISSUE
NOT FOR CONSTRUCTION

Drawing standard in accordance with EGP-04-01 & EGP-04-02

Used on / Next higher assembly:

Filename: SK-1001_LONGSEC.dwg

Alternate DMS number:

Rev	Date	Revision Description	Designed	Checked	Ind. Rev.	Approv.
01	22.03.17	ISSUED FOR CONCEPT REPORT	T.C			

Designing Company: AECOM aurecon

Designed T.C. 22.03.17

Checked

Ind.Rev. Company | Ind.Rev. Name

Review Signature

ARTC ACCEPTANCE
Accepted By
Signed:
Acceptance Date

ARTC

01

SK-1001-LS-01

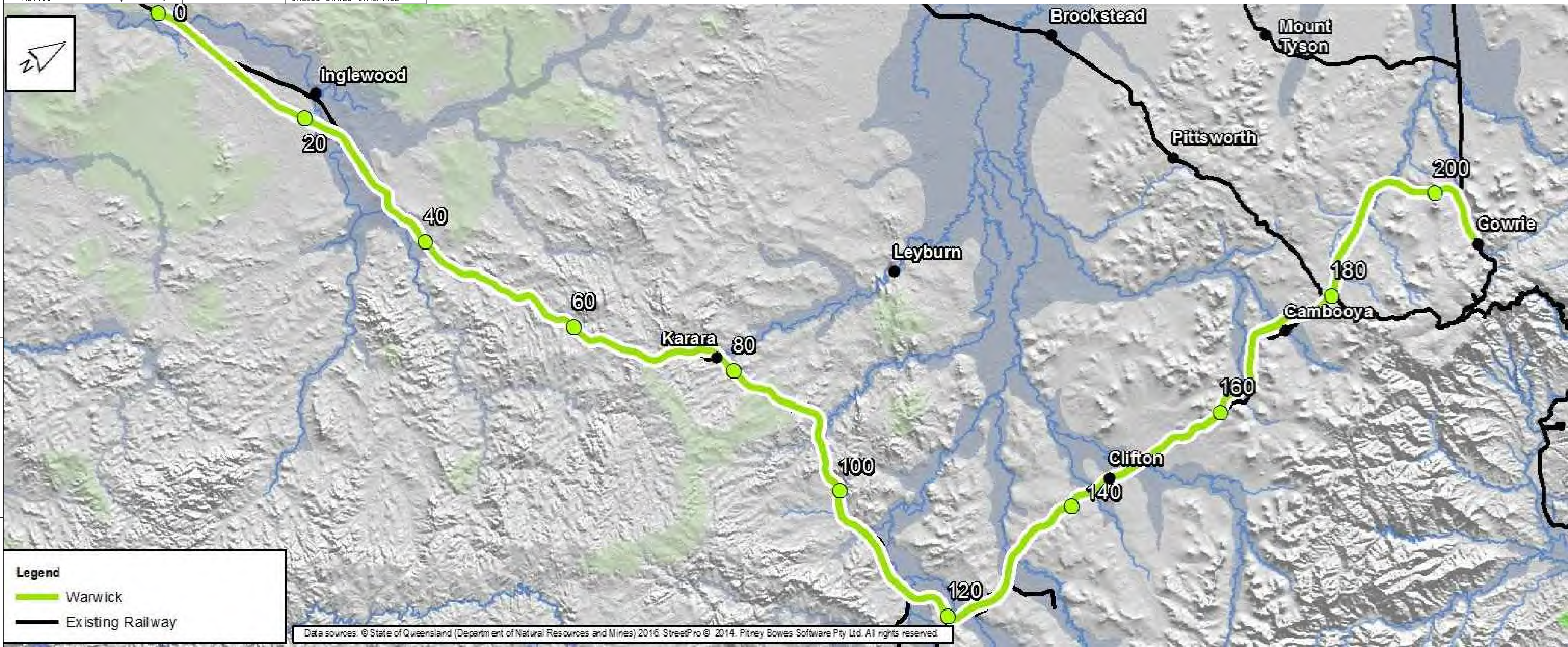
Sheet No.

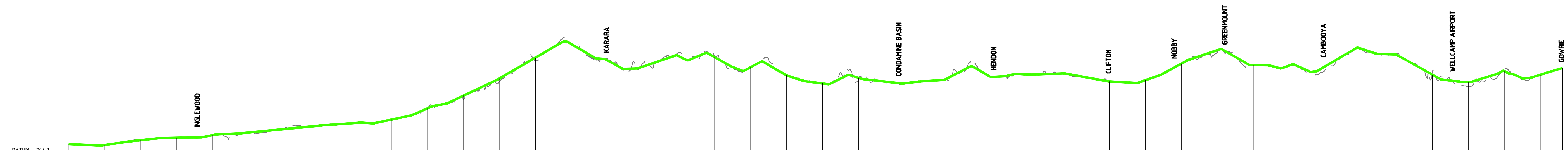
Scale: N.T.S

SHEET SIZE A1

MELBOURNE-BRISBANE INLAND RAIL
YELARBON TO GOWRIE
KARARA-LEYBURN - PLAN AND LONGITUDINAL SECTION

DRAWN TO AS1100		DO NOT SCALE	ALL DIMENSIONS IN m UNLESS STATED OTHERWISE





DATUM 243.0

EXISTING SURFACE LEVELS	267.753	264.468	277.623	283.806	293.239	297.454	311.955	320.459	326.171	335.606	366.661
DEPTH FILL+ / CUT -	0.000	0.714	1.167	1.822	-0.670	2.464	-2.323	-1.113	0.500	0.637	0.708
DESIGN FORMATION LEVELS	267.753	265.182	278.790	285.628	292.569	299.918	309.632	319.346	326.671	336.243	367.368
KILOMETRAGE	00km	5km	10km	15km	20km	25km	30km	35km	40km	45km	50km

EXISTING SURFACE LEVELS	391.035	442.009	499.149	546.633	507.037	492.170	522.087	511.888	479.991	458.546	434.688
DEPTH FILL+ / CUT -	11.518	8.116	8.742	-0.670	-6.090	-9.037	-10.153	-2.807	1.576	0.112	1.783
DESIGN FORMATION LEVELS	402.553	450.125	507.891	545.963	500.947	483.133	511.934	509.080	481.568	458.657	436.471
KILOMETRAGE	55km	60km	65km	70km	75km	80km	85km	90km	95km	100km	105km

EXISTING SURFACE LEVELS	442.444	434.989	444.931	475.996	454.993	462.519	455.197	439.226	444.816	490.937	523.320
DEPTH FILL+ / CUT -	9.542	3.554	-1.365	1.496	0.769	-0.802	4.301	2.518	0.590	0.297	5.187
DESIGN FORMATION LEVELS	451.986	438.543	443.566	477.492	455.762	461.717	459.498	441.744	445.406	491.234	528.507
KILOMETRAGE	110km	115km	120km	125km	130km	135km	140km	145km	150km	155km	160km

EXISTING SURFACE LEVELS	487.222	484.921	473.019	530.443	519.169	470.524	427.974	475.054	460.029	478.543
DEPTH FILL+ / CUT -	-0.044	1.023	10.530	2.635	-3.316	-10.204	13.126	-4.712	0.355	0.640
DESIGN FORMATION LEVELS	487.178	485.945	483.549	533.078	515.853	460.320	441.100	470.342	460.384	479.183
KILOMETRAGE	165km	170km	175km	180km	185km	190km	195km	200km	205km	208.1km

PRELIMINARY ISSUE
NOT FOR CONSTRUCTION

Drawing standard in accordance with EGP-04-01 & EGP-04-02

Used on / Next higher assembly:

Filename: SK-4102_LONGSEC.dwg

Alternate DMS number:

Rev	Date	Revision Description	Designed	Checked	Ind. Rev.	Approv.
01	22.03.17	ISSUED FOR CONCEPT REPORT	T.C			

Designing Company: AECOM aurecon

Designed	T.C.	22.03.17
Checked		
Ind.Rev. Company	Ind.Rev. Name	
Review Signature		

ARTC ACCEPTANCE
Accepted By
Signed:
Acceptance Date

ARTC

01

SK-4102-LS-01

Sheet No.

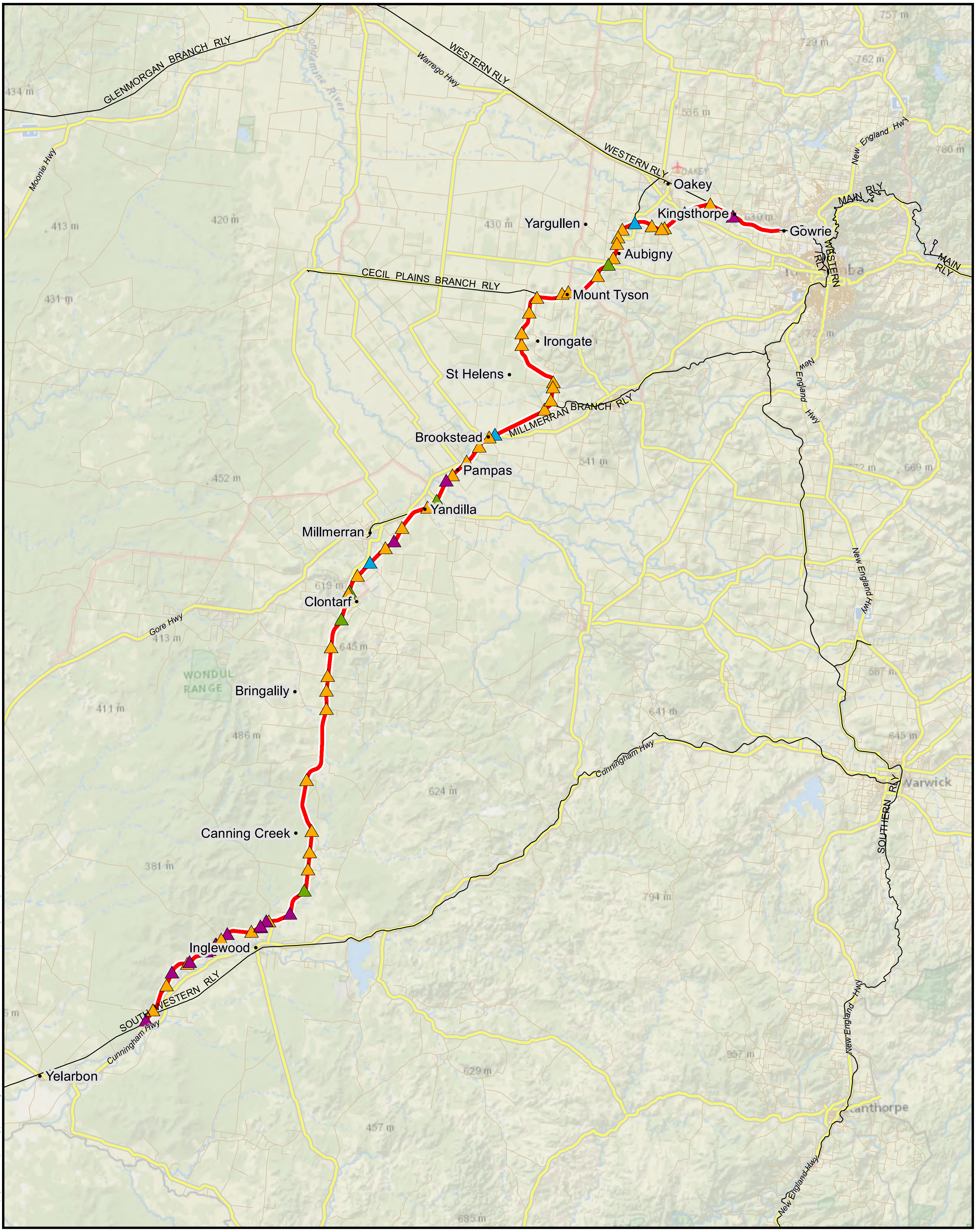
Scale: N.T.S

SHEET SIZE A1

MELBOURNE-BRISBANE INLAND RAIL
YELARBON TO GOWRIE
WARWICK - PLAN AND LONGITUDINAL SECTION

Appendix G

Road Crossings



AECOM does not warrant the accuracy or completeness of information displayed in this map and any person using it does so at their own risk. AECOM shall bear no responsibility or liability for any errors, faults, defects, or omissions in the information.

N

AECOM
www.aecom.com

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator

0 5 10 20
Kilometres
1:500,000 (when printed at A3)

Legend

- Base Case Modified
- Existing Railway
- Main Roads

Road Crossings

- Major
- Minor
- Grade Seperation
- Passive

ARTC

BASE CASE MODIFIED ALIGNMENT ROAD CROSSINGS

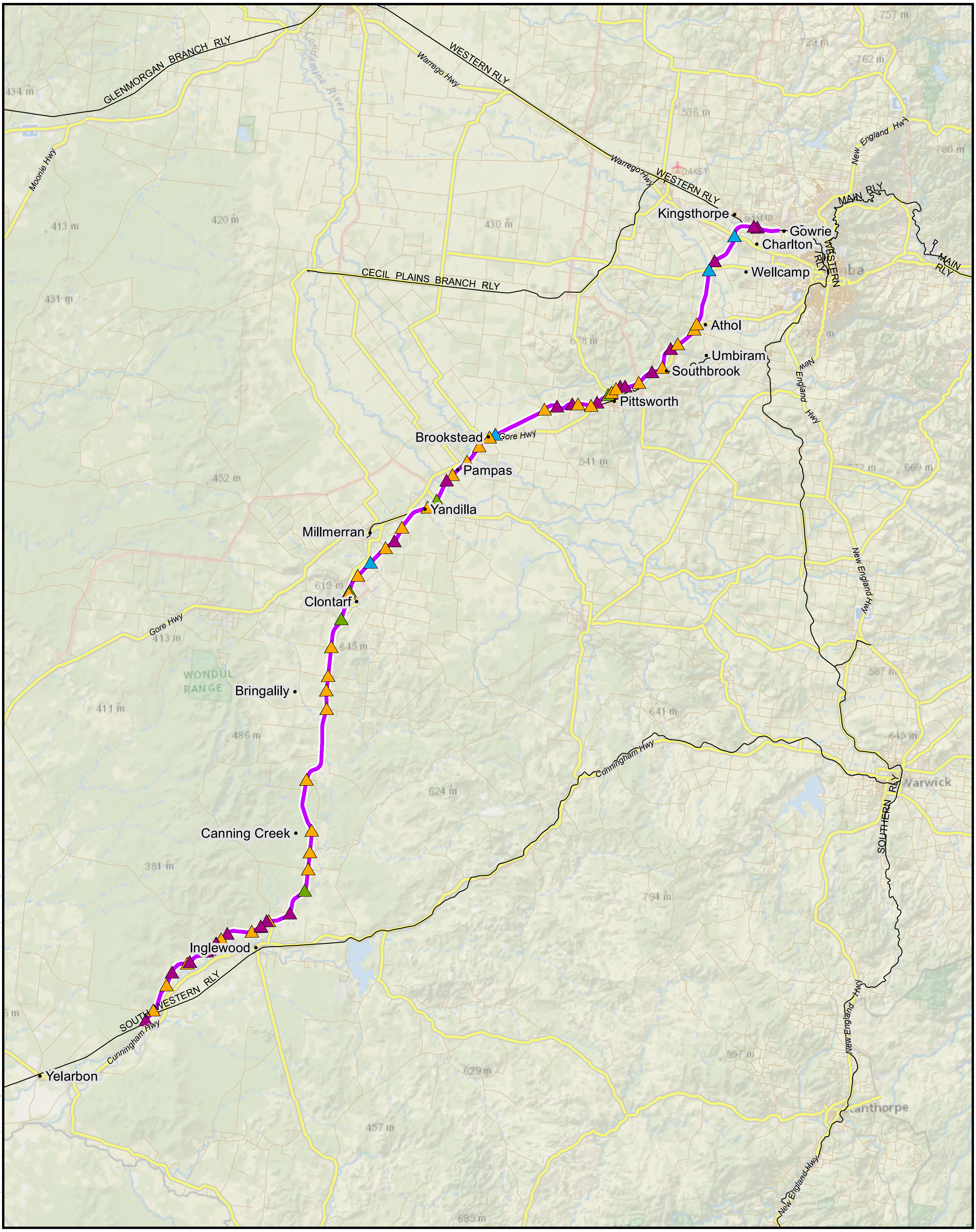
Yelarbon to Gowrie (Y2G) Project

PROJECT ID	60492124
CREATED BY	MF
LAST MODIFIED	FryM - 31/03/2017
VERSION:	1

Map 6

Filename: P:\604X\60492124\4. Tech Work Area\4.99 GIS\02_MXDs\CorridorOptionsAssessment\Civil\CIV-06_60492124_ARTC_RoadCrossings_BaseCase .mxd

A3 size



AECOM shall bear no responsibility or liability for any errors, faults, defects, or omissions in the information. AECOM does not warrant the accuracy or completeness of information displayed in this map and any person using it does so at their own risk.

