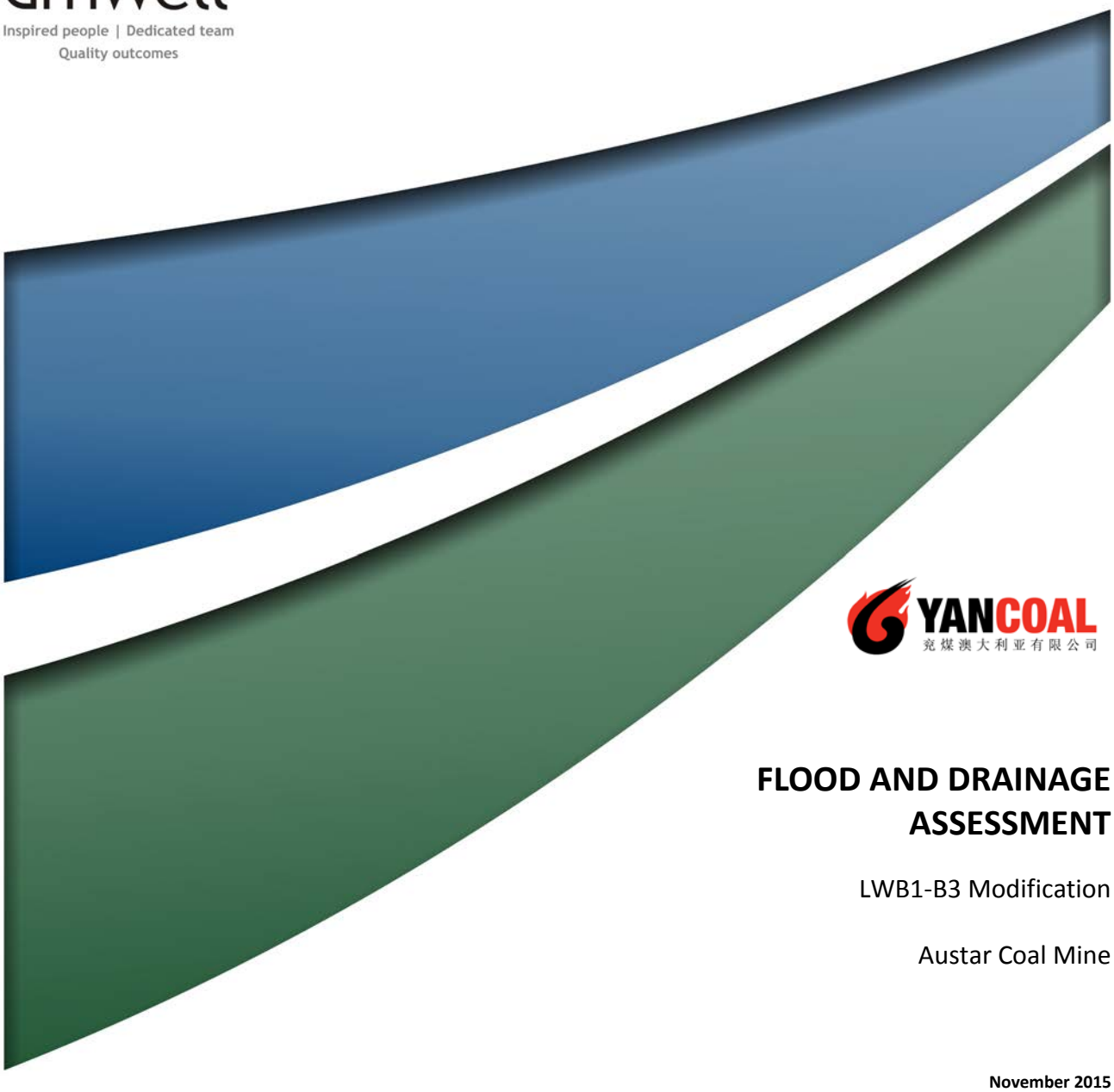
umwelt

Inspired people | Dedicated team
Quality outcomes



YANCOAL
兖煤澳大利亚有限公司

FLOOD AND DRAINAGE ASSESSMENT

LWB1-B3 Modification

Austar Coal Mine

November 2015

FLOOD AND DRAINAGE ASSESSMENT

LWB1-B3 Modification

Austar Coal Mine

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Austar Coal Mine Pty Ltd

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1.0 Introduction

1.1 Background

Austar Coal Mine Pty Ltd (Austar), a subsidiary of Yancoal Australia Limited (Yancoal) operates Austar Coal Mine, an underground coal mine located approximately 10 kilometres south of Cessnock in the Lower Hunter Valley in NSW. The Austar Coal Mine is an aggregate of the former Ellalong, Pelton, Cessnock No. 1 and Bellbird South Collieries and is located in the South Maitland Coalfields (refer to **Figure 1.1**).

Austar commenced underground mining in the Bellbird South Colliery area in 2005 under Development Consent DA 29/95 (the Bellbird South Consent), later employing the Longwall Top Coal Caving (LTCC) mining method after modifications to the Bellbird South Consent were approved. Austar has approval to carry out underground mining in three areas (refer to **Figure 1.2**). Mining of Austar's Stage 1 and Stage 2 areas within the Bellbird South Colliery area was completed in 2013. Since 2013, underground longwall mining has been progressing in the Stage 3 area, with the completion of LWA8 in June 2015. Austar has approval to mine Longwalls A9 to A19 in Stage 3.

Development operations have been suspended in Stage 3 for the time being. This has caused a discontinuity to Stage 3 longwall operations. Austar has made a business decision to relocate development operations to an alternate area of its mining leases to maintain business continuity in the medium term.

Austar has identified existing approved coal resources in the Bellbird South and Ellalong Colliery areas. Three longwalls, LWB1 to LWB3, have been identified (refer to **Figure 1.2**) that can be accessed from the Bellbird South workings and be mined with minimal additional development work.

Austar proposes to modify development consent DA 29/95 to permit the transfer and processing of coal from LWB1 to LWB3 via the existing Bellbird South mains, and at the same time contemporise extraction management regulation. The proposed modification is referred to as the LWB1-B3 Modification and includes:

- extending the development consent area to cover the 3 longwall panels (refer to **Figure 1.2**);
- a new Extraction Plan condition to cover the LWB1 to B3 workings, consistent with contemporary Extraction Plan requirements; and
- extending the life of the Bellbird South Consent by a further 5 years to provide sufficient time for LWB1 to B3 to be completed.

The proposed modification will provide access to approximately 4.5 million tonnes of Run of Mine (ROM) coal and will provide sufficient throughput for the Austar Coal Mine to maintain business continuity in the medium term.

No other changes to the approved mining operations are proposed as part of the modification.

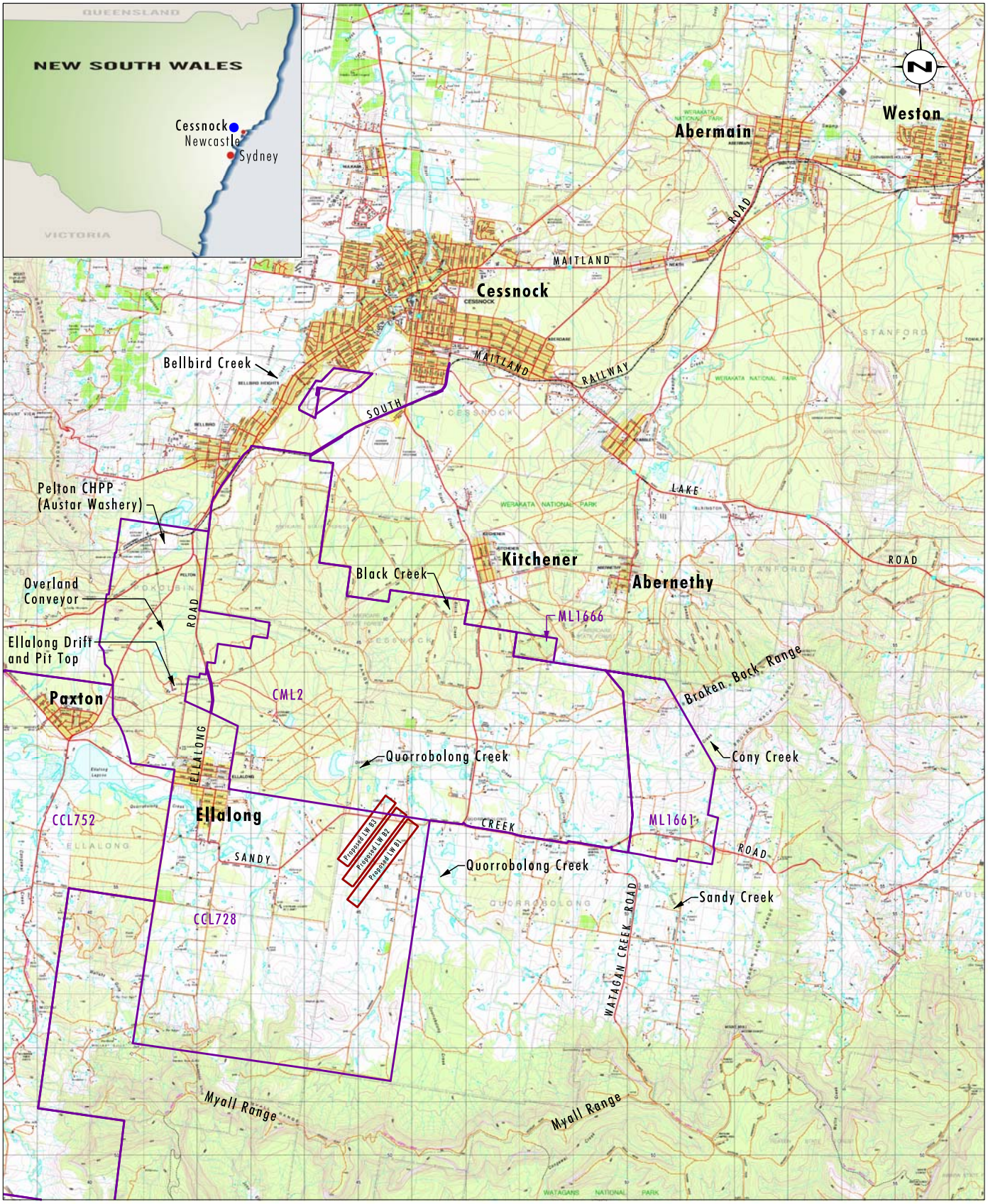

Image Source: LPI NSW (2009)
Data Source: Austar Coal Mine (2015)

0 1.0 2.5 5.0km
1:100 000

Legend

- Proposed LWB1-B3 Longwall Panels
- Mining Lease Boundary

FIGURE 1.1

Locality Plan

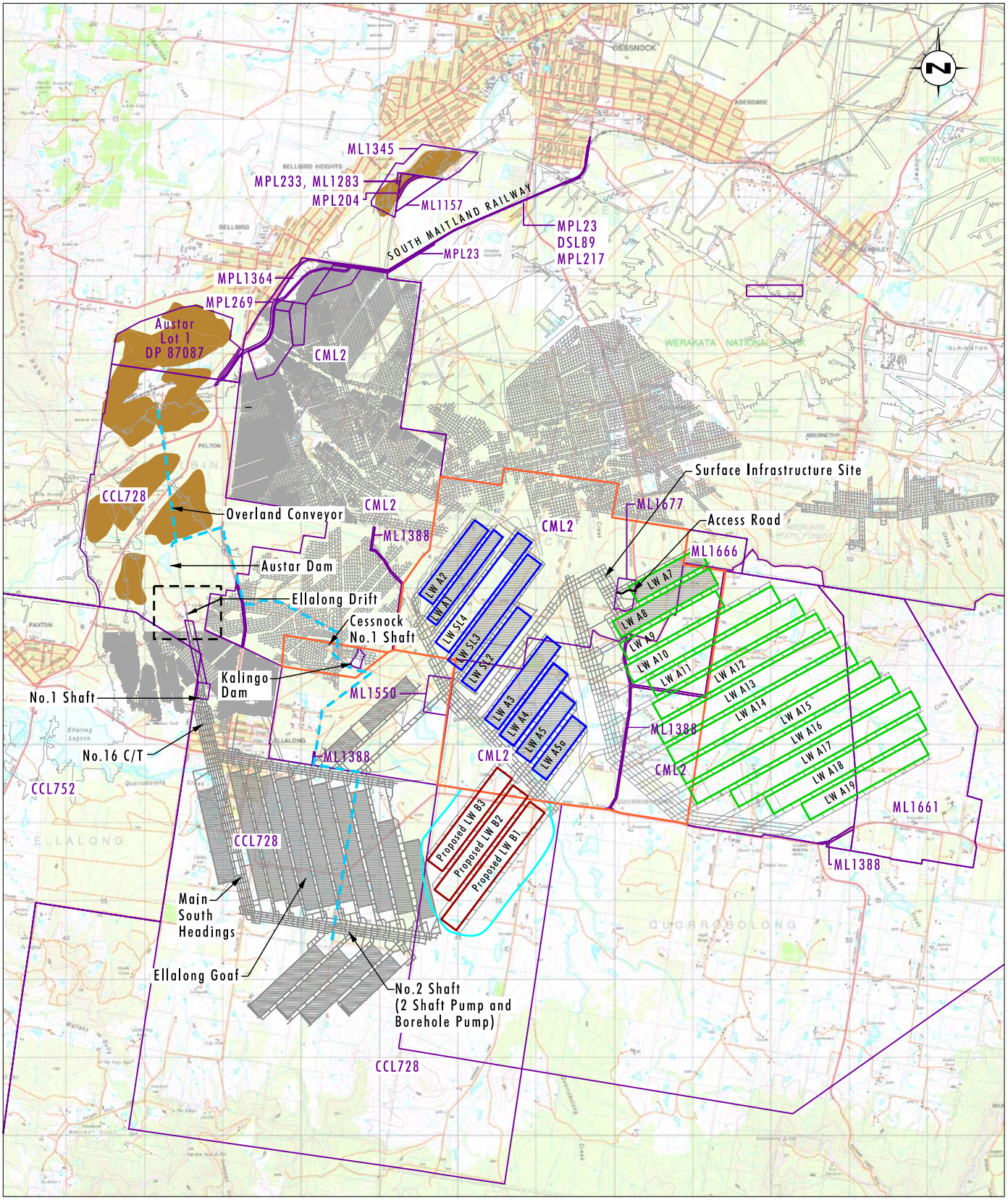

Image Source: LPI NSW (2009)
Data Source: Austar Coal Mine (2015)

