6.0 Model Sensitivity and Calibration

6.1 Approach

As part of the Stage 2 flood assessment (Umwelt, 2007) a series of models were run to determine the sensitivity of the flood model to different initial rainfall loss rates and hydraulic roughness characteristics (refer to **Section 6.2**).

During the Stage 2 flood assessment (Umwelt, 2007) the model was also run to simulate the 1990 storm event and the results compared to observations from local residents (refer to **Section 6.3**). The model was run based on terrain information obtained from the 2006 ALS data (AAMHatch, 2006).

Additional flood observation data was gathered for the June 2007 storm event. These observed levels have been assessed against the pre Stage 2 mining landform model outputs (refer to **Section 6.3**).

6.2 Sensitivity Analysis

A sensitivity analysis was carried out as part of the Stage 2 flood assessment (Umwelt, 2007). This analysis examined the sensitivity of the models to rainfall losses, hydraulic roughness and marsh porosity factors.

The analysis indicated that initial rainfall loss rates had little or no effect on flood flows within the RMA-2 model.

The sensitivity analysis for hydraulic roughness over a range of +/- 20% in Mannings 'n' value showed no discernable changes in flood flows or extents in the mining area or at the outlet of the model at Ellalong Bridge.

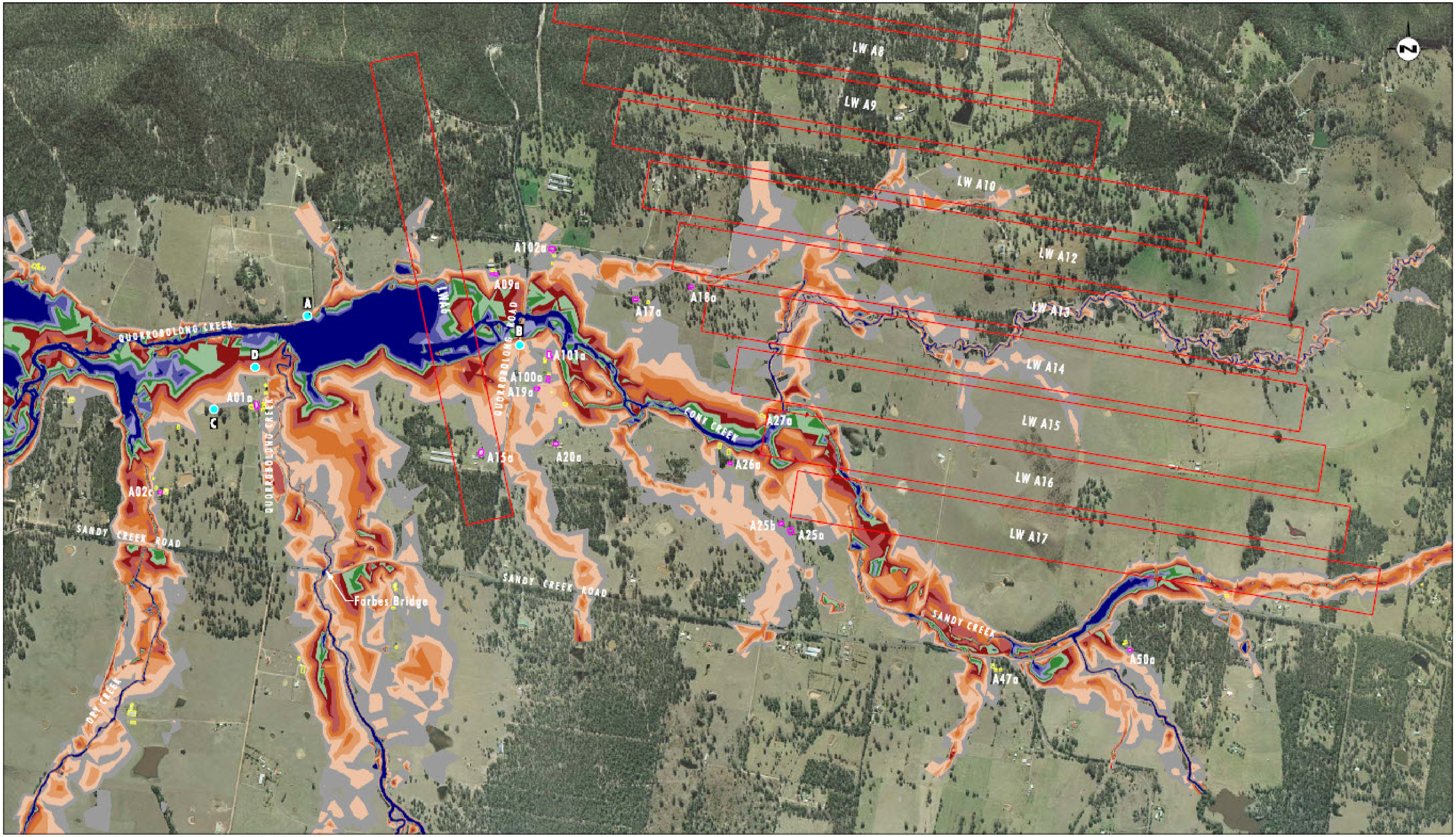
The flood model was run with different transitions zones and porosity values to determine the impact of the marsh elements on the dynamics of the flood modelling and to determine whether the flows in the subsurface zone are significant. The results indicated that changing the transition and porosity values by +/- 20% has little effect on the outflows of the model and has an insignificant impact on the shape of the outflow hydrograph. These results demonstrate that the flow conveyance in the marsh elements for the parameters assumed in the Quorrobolong Valley model is an insignificant proportion of the total flow.