N

AECOM
www.aecom.com

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator

0 5 10 20
Kilometres
1:500,000 (when printed at A3)

Legend

- Wellcamp-Charlton
- Existing Railway
- Main Roads

Road Crossings

- Major
- Minor
- Grade Seperation
- Passive

ARTC

WELLCAMP-CHARLTON ALIGNMENT ROAD CROSSINGS

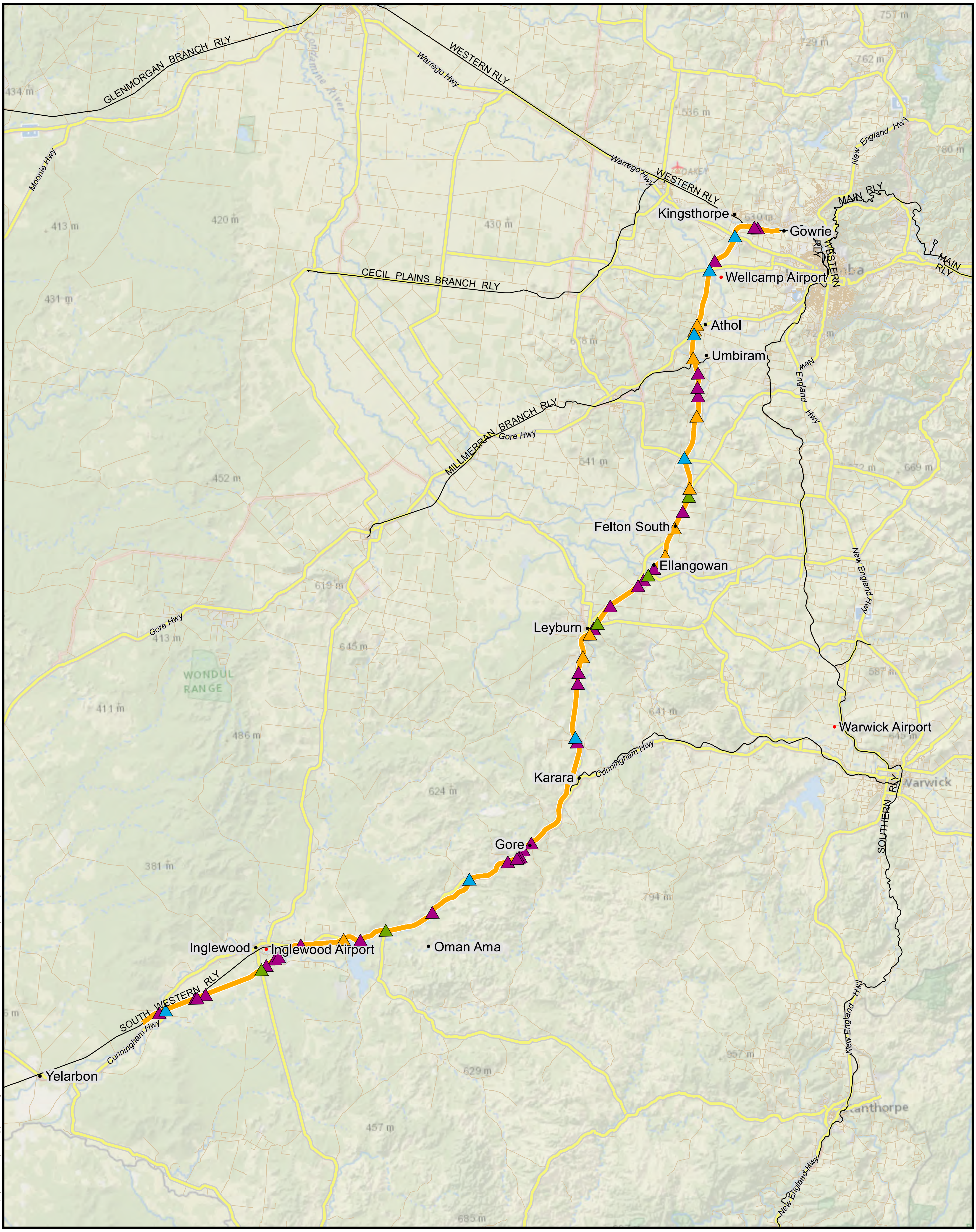
Yelarbon to Gowrie (Y2G) Project

PROJECT ID	60492124
CREATED BY	MF
LAST MODIFIED	FryM - 31/03/2017
VERSION:	1

Map
7

Filename: P:\604X\60492124\4. Tech Work Area\4.99 GIS\02_MXDs\CorridorOptionsAssessment\Civil\CIV-07_60492124_ARTC_RoadCrossings_Wellcamp_Charlton.mxd

A3 size



N

AECOM
www.aecom.com

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator

0 5 10 20
Kilometres
1:500,000 (when printed at A3)

Legend

- Karara-Leyburn
- Existing Railway
- Main Roads

Road Crossings

- Major
- Minor
- Grade Seperation
- Passive

Data sources: © State of Queensland (Department of Natural Resources and Mines) 2016
StreetPro © 2014. Pitney Bowes Software Pty Ltd.

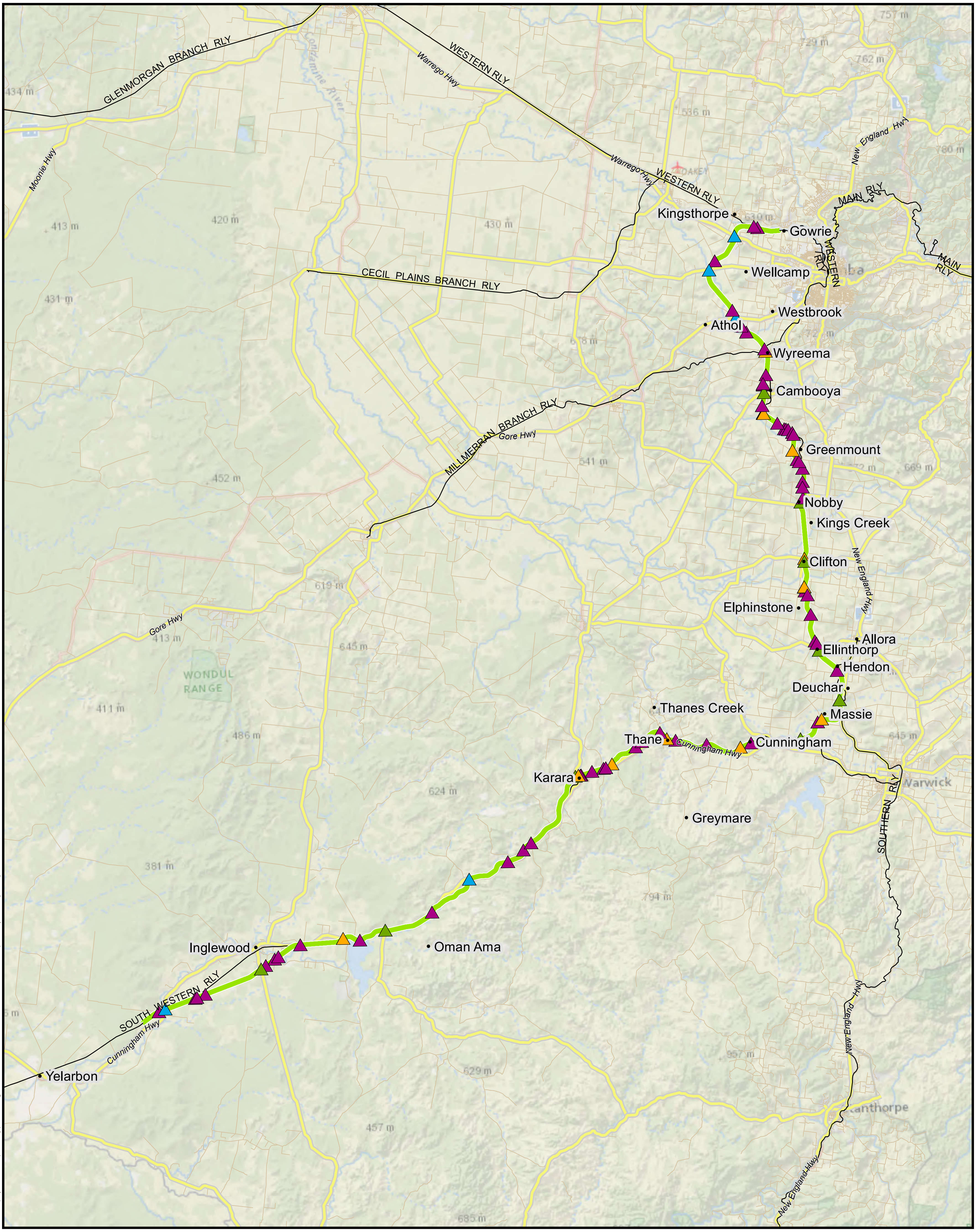
ARTC

KARARA-LEYBURN ALIGNMENT ROAD CROSSINGS

Yelarbon to Gowrie (Y2G) Project

PROJECT ID	60492124
CREATED BY	MF
LAST MODIFIED	FryM - 28/03/2017
VERSION:	1

Map
8



AECOM
www.aecom.com

N

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator

0 5 10 20
Kilometres
1:500,000 (when printed at A3)

Legend

- Warwick
- Existing Railway
- Main Roads

Road Crossings

- Major
- Minor
- Grade Seperation
- Passive

ARTC

WARWICK ALIGNMENT ROAD CROSSINGS

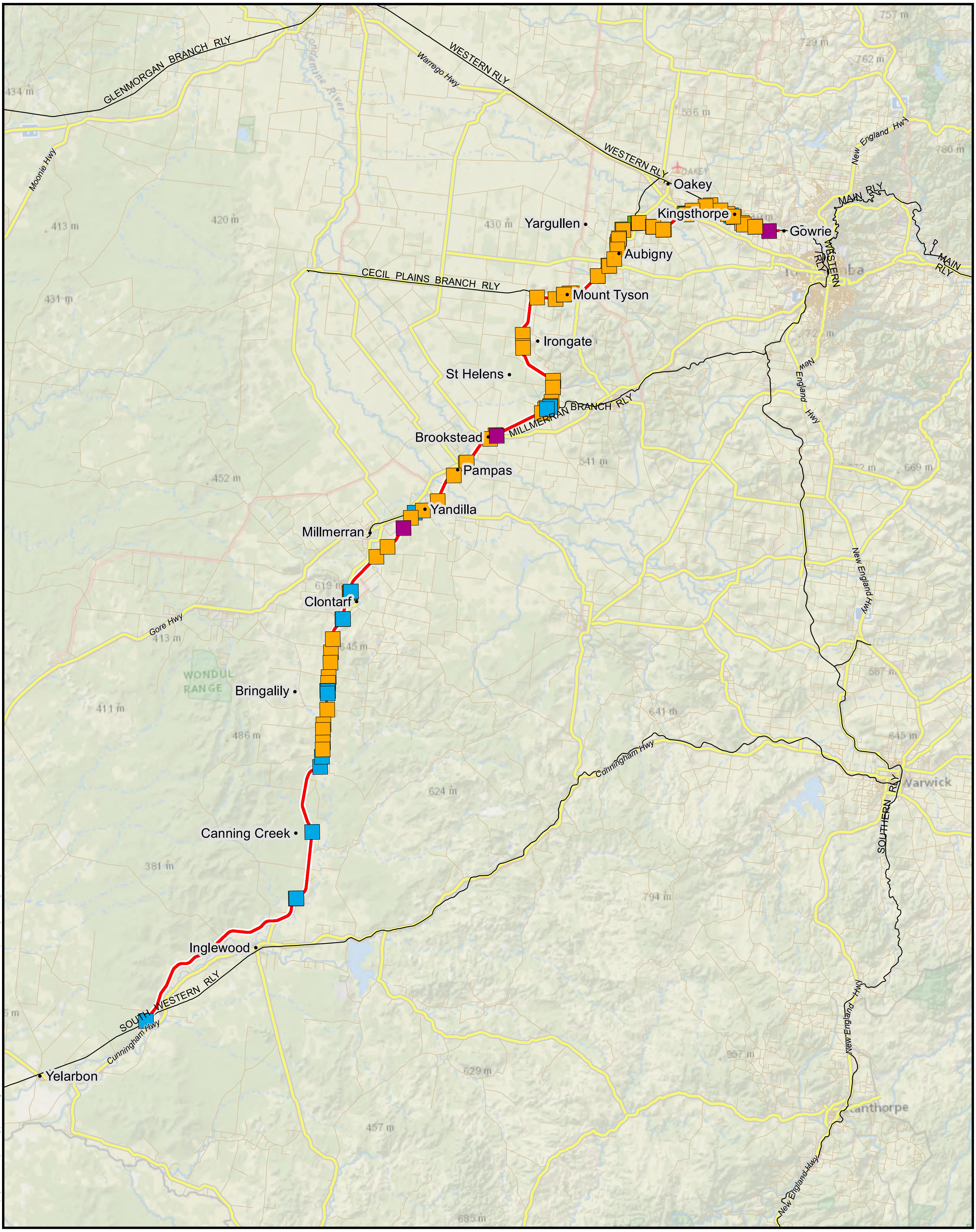
Yelarbon to Gowrie (Y2G) Project

PROJECT ID	60492124
CREATED BY	MF
LAST MODIFIED	FryM - 31/03/2017
VERSION:	1

Map 9

Appendix H

PUP Crossings



AECOM
www.aecom.com

N

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator

0 5 10 20
Kilometres
1:500,000 (when printed at A3)

Legend

- Base Case Modified
- Existing Railway
- Main Roads

Utility Crossings

- Gas
- Telecommunications
- Water
- Power

Data sources: © State of Queensland (Department of Natural Resources and Mines) 2016
StreetPro © 2014. Pitney Bowes Software Pty Ltd.
All rights reserved.