0 1 2 3 km
1:70 000

Legend

- Completed Bellbird South Stage 1, Stage 2 and Southland Longwall Panels (DA 29/95)
- Stage 3 Longwall Panels (PA08_0111) (In Progress)
- Proposed LWB1-B3 Longwall Panels
- Approved Reject Emplacement Areas
- Completed Underground Workings
- Mining Lease Boundary
- Austar owned CHPP Land
- Water Pipeline
- DA 29/95 Bellbird South Consent Area (Subsurface) - As Approved
- DA 29/95 Bellbird South Consent Area (Subsurface) - Proposed Extension

FIGURE 1.2

Austar Coal Mine and Proposed LWB1-B3

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20151016 13.43

1.2 Scope of Assessment

The primary aim of this flood and drainage assessment is to determine the potential impacts of the proposed mining of LWB1 to LWB3 on the flood and drainage behaviour of the surrounding area, including cumulative impacts to the estimated flood behaviour as assessed for the previously approved Stage 2 and Stage 3 mine plans.

This report has been prepared to support an Environmental Assessment (EA) that identifies and assesses the potential environmental impacts of LWB1 to LWB3. These proposed longwalls are upstream of the area that was underground mined as part of Stage 2 (longwallls A3 to A5a as shown on **Figure 1.2**).

1.3 Catchment Context

The LWB1-B3 Modification Area (delineated by the 20 mm predicted subsidence contour) is located within the Quorrobolong Creek catchment area (refer to **Figure 1.3**). Quorrobolong Creek drains in a northerly direction along the north-east boundary of LWB1-B3 Modification Area. An unnamed tributary of Quorrobolong Creek that includes a number of secondary drainage channels drains in a northerly direction through the LWB1-B3 Modification Area. The drainage channels converge into a single drainage channel upstream of Sandy Creek Road and with the unnamed tributary joining Quorrobolong Creek approximately 750 metres north of the Modification Area. Both Quorrobolong Creek and its unnamed tributary are ephemeral creeks with flows only occurring as a result of prolonged or high rainfall periods.

One soil landscape type is found within the LWB1-B3 Modification Area, being the Quorrobolong soil landscape (Kovac and Lawrie 1991). The main soils within this landscape are prairie soils which form in alluvium and occur in drainage depressions and on lower slopes. They are generally poorly drained, have moderate permeability and the upper horizon has moderate erodibility (Kovac and Lawrie 1991).

The dominant land use within and surrounding the LWB1-B3 Modification Area is grazing, however other land uses also include rural residential, vegetated land and underground mining and coal processing associated with the Austar Coal Mine. The villages of Kitchener, Abernethy, Ellalong and Paxton are located within four kilometres to the north and west of the LWB1-B3 Modification Area (refer to **Figure 1.2**).

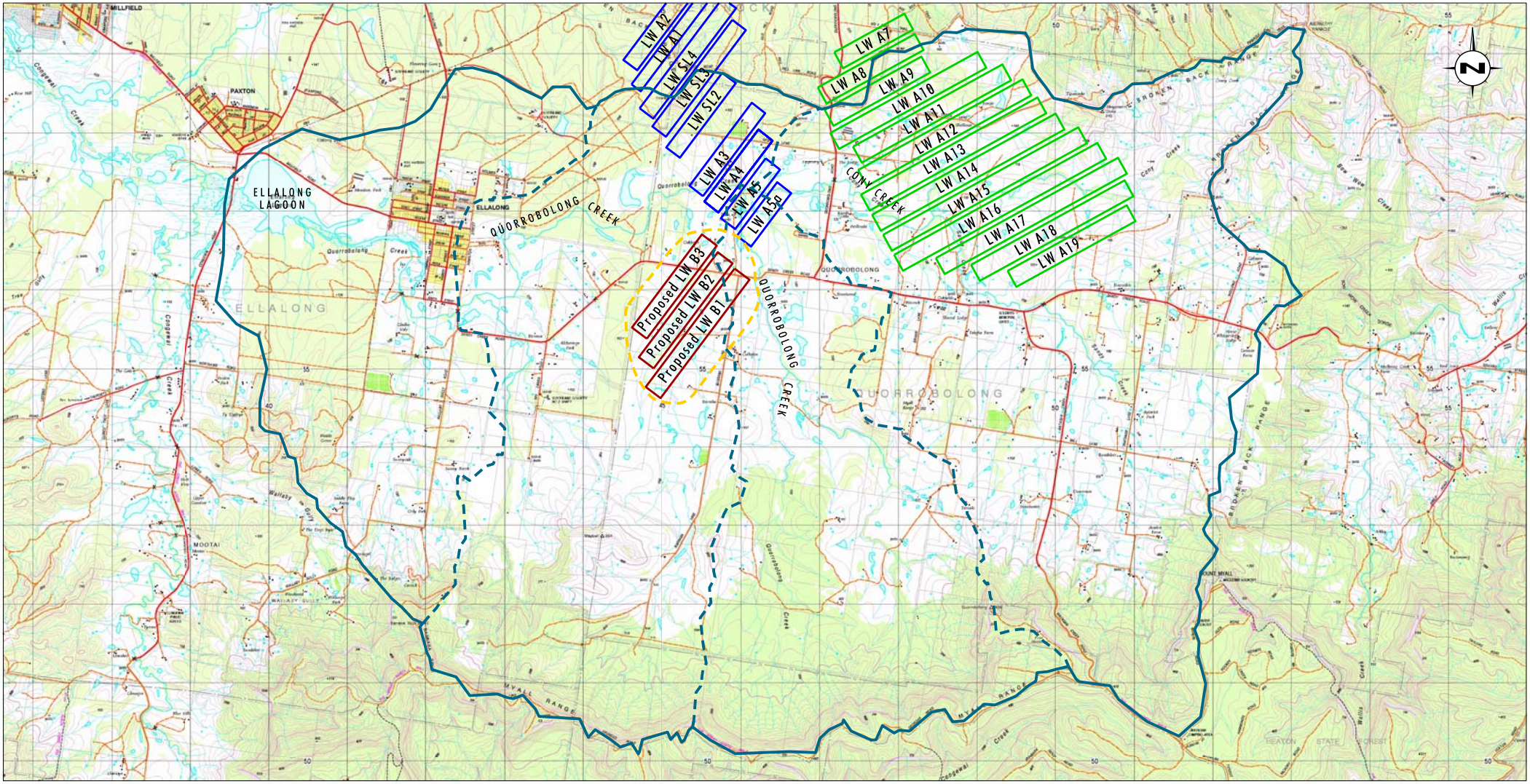

Image Source: LPI NSW 1:25 000 Topographic Map
Data Source: Austar Coal Mine

0 1 2 3 km
1:70 000

Legend

- Completed Bellbird South Stage 1, Stage 2 and Southland Longwall Panels (DA 29/95)
- Stage 3 Longwall Panels (PA08_0111) (In Progress)
- Proposed LWB1-B3 Longwall Panels
- LWB1-B3 Modification Area
- Quorrobolong Creek Catchment Boundary
- Quorrobolong Creek Sub-Catchment Boundary

FIGURE 1.3

Catchment Context

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20150929 11.51

1.4 Modelling and Assessment Approach

A two dimensional (2D) hydrodynamic model previously developed for Austar Coal Mine to describe the flood behaviour of Quorrobolong Creek and its tributaries was used to assess the potential impacts of the LWB1-B3 Modification. The development of the 2D hydrodynamic model is detailed fully in previous reports, being *Flooding Assessment: Longwalls A3, A4 and A5* (Umwelt, 2007), and *Flood and Drainage Assessment: Stage 3* (Umwelt, 2008). Further flood and drainage assessment of underground mining at the Austar Coal Mine using the 2D hydrodynamic model is documented in *Proposed Stage 2 Extension – Flood and Drainage Assessment for Longwall A5a (Umwelt, 2010), Flood and Drainage Assessment: Stage 3 Modification* (Umwelt, 2011), *Longwall A5a Extension Flood and Drainage Assessment* (Umwelt, 2012) and *Austar Coal Mine LWA7-A10 Modification – Stage 3 Area Environmental Assessment* (Umwelt, 2013).

The previously developed 2D hydrodynamic model was modified to incorporate the predicted subsidence expected as a consequence of the mining operations proposed in the LWB1-B3 Modification. This includes the cumulative impacts of subsidence from the earlier mining stages that were completed prior to mining of LWB1 to B3.

Inflows, boundary conditions, roughness categories and values, and the mesh structure adopted for the previous studies for this site (i.e. Umwelt, 2007 and 2008) were again used to model the likely changes to the flood and drainage responses due to the proposed mining operations. Consistent with previous studies, the 100% and 1% Annual Exceedance Probability (AEP) design storm events were assessed.

Modelling was undertaken to assess the cumulative impact of the proposed modification on flooding and drainage for the following scenarios:

- the existing landform (reflecting underground mining completed to date within the Stage 2 and 3 areas); and
- the future approved landform (incorporating all approved underground mining within the Stage 2 and 3 areas, being LWA3 to A19 as shown on **Figure 1.3**).

The following terminology is subsequently used in this report to refer to the modelling results:

- Existing mining scenario - Longwalls A3 to A8 in the Stage 2 and 3 area, plus proposed LWB1-B3; and
- Future approved mining scenario - Longwalls A3 to A19 in the Stage 2 and Stage 3 area, plus proposed LWB1-B3.

After running the models, the output data was loaded into a database. From this database the peak flood depths, elevations and velocities were extracted and flood hazard categories generated according to Appendix G of the *Floodplain Development Manual* (NSW Government, 2005).

Flood depth, velocity and flood hazard category maps for the existing mining scenario were prepared for the 100% and 1% AEP storm events in order to demonstrate the impact of the proposed modification on the existing landform. Similar maps were produced for the future approved mining scenario in order to demonstrate the cumulative impacts of the proposed modification (refer to **Section 4**).

Based on the modelling outcomes, the following potential impacts of the proposed modification were assessed (refer to **Section 3.0**):

- changes to flood depths (in channel and out of channel);
- changes to freeboard at dwellings;
- impacts on scouring and erosion due to changes in flow velocities;
- flood hazard categories for dwellings and private property access routes; and
- changes to flood regimes, including impacts on flood prone land, creek channels, flow paths and remnant ponding.

2.0 Subsidence Predictions

In order to model the potential impacts that the proposed mining operations could have on the flood response of the Quorrobolong Valley, predictions of the likely subsidence are required. Subsidence predictions provided by MSEC (2015) for the proposed mining operations were used for this purpose. Subsidence monitoring in the Stage 2 area indicates that actual subsidence is close to the maximum predicted subsidence levels. Therefore, flood modelling was conducted using maximum predicted subsidence only.

The subsidence predictions indicate that the landform is estimated to be subsided by up to 0.925 metres, and subsidence is predicted to occur as a broad, shallow bowl as shown in **Figure 2.1**.

Predicted subsidence impacts on the landform will occur within the vicinity of the unnamed tributary of Quorrobolong Creek (refer to **Figure 2.1**), and its associated culvert under Sandy Creek Road.

The predicted subsidence has the potential to change the flooding and drainage behaviour of the area. This report aims to quantify these changes and assess the potential impacts to the surrounding area, with regard to both natural and built features.

The predicted landform following subsidence is shown on **Figure 2.2**. As can be seen by **Figure 2.2** the subsided landform, based on the maximum predicted subsidence, will remain free draining.