6.3 Model Suitability

As part of the Stage 2 flood assessment (Umwelt, 2007) flood level information available from Cessnock City Council and two local residents (refer to **Section 3.5**) were reviewed. The modelled flows from the RMA-2 model were also compared to peak flows indicated by the Probabilistic Rational Method and the Regional Flood Frequency Results (average value) (refer to **Sections 4.1** and **4.2**).

The discussions with the two local residents identified four flood observation levels for the central section of the Quorrobolong Valley during the 1990 storm event. The flood observation points are shown on **Figure 6.1** and were considered to be consistent with the model results from the Stage 2 flood assessment for the 1990 storm event for the pre Stage 2 mining operations landform (Umwelt, 2007). As discussed, the RMA-2 model

Umwelt



Source: Longwall Layout: Austar Coal Mine, Aerial Photography: AAM Hatch 2006
Note: Dwellings only shown within flood model extent

0 300 600 900m
1:18 000

Legend

- Conceptual Layout for Stage 3 Longwall Panels
- Building
- Dwelling
- A01a Dwelling Reference Number
- Observation Points

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]

FIGURE 6.1

1990 Storm: Modelled Maximum Water Depths - Observation Points

File Name (A3): R16_V1/2274_288.dgn

developed for Stage 2 was extended to include the floodplain above the proposed Stage 3 mining area. Analysis of the extended model indicated that the model results for the 1990 storm event for Stage 3 Mining Area flood model using the pre Stage 2 mining landform are consistent with the recorded observations.

A review of existing flood information and the sensitivity analysis that has been undertaken (refer to **Section 6.2**) indicates that the developed RMA-2 flood model is suitable to assess potential changes to flooding regime, including flood levels, velocities and associated flood hazards, as a result of the proposed Stage 3 mining operations.

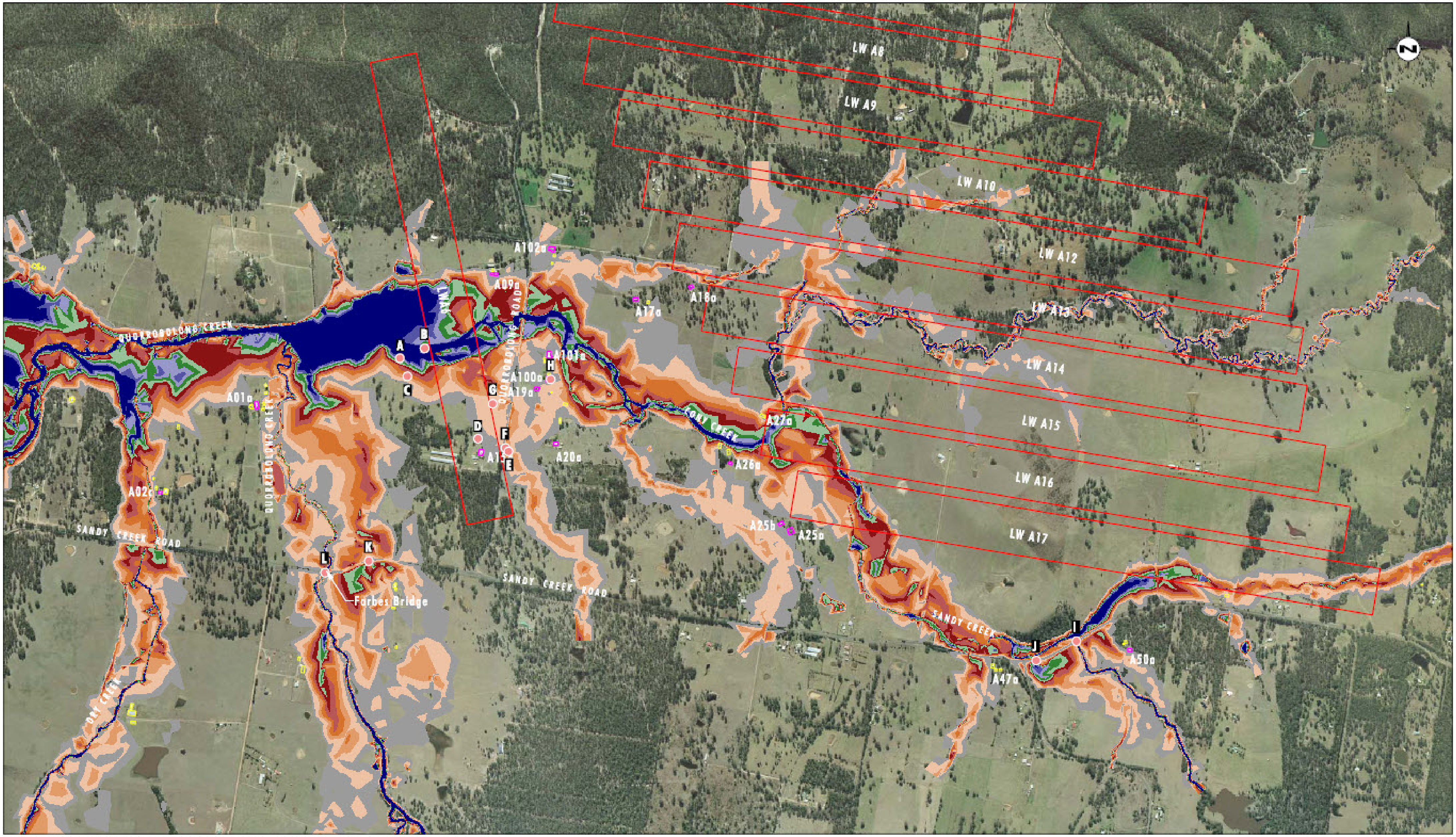
Subsequent to the commencement of this assessment, the major storm event of 9 June 2007 occurred. Analysis indicates that the June 2007 storm event generated considerably less rainfall than was experienced over the duration of the 1990 storm event. Analysis indicates that the June 2007 storm event was equivalent to a 60 year ARI 36 hour storm event or a 115 year ARI 24 hour storm event (refer to **Section 3.3.2**). As previously discussed, analysis indicates that the critical storm duration for flooding in Quorrobolong Valley in the vicinity of the proposed mining areas is the 36 hour storm event. Mining operations in the Stage 2 Mining Area had not commenced by the June 2007 storm and therefore there had been no substantive changes to the topography of the valley between the February 1990 storm and the June 2007 storm events.