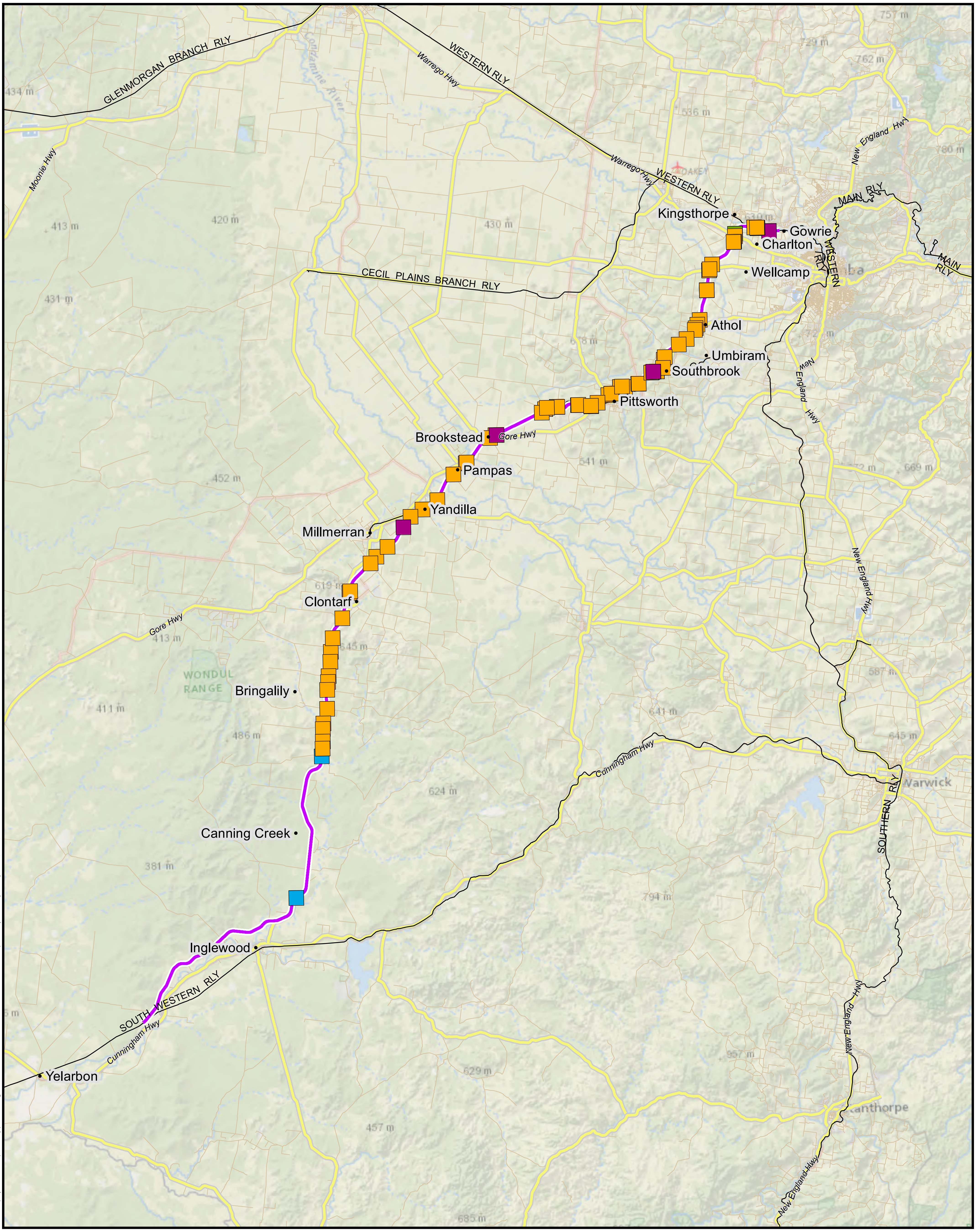
ARTC

BASE CASE MODIFIED ALIGNMENT PUBLIC UTILITY PLANT CROSSINGS

Yelarbon to Gowrie (Y2G) Project

PROJECT ID	60492124
CREATED BY	MF
LAST MODIFIED	frym - 3/04/2017
VERSION:	1

Map
10



ARTC

WELLCAMP-CHARLTON ALIGNMENT PUBLIC UTILITY PLANT CROSSINGS

Yelarbon to Gowrie (Y2G) Project

AECOM
www.aecom.com

N

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator

0 5 10 20
Kilometres
1:500,000 (when printed at A3)

Legend

- Wellcamp-Charlton
- Existing Railway
- Main Roads

Utility Crossings

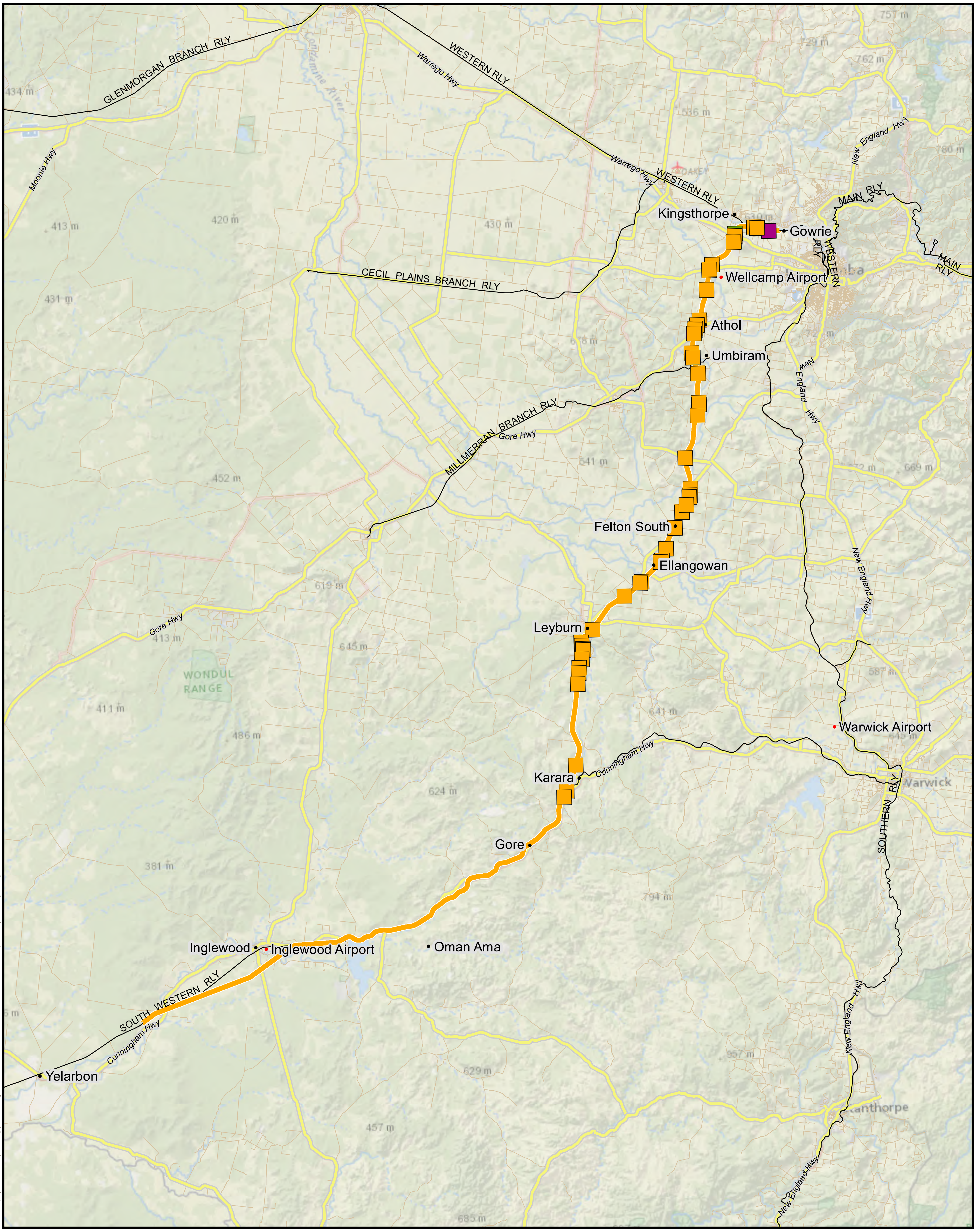
- Gas
- Telecommunications
- Water
- Power

PROJECT ID	60492124
CREATED BY	MF
LAST MODIFIED	frym - 3/04/2017
VERSION:	1

Map 11

A3 size

Filename: P:\604X\60492124\4. Tech Work Area\4.99 GIS\02_MXDs\CorridorOptionsAssessment\Civil\CIV-11_60492124_ARTC_PUPS_Wellcamp_Charlton.mxd



N

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator

0 5 10 20
Kilometres
1:500,000 (when printed at A3)

AECOM
www.aecom.com

Legend
- Karara-Leyburn
- Existing Railway
- Main Roads

Utility Crossings
- Gas
- Telecommunications
- Water
- Power

Data sources: © State of Queensland (Department of Natural Resources and Mines) 2016
StreetPro © 2014. Pitney Bowes Software Pty Ltd.

ARTC

KARARA-LEYBURN ALIGNMENT PUBLIC UTILITY PLANT CROSSINGS

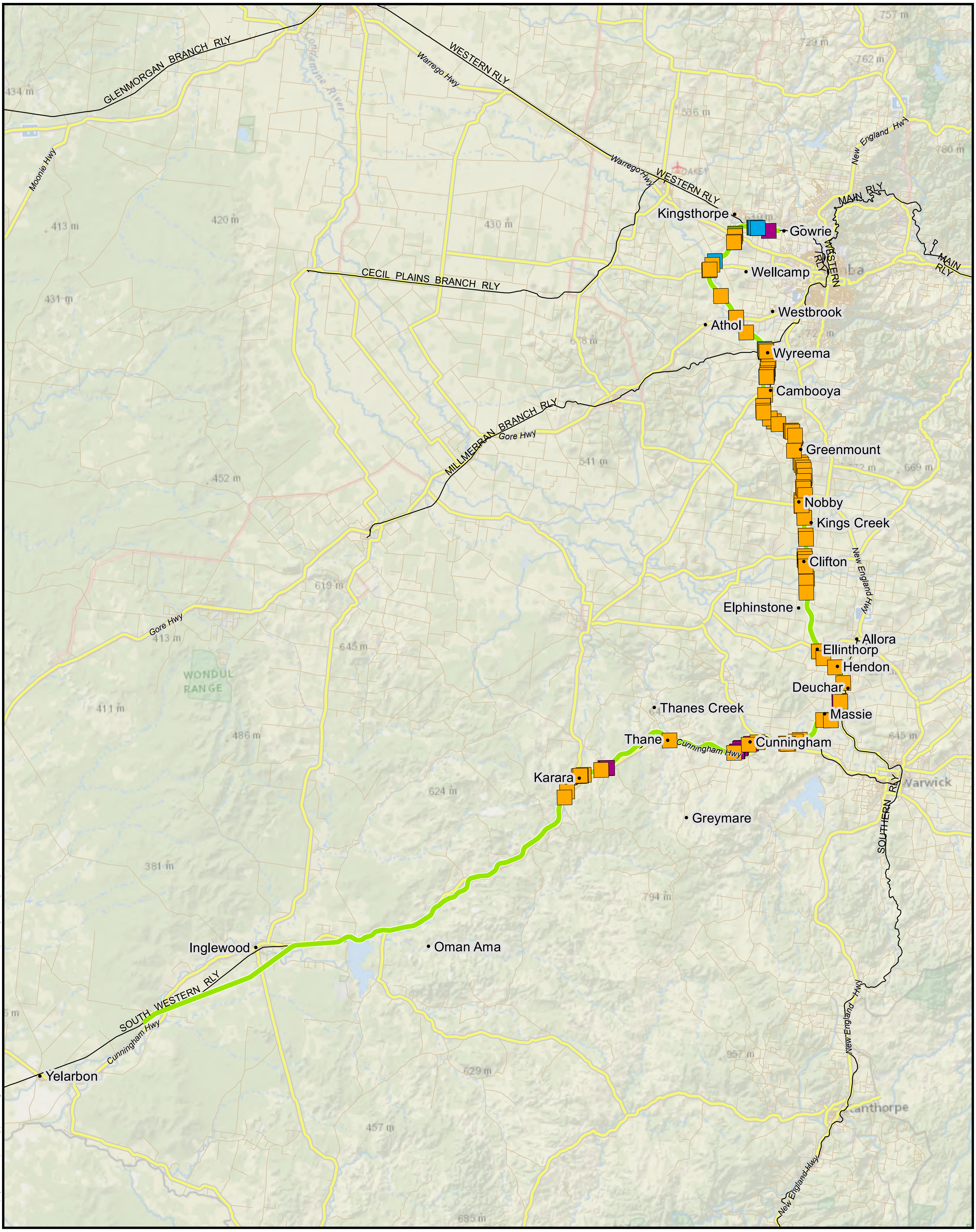
Yelarbon to Gowrie (Y2G) Project

PROJECT ID	60492124
CREATED BY	MF
LAST MODIFIED	frym - 3/04/2017
VERSION:	1

Map
12

A3 size

Filename: P:\604X\60492124\4. Tech Work Area\4.99 GIS\02_MXDs\CorridorOptionsAssessment\Civil\CIV-12_60492124_ARTC_PUPS_KararaLeyburn.mxd



N

AECOM
www.aecom.com

Coordinate System: GDA 1994 MGA Zone 56
Projection: Transverse Mercator

0 5 10 20
Kilometres
1:500,000 (when printed at A3)

Legend

- Warwick
- Existing Railway
- Main Roads

Utility Crossings

- Gas
- Telecommunications
- Water
- Power

ARTC

WARWICK ALIGNMENT
PUBLIC UTILITY PLANT CROSSINGS

Yelarbon to Gowrie (Y2G) Project

PROJECT ID	60492124
CREATED BY	MF
LAST MODIFIED	frym - 3/04/2017
VERSION:	1

Map
13

Filename: P:\604X\60492124\4. Tech Work Area\4.99 GIS\02_MXDs\CorridorOptionsAssessment\Civil\CIV-13_60492124_ARTC_PUPS_Warwick.mxd

A3 size

Appendix I

Condamine River Hydraulic Assessment Report - Modified Base Case and Wellcamp

Inland Rail - Yelarbon to Gowrie
Australian Rail Track Corporation Limited
31-Mar-2017

Condamine River - Hydraulic Assessment Report

Base Case Modified and Wellcamp - Charlton Alignment Options

Condamine River - Hydraulic Assessment Report

Base Case Modified and Wellcamp - Charlton Alignment Options

Client: Australian Rail Track Corporation Limited

ABN: 75081455754

Prepared by

AECOM Australia Pty Ltd
Level 8, 540 Wickham Street, PO Box 1307, Fortitude Valley QLD 4006, Australia
T +61 7 3553 2000 F +61 7 3553 2050 www.aecom.com
ABN 20 093 846 925

31-Mar-2017

Job No.: 60492124

AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 AS/NZS4801 and OHSAS18001.

Quality Information

Document Condamine River - Hydraulic Assessment Report

Ref 60492124

Date 31-Mar-2017

Prepared by Brijesh Mehta

Reviewed by Martin Boshoff & Jennifer Ahern

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
A	31-Mar-2017	For Client Issue	Robert Green Technical Director - Rail	

Table of Contents

1.0 Introduction

1.1 The Project and Study Area

As part of the Corridor Options Assessment for Inland Rail – Yelarbon to Gowrie (the Project), AECOM was commissioned by Australian Rail Track Corporation Ltd (ARTC) to undertake a hydraulic assessment of the Condamine River and floodplain at its intersection with the proposed Base Case Modified and Wellcamp - Charlton rail corridor options.

The hydraulic assessment was undertaken to establish the existing flood conditions, determine potential flood impacts, and inform the design of cross drainage infrastructure to establish comparative cost estimates and enable a Multi-Criteria Analysis (MCA) of the four corridor options. The four corridor options are:

- Base Case Modified
- Wellcamp - Charlton
- Karara - Leyburn
- Warwick.

The proposed Base Case Modified and Wellcamp - Charlton alignment options cross the Condamine River approximately 10 km north-east of Millmerran (Map 1, **Appendix A**). At this location, the two alignments are identical and are assessed by the same hydraulic model presented in this report. During high flow events, the Condamine River at this location breaks out into a complex floodplain covering an area of around 13 km wide. The floodplain is formed by three main branches, namely the Northern Branch, Main Branch and Southern Branch (also known as Grasstree Creek). Three viaducts/bridges and a series of balancing culverts are proposed at these crossings and along the floodplain as part of the Project.