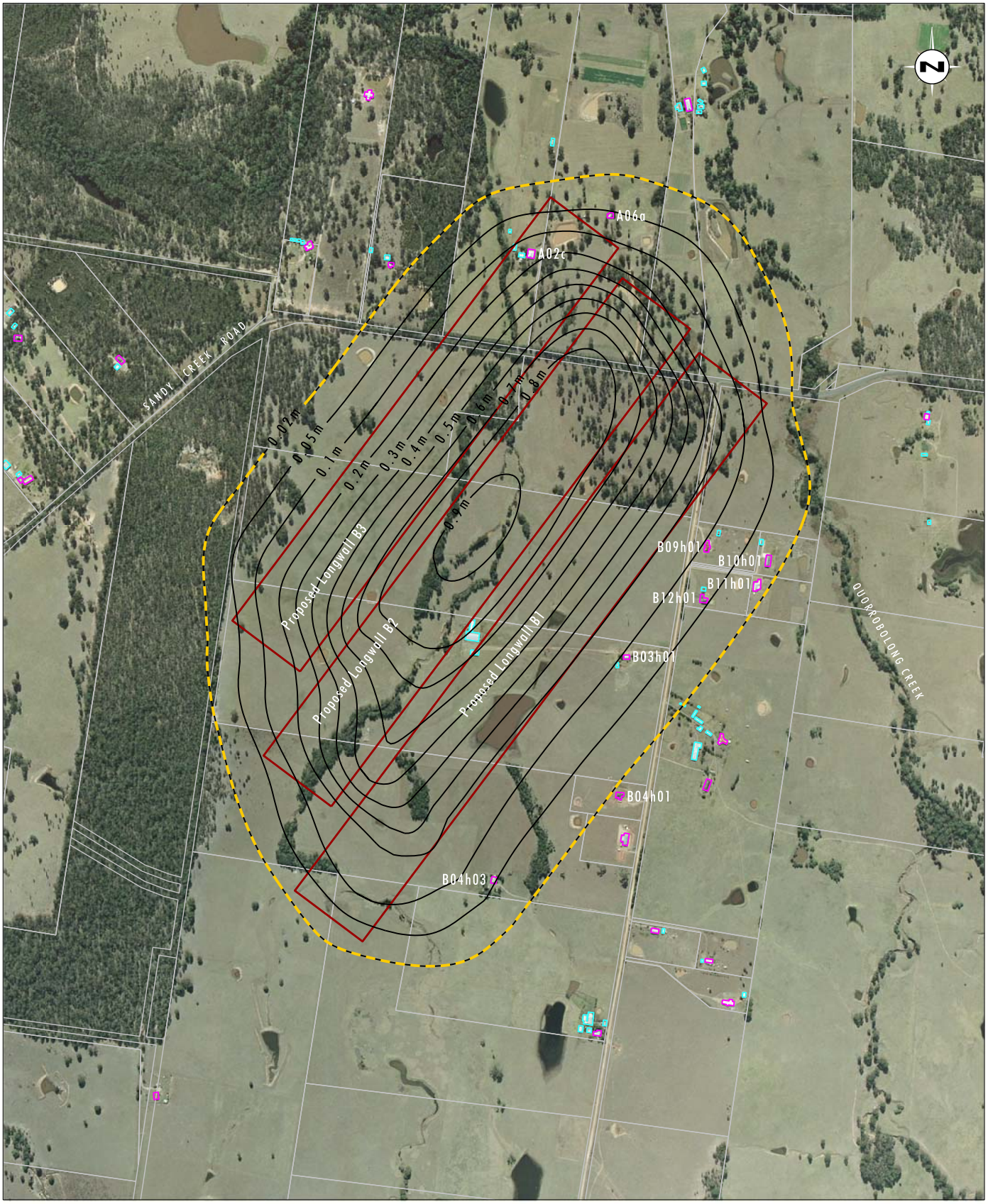

Image Source: Austar Coal Mine
Data Source:Austar Coal Mine, LPI - Cadastral Boundaries

0 250 500 750m
1:15 000

Legend

- Dwelling
- Other Structure
- Cadastral Boundary
- Proposed LWB1-B3 Longwall Panels
- LWB1-B3 Modification Area
- LWB1-B3 Predicted Subsidence Contour

FIGURE 2.1

LWB1 - B3 Modification
Maximum Predicted Subsidence

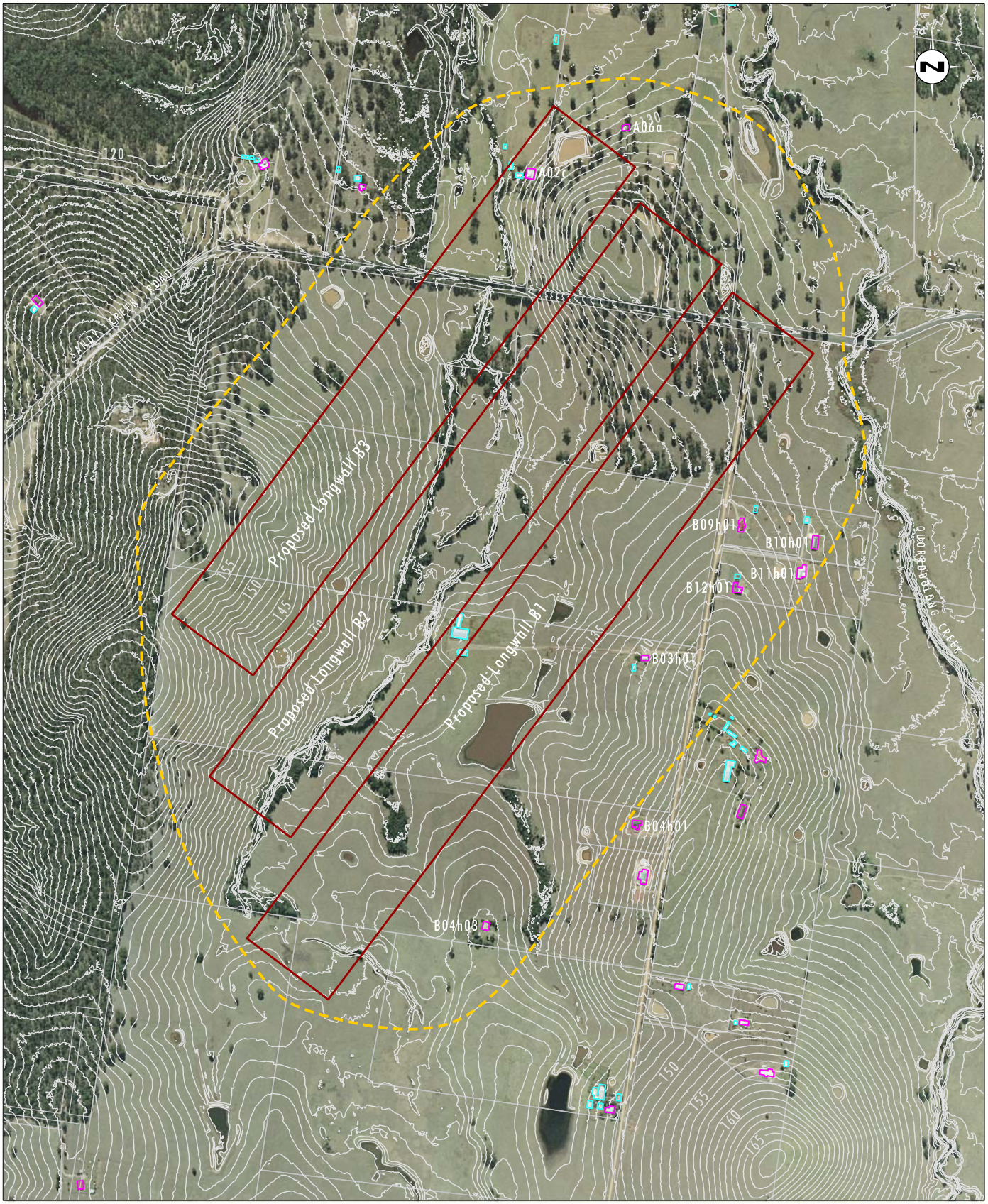

Image Source: Austar Coal Mine
Data Source:Austar Coal Mine, LPI - Cadastral Boundaries
Note: 1m Contours Interval

0 200 400 600m
1:12 5000

Legend

- Dwelling
- Other Structure
- Cadastral Boundary
- Contour Line
- Proposed LWB1-B3 Longwall Panels
- LWB1-B3 Modification Area

FIGURE 2.2

LWB1-B3 Modification
Predicted Subsidence Landform

3.0 Model Outcomes

3.1 Key Modelling Outcomes

The potential flooding and drainage impacts of the proposed modification were determined using the modelling approach outlined in **Section 1.4** of this report.

The modelling indicates that the potential impacts on flooding and drainage associated with LWB1 to LWB3 are generally limited in extent to the LWB1-B3 Modification Area. In addition, there is negligible difference in the modelled outcomes for flood behaviour either within the downstream creek systems or above the LWB1-B3 Modification Area when comparing the proposed LWB1 to LWB3 and the existing mining or the future approved mining scenarios. A detailed description of the outcomes of the flood and drainage assessment is included in **Sections 3.1** to **3.5**, with a summary of impacts described below.

Modelling indicates that mining of LWB1 to LWB3 will result in increased flood depths and associated flow velocities in the central sections of LWB2 and LWB3 where the longwalls intersect the central drainage channels of the unnamed tributary of Quorrobolong Creek. In addition, there are predicted increases and decreases in out of channel flood depths in the south of LWB1 in the catchment of the unnamed tributary.

Similarly minor differences in peak flood depths and associated velocities are predicted in the main channel of Quorrobolong Creek and to the west of the main channel of Quorrobolong Creek adjacent to the northerly extents of LWB1 and LWB2.

Analysis of the flood modelling results indicate no changes will occur to the flood hazard category at Sandy Creek Road during the 1% AEP storm event with the road remaining impassable to vehicles during this event. Similarly, there are no predicted impacts on freeboards at dwellings or private access routes and only minor impacts predicted to remnant ponding.

3.1.1 Detailed Model Results

Flood depth, velocity and flood hazard category maps for the existing mining scenario and for the future approved mining scenario for the 100% and 1% AEP storm events are provided in **Appendix A**.

Figures showing predicted flooding behaviour as a result of mining LWB1 to LWB3 are provided in **Appendix B** which contains the following:

- Figures B1 to B4 describe the maximum modelled **flood depths** for the 100% and 1% AEP storm events with the maximum predicted subsidence for the two modelled scenarios.
- Figures B5 to B8 describe the maximum modelled **velocities** for the 100% and 1% AEP storm events with the maximum predicted subsidence for the two modelled scenarios.
- Figures B9 to B12 describe the maximum modelled **flood hazard categories** for the 100% and 1% AEP storm events with the maximum predicted subsidence for the two modelled scenarios.
- Figure B13 shows **flow hydrographs** extracted from the modelling for the 1% AEP storm event downstream of LWB1 to LWB3.
- Figure B14 shows the predicted changes to **remnant ponding** as a result of LWB1 to LWB3.

3.2 Flood Depths

3.2.1 Within Channel

Predicted impacts on flood depths with the Proposed Modification are mostly limited to the LWB1-B3 Modification Area. For both modelled scenarios there are minimal predicted changes in peak flood depths along Quorrobolong Creek as a result of the proposed modification. Changes to flood depths within the channel of Quorrobolong Creek are localised, with increases of flood depths of up to 0.015 metres predicted for both the 100% and 1% AEP storm events. Along the unnamed tributary, the modelling predicts increases of in channel flood depths within the LWB1-B3 Modification Area in areas both downstream and upstream of Sandy Creek Road.

The maximum and average modelled increase in flood depths for Quorrobolong Creek and its unnamed tributary are summarised in **Table 3.1** and described in further detail below.

Table 3.1 Maximum and Average Modelled Increase in Flood Depth Within Channel

Watercourse	Maximum Modelled Increase in Flood Depth (m)		Average Modelled Increase in Flood Depth (m)	
	100% AEP Storm Event	1% AEP Storm Event	100% AEP Storm Event	1% AEP Storm Event
Quorrobolong Creek	0.02	0.01	<0.01	<0.01
Unnamed tributary of Quorrobolong Creek	0.19	0.19	0.04	0.04

There are minimal changes in peak flood depths predicted within the channel of Quorrobolong Creek. The maximum modelled increase in peak flood depths for the 100% AEP storm event in the channel is in the order of 0.015 metres, with an average increase of approximately 0.005 metres. The maximum modelled increase in peak flood depths in the channel for the 1% AEP storm event is in the order of 0.014 metres, with an average increase of approximately 0.005 metres.

The modelled flood response indicates that the proposed modification will increase peak flood depths in the unnamed tributary of Quorrobolong Creek for both the 100% and 1% AEP storm events. The increases in peak flood depths extend approximately 350 metres downstream and approximately 500 metres upstream of Sandy Creek Road during the 100% AEP storm event. The modelling indicates that the potential increases in peak flood depths extend approximately 600 metres downstream of and 850 metres upstream of Sandy Creek Road for the 1% AEP storm event. The maximum modelled increase for the 1% AEP storm event is approximately 0.19 metres and occurs immediately downstream of Sandy Creek Road in an area where existing modelled peak flood depths are in the order of 1 metre. The average modelled increase in flood depths during the 1% AEP storm event within the channel is approximately 0.04 metres.

3.2.2 Out Of Channel

Modelling indicates that with the Proposed Modification out of channel flooding to the west of Quorrobolong Creek within the LWB1-B3 Modification Area will typically increase by up to 0.1 metres in depth for an extent of approximately 200 metres to the west of the main creek channel. This increase in out of channel flooding to the west of the creek is associated with a minor decrease (in the order of 0.02 metres) in out of channel flooding to the east of the creek channel. Similar impacts are predicted for the 100% AEP storm event in Quorrobolong Creek, with the mining of longwalls LWB1 to LWB3.