Discussions with two additional local residents (Mr Muxlow and Mr Brown) after the June 2007 storm event identified eight locations where flood levels had been observed (Observation Points A to H in **Table 6.1**) in the Quorrobolong Valley during the June 2007 storm event. The flood observation points are shown on **Figure 6.2**.

Umwelt also conducted a field survey after the June 2007 storm event and recorded four additional locations where flood level could be observed. These flood observations (Observations Points I to L in **Table 6.2**) are shown on **Figure 6.2**.

Table 6.1 – June 2007 Observed Flood Data from discussions with Local Residents

Observation Point	Description	100 year ARI Storm Event (Pre Stage 2 Mining Operations Landform)
A	Flood level approximately halfway along the northern edge of the oat field estimated to have been over Mr Muxlow's head (estimated to be approximately 1.8 metres).	The modelled 100 year ARI storm event indicates approximately 1.70 metres depth of water in this location. The estimated 100 year ARI storm event flood depth along the northern boundary of the oats ranges from approximately 2.3 metres at the north-eastern corner to 1.2 metres at the north-western corner.
B	The flood mark identified on the inside the pump shed on the dam wall is approximately 1.0 metres above the top of the dam wall.	The modelled 100 year ARI storm event indicates a maximum flood depth of approximately 1.2 metres in this location.
C	Maximum flood extent was to the south-eastern corner of the oat field.	The modelled 100 year ARI storm event indicates a depth of up to approximately 400 mm in this location.
D	Flood waters extended to the southern edge of the dam.	The modelled 100 year ARI storm event indicates that the flood will reach within 15 metres of this location.



Source: Longwall Layout: Austar Coal Mine, Aerial Photography: AAM Hatch 2006
Note: Dwellings only shown for flood model extent

0 300 600 900m
1:18 000

Legend

- Conceptual Layout for Stage 3 Longwall Panels
- Building
- Dwelling
- A01a Dwelling Reference Number
- Observation Points

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]

FIGURE 6.2

100 year ARI Storm: Maximum Water Depths Pre Stage 2 Mining Landform

File Name (A3): R16_V1/2274_217.dgn

Table 6.1 – June 2007 Observed Flood Data from discussions with Local Residents (cont)

Observation Point	Description	100 year ARI Storm Event (Pre Stage 2 Mining Operations Landform)
E	Quorrobolong Road cut and opposite neighbour unable to access driveway.	The modelled 100 year ARI storm event indicates that water depth in this location is approximately 0.30 metres to 0.35 metres depth with an associated flood hazard category of “Vehicles Unstable”.
F	Road flooded.	The modelled 100 year ARI storm event indicates that the road is inundated to a depth of 50 mm.
G	Fence knocked down.	The modelled 100 year ARI storm event indicates that water depth in this location is approximately 150 mm to 200 mm metres and flow velocities approximately 0.25 m/s.
H	Flood waters extended to the eastern edge of Mr Brown’s house.	The modelled 100 year ARI storm event indicates a flood extent within approximately 5 metres to 10 metres from the eastern and southern edges of the house respectively.