Construction of a new rail embankment within the floodplain and the establishment of new river crossings have the potential to change existing flooding patterns and impact properties and infrastructure in the vicinity of the rail alignment. This impact is assessed by two-dimensional (2D), hydrodynamic modelling.

1.2 Study Objectives

The aims of this hydraulic assessment were to:

- establish a 2D hydrodynamic model in TUFLOW for the Study Area (Map 2, **Appendix A**)
- estimate the flood extent, level and velocities of the Condamine River for the existing condition in 10% and 1% Annual Exceedance Probability (AEP) flood events
- determine the cross drainage infrastructure (viaducts/bridges and balancing culverts) to achieve the project design criteria
- assess potential impacts to existing case flooding in 10% and 1% AEP events.

1.3 Design Criteria

ARTC have provided design values for the entire Melbourne to Brisbane Inland Rail project, including this Yelarbon to Gowrie section. These are:

- 1% AEP flood immunity for the rail
- no change in flood inundation footprint
- no redistribution of flood flows
- minimise changes in flood peak timing

- consider critical infrastructure
- minimise changes in flood levels with an aim of no net worsening
- minimise downstream erosion and minimise changes in flow velocities.

In future stages, the Project will have specific design criteria set during the Environmental Impact Statement (EIS) process. In the absence of these site specific design criteria, typical conditions for other recent rail projects in Queensland have been used to assess each alignment corridor option. This ensures areas of potential impact are similar for each alignment option, and therefore suitable for the comparative purposes of the cost estimate and MCA corridor option selection process.

The following criteria are an example of a recent Queensland Rail project extracted from Co-ordinator General Conditions of Approval document:

(a) A suitably qualified person must document and certify that the design and construction of the rail component of the project:

i. is in accordance with the design criteria in the Department of Transport and Main Roads (March 2010) Road Drainage Manual 2nd edition

ii. meets the following criteria for a two per cent Annual Exceedance Probability rainfall event (50 year Annual Recurrence Interval):

1. not cause, or have the potential to increase flood damage at a residential premises or occupied commercial workplace

2. a maximum increase in afflux of 0.1 m at a residential premises or occupied commercial workplace

3. a maximum increase in afflux of 0.2 m at infrastructure

4. a design objective of an increase in afflux of 0.3 m, with a maximum increase in afflux of 0.5 m at other locations

5. a maximum culvert outlet velocity of 2.5 m/s

6. any increase in duration of floodplain inundation is not to exceed 72 hours or 20 per cent of existing flood duration (whichever is greater)

7. any increase in duration of inundation must not alter rural land uses or result in significant impacts upon valued pasture land, other valued agricultural land uses such as cultivated ground or flood-free ground and evacuation access for cattle.

(b) Relevant land owners likely to be impacted by changes to the existing flooding/drainage system must be consulted prior to completion of the final design for the rail component of the project.

2.0 Available Data

2.1 Previous Studies

2.1.1 Upper Condamine River Flood Study, TRC (2013)

In 2013, SKM undertook a 2D flood study for the Upper Condamine River catchment on behalf of Toowoomba Regional Council (TRC). This flood study included historical and design event modelling and was based on an URBS hydrological model. The hydraulic model utilised a 60 m grid due to lack of LiDAR (Light Detection and Ranging Survey) information at the time.

The Bureau of Meteorology (BoM) developed a number of URBS models for the use in its flood forecasting and flood warning system in 2003. The model was calibrated to the 1976 flood event. SKM undertook a review and revision of the BoM URBS model and developed a new Upper Condamine URBS model in 2012. This model was calibrated to a number of flood events including the 2010/11 event.

In 2013, an URBS model for TRC was developed by extending the 2012 Upper Condamine URBS model to Cecil Plains using catchment data from the BoM 2003 URBS model. The extended URBS model was validated against the 1976 and 2010/11 flood events. In 2013, SKM used the extended URBS model to derive the design flows for a number of design events (10, 5, 1 and 0.2% AEP) for the input into the hydraulic model. The critical duration of the design events was identified as 72 hours.

Information regarding observed flood extents during the December 2010/January 2011 flood event was collected around the township of Ellangowan, located approximately 5 km upstream of the SKM model extent as part of a community consultation process. This information was used to validate the results for this assessment.

2.1.2 Condamine River Flood Study, TRC (2015)

Water Modelling Solutions (WMS) built a new hydraulic model of the Upper Condamine River catchment using the MIKEFLOOD FlexiMesh software on behalf of TRC in 2015. This model used LiDAR data and extended the SKM model domain to include the township of Ellangowan. The model domain extends from approximately 10 km south of Ellangowan to approximately 14 km north of Cecil Plains, and includes the Study Area for this assessment.

TRC supplied the MIKEFLOOD model and results files to support this assessment. The model includes cross-drainage structures under the Gore Highway downstream of the proposed rail alignment. Dimensional data for these structures were used in the development of the TUFLOW model for this assessment.

The MIKEFLOOD model had been validated against observed records for the Upper Condamine River catchment by WMS. The model results had reasonable (-0.25 m) fits against observed records at the DNRM gauge (422347 – North Condamine River at Pampas) within the Study Area.

There remains a discrepancy of -0.25 m in the calculated and observed flood levels at Pampas which require further investigation and validation that is beyond the scope of this report.

It is possible that the current TRC hydrological modelling underestimates the flow of the Condamine River North Branch. The hydrology for the north branch may require further refinements to better represent historical flood levels in the immediate vicinity of Pampas.

The validated model was used to estimate design peak flood surface elevations, peak water depths, hazard and hydraulic categories for the 10, 5, 1 and 0.2% AEP design events.

2.1.3 Topographic Data

LiDAR data covering a corridor of approximately 12 km wide was provided by ARTC.

2.1.4 Proposed Rail Alignment

The rail formation for the proposed Base Case Modified and Wellcamp - Charlton alignment options was provided as a 12d earthworks model for input into the developed case scenario TUFLOW model.

3.0 Hydrological Assessment

The hydrology inflows adopted for this assessment for the Condamine River and its tributaries are based on flow hydrographs extracted from this WMS MIKEFLOOD model. The WaterRide software package was used to extract the flow hydrographs at the upstream model boundary locations for the North Branch, Main Branch and South Branch, respectively.

In addition, a flow hydrograph representing a local inflow was taken from the MIKEFLOOD boundary file. Peak flows adopted in the model are summarised in **Table 1.**

Table 1 Peak Hydrology Inflows

Waterways	Peak Flow (m^3/s)	
	10% AEP	1% AEP
North Branch	253	596
Main Branch	1,420	2,645
South Branch (Grasstree Creek)	454	1,348
Tributaries	203	363

4.0 Hydraulic Assessment

4.1 Model setup

A hydrodynamic flood model was developed and simulated using the TUFLOW software package (Version 2013-03-AE-w64). The model was used to provide an estimate of existing flood levels, extents and velocities; inform the design of the cross drainage solutions for the Project; and estimate any potential impacts on flooding as a result of the Project.

4.1.1 Model Extent

The spatial extent of the TUFLOW model was selected to ensure that flood behaviour of the Condamine River within the Study Area is adequately captured. The model extent covers a 12 km long reach of Condamine River as shown in Map 2 in **Appendix A.**

4.1.2 Model Terrain

The topography within the TUFLOW model was based on the LiDAR data for the 12 km corridor, and a small portion was based on WMS' Fleximesh terrain. The total modelling extent covers an area of 238 km^2. A 10m x 10m grid size was adopted. The model's Digital Terrain Model (DTM) is shown in Map 2 in **Appendix A.**

4.1.3 Boundary Conditions

The TUFLOW model was run dynamically using hydrograph inflows extracted from WMS' MIKEFLOOD model as described in **Section 3.0**. The downstream boundary conditions were modelled as 'normal depth'.

4.1.4 Roughness

Areas with similar land use and vegetation cover types were defined within the 2D domain and assigned appropriate roughness values (Manning's 'n' coefficients). These areas include the waterway, light vegetation, floodplains, dense vegetation, and road.

The roughness values were assigned at a block-scale, and are typically representative of the average roughness across each category and account for obstructions to flow. **Table 2** provides the Manning's 'n' roughness coefficients adopted for different land use types in the Study.

It is possible that the current flood levels are underestimated at Pampas as no allowance has been made for separate housing land use. Adopting a roughness coefficient for housing 0.2 may be considered in future phases of the project.

Table 2 Adopted Manning's 'n' Roughness Values

Land use category	Manning's 'n'
Ponded water	0.020
Waterways	0.035
Agricultural floodplains	0.050
Dense vegetation	0.090
Road	0.020

4.1.5 Existing Drainage Structures

Existing culverts were modelled as 1D elements, nested within the 2D domain. The existing bridges were modelled in the 2D domain. **Table 3** provides details of the existing drainage structures modelled. Structure dimensions were taken from the WMS MIKEFLOOD model.

Table 3 Existing Cross Drainage Structures

Existing Bridges	Existing Culvert
95m Bridge on Condamine River	8/2.4mx1.2m RCBC - North Branch 8/2.4mx 1.2m RCBC – Floodplain 2/2.4mx 1.2m RCBC – Floodplain 8/2.4mx 1.2m RCBC – Floodplain 3/2.4mx 1.2m RCBC – Floodplain

4.2 Model Validation

4.2.1 WMS MIKEFLOOD Modelling

The TUFLOW model results were validated against the water levels estimated with WMS' MIKEFLOOD model for a 1% AEP design event.

The model was calibrated by adjusting the Manning's 'n' roughness values and boundary locations until a satisfactory match to the peak MIKEFLOOD flood levels was achieved. Land use categories and their associated Manning's 'n' roughness values as adopted in the model calibration are shown in **Table 2,** and are within accepted industry standards for Manning's 'n' values.

Map 3 in **Appendix A** displays the comparison of the peak water levels estimated by the two models for a 1% AEP design event. The flood extent of the two models is mostly the same. The difference in peak water levels at the proposed alignment is mostly within ±0.05 m. In the remaining floodplain area, the difference is typically within ±0.15 m.

Table 4 provides the comparison of peak water levels estimated by the two models at the intersection of the three waterways and the proposed rail alignment. The difference in estimated peak water levels from the two models is within ±0.02 m.

The differences in results estimated by the two models can be attributed to the finer grid size adopted for TUFLOW. However, the differences in results are minimal in the vicinity of the proposed alignment.

Table 4 Comparison of the Results of TUFLOW Model and MIKEFLOOD FlexiMesh Model – 1% AEP

Location	Peak Flood Level (m AHD)		
	WMS MIKEFLOOD	TUFLOW Model	Difference (m)
Main Branch	380.20	380.22	+0.02
North Branch	382.48	382.46	-0.02
South Branch	380.38	380.38	0.00

Table 5 shows the results of model calibration against the 2010/11 event. Simulated flood levels were predicted to match very well with the observed water level records at the DNRM Pampas gauging station. The 2010/211 flood event was smaller than a 2% AEP (or between 5% and 2% AEP) based on 54 years historical records of flow data at Tummaville Station (422323) on the Condamine River located approximately 1 km upstream of the Study Area.

Table 5 Simulated Flood Levels by TUFLOW and Observed Levels for 2010/11 Event

Location	Peak Flood Level (m AHD)		
	Observed 2010/11 Level	Simulated 2010/11 Event Flood Level	Difference (m)
Pampas 422347B- North Condamine River	382.59	380.56	-0.03
Flood Mark 1 (FM1) Pampas	382.30	382.14	-0.16
Flood Mark 2 (FM2) Pampas	382.21	382.41	+0.20
Flood Mark 3 (FM3) Pampas	382.11	382.14	+0.03

4.2.2 Site Visit

A guided tour of the Base Case Modified and Wellcamp - Charlton alignment options was undertaken on 18 January 2017 with 23 landholders along the alignments. Historical water depths from 2010/11 flood and debris markers were photographed, measured and recorded. These water depths were compared against the results of the TUFLOW flood model simulating the 2010/11 flood.

This comparison is shown in Map 4 in **Appendix A**. The comparison shows that the 2010/11 flood model results are within a reasonable level of accuracy to observed flood markers, generally within ±0.1 m. At locations shown, the greatest difference in model results is ±0.66 m near the Southern Branch (Grasstree Creek). It is believed that this difference could be attributed to timing of coincident flood peaks between Back Greek and Grasstree Creeks, and associated backwater effects. Calibration in this location should be considered in more detail during future design development stages.

4.3 Modelled Scenarios

The following two scenarios were simulated:

- Existing Condition

The existing condition is represented by the existing drainage structures under the Gore Highway and the existing terrain. **Table 3** provides details of the existing drainage structures.

- Developed Condition

The developed condition model includes the following elements in addition to the existing condition model:

- Design earthworks model to represent the proposed rail embankment.
- Proposed cross drainage viaducts/bridges and balancing culverts shown in **Table 6**. The structure configuration includes an allowance for a minimum of 20% blockage of culverts due to debris, such as hay bales. (Refer **Section 4.3.1** for more details.)

The proposed cross drainage structures shown in **Table 6** were determined through iterative model runs to achieve 1% AEP flood immunity for the rail and comparable areas of potential impact for each of the corridor alignment options. In the absence of site specific design criteria, this allows for the like-for-like comparison of alignments in terms of cross drainage infrastructure, cost estimates and potential impacts as a result of the Project.

Table 6 Proposed Cross Drainage Structures for Modified Base Case and Wellcamp - Charlton Alignment Options

Proposed Viaducts/Bridges	Proposed Balancing Culverts
750m – Main Branch 750m – South Branch 300m – North Branch	590/1.8m RCP 310/2.1m RCP (Total 900 Culverts) 30/3.6mx1.5m RCBC (at Pampas)
Note: Bridge soffit levels assumed to be above the 1% AEP.	

4.3.1 Blockage

Australian Rainfall and Runoff (ARR 2016) Project 11 – Blockage of Hydraulic Structures was used as a basis for determining blockage factors to apply to the structures. The ARR approach is a site specific risk based approach which determines:

- debris availability
- debris transportability
- debris Mobility
- size of the debris versus the structure type.

Typically blockage would be considered in later design phases. At this time, a site inspection would be undertaken to review site specific conditions and determine the appropriate blockage factor to apply to different catchments. For the purpose of this assessment, for comparative purposes, an indicative blockage assessment was undertaken for all crossings. This assessment resulted in a blockage factor to be applied to the structures of 20%. This is in agreement with the Queensland Urban Drainage Manual (QUDM, 2013) that provides guidance that, in the absence of site specific catchment data, a blockage factor of 20% should be applied.

The 20% blockage factor was applied to the balancing culverts in the TUFLOW models for the developed case option for each alignment. In addition, the balancing culvert sizes were increased in the model to account for the impact of blockage.

4.4 Existing Condition Results

Flood inundation maps of the Condamine River for the existing condition are presented in Map 5 and 6 in **Appendix A** for the 10% and 1% AEP events respectively. This flood inundation map visually represents flood depth and flood extent information. Flood extent along the proposed alignment is approximately 12.2 km and 12.5 km wide during the 10% and 1% AEP events, respectively. Estimated water depths vary between less than 0.5 m in floodplain areas to over 7 m within the channel of the main Condamine River branch.

Map 7 and 8 in **Appendix A** show a graphical representation of estimated flood levels in the Condamine River and floodplain for the existing conditions.

Map 9 and 10 in **Appendix A** show a graphical representation of estimated peak flow velocities for the 10% and 1% AEP events in the Condamine River and floodplain for the existing conditions. The estimated peak velocity in the Condamine River floodplain is mostly less than 1.0 m/s.

4.5 Impact Assessment

Potential impacts to flooding were assessed for the Condamine River by comparing the TUFLOW model results for the developed case against the results of the existing case model.