Adjacent to the unnamed tributary of Quorrobolong Creek, modelling indicates that out of channel flooding during the 100% AEP storm event for the existing mining scenario is typically in the order of 0.37 metres. With the proposed modification, out of channel flooding is predicted to increase on average 0.04 metres (extending approximately 1000 metres downstream of central section of LWB2) adjacent to the unnamed tributary of Quorrobolong Creek, and to decrease on average by approximately 0.04 metres (extending approximately 1500 metres upstream of central section of LWB2). The modelled changes to out of channel flooding are typically predicted to occur over LWB2 and LWB3 of the unnamed tributary. A minor change to out of channel flooding is also predicted over the southern extent of LWB1.

During the 1% AEP storm event for the existing mining scenario, modelling indicates that out of channel flooding adjacent to the unnamed tributary of Quorrobolong Creek is typically in the order of 0.43 metres. Modelling indicates that out of channel flooding is predicted to increase by up to approximately 0.2 metres in the southern section of LWB1 adjacent to the unnamed tributary. Decreases in out of channel flooding up to 0.4 metres are predicted in the middle of LWB1 and to the west of the unnamed tributary above LWB2 and LWB3.

3.2.3 At Dwellings

The modelling indicates that the maximum predicted flood extent for the 1% AEP storm event does not result in flooding of any dwellings within the LWB1-B3 Modification Area. As discussed in **Section 3.0**, modelling indicates that the impacts on flood behaviour associated with proposed LWB1 to LWB3 are limited to the area local to the proposed modification. No impacts on flood level freeboards at dwellings are predicted as a result of the proposed modification. A further discussion of flood hazard categories at dwellings and access routes is provided in **Section 3.3**.

3.3 Flow Velocities

Maximum modelled flow velocities for the 100% AEP storm event within the unnamed tributary of Quorrobolong Creek range between 0.16 m/s to 1.92 m/s for both the existing mining scenario and the future approved mining scenario.

The modelled flow velocities for the 1% AEP storm event range between 0.37 m/s to 2.49 m/s for both the existing mining scenario and the future approved mining scenario.

With the proposed modification, it is predicted that maximum flow velocities in the unnamed tributary of Quorrobolong Creek will have localised increases and decreases in the order of 0.1 m/s for both the 100% and 1% AEP storm events. Modelling indicates that the absolute maximum and minimum peak flow velocities with the proposed modification will remain similar to those modelled for both the existing mining scenario and the future mining scenario. As such, the analysis indicates that the maximum flow velocities will remain within non scouring ranges for the 100% and the 1% AEP storm events as a result of the proposed modification.

The modelling indicates that no significant changes to channel stability or erosion or scouring are expected as a result of the proposed modification.

3.4 Flood Hazard

In order to assess the potential flood hazards associated with the proposed modification, the flood hazard categories outlined in Appendix G of the *Floodplain Development Manual* (2005) were utilised. The four flood hazard categories, in order of increasing hazard, are:

- walking and vehicles access;
- vehicles unstable;
- wading unsafe (and vehicles unstable); and
- damage to light structures.

Flood hazard category maps for the existing mining scenario and the existing mining scenario plus the proposed modification for the 100% and 1% AEP storm events are provided in **Appendix A** (Figures A9 and A11) and **Appendix B** (Figures B9 and B11). Flood hazard category maps for the future approved mining scenario and the future approved mining scenario plus the proposed modification for the 100% and 1% AEP storm events are provided in **Appendix A** (Figures A10 and A12) and **Appendix B** (Figures B10 and B12).

Modelling indicates that the access routes to properties in the LWB1-B3 Modification Area are currently flood free and will remain so with the proposed modification.

A flood hazard category analysis was also undertaken for Sandy Creek Road. The analysis indicates that the road will remain in the "vehicles unstable" flood hazard category for the 1% AEP Storm event with the proposed modification. The modelling also predicts an increase in the duration when the road is flooded from approximately 4 hours to approximately 4 hours 45 mins with the proposed modification during the 1% AEP storm event.

3.5 Flood Duration and Remnant Ponding

Flood model hydrographs on Quorrobolong Creek immediately downstream of the unnamed tributary and downstream of LWB1 to LWB3 (refer to **Appendix B** - Figure B13) are comparable to the flood hydrographs derived previously for the approved Stage 2 and 3 mine plans (i.e. future approved mining scenario), indicating that the proposed modification will have negligible effect on the flood response downstream of the mining area during the 100% and 1% AEP storm events.

There are predicted to be negligible changes to remnant surface ponding in the area to be undermined (refer to **Appendix B** - Figure B14). The predicted impacts on remnant ponding are confined to existing flow paths, paddocks and farm dams, with no predicted impact on access routes to, or within, the properties along Quorrobolong Creek or its unnamed tributary. The analysis indicates a minor increase in ponding along the western edge of a farm dam located above LWB1 (refer to **Appendix B** - Figure B14). This change will be associated with a negligible change in farm dam volume. Modelling also indicates that there will be a minor increase in ponding associated with a culvert under Sandy Creek Road in the north of the LWB1-B3 Modification Area.

3.6 Stream Flow and Channel Stability

The flood modelling analysis indicates that the proposed modification is unlikely to have a significant impact on the flow regimes of Quorrobolong Creek or its unnamed tributary, with only minor changes predicted in runoff regimes and peak discharges.

Based on the subsidence predictions (refer to **Section 2.0**), the maximum predicted subsidence associated with the underground mining of LWB1 to LWB3 will result in maximum changes in longitudinal channel grade of approximately 0.37 per cent, within the drainage channels of the unnamed tributary of Quorrobolong Creek (refer to **Appendix B** - Figure B15), and negligible change within Quorrobolong Creek compared to the existing channel conditions.

As the predicted changes in longitudinal channel grade are minor and lie within the natural variations in longitudinal grades of the drainage channels within the Quorrobolong Valley, it is considered that the proposed modification will not significantly alter the flow capacity or stream velocities within the existing drainage channels. It is also considered that there is minimal potential for channel realignment to occur as a result of the proposed modification. As the modelled changes to the longitudinal channel grade and changes to flow velocities are consistent with the ranges that occur naturally within the Quorrobolong Valley, the potential for changes to the bed shear stress within these creek systems is expected to be minimal.

The potential to increase erosion on the landform is also expected to be minimal due to the relatively small predicted changes in landform grades combined with the high level of groundcover and limited amount of exposed soils in the area.

4.0 Summary and Conclusions

Analysis indicates that the maximum predicted subsidence associated with the proposed modification would have only a minor impact on the flood response in the surrounding area. Modelling indicates there will be no change to the free board of dwellings.

The main area that is likely to be affected by minor changes to the flood response is the section of the unnamed tributary of Quorrobolong Creek from the chain pillar between LWB2 and LWB3 (south of Sandy Creek Road) downstream to its confluence with Quorrobolong Creek, with minor changes predicted to both peak flood depths and flow velocities. However, no significant changes to velocity induced scouring or erosion are expected as a result of the proposed modification and no impacts on flood level freeboards at dwellings are predicted.

The modelled changes to flood hazard categories and flood extents as a result of the proposed modification are considered to be negligible. No access routes to private properties will be adversely affected as a result of the proposed modification. Similarly, the modelling indicates that Sandy Creek Road will continue to be flood affected during the 1% AEP storm event with the proposed modification with the road remaining impassable to vehicles during the flood peak.

No significant changes to remnant ponding are predicted as a result of the proposed modification, with minor predicted impacts limited to existing flowpaths and farm dams within the LWB1-B3 Modification Area.

5.0 References

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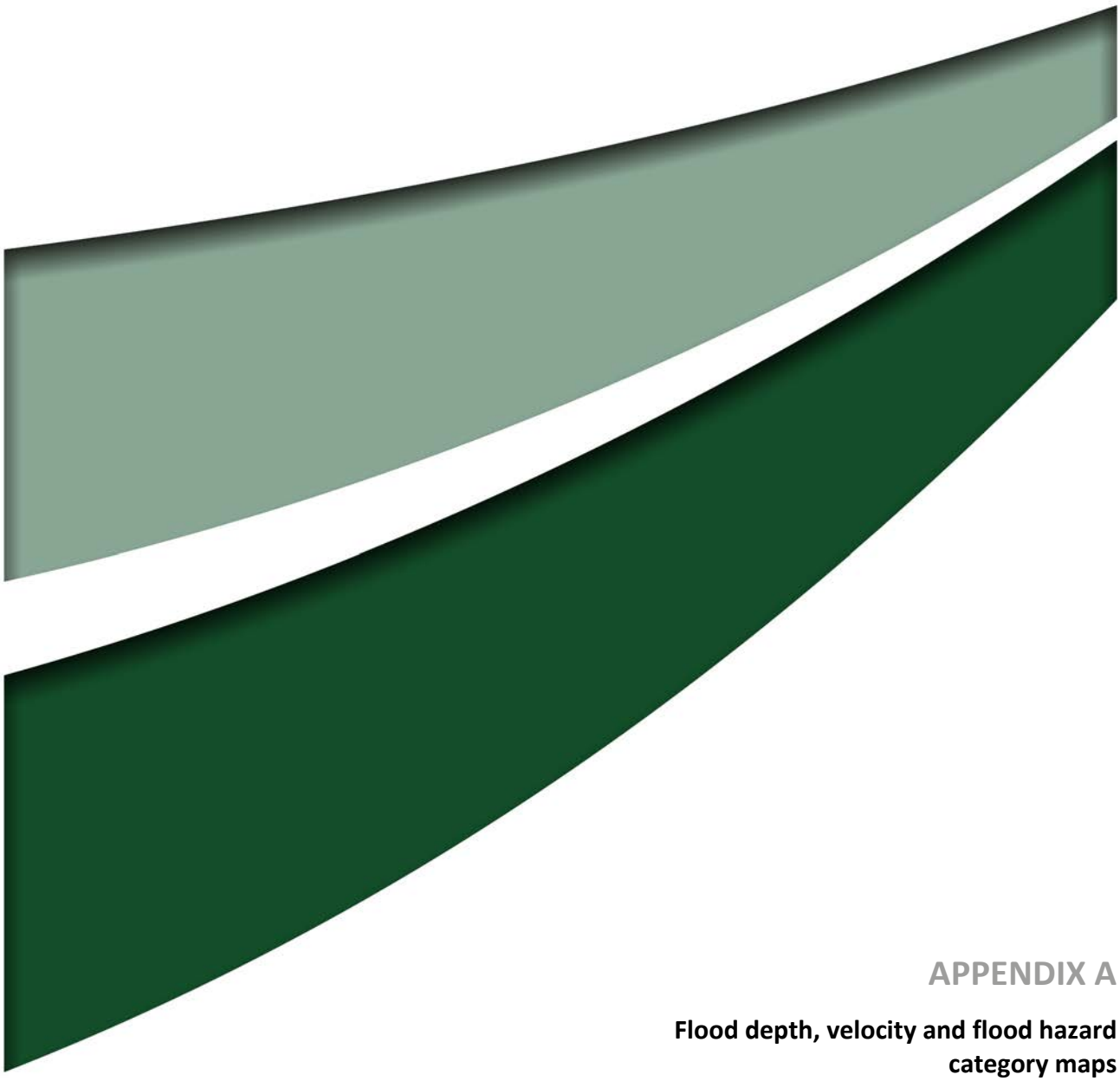

APPENDIX A

Flood depth, velocity and flood hazard category maps

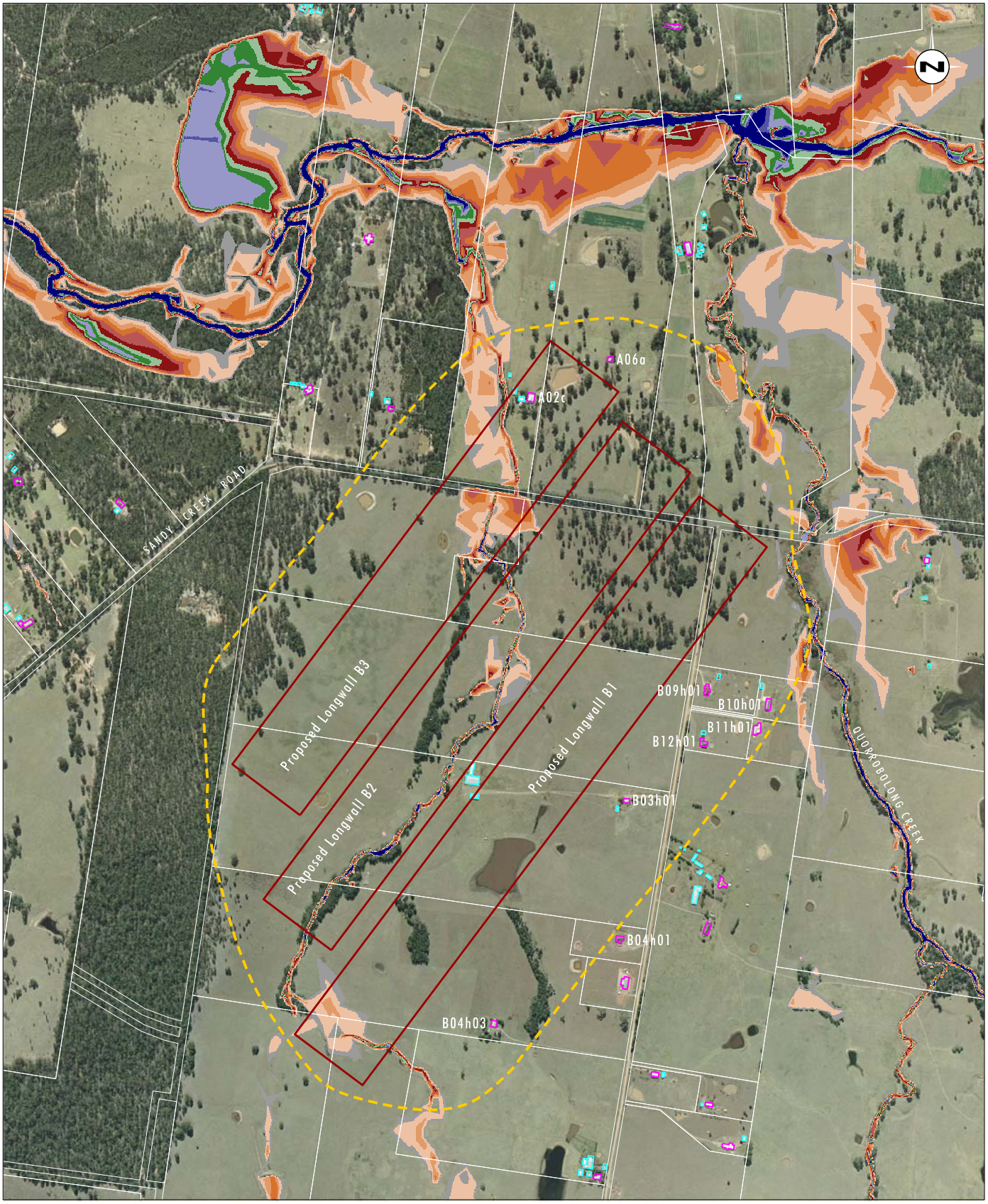

Image Source: Austar Coal Mine
Data Source:Austar Coal Mine, LPI - Cadastral Boundaries