Table 6.2 – June 2007 Observed Flood Data by Umwelt

Observation Point	Description	100 year ARI Storm Event (Pre Stage 2 Mining Operations Landform)
I	Appears road was flooded. Water depth estimated to be approximately 50 mm to 100 mm.	The modelled 100 year ARI storm event shows that the crest of the road (for a width of approximately 2 metres) did not flood.
J	Flood water did not overtop the road at this location.	The modelled 100 year ARI storm event indicates that the road is not overtopped during the modelled storm event.
K	Appears that water overtopped the road at this location. Observed edge of flooding extent to the east.	Flood modelling indicates that water depth in this location would be up to 120 mm.
L	Appears that water did not overtop the road at this location.	The modelled 100 year ARI storm event indicates that the road is not flooded.

The flood levels observed during and after the June 2007 storm event (which based on rainfall data at Austar was a 60 year ARI event for a 36 hours storm and a 115 year ARI event for 24 hour storm event) are consistent with the modelled 100 year ARI flood levels predicted for the Quorrobolong Valley.

6.3.1 Conclusions

Combined with the results of the sensitivity analysis (refer to **Section 6.2**) and the flood assessment (refer to **Section 6.3**) it is considered that the developed flood model is suitable to assess potential impacts on flooding, including flood levels, velocities and associated flood hazards, that are likely to occur as a result of the proposed underground mining in the Stage 3 Mining Area.

7.0 Summary of Quorrobolong Valley Flood Regime and Predicted Stage 3 Mining Area Impacts

7.1 Pre Stage 2 Mining Operations Flood and Drainage Regime

The floodplain associated with Quorrobolong Creek and its major tributaries of Cony Creek and Sandy Creek extends up to 400 metres wide (refer to **Figure 2.2**). The floodplain has been predominantly cleared and contains numerous farm dams. A thin strip of riparian vegetation remains along the majority of the drainage lines in the valley.

There are three different flooding regimes that govern flood extent, depths and velocities in the Quorrobolong Valley:

- Flooding within the narrow channels in the upper catchment. Flooding is confined by the relatively steep sides of the channels.
- Overland flow flooding, which affects the majority of the floodplain areas. This flow is governed by the characteristics of the creek channels and overland flow areas.
- Backwater flooding due to natural and man-made constrictions (e.g. bridges). Flooding in these areas is defined by the hydraulic capacities of the constrictions and available flood storage zones upstream.

There are two natural major constrictions in the vicinity of the proposed Stage 2 and Stage 3 mining areas. Those being immediately downstream of Stage 2 at the junction of Dry Creek and Quorrobolong Creek and downstream of the junction of Quorrobolong Creek and Cony Creek where the floodplain is constricted by ridge spurs (refer to **Figure 2.1**).

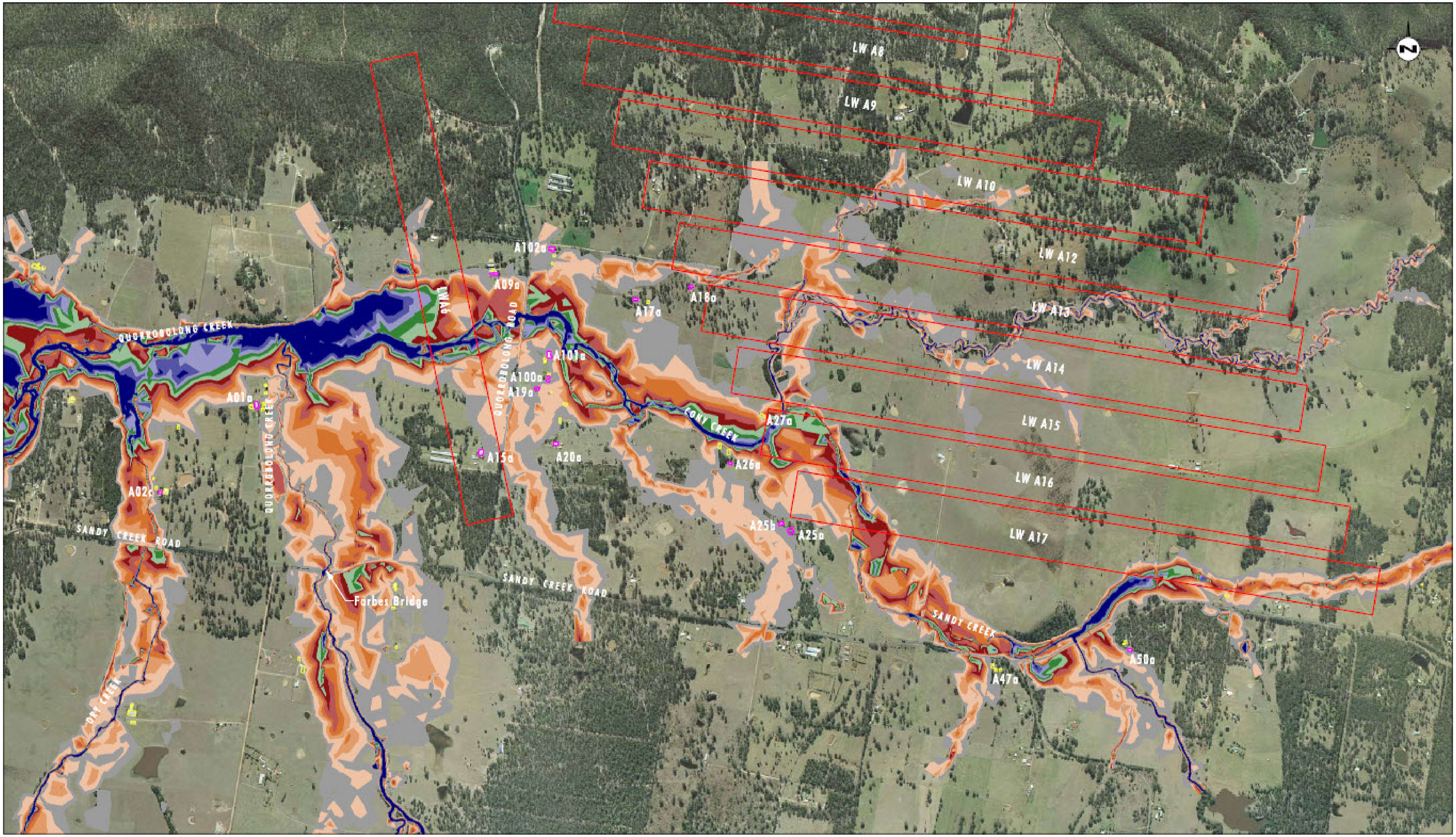
Man-made constrictions also occur in the floodplain including Quorrobolong Road and Sandy Creek Road and their associated bridges and culverts (refer to **Figure 2.1**).