The assessment of impacts included the comparison of peak flood levels and peak velocities to confirm potential impacts on flooding were similar for each alignment in the 1% AEP. In the absence of site specific design criteria, this allows for the like-for-like comparison of alignments in terms of cross drainage infrastructure, cost estimates and potential impacts as a result of the Project.

An assessment was also made of changes in flooding extent and duration between the existing and developed case scenarios. The results found that there was negligible change to both flooding extent and total duration in flooding.

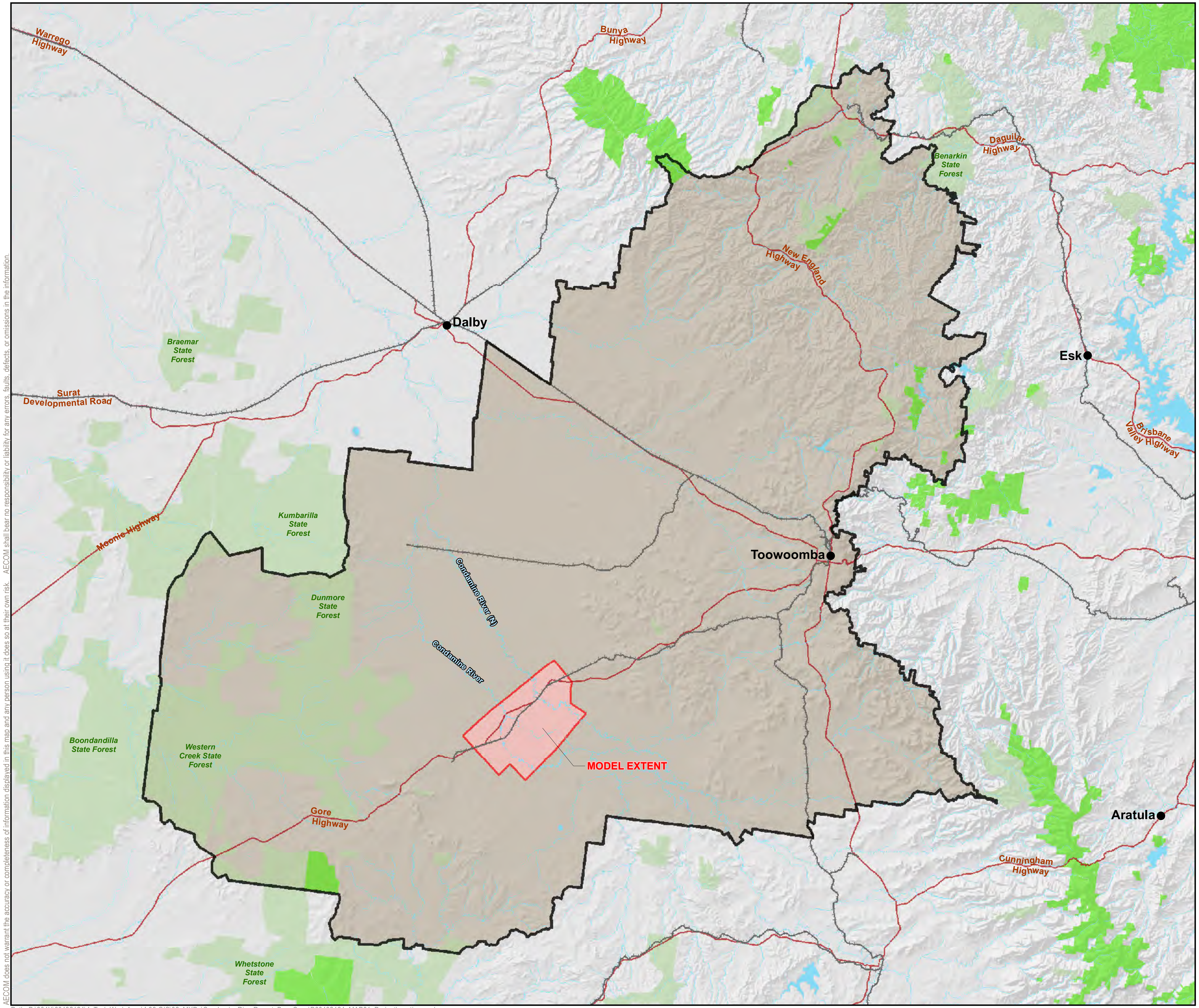
4.6 Future Design Stages

In future stages, as outlined in **Section 1.3**, the Project will have specific design criteria set during the Environmental Impact Statement (EIS) process that will govern design considerations such as allowable flood impacts, flood immunity, blockage considerations etc. Also, additional detailed topographic data will be acquired in future design stages in the form of topographic field survey.

Further, more refined flood modelling will therefore be required as part of future design development stages to update flood models with actual survey data, and to consider project specific design criteria that will inform appropriate mitigation measures.

Appendix A

Flood Maps



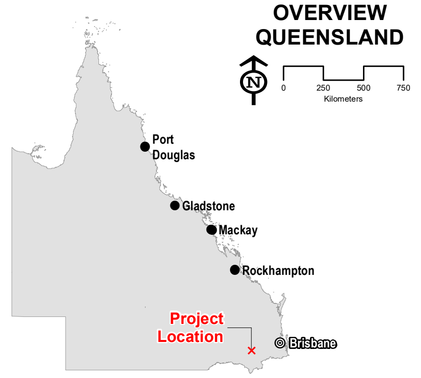
AECOM
www.aecom.com

Coordinate System: GDA 1994 MGA Zone 56
0 10 20
Kilometres
1:650,000 (when printed at A3)

LEGEND

- Place Name
- Waterway
- Existing Railway Line
- Road
- Model Extent
- Toowoomba LGA
- National Park
- State Forest

OVERVIEW QUEENSLAND



Data sources:
1. Existing Railway, Drainage Line and Areas © Street Pro, 2011
2. Protected areas of Queensland © State of Queensland (Department of National Parks, Sport and Racing) 2016
3. Canvas/World_Light_Gray_Base © Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community
4. Local government area boundaries - Queensland (Toowoomba) © State of Queensland (Department of Natural Resources and Mines) 2017
5. Place names gazetteer - Queensland © State of Queensland (Department of Natural Resources and Mines) 2017

Inland Rail - Yelarbon to Gowrie

CONDAMINE RIVER BASE CASE MODIFIED / WELLCAMP - CHARLTON OPTION

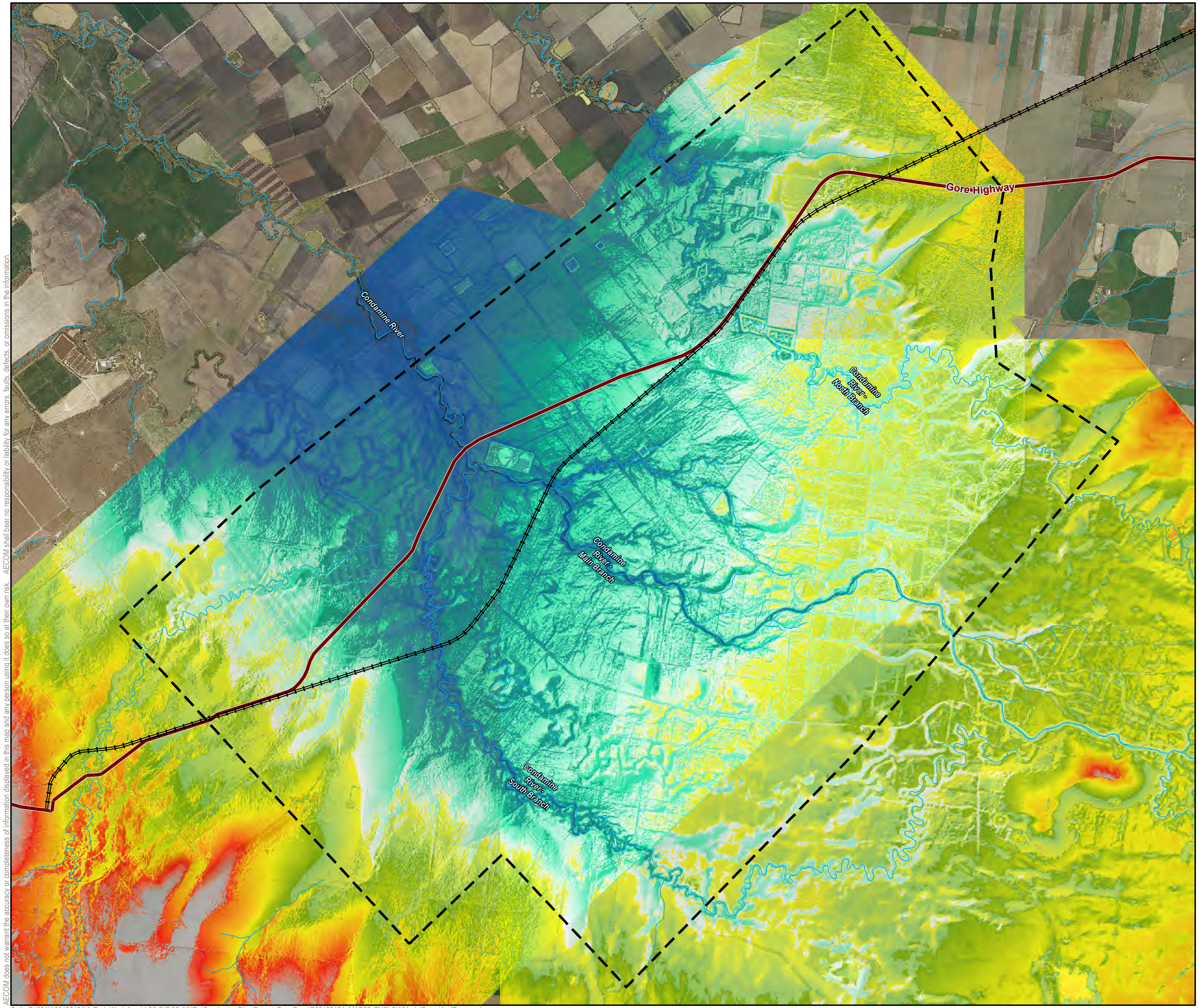
PROJECT LOCATION

PROJECT ID: 60492124
LAST PRINTED BY: manescuB
LAST MODIFIED: 28/03/2017
VERSION: 3

MAP 01

Path: P:\604X\60492124\4. Tech Work Area\4.99 GIS\02_MXDs\CondamineRiverReport_BaseCase\P60492124_MAP01_ProjectLocation.mxd

A3 size



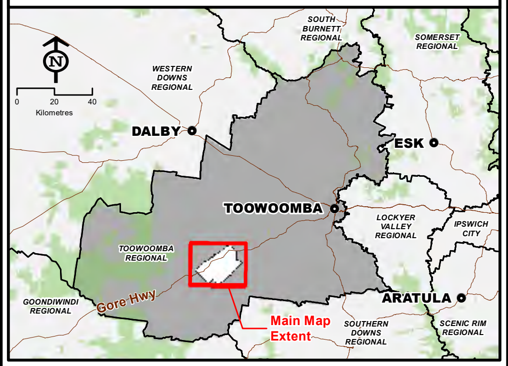
AECOM
www.aecom.com

Coordinate System: GDA 1994 MGA Zone 56
0 1 2
Kilometres
1:80,000 (when printed at A3)

LEGEND
- Waterway
- Highway
- Proposed Railway
- Model Extent

Data Elevation Model (m AHD)
High : 420
Low : 370

TOOWOOMBA REGIONAL (OVERVIEW)



Data sources:
1. Place names gazetteer - Queensland © State of Queensland (Department of Natural Resources and Mines) 2017
2. Ordered drainage 100K - Queensland © State of Queensland (Department of Natural Resources and Mines) 2014
3. Emergency Locations, Existing Bridge, Existing Culverts, Proposed Rail, Water Model © AECOM, 2017
4. SEQ Regional 30 cm Imagery © SISP, 2013
5. Protected areas of Queensland © State of Queensland (Department of National Parks, Sport and Racing) 2016

Inland Rail - Yelarbon to Gowrie

CONDAMINE RIVER BASE CASE MODIFIED / WELLCAMP - CHARLTON OPTION

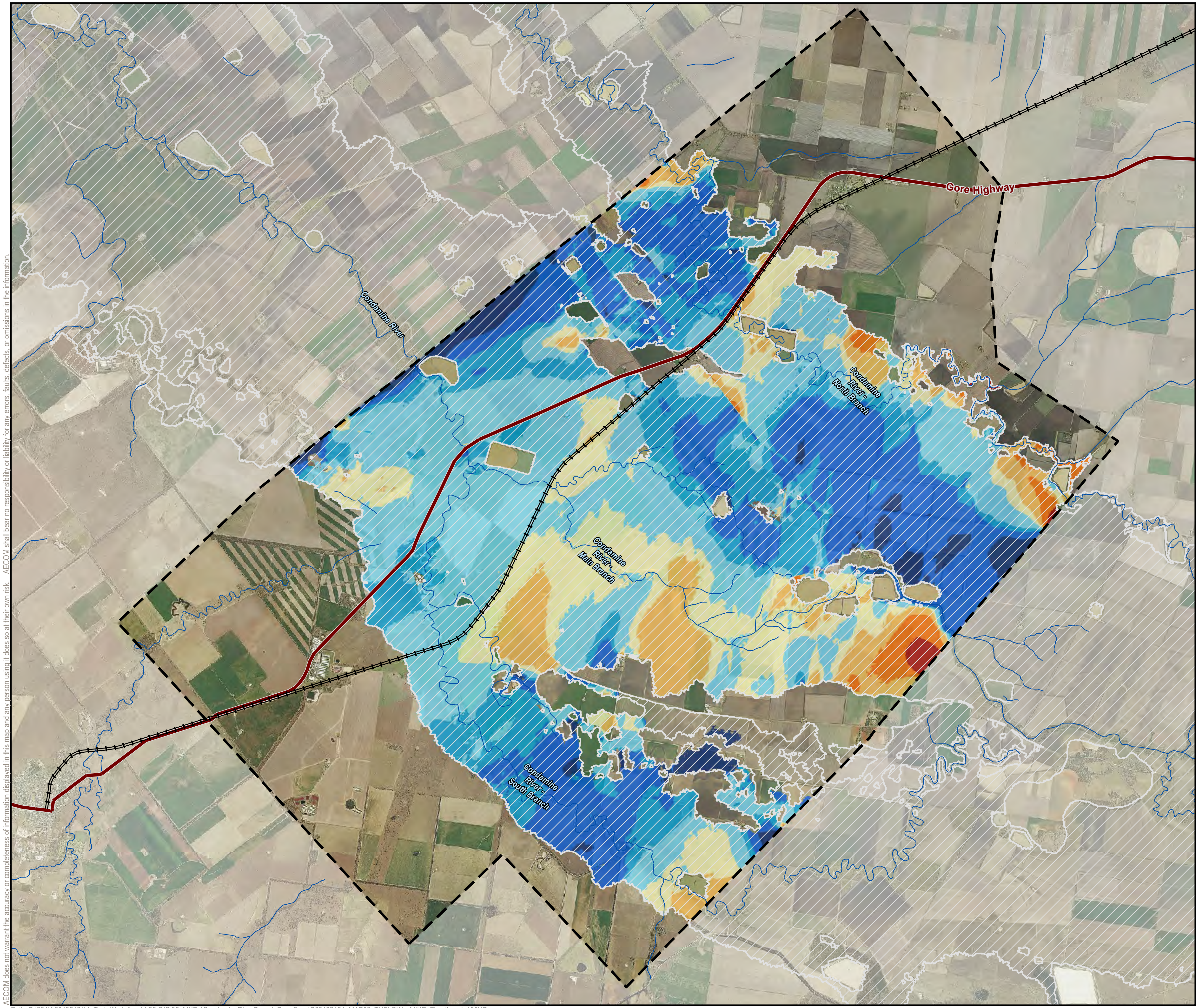
TUFLOW MODEL EXTENT AND TOPOGRAPHY

PROJECT ID:	60492124
LAST PRINTED BY:	manescuB
LAST MODIFIED:	30/03/2017
VERSION:	1

MAP 02

A3 size

Path: P:\604X\60492124\4. Tech Work Area\4.99 GIS\02_MXDs\CondamineRiverReport_BaseCase\P60492124_MAP02_TUFLOWModelExtentAndTopo.mxd