0 250 500 750m
1:15 000

Legend

- Dwelling
- Other Structure
- Cadastral Boundary
- Proposed LWB1-B3 Longwall Panels
- LWB1-B3 Modification Area

Water Depth (m)

- Range [0.001 : 0.100]
- Range [0.100 : 0.300]
- Range [0.300 : 0.500]
- Range [0.500 : 0.700]
- Range [0.700 : 0.900]
- Range [0.900 : 1.100]
- Range [1.100 : 1.300]
- Range [1.300 : 1.500]
- Range [1.500 : 1.700]
- Range [1.700 : 1.900]
- Range [1.900 : 8.000]

FIGURE A1

100% AEP Storm Event: Maximum Modelled Flood Depths, Predicted Subsidence Approved LWA3 - A8

File Name (A4): R10/3542_131.dgn
20151103 11.14

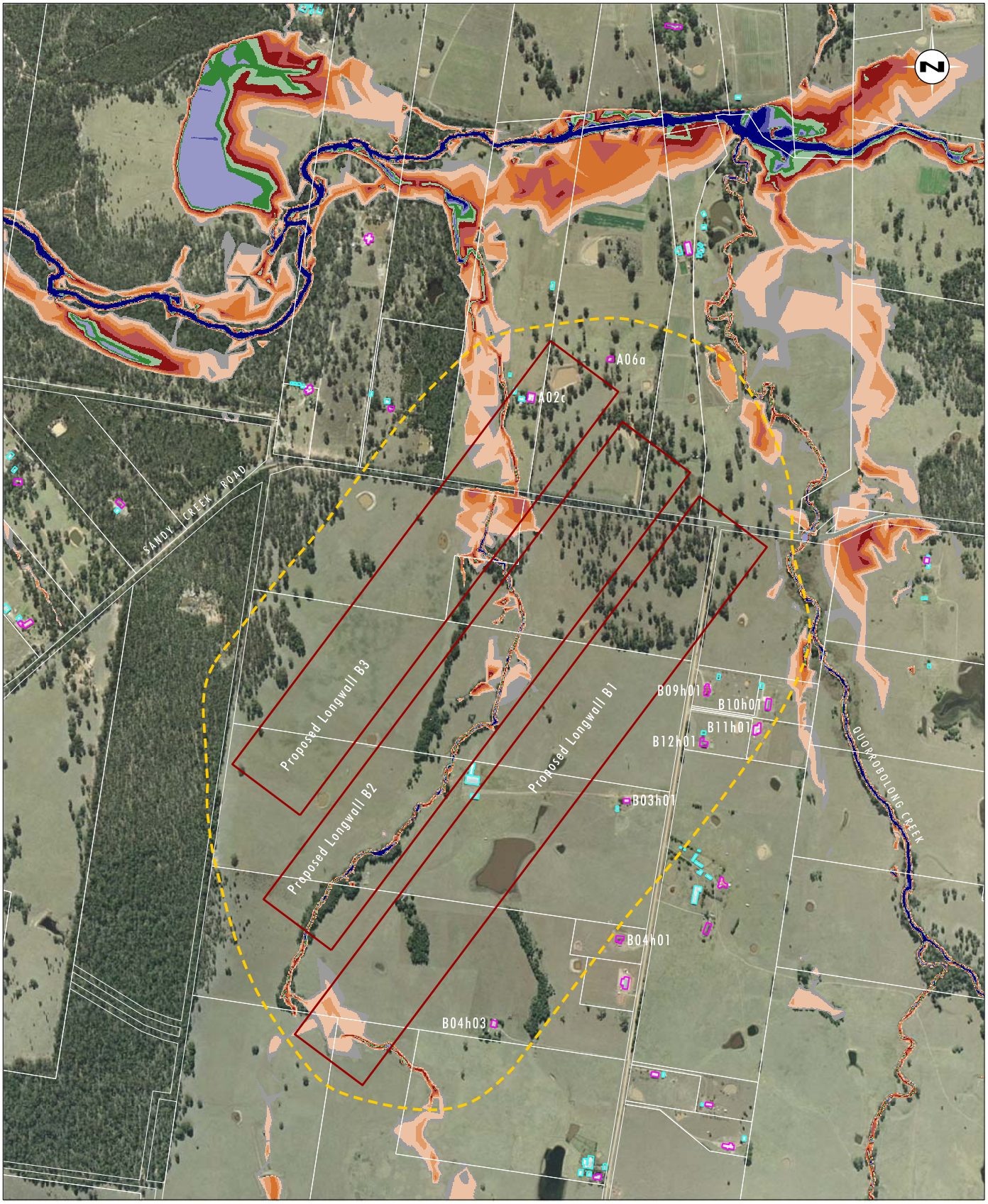

Image Source: Austar Coal Mine
Data Source:Austar Coal Mine, LPI - Cadastral Boundaries

0 250 500 750m
1:15 000

Legend

- Dwelling
- Other Structure
- Cadastral Boundary
- Proposed LWB1-B3 Longwall Panels
- LWB1-B3 Modification Area

Water Depth (m)

- Range [0.001 : 0.100]
- Range [0.100 : 0.300]
- Range [0.300 : 0.500]
- Range [0.500 : 0.700]
- Range [0.700 : 0.900]
- Range [0.900 : 1.100]
- Range [1.100 : 1.300]
- Range [1.300 : 1.500]
- Range [1.500 : 1.700]
- Range [1.700 : 1.900]
- Range [1.900 : 8.000]

FIGURE A2

100% AEP Storm Event: Maximum Modelled Flood Depths, Predicted Subsidence Approved LWA3 - A19

File Name (A4): R10/3542_132.dgn
20151103 11.15

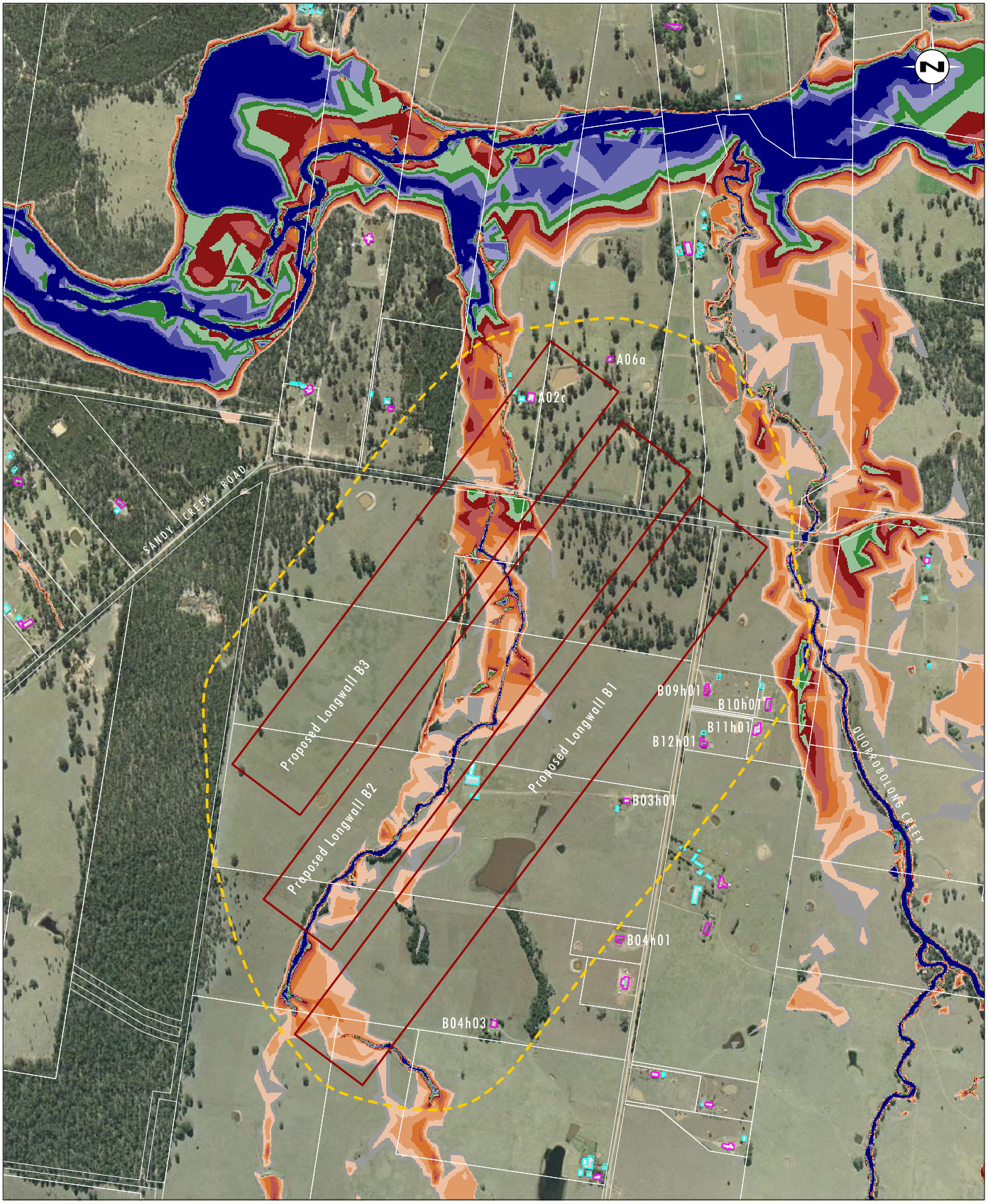

Image Source: Austar Coal Mine
Data Source:Austar Coal Mine, LPI - Cadastral Boundaries

0 250 500 750m
1:15 000

Legend

- Dwelling
- Other Structure
- Cadastral Boundary
- Proposed LWB1-B3 Longwall Panels
- LWB1-B3 Modification Area

Water Depth (m)

- Range [0.001 : 0.100]
- Range [0.100 : 0.300]
- Range [0.300 : 0.500]
- Range [0.500 : 0.700]
- Range [0.700 : 0.900]
- Range [0.900 : 1.100]
- Range [1.100 : 1.300]
- Range [1.300 : 1.500]
- Range [1.500 : 1.700]
- Range [1.700 : 1.900]
- Range [1.900 : 8.000]

FIGURE A3

1% AEP Storm Event: Maximum Modelled Flood Depths, Predicted Subsidence Approved LWA3 - A8