Modelling undertaken for the Stage 2 flood assessment (Umwelt, 2007) indicated a storm duration of 36 hours would produce peak discharges through Ellalong Bridge (refer to **Figure 2.1**) of approximately 270 m^3/s during the 100 year ARI storm event.

Modelling indicates that the 100 year ARI storm event fills the floodplain regions of the valley (refer to **Figure 6.2**). Associated with this flooding are several major flood storage zones. These storage zones are typically located upstream of natural and man-made constrictions. Flood storage areas exist at the upstream boundary of Stage 2 and at the downstream boundary of Stage 3 Mining Areas (refer to **Figure 7.1**).

The flooding analysis indicates that the ground level at one dwelling that is adjacent to the proposed Stage 2 and Stage 3 Mining Areas will be inundated to a depth of approximately 70 mm during the 100 year ARI flood event. The floor level of this dwelling is approximately 400 mm higher than the surrounding ground level at this point. As such the floor of this dwelling is above the predicted 100 year ARI flood level. This dwelling is labelled A102a (refer to **Figure 7.1**). Dwelling A102a is located on Cony Creek Lane just off Quorrobolong Road.

Umwelt



Source: Longwall Layout: Austar Coal Mine, Aerial Photography: AAM Hatch 2006
Note: Dwellings only shown for flood model extent

0 300 600 900m
1:18 000

Legend

- Conceptual Layout for Stage 3 Longwall Panels
- Building
- Dwelling
- A01a Dwelling Reference Number

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]

FIGURE 7.1

100 year ARI Storm: Maximum Water Depths for Pre Stage 3 Mining Landform

File Name (A3): R16_V1/2274_220.dgn

7.2 Predicted Flooding and Drainage Regime – After Stage 2 Mining Operations

Previous flood assessment work (Umwelt, 2007) indicated that the Stage 2 mining operations have the potential to influence the flooding regime for up to 600 metres upstream of the Quorrobolong Road bridge over Cony Creek. In this region which is upstream of the Stage 2 mining area it was predicted that flood depths would decrease as a result of subsidence from Stage 2 mining.

The flood assessment for the Stage 2 Mining Area (Umwelt, 2007) indicates that flood depths will be typically increased in the mining area, however, there will be minimal impact on flow velocities.

The Stage 2 flood assessment (Umwelt, 2007) also indicated that there will be no changes to the depth of flood inundation or their associated flood hazards on access roads to dwellings with the Stage 2 Mining Area.

In addition, the Stage 2 flood assessment (Umwelt, 2007) indicated that the subsidence associated with the Stage 2 mining operations will not result in the inundation of any dwellings during the 100 year ARI storm event that were not previously inundated.