AECOM
www.aecom.com

Coordinate System: GDA 1994 MGA Zone 56
0 1 2
Kilometres
1:80,000 (when printed at A3)

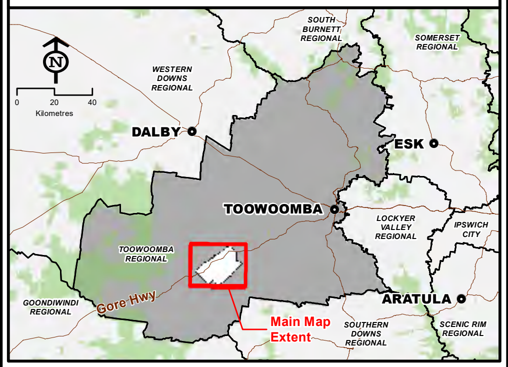
LEGEND

- Waterway
- Highway
- Proposed Railway
- Model Extent
- WMS Mike Flood

Difference in Flood Level (m)

- <-0.2
- -0.2 - -0.1
- -0.1 - -0.05
- -0.05 - 0.05
- 0.05 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4

TOOWOOMBA REGIONAL (OVERVIEW)



Data sources:
1. Place names gazetteer - Queensland © State of Queensland (Department of Natural Resources and Mines) 2017
2. Ordered drainage 100K - Queensland © State of Queensland (Department of Natural Resources and Mines) 2014
3. Emergency Locations, Existing Bridge, Existing Culverts, Proposed Rail, Water Model © AECOM, 2017
4. SEQ Regional 30 cm Imagery © SISP, 2013
5. Protected areas of Queensland © State of Queensland (Department of National Parks, Sport and Racing) 2016
5. Water Model based on ALS data from 1m DEM © TRC through Aurecon, 30 August 2014

Inland Rail - Yelarbon to Gowrie

CONDAMINE RIVER BASE CASE MODIFIED / WELLCAMP - CHARLTON OPTION

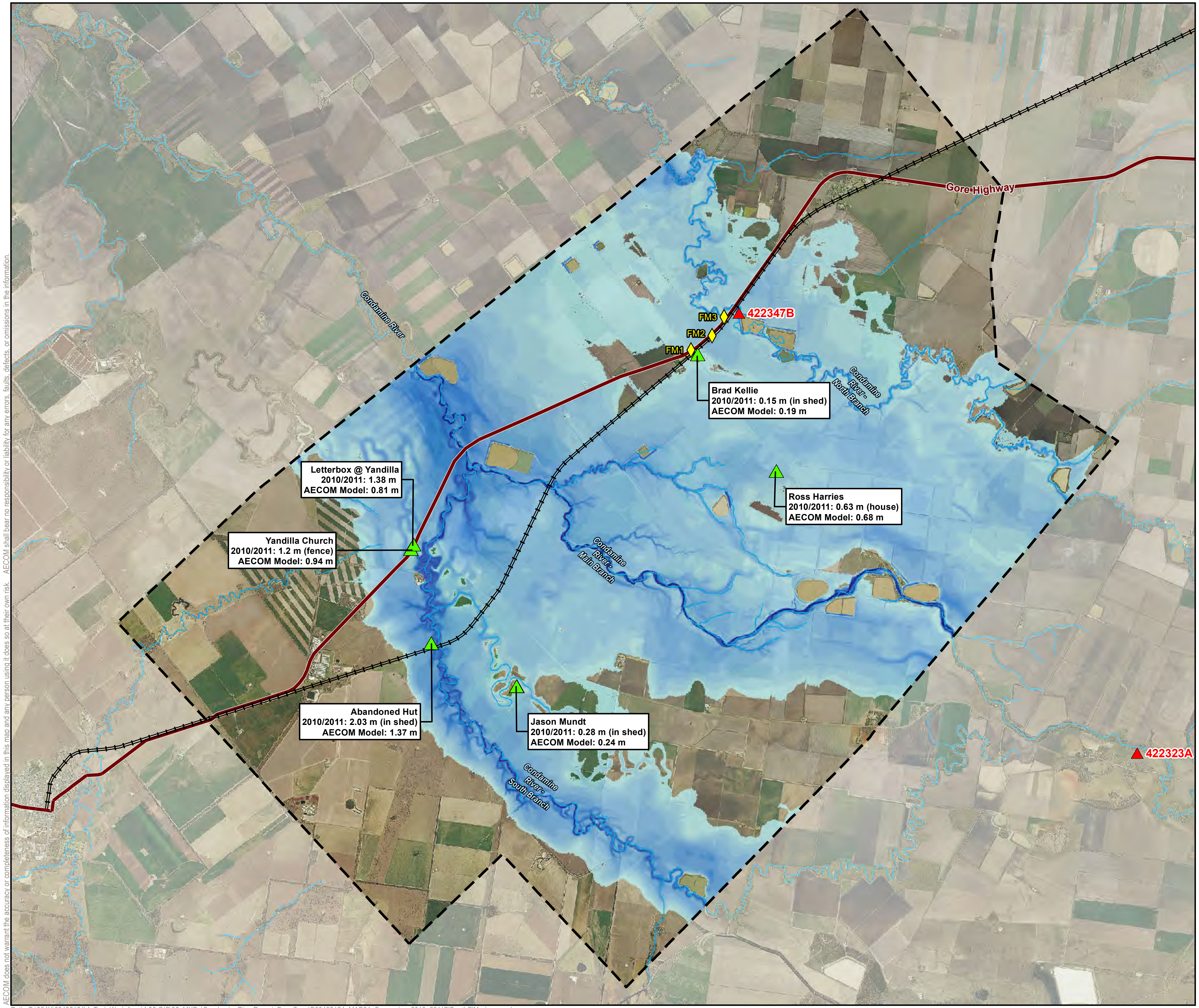
COMPARISON BETWEEN TUFLOW AND WMS MIKEFLOOD - 1% AEP FLOOD LEVEL

PROJECT ID: 60492124
LAST PRINTED BY: manescuB
LAST MODIFIED: 28/03/2017
VERSION: 3

MAP 03

Path: P:\604X\60492124\4. Tech Work Area\4.99 GIS\02_MXDs\CondamineRiverReport_BaseCase\P60492124_MAP03_TUFLOWvsMIKE_FloodLevel_100YR.mxd

A3 size



AECOM
www.aecom.com

Coordinate System: GDA 1994 MGA Zone 56

0 1 2
Kilometres

1:80,000 (when printed at A3)

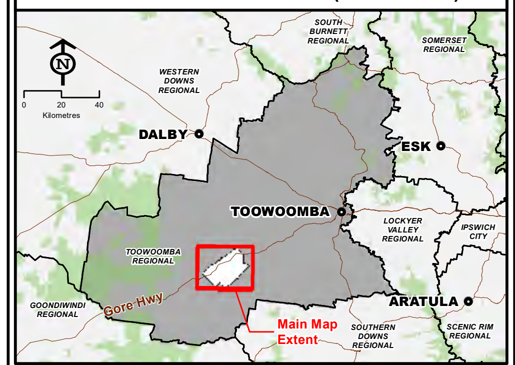
LEGEND

- Streamflow Gauge
- Flood Marks 2011 Event (TRC)
- Flood Marks 2011 Event (AECOM)
- Waterway
- Highway
- Proposed Railway
- Model Extent

Estimated Water Depth 2011 (m)

0.0 - 0.25	2.0 - 2.5
0.25 - 0.5	2.5 - 3
0.5 - 0.75	3.0 - 3.5
0.75 - 1	3.5 - 4
1.0 - 1.25	4.0 - 4.5
1.25 - 1.5	4.5 - 5
1.5 - 1.75	5.0 - 5.5
1.75 - 2	>5.5

TOOWOOMBA REGIONAL (OVERVIEW)



Data sources:
1. Place names gazetteer - Queensland © State of Queensland (Department of Natural Resources and Mines) 2017
2. Ordered drainage 100K - Queensland © State of Queensland (Department of Natural Resources and Mines) 2014
3. Emergency Locations, Existing Bridge, Existing Culverts, Proposed Rail, Water Model © AECOM, 2017
4. SEQ Regional 30 cm Imagery © SISP, 2013
5. Protected areas of Queensland © State of Queensland (Department of National Parks, Sport and Racing) 2016
5. Water Model based on ALS data from 1m DEM © TRC through Aurecon, 30 August 2014

Inland Rail - Yelarbon to Gowrie

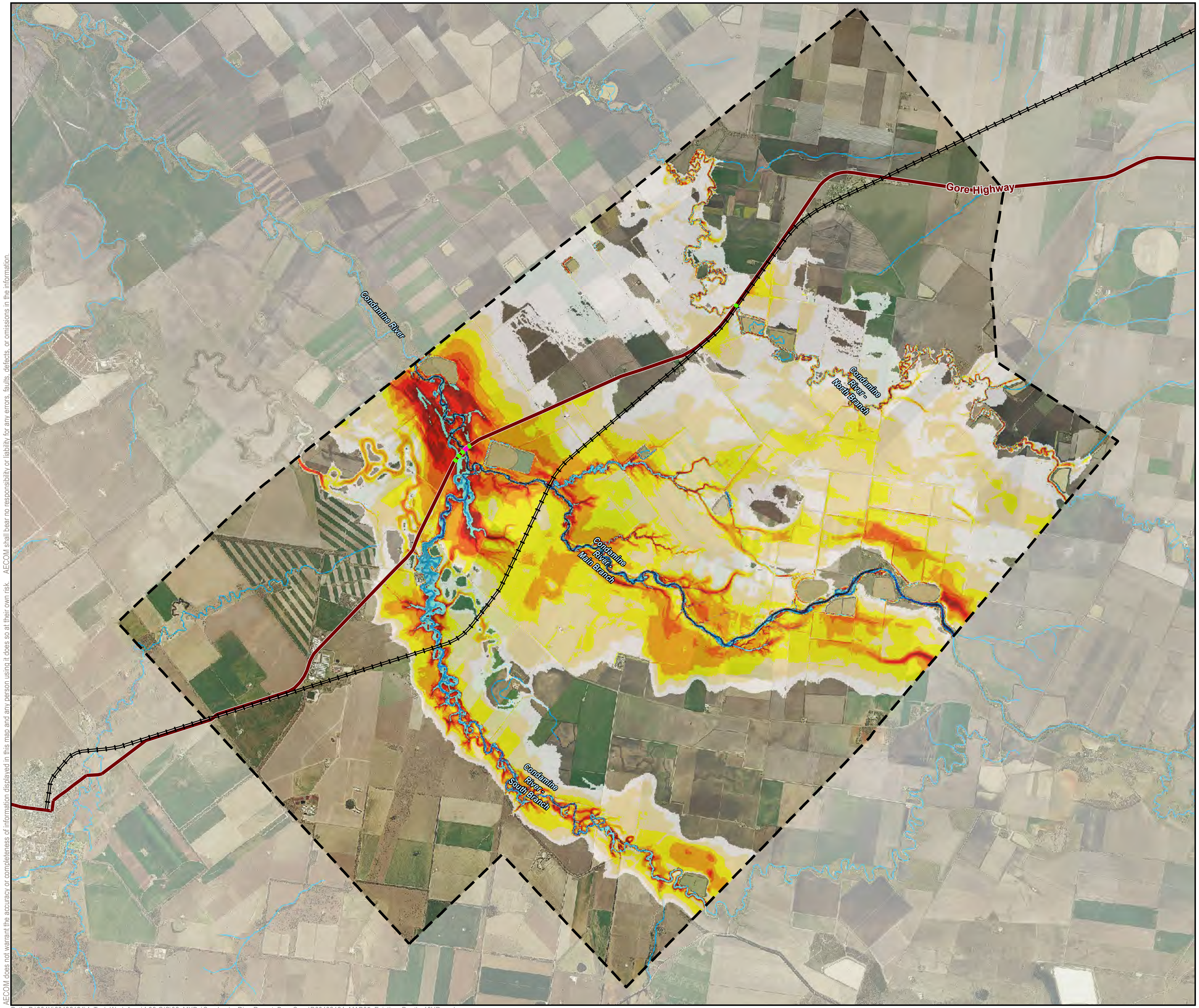
CONDAMINE RIVER BASE CASE MODIFIED / WELLCAMP - CHARLTON OPTION

COMPARISON 2010/11 FLOOD DEPTHS AGAINST OBSERVED FLOOD MARKERS

PROJECT ID:	60492124	**MAP 04**
LAST PRINTED BY:	manescuB	
LAST MODIFIED:	30/03/2017	
VERSION:	2	

Path: P:\604X\60492124\4. Tech Work Area\4.99 GIS\02_MXDs\CondamineRiverReport_BaseCase\P60492124_MAP04_Comparison2010_2011FlDepthFlMarkers.mxd

A3 size



AECOM
www.aecom.com

Coordinate System: GDA 1994 MGA Zone 56
0 1 2
Kilometres
1:80,000 (when printed at A3)

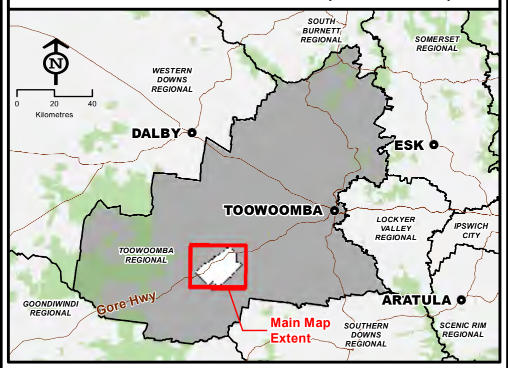
LEGEND

- Waterway
- Highway
- Proposed Railway
- Existing Culverts
- Existing Bridge
- Model Extent

Peak Water Depth (m)

0.00 - 0.25	2.00 - 2.50
0.25 - 0.50	2.50 - 3.00
0.50 - 0.75	3.00 - 3.50
0.75 - 1.00	3.50 - 4.00
1.01 - 1.25	4.00- 4.50
1.25 - 1.50	4.50 - 5.00
1.50 - 1.75	5.00 - 5.50
1.75 - 2.00	> 5.50

TOOWOOMBA REGIONAL (OVERVIEW)



Data sources:

1. Place names gazetteer - Queensland © State of Queensland (Department of Natural Resources and Mines) 2017
2. Ordered drainage 100K - Queensland © State of Queensland (Department of Natural Resources and Mines) 2014
3. Emergency Locations, Existing Bridge, Existing Culverts, Proposed Rail, Water Model © AECOM, 2017
4. SEQ Regional 30 cm Imagery © SISP, 2013
5. Protected areas of Queensland © State of Queensland (Department of National Parks, Sport and Racing) 2016
5. Water Model based on ALS data from 1m DEM © TRC through Aurecon, 30 August 2014