File Name (A4): R10/3542_133.dgn
20151103 11.15

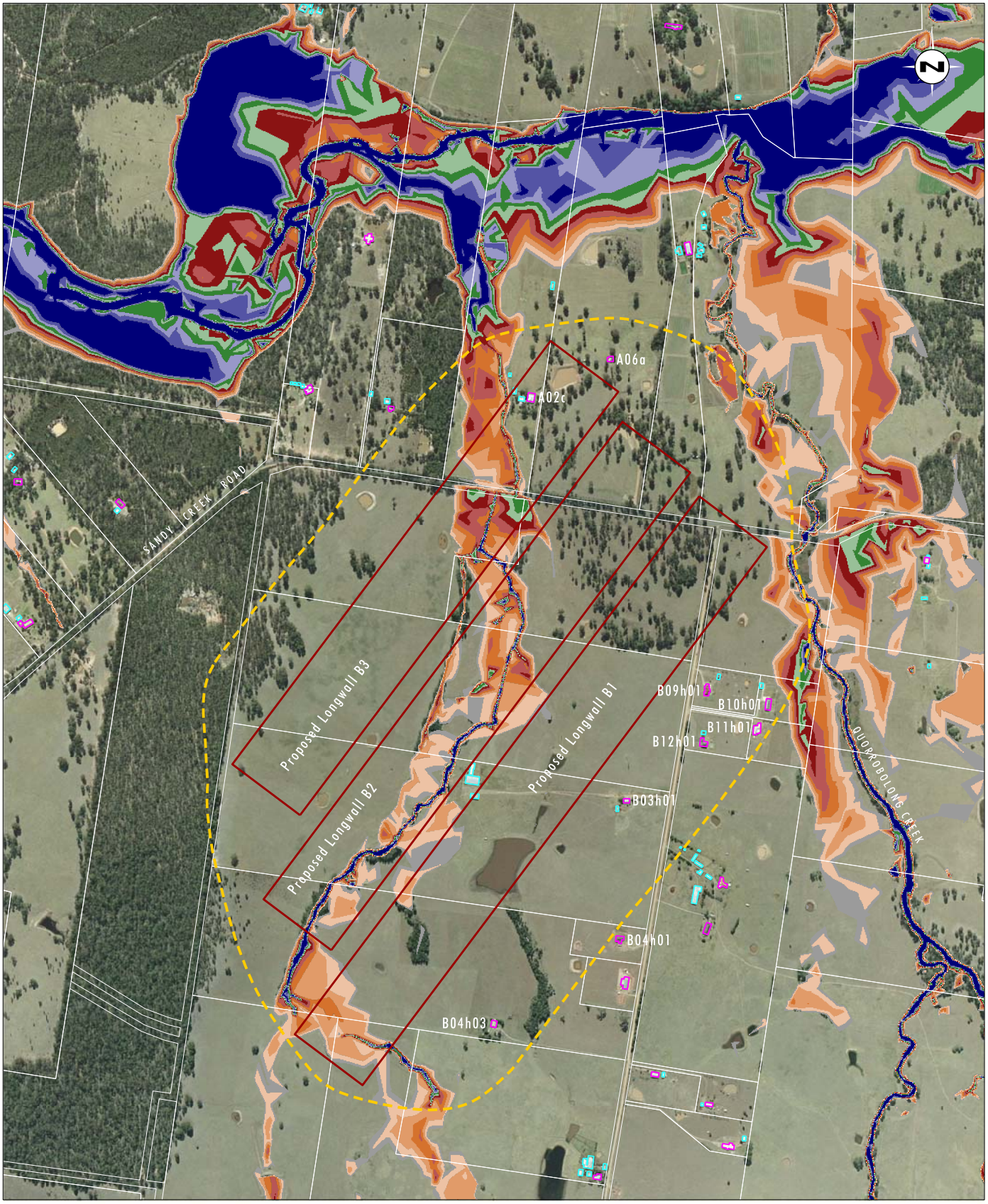

Image Source: Austar Coal Mine
Data Source:Austar Coal Mine, LPI - Cadastral Boundaries

0 250 500 750m
1:15 000

Legend

- Dwelling
- Other Structure
- Cadastral Boundary
- Proposed LWB1-B3 Longwall Panels
- LWB1-B3 Modification Area

Water Depth (m)

- Range [0.001 : 0.100]
- Range [0.100 : 0.300]
- Range [0.300 : 0.500]
- Range [0.500 : 0.700]
- Range [0.700 : 0.900]
- Range [0.900 : 1.100]
- Range [1.100 : 1.300]
- Range [1.300 : 1.500]
- Range [1.500 : 1.700]
- Range [1.700 : 1.900]
- Range [1.900 : 8.000]

FIGURE A4

1% AEP Storm Event: Maximum Modelled Flood Depths, Predicted Subsidence Approved LWA3 - A19

File Name (A4): R10/3542_134.dgn
20151103 11.16

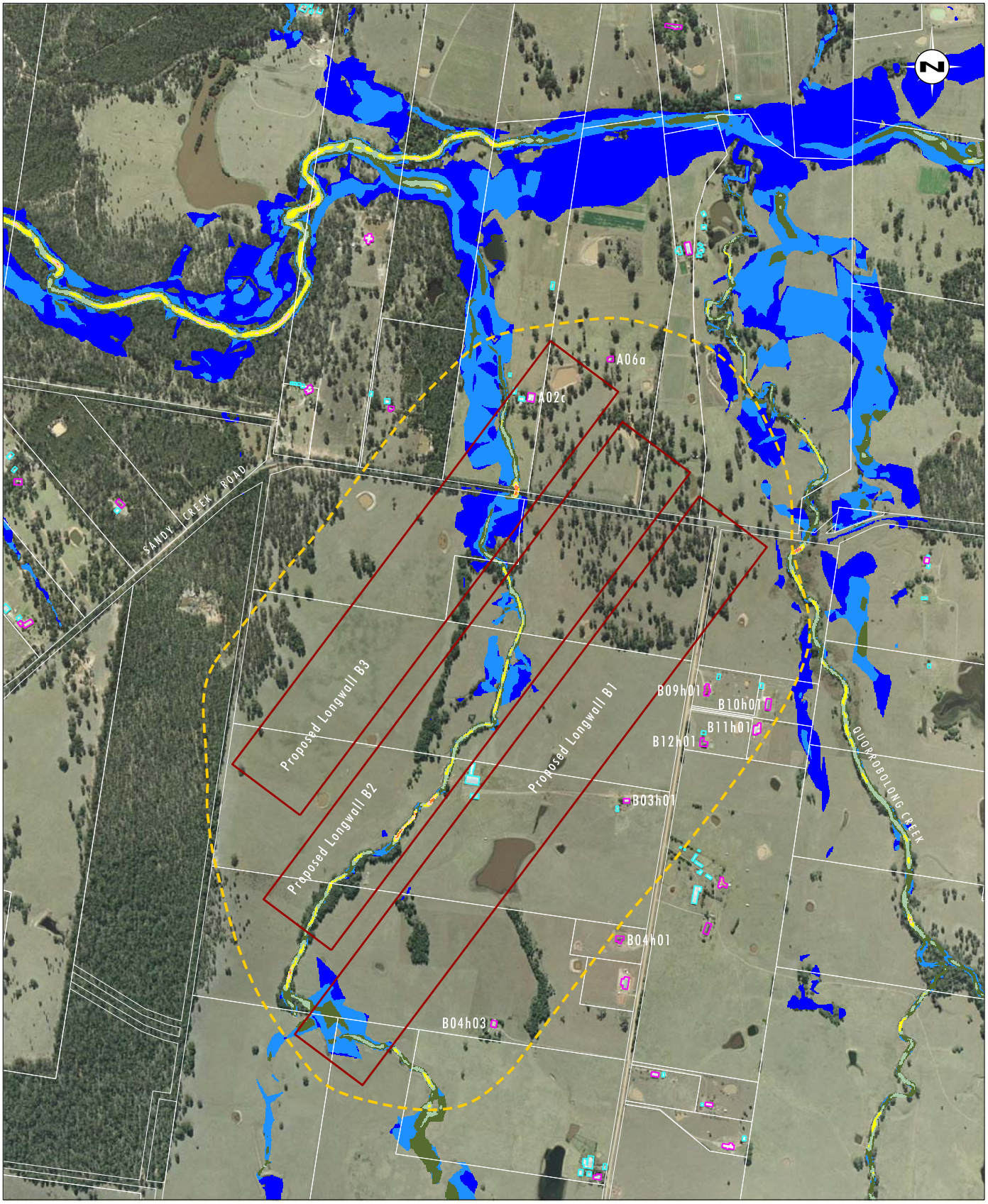

Image Source: Austar Coal Mine
Data Source:Austar Coal Mine, LPI - Cadastral Boundaries

0 250 500 750m
1:15 000

Legend

- Dwelling
- Other Structure
- Cadastral Boundary
- Proposed LWB1-B3 Longwall Panels
- LWB1-B3 Modification Area

Water Velocity (m/s)

- Range [0.100 : 0.250]
- Range [0.250 : 0.500]
- Range [0.500 : 0.750]
- Range [0.750 : 1.000]
- Range [1.000 : 1.250]
- Range [1.250 : 1.500]
- Range [1.500 : 1.750]
- Range [1.750 : 2.000]
- Range [2.000 : 2.250]
- Range [2.250 : 3.000]

FIGURE A5

100% AEP Storm Event: Maximum Modelled Flow Velocities, Predicted Subsidence Approved LWA3 - A8

File Name (A4): R10/3542_135.dgn
20151103 11.17

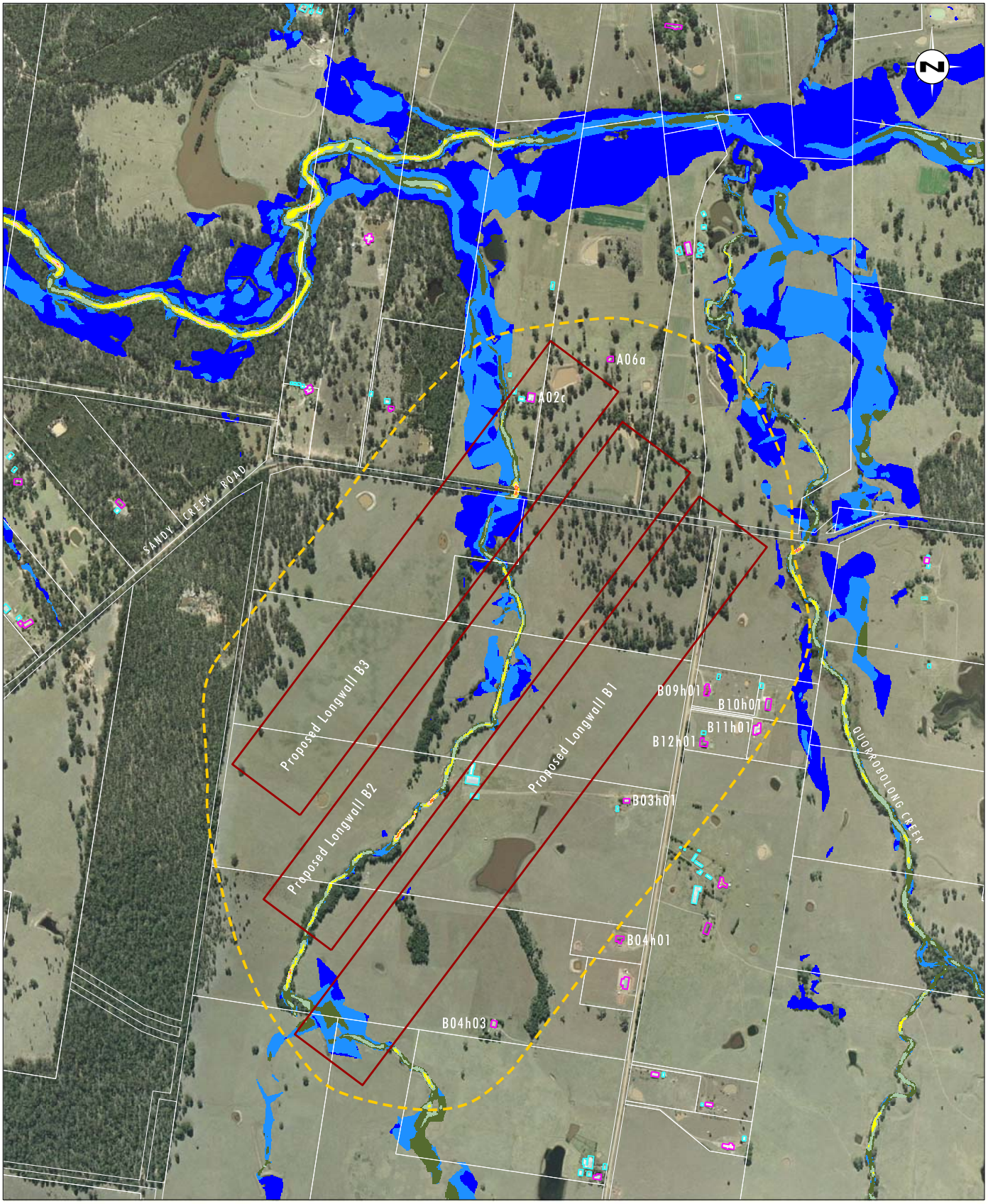

Image Source: Austar Coal Mine
Data Source:Austar Coal Mine, LPI - Cadastral Boundaries

0 250 500 750m
1:15 000

Legend

- Dwelling
- Other Structure
- Cadastral Boundary
- Proposed LWB1-B3 Longwall Panels
- LWB1-B3 Modification Area

Water Velocity (m/s)

- Range [0.100 : 0.250]
- Range [0.250 : 0.500]
- Range [0.500 : 0.750]
- Range [0.750 : 1.000]
- Range [1.000 : 1.250]
- Range [1.250 : 1.500]
- Range [1.500 : 1.750]
- Range [1.750 : 2.000]
- Range [2.000 : 2.250]
- Range [2.250 : 3.000]

FIGURE A6

100% AEP Storm Event: Maximum Modelled Flow Velocities, Predicted Subsidence Approved LWA3 - A19