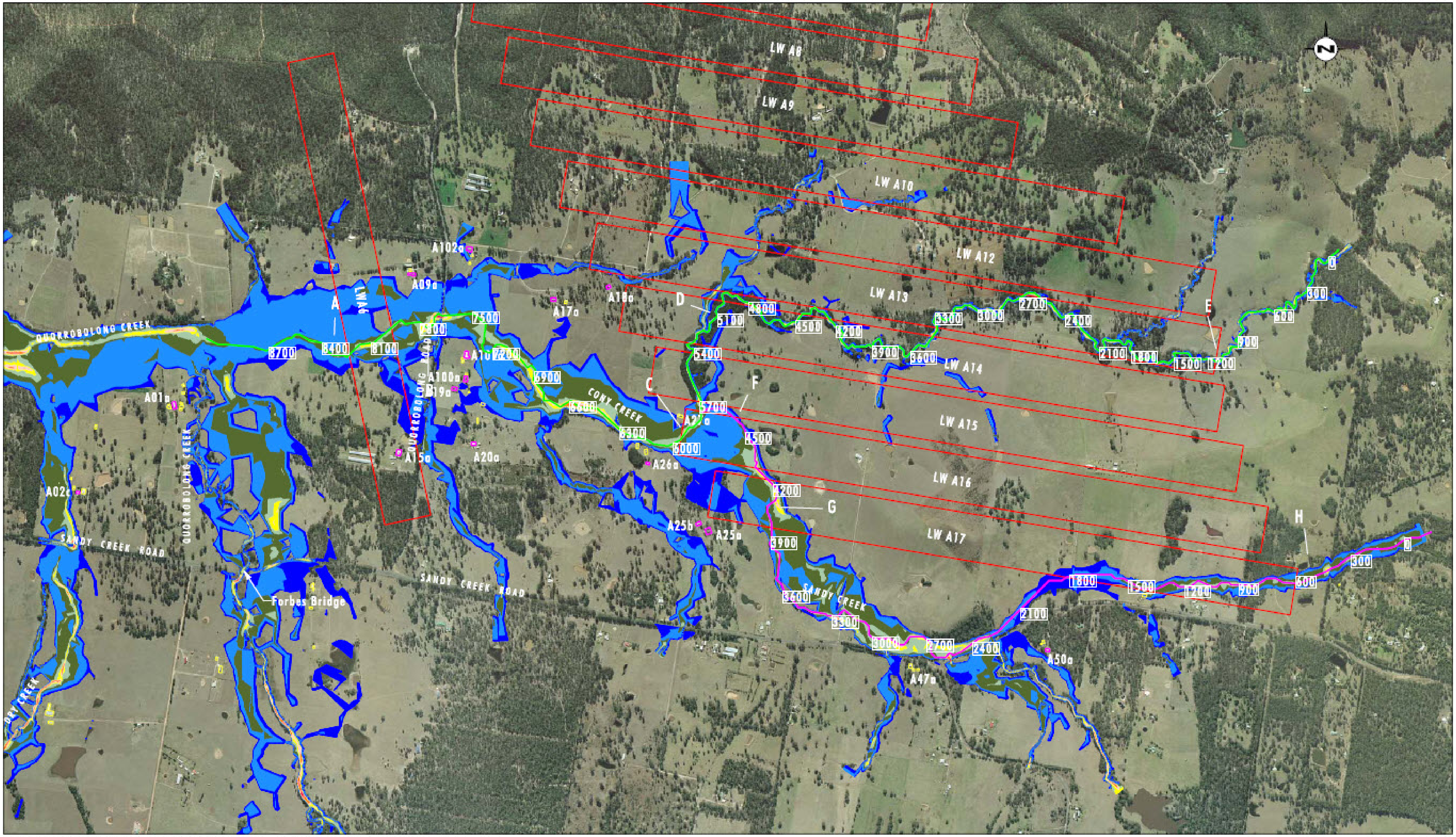
7.3 Stage 3 Mining Area Assessment – Base Case Conditions

The results from the RMA-2 model for the 100 year ARI storm event for the pre Stage 2 mining landform and pre Stage 3 mining landform (i.e. with predicted subsidence for Stage 2 Mining Area) are shown on the following figures:

- **Figure 6.2** – 100 Year ARI Storm: Maximum Water Depths for pre Stage 2 mining operations;
- **Figure 7.1** – 100 Year ARI Storm: Maximum Water Depths for pre Stage 3 mining operations;
- **Figure 7.2** – 100 Year ARI Storm: Maximum Water Velocities for pre Stage 3 mining operations;
- **Figure 7.3** – 1 Year ARI Storm: Maximum Water Depths for pre Stage 3 mining operations; and
- **Figure 7.4 –** 1 Year ARI Storm: Maximum Water Velocities for pre Stage 3 mining operations.

The influence of the natural constriction located near the chain pillar within the Stage 2 Mining Area between Longwall A4 and A5 on flooding, can readily be seen on **Figures 6.2** and **7.1**. **Figures 6.2** and **7.1** indicate that ponding occurs upstream of this natural constriction during major storm events and that the constriction influences flood depths, velocities and hazard both within the Stage 2 Mining Area and upstream in the proposed Stage 3 Mining Area (LW A6).

Umwelt



Source: Longwall Layout: Austar Coal Mine, Aerial Photography: AAM Hatch 2006
Note: Dwellings only shown for flood model extent

0 300 600 900m
1:18 000

Legend

- Conceptual Layout for Stage 3 Longwall Panels
- Building
- Dwelling
- A01a Dwelling Reference Number
- Longsection 1
- Longsection 2
- 1000 Longsection Chainage