Inland Rail - Yelarbon to Gowrie

CONDAMINE RIVER BASE CASE MODIFIED / WELLCAMP - CHARLTON OPTION

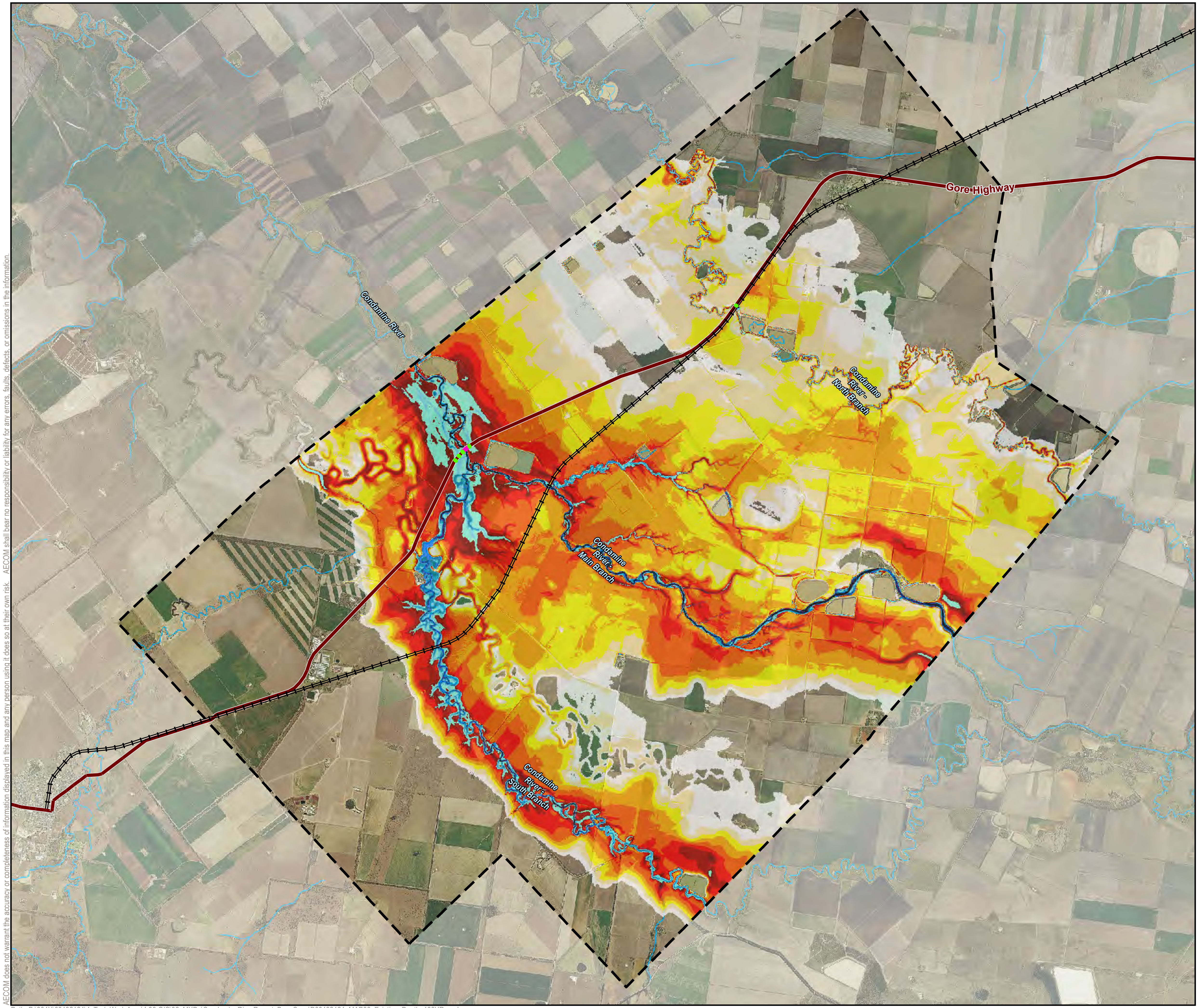
10% AEP ESTIMATED FLOOD DEPTH EXISTING CONDITION

PROJECT ID: 60492124
LAST PRINTED BY: manescuB
LAST MODIFIED: 28/03/2017
VERSION: 3

MAP 05

Path: P:\604X\60492124\4. Tech Work Area\4.99 GIS\02_MXDs\CondamineRiverReport_BaseCase\P60492124_MAP05_Existing_Depth_10YR.mxd

A3 size



AECOM
www.aecom.com

Coordinate System: GDA 1994 MGA Zone 56
0 1 2
Kilometres
1:80,000 (when printed at A3)

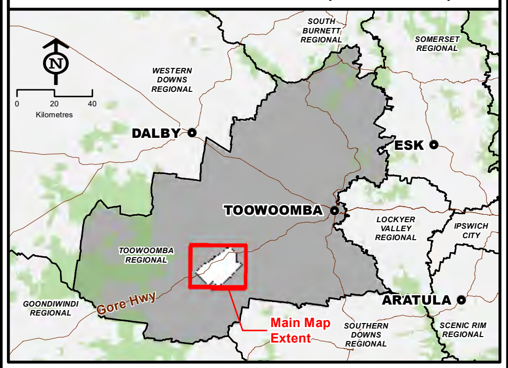
LEGEND

- Waterway
- Highway
- Proposed Railway
- Existing Culverts
- Existing Bridge
- Model Extent

Peak Water Depth (m)

0.00 - 0.25	2.00 - 2.50
0.25 - 0.50	2.50 - 3.00
0.50 - 0.75	3.00 - 3.50
0.75 - 1.00	3.50 - 4.00
1.01 - 1.25	4.00- 4.50
1.25 - 1.50	4.50 - 5.00
1.50 - 1.75	5.00 - 5.50
1.75 - 2.00	> 5.50

TOOWOOMBA REGIONAL (OVERVIEW)



Data sources:
1. Place names gazetteer - Queensland © State of Queensland (Department of Natural Resources and Mines) 2017
2. Ordered drainage 100K - Queensland © State of Queensland (Department of Natural Resources and Mines) 2014
3. Emergency Locations, Existing Bridge, Existing Culverts, Proposed Rail, Water Model © AECOM, 2017
4. SEQ Regional 30 cm Imagery © SISP, 2013
5. Protected areas of Queensland © State of Queensland (Department of National Parks, Sport and Racing) 2016
5. Water Model based on ALS data from 1m DEM © TRC through Aurecon, 30 August 2014

Inland Rail - Yelarbon to Gowrie

CONDAMINE RIVER BASE CASE MODIFIED / WELLCAMP - CHARLTON OPTION

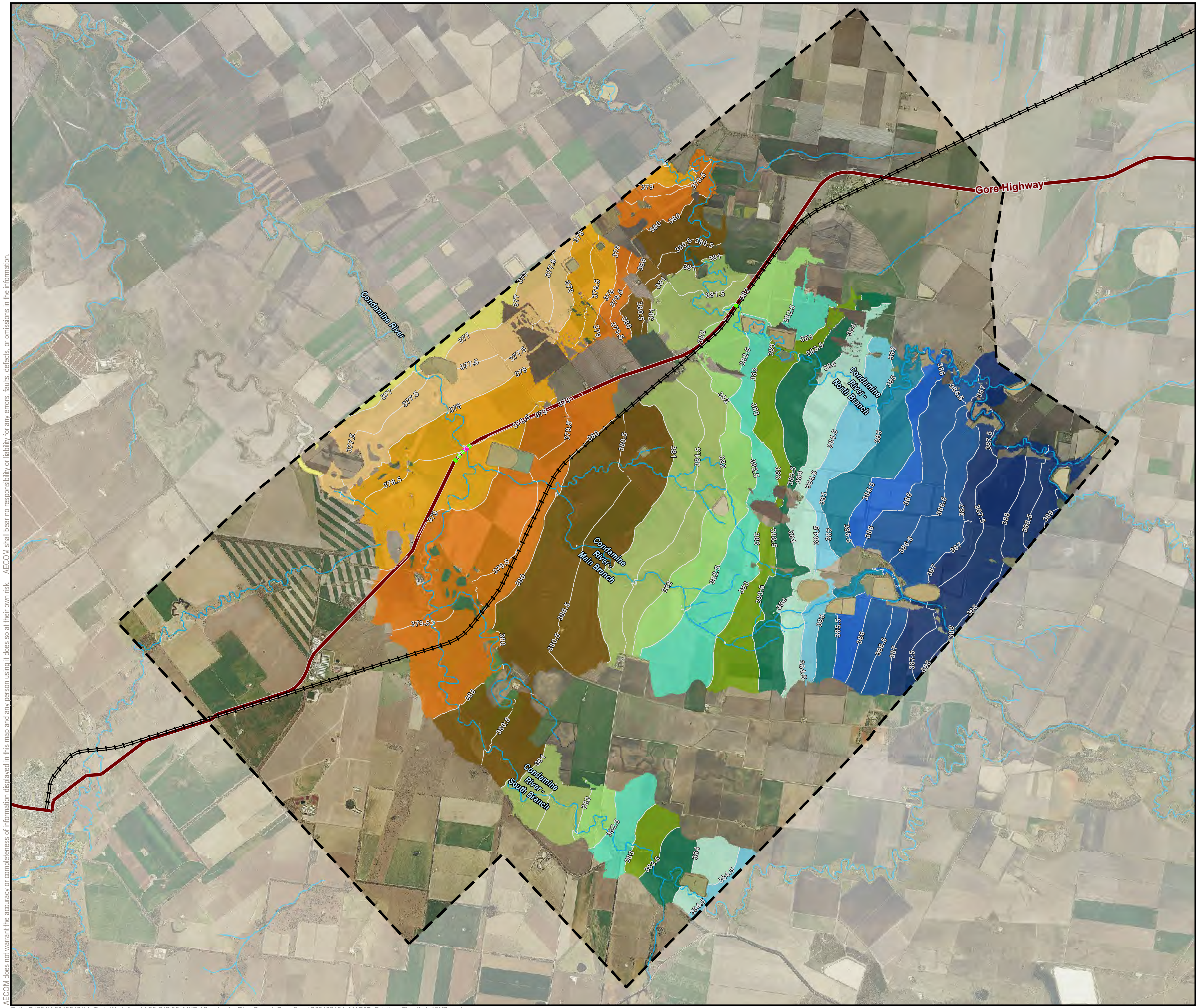
1% AEP ESTIMATED FLOOD DEPTH EXISTING CONDITION

PROJECT ID: 60492124
LAST PRINTED BY: manescuB
LAST MODIFIED: 28/03/2017
VERSION: 3

MAP 06

A3 size

Path: P:\604X\60492124\4. Tech Work Area\4.99 GIS\02_MXDs\CondamineRiverReport_BaseCase\P60492124_MAP06_Existing_Depth_100YR.mxd



AECOM
www.aecom.com

Coordinate System: GDA 1994 MGA Zone 56

0 1 2
Kilometres

1:80,000 (when printed at A3)

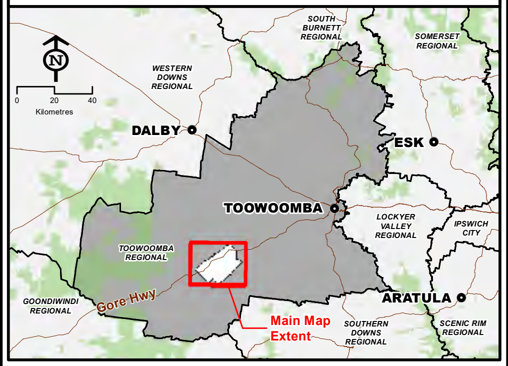
LEGEND

- Flood Level Contours 0.5 m
- Waterway
- Highway
- Proposed Railway
- Existing Culverts
- Existing Bridge
- Model Extent

Peak Water Level (m AHD)

<376	381 - 382	384.5 - 385
376 - 377	382 - 382.5	385 - 385.5
377 - 378	382.5 - 383	385.5 - 386
378 - 379	383 - 383.5	386 - 387
379 - 380	383.5 - 384	387 - 388
380 - 381	384 - 384.5	

TOOWOOMBA REGIONAL (OVERVIEW)



Data sources:
1. Place names gazetteer - Queensland © State of Queensland (Department of Natural Resources and Mines) 2017
2. Ordered drainage 100K - Queensland © State of Queensland (Department of Natural Resources and Mines) 2014
3. Emergency Locations, Existing Bridge, Existing Culverts, Proposed Rail, Water Model © AECOM, 2017
4. SEQ Regional 30 cm Imagery © SISP, 2013
5. Protected areas of Queensland © State of Queensland (Department of National Parks, Sport and Racing) 2016
5. Water Model based on ALS data from 1m DEM © TRC through Aurecon, 30 August 2014

Inland Rail - Yelarbon to Gowrie

CONDAMINE RIVER BASE CASE MODIFIED / WELLCAMP - CHARLTON OPTION

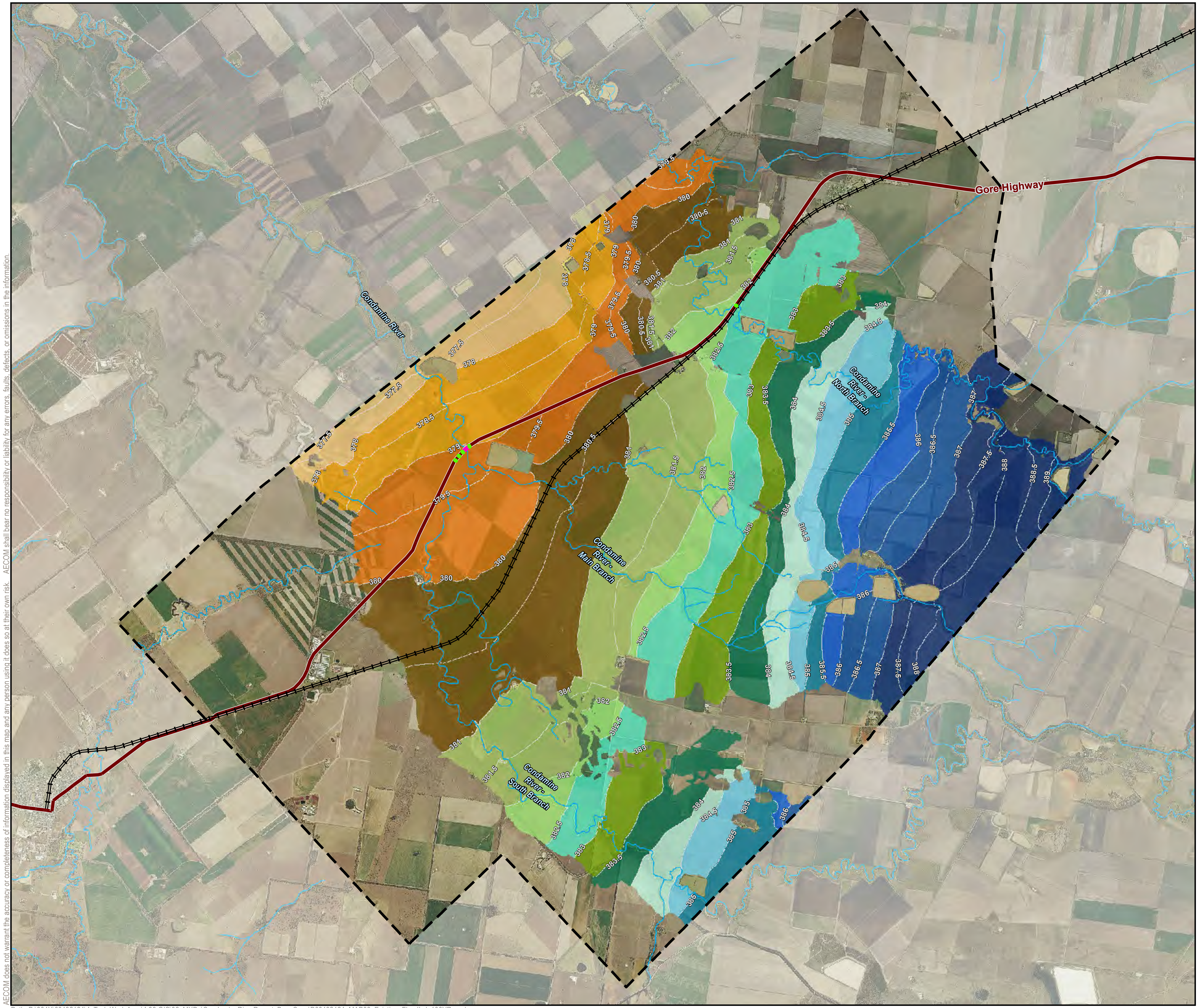
10 % AEP ESTIMATED FLOOD LEVEL EXISTING CONDITION

PROJECT ID: 60492124
LAST PRINTED BY: manescuB
LAST MODIFIED: 30/03/2017
VERSION: 3

MAP 07

A3 size

Path: P:\604X\60492124\4. Tech Work Area\4.99 GIS\02_MXDs\CondamineRiverReport_BaseCase\P60492124_MAP07_Existing_FloodLvl_10YR.mxd