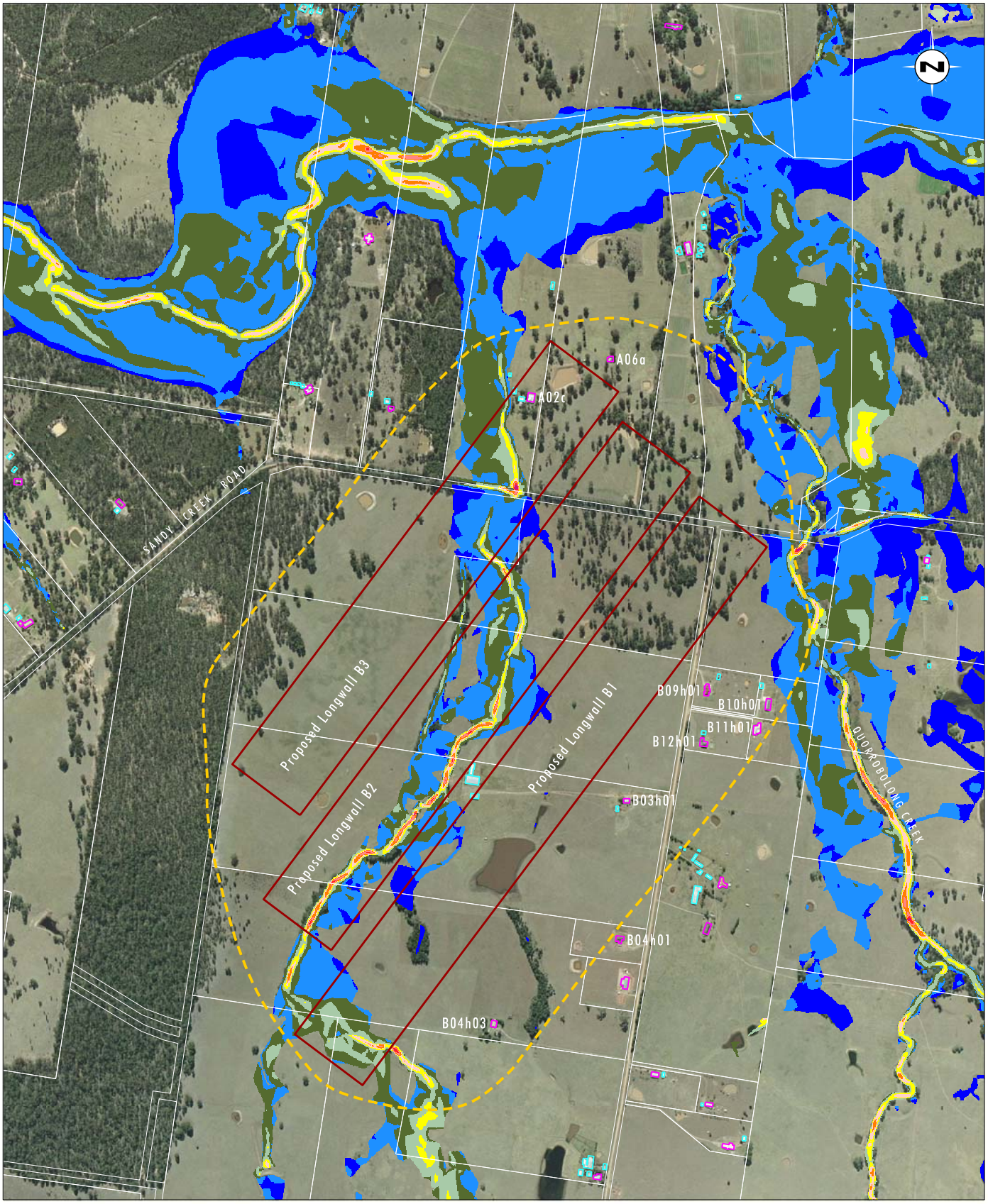

Image Source: Austar Coal Mine
Data Source:Austar Coal Mine, LPI - Cadastral Boundaries

0 250 500 750m
1:15 000

Legend

- Dwelling
- Other Structure
- Cadastral Boundary
- Proposed LWB1-B3 Longwall Panels
- LWB1-B3 Modification Area

Water Velocity (m/s)

- Range [0.100 : 0.250]
- Range [0.250 : 0.500]
- Range [0.500 : 0.750]
- Range [0.750 : 1.000]
- Range [1.000 : 1.250]
- Range [1.250 : 1.500]
- Range [1.500 : 1.750]
- Range [1.750 : 2.000]
- Range [2.000 : 2.250]
- Range [2.250 : 3.000]

FIGURE A7

1% AEP Storm Event: Maximum Modelled Flow Velocities, Predicted Subsidence Approved LWA3 - A8

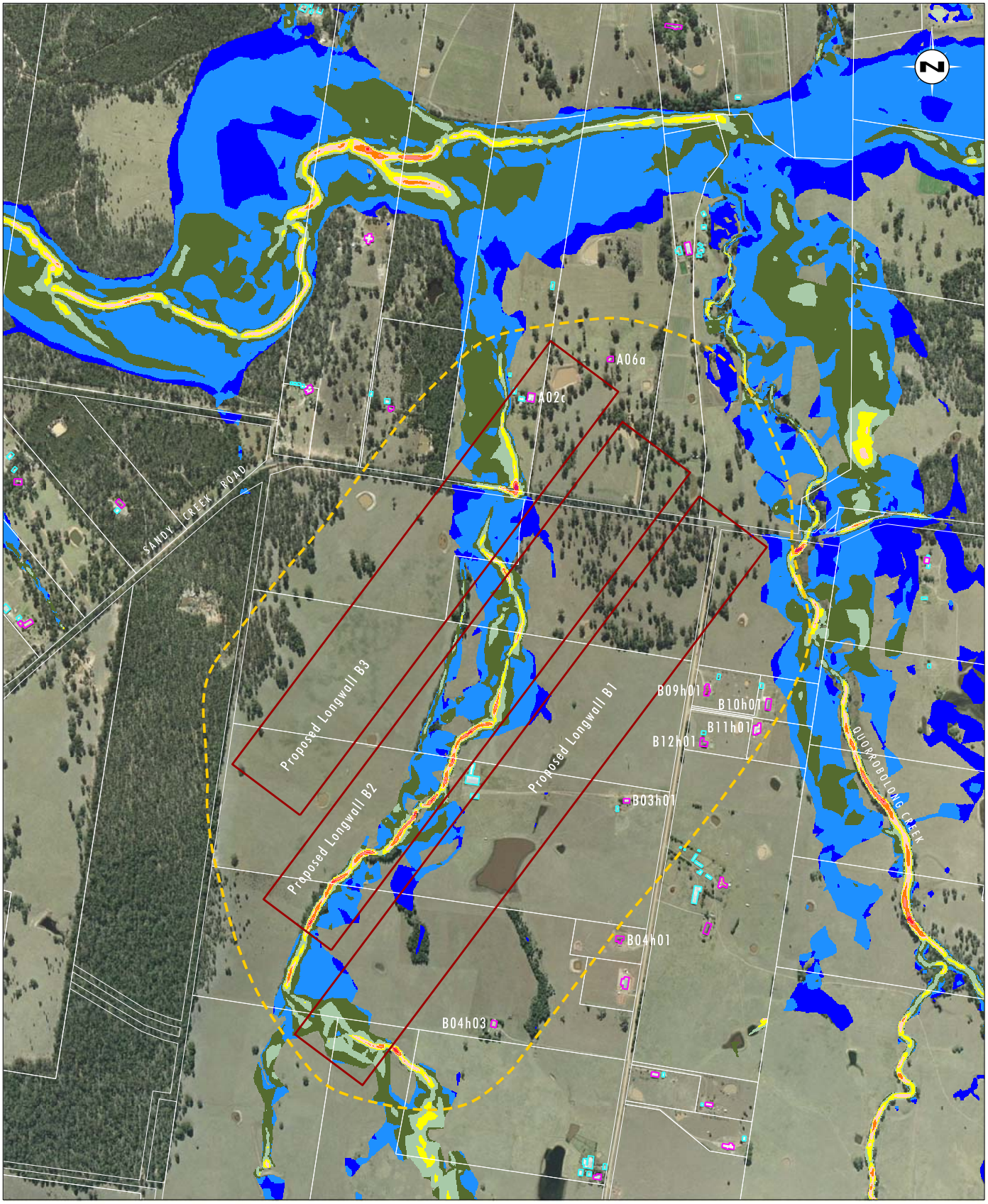

Image Source: Austar Coal Mine
Data Source:Austar Coal Mine, LPI - Cadastral Boundaries

0 250 500 750m
1:15 000

Legend

- Dwelling
- Other Structure
- Cadastral Boundary
- Proposed LWB1-B3 Longwall Panels
- LWB1-B3 Modification Area

Water Velocity (m/s)

- Range [0.100 : 0.250]
- Range [0.250 : 0.500]
- Range [0.500 : 0.750]
- Range [0.750 : 1.000]
- Range [1.000 : 1.250]
- Range [1.250 : 1.500]
- Range [1.500 : 1.750]
- Range [1.750 : 2.000]
- Range [2.000 : 2.250]
- Range [2.250 : 3.000]

FIGURE A8

1% AEP Storm Event: Maximum Modelled Flow Velocities, Predicted Subsidence Approved LWA3 - A19

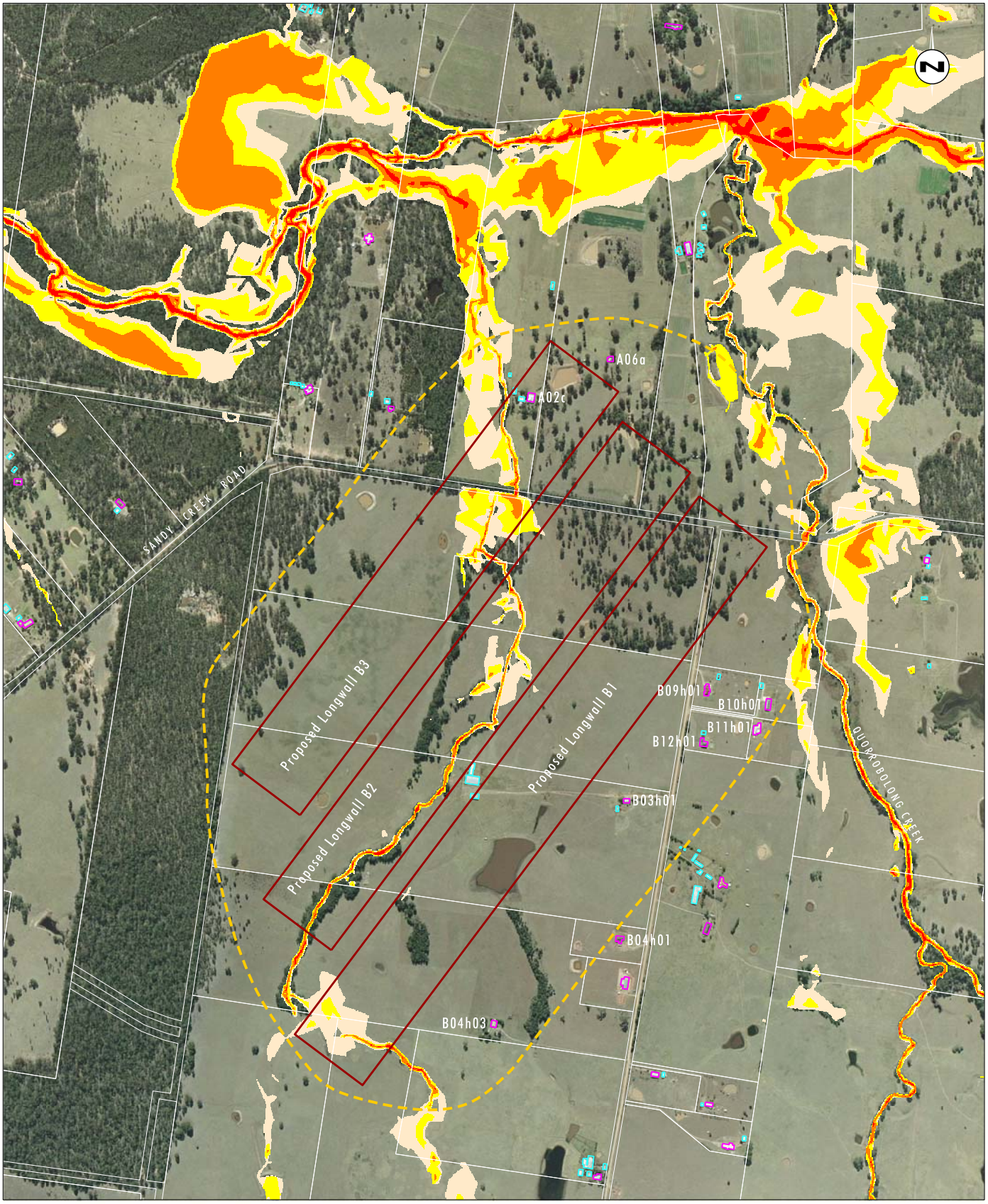

Image Source: Austar Coal Mine
Data Source:Austar Coal Mine, LPI - Cadastral Boundaries

0 250 500 750m
1:15 000

Legend

- Dwelling
- Other Structure
- Cadastral Boundary
- Proposed LWB1-B3 Longwall Panels
- LWB1-B3 Modification Area

Hazard Category

- Low Hazard - Walking and Vehicle Access
- Low Hazard - Vehicles unstable
- High Hazard - Wading unsafe
- High Hazard - Damage to light structures

FIGURE A9

100% AEP Storm Event: Maximum Modelled Flood Hazard, Predicted Subsidence Approved LWA3 - A8