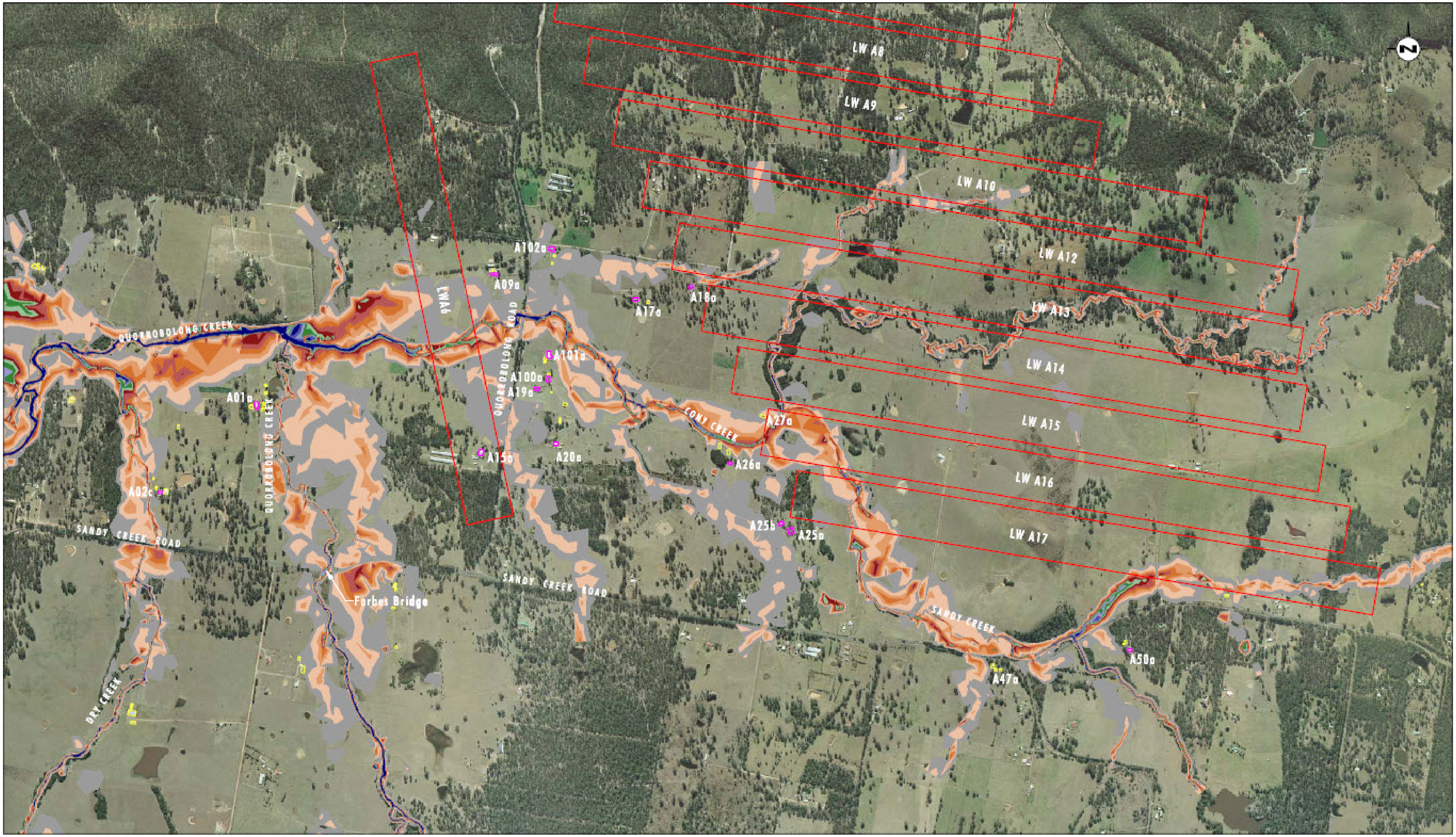
Velocity (m/s)

- 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 : 3.500]

FIGURE 7.2

100 year ARI Storm: Maximum Water Velocities for Pre Stage 3 Mining Landform

File Name (A3): R16_V1/2274_221.dgn



Source: Longwall Layout: Austar Coal Mine, Aerial Photography: AAM Hatch 2006
Note: Dwellings only shown for flood model extent

Legend

- Conceptual Layout for Stage 3 Longwall Panels
- Building
- Dwelling
- A01a Dwelling Reference Number