AECOM
www.aecom.com

Coordinate System: GDA 1994 MGA Zone 56
0 1 2
Kilometres
1:80,000 (when printed at A3)

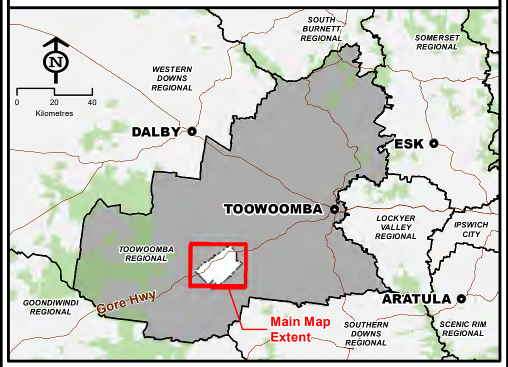
LEGEND

- Flood Level Contours 0.5 m
- Waterway
- Highway
- Proposed Railway
- Existing Culverts
- Existing Bridge
- Model Extent

Peak Water Level (m AHD)

<376	381 - 382	384.5 - 385
376 - 377	382 - 382.5	385 - 385.5
377 - 378	382.5 - 383	385.5 - 386
378 - 379	383 - 383.5	386 - 387
379 - 380	383.5 - 384	387 - 388
380 - 381	384 - 384.5	

TOOWOOMBA REGIONAL (OVERVIEW)



Data sources:
1. Place names gazetteer - Queensland © State of Queensland (Department of Natural Resources and Mines) 2017
2. Ordered drainage 100K - Queensland © State of Queensland (Department of Natural Resources and Mines) 2014
3. Emergency Locations, Existing Bridge, Existing Culverts, Proposed Rail, Water Model © AECOM, 2017
4. SEQ Regional 30 cm Imagery © SISP, 2013
5. Protected areas of Queensland © State of Queensland (Department of National Parks, Sport and Racing) 2016
5. Water Model based on ALS data from 1m DEM © TRC through Aurecon, 30 August 2014

Inland Rail - Yelarbon to Gowrie

CONDAMINE RIVER BASE CASE MODIFIED / WELLCAMP - CHARLTON OPTION

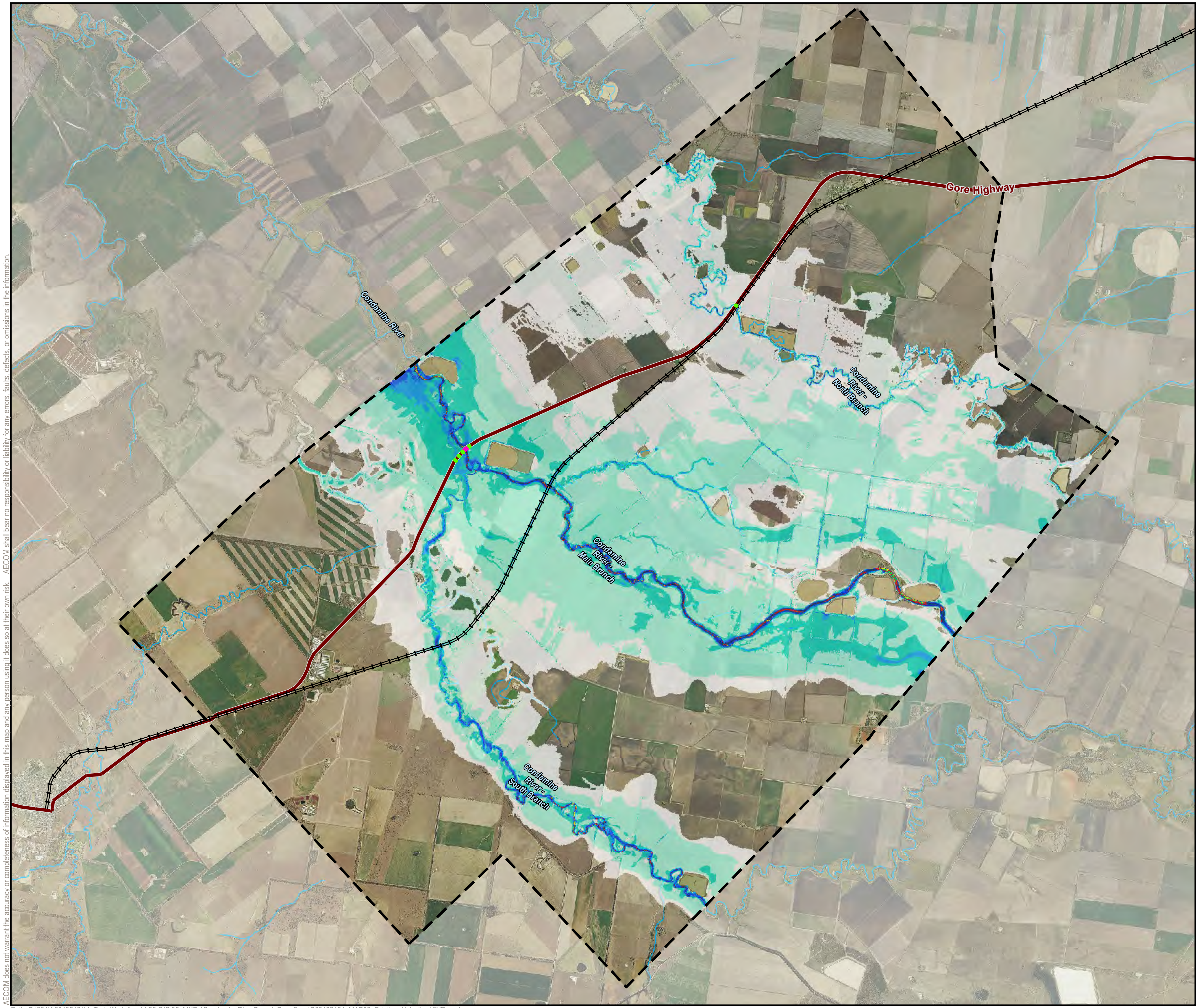
1% AEP ESTIMATED FLOOD LEVEL EXISTING CONDITION

PROJECT ID: 60492124
LAST PRINTED BY: manescuB
LAST MODIFIED: 30/03/2017
VERSION: 3

MAP 08

Path: P:\604X\60492124\4. Tech Work Area\4.99 GIS\02_MXDs\CondamineRiverReport_BaseCase\P60492124_MAP08_Existing_FloodLvl_100YR.mxd

A3 size



AECOM
www.aecom.com

Coordinate System: GDA 1994 MGA Zone 56

0 1 2
Kilometres

1:80,000 (when printed at A3)

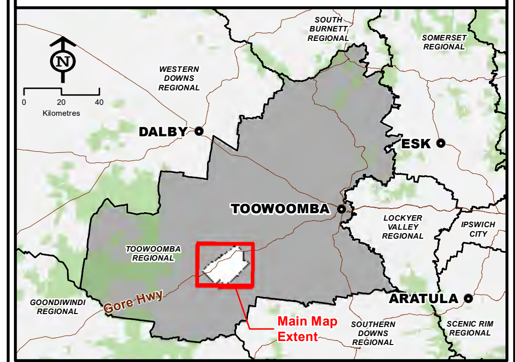
LEGEND

- Waterway
- Highway
- Proposed Railway
- Existing Culverts
- Existing Bridge
- Model Extent

Peak Velocity (m/s)

- < 0.25
- 0.25 - 0.5
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 2.00
- 2.00 - 2.50
- 2.50 - 3.00
- >3.00

TOOWOOMBA REGIONAL (OVERVIEW)



Data sources:

1. Place names gazetteer - Queensland © State of Queensland (Department of Natural Resources and Mines) 2017
2. Ordered drainage 100K - Queensland © State of Queensland (Department of Natural Resources and Mines) 2014
3. Emergency Locations, Existing Bridge, Existing Culverts, Proposed Rail, Water Model © AECOM, 2017
4. SEQ Regional 30 cm Imagery © SISP, 2013
5. Protected areas of Queensland © State of Queensland (Department of National Parks, Sport and Racing) 2016
5. Water Model based on ALS data from 1m DEM © TRC through Aurecon, 30 August 2014

Inland Rail - Yelarbon to Gowrie

CONDAMINE RIVER BASE CASE MODIFIED / WELLCAMP - CHARLTON OPTION

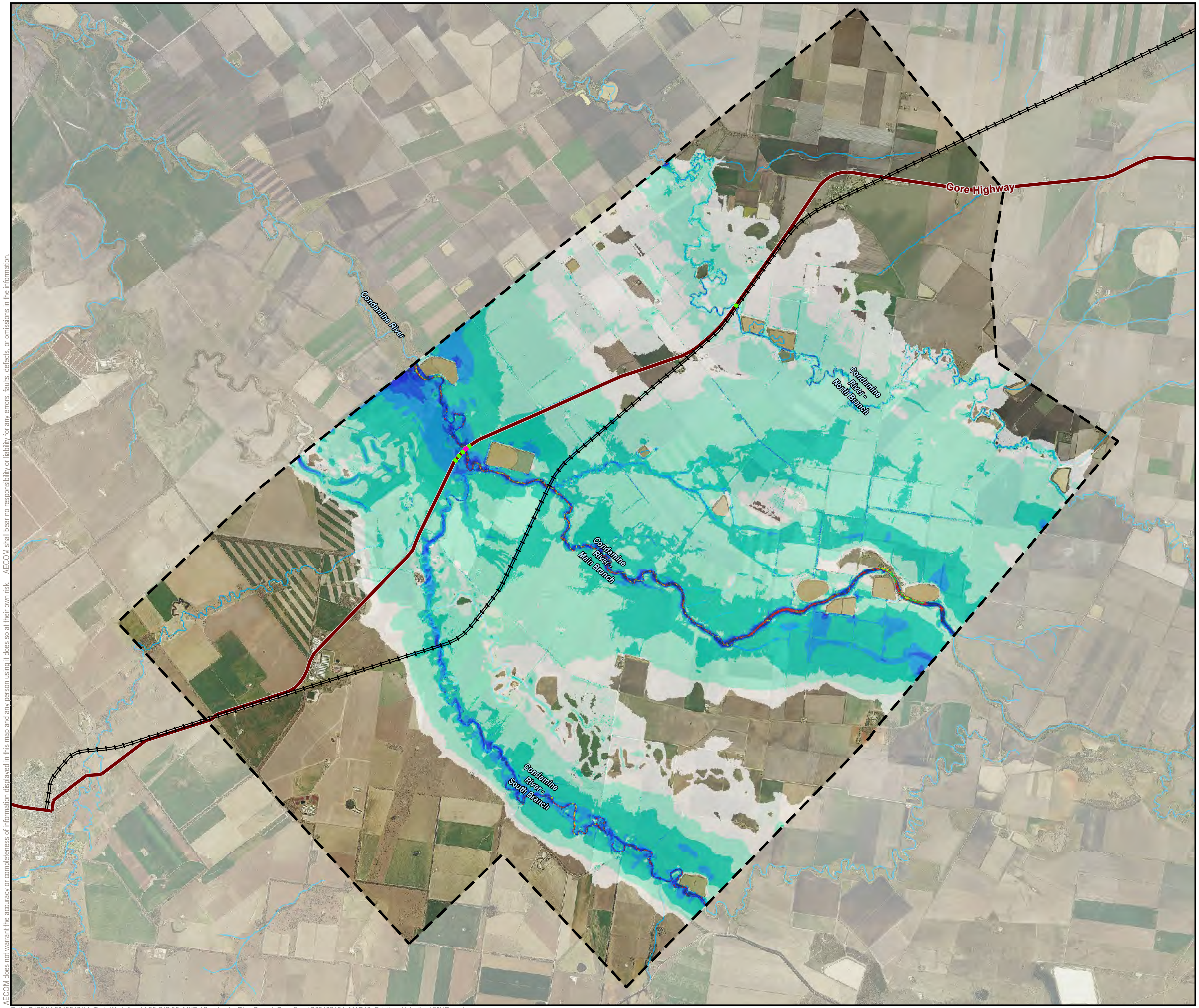
10% AEP ESTIMATED PEAK VELOCITY EXISTING CONDITION

PROJECT ID: 60492124
LAST PRINTED BY: manescuB
LAST MODIFIED: 28/03/2017
VERSION: 3

MAP 09

Path: P:\604X\60492124\4. Tech Work Area\4.99 GIS\02_MXDs\CondamineRiverReport_BaseCase\P60492124_MAP09_Existing_Velocity_10YR.mxd

A3 size



AECOM
www.aecom.com

Coordinate System: GDA 1994 MGA Zone 56

0 1 2
Kilometres

1:80,000 (when printed at A3)

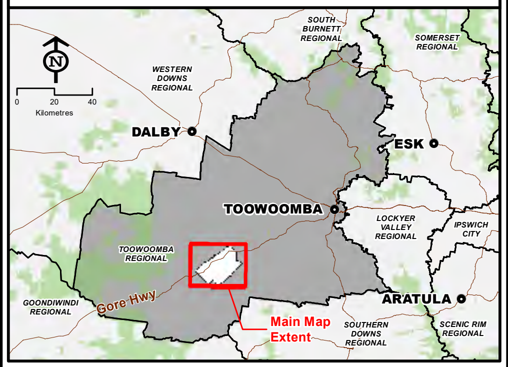
LEGEND

- Waterway
- Highway
- Proposed Railway
- Existing Culverts
- Existing Bridge
- Model Extent

Peak Velocity (m/s)

< 0.25	1.25 - 1.50
0.25 - 0.5	1.50 - 2.00
0.50 - 0.75	2.00 - 2.50
0.75 - 1.00	2.50 - 3.00
1.00 - 1.25	>3.00

TOOWOOMBA REGIONAL (OVERVIEW)



Data sources:

1. Place names gazetteer - Queensland © State of Queensland (Department of Natural Resources and Mines) 2017
2. Ordered drainage 100K - Queensland © State of Queensland (Department of Natural Resources and Mines) 2014
3. Emergency Locations, Existing Bridge, Existing Culverts, Proposed Rail, Water Model © AECOM, 2017
4. SEQ Regional 30 cm Imagery © SISP, 2013
5. Protected areas of Queensland © State of Queensland (Department of National Parks, Sport and Racing) 2016
5. Water Model based on ALS data from 1m DEM © TRC through Aurecon, 30 August 2014

Inland Rail - Yelarbon to Gowrie

CONDAMINE RIVER BASE CASE MODIFIED / WELLCAMP - CHARLTON OPTION

1% AEP ESTIMATED PEAK VELOCITY EXISTING CONDITION

PROJECT ID:	60492124
LAST PRINTED BY:	manescuB
LAST MODIFIED:	28/03/2017
VERSION:	3

MAP 10

A3 size

Path: P:\604X\60492124\4. Tech Work Area\4.99 GIS\02_MXDs\CondamineRiverReport_BaseCase\P60492124_MAP10_Existing_Velocity_100YR.mxd

Appendix J

Condamine River Hydraulic Assessment Report - Karara-Leyburn