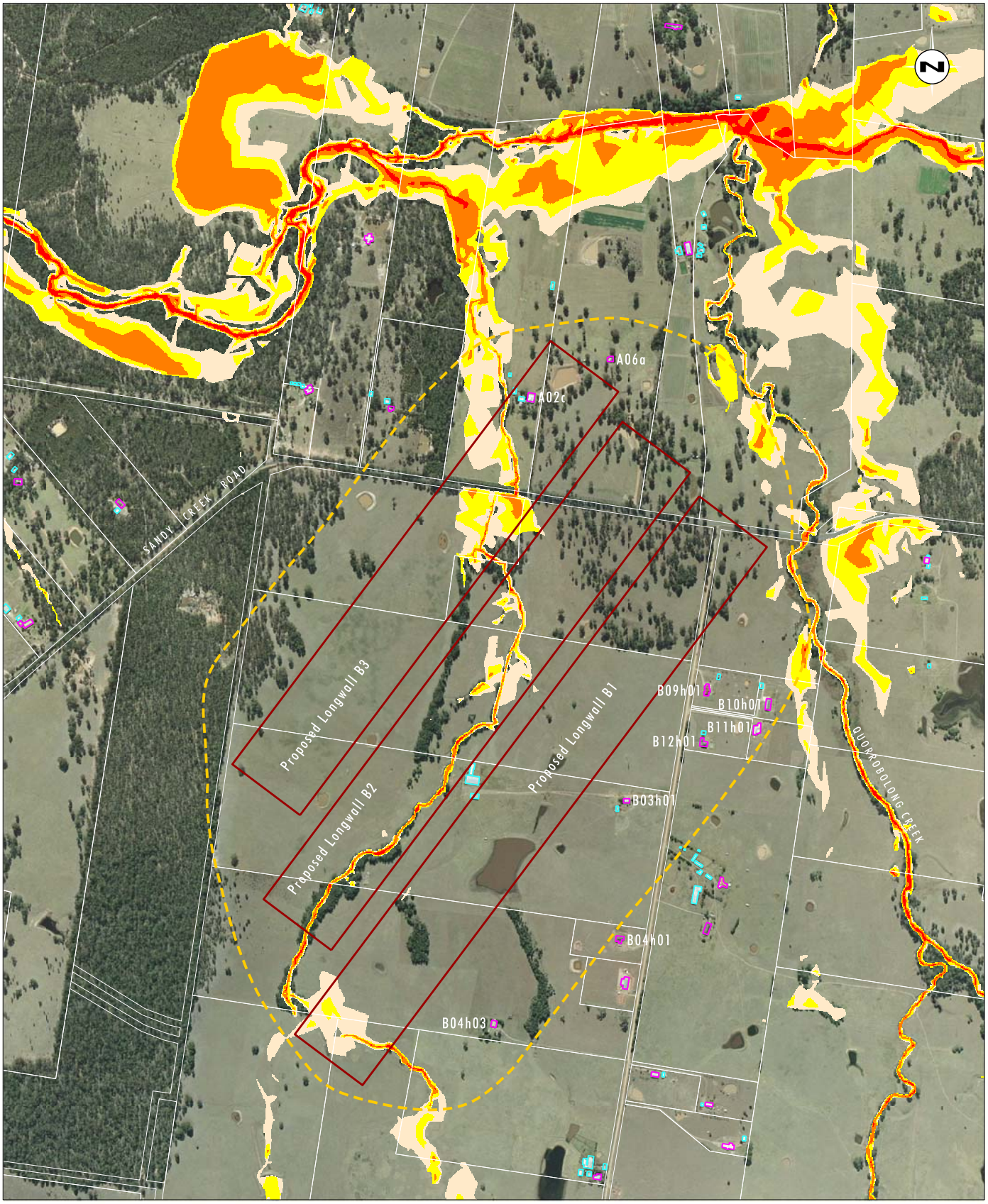

Image Source: Austar Coal Mine
Data Source:Austar Coal Mine, LPI - Cadastral Boundaries

0 250 500 750m
1:15 000

Legend

- Dwelling
- Other Structure
- Cadastral Boundary
- Proposed LWB1-B3 Longwall Panels
- LWB1-B3 Modification Area

Hazard Category

- Low Hazard - Walking and Vehicle Access
- Low Hazard - Vehicles unstable
- High Hazard - Wading unsafe
- High Hazard - Damage to light structures

FIGURE A10

100% AEP Storm Event: Maximum Modelled Flood Hazard, Predicted Subsidence Approved LWA3 - A19

File Name (A4): R10/3542_140.dgn
20151103 11.20

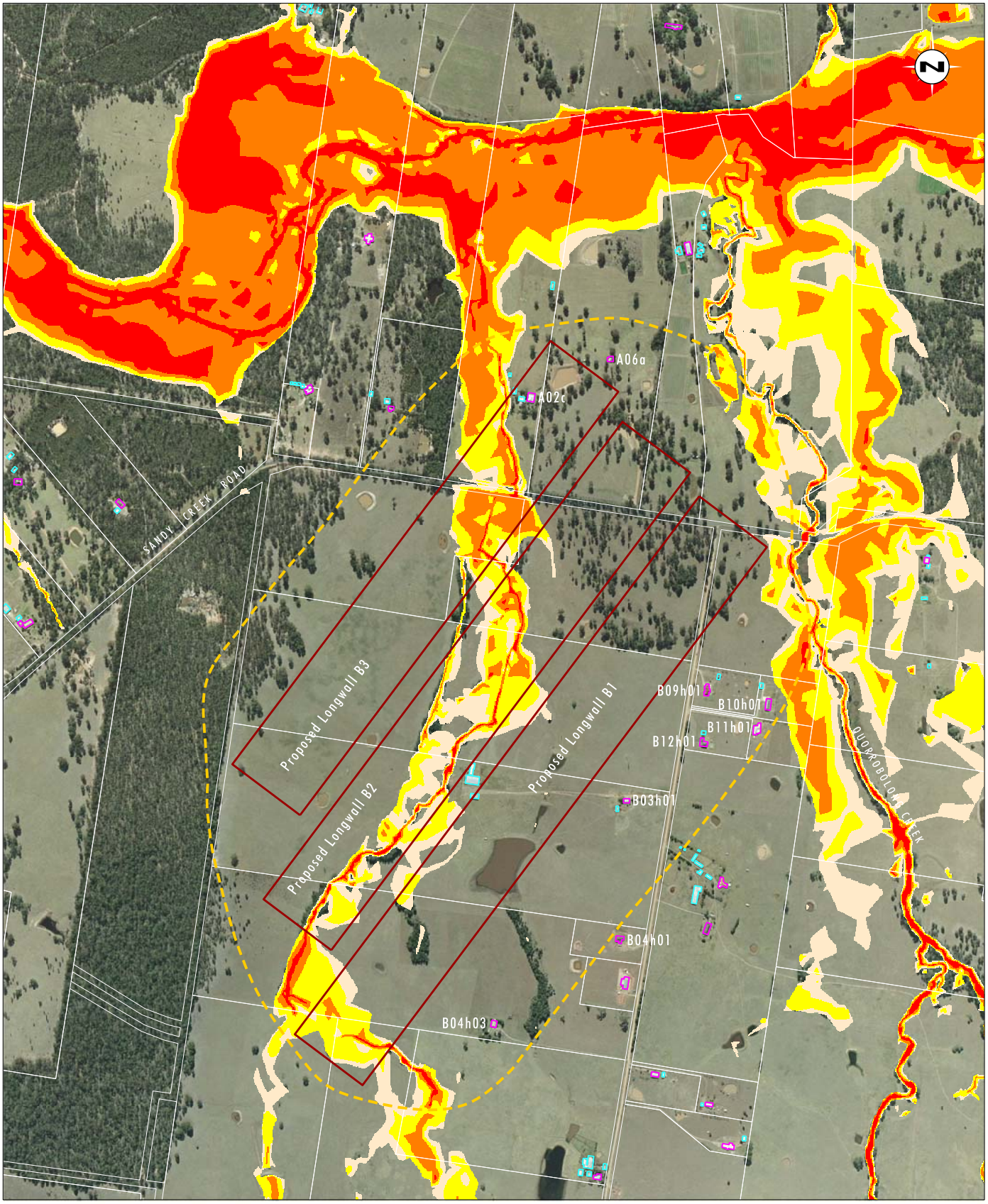

Image Source: Austar Coal Mine
Data Source:Austar Coal Mine, LPI - Cadastral Boundaries

0 250 500 750m
1:15 000

Legend

- Dwelling
- Other Structure
- Cadastral Boundary
- Proposed LWB1-B3 Longwall Panels
- LWB1-B3 Modification Area

Hazard Category

- Low Hazard - Walking and Vehicle Access
- Low Hazard - Vehicles unstable
- High Hazard - Wading unsafe
- High Hazard - Damage to light structures

FIGURE A11

1% AEP Storm Event: Maximum Modelled Flood Hazard, Predicted Subsidence Approved LWA3 - A8

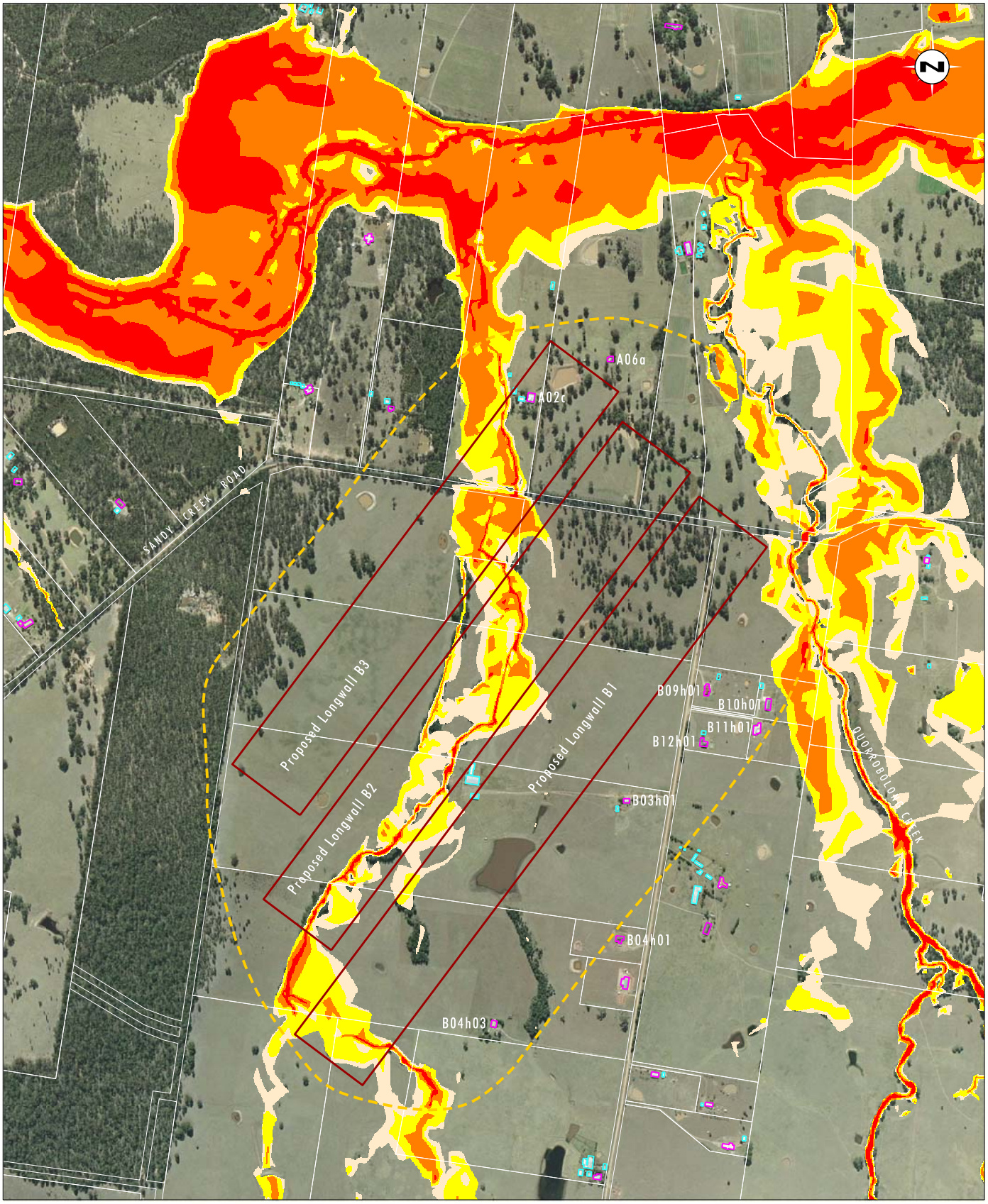

Image Source: Austar Coal Mine
Data Source:Austar Coal Mine, LPI - Cadastral Boundaries

0 250 500 750m
1:15 000

Legend

- Dwelling
- Other Structure
- Cadastral Boundary
- Proposed LWB1-B3 Longwall Panels
- LWB1-B3 Modification Area

Hazard Category

- Low Hazard - Walking and Vehicle Access
- Low Hazard - Vehicles unstable
- High Hazard - Wading unsafe
- High Hazard - Damage to light structures

FIGURE A12

1% AEP Storm Event: Maximum Modelled Flood Hazard, Predicted Subsidence Approved LWA3 - A19

File Name (A4): R10/3542_142.dgn
20151014 10.55