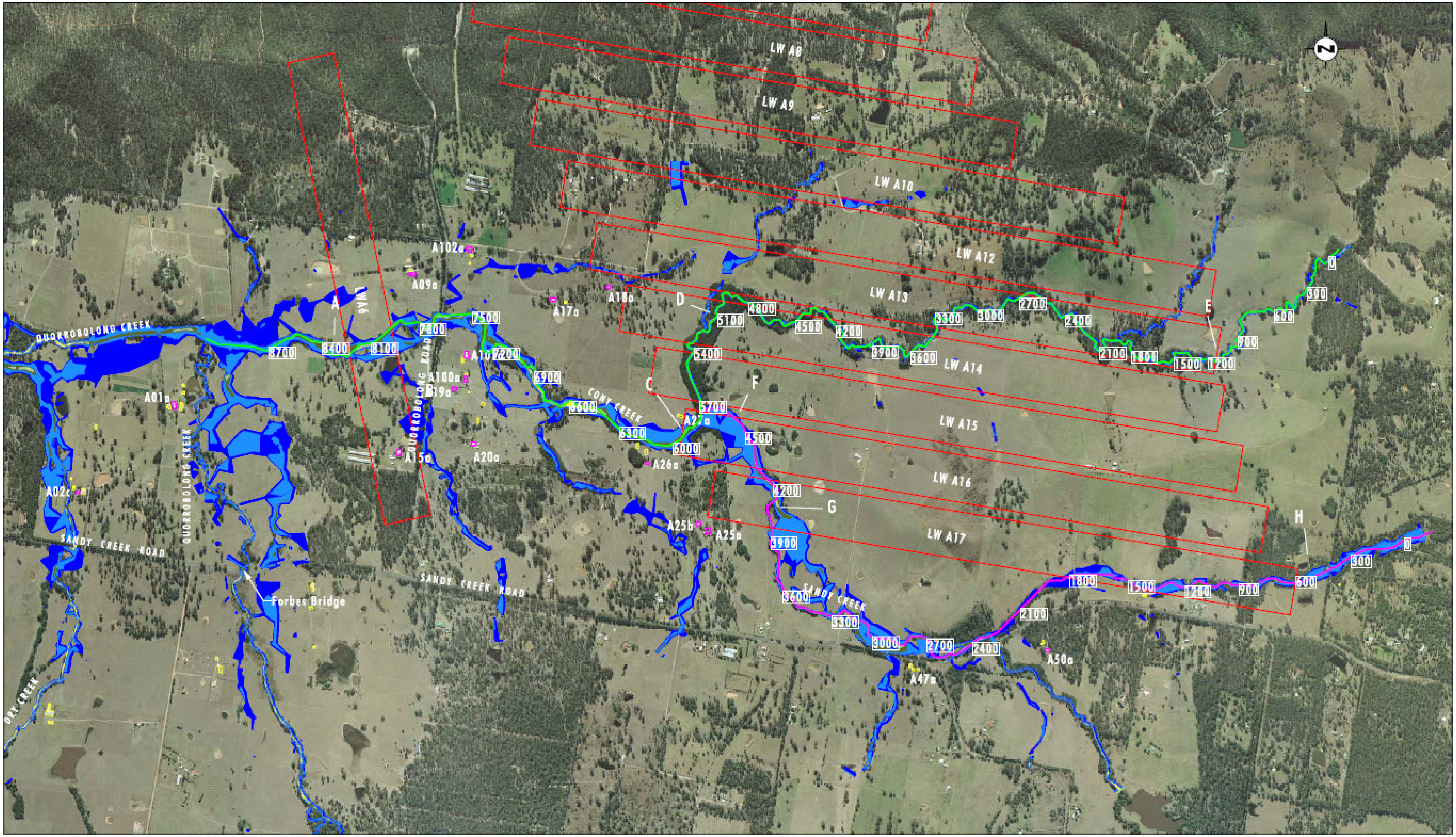
Water Depth (m)

- 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]

FIGURE 7.3

1 year ARI Storm: Maximum Water Depths for Pre Stage 3 Mining Landform

File Name (A3): R16_V1/2274_223.dgn



Source: Longwall Layout: Austar Coal Mine, Aerial Photography: AAM Hatch 2006
Note: Dwellings only shown for flood model extent

0 300 600 900m
1:18 000

Legend

- Conceptual Layout for Stage 3 Longwall Panels
- Building
- Dwelling
- A01a Dwelling Reference Number
- Longsection 1
- Longsection 2
- 1000 Longsection Chainage

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 : 3.500]

FIGURE 7.4

1 year ARI Storm: Maximum Water Velocities for Pre Stage 3 Mining Landform

File Name (A3): R16_V1/2274_224.dgn

8.0 Predicted Effects of Mine Subsidence

8.1 Subsidence Information

In order to assess the potential impacts of the proposed Stage 3 underground mining on the flooding regimes, subsidence predictions prepared by MSEC (2007) for the mining of proposed Longwalls A6 to A17 were used to develop post-mining landforms. Post mining landforms for the maximum predicted subsidence case and upper bound subsidence case as derived by MSEC (2007) were generated for the flooding assessment.

8.2 Approach

The RMA-2 hydrodynamic flood model described in **Section 5.2** was used to undertake an assessment of the potential flood and drainage impacts of underground mining at Longwalls A6 to A17 within the Stage 3 Mining Area.

The elevations of nodes in the RMA-2 network located within the subsidence zone were modified to take into account the predicted subsidence and upper bound subsidence (refer to **Section 8.1**).

The potential changes to overland and in-channel flowpaths and remnant ponding areas within the Stage 3 Mining Area were assessed using the pre Stage 3 mining landform and post Stage 3 mining landforms with predicted subsidence and upper bound subsidence (refer to **Section 8.3**).

The RMA-2 model was run for four scenarios:

- 100 year ARI storm event with the maximum predicted subsidence landform after underground mining of Stage 3;
- 100 year ARI storm event with the upper bound subsidence landform after underground mining of Stage 3;
- 1 year ARI storm event with the maximum predicted subsidence landform after underground mining of Stage 3; and
- 1 year ARI storm event with the upper bound subsidence landform after underground mining of Stage 3.

The same inflows, boundary conditions, roughness characteristics and mesh structure as were used for the 100 year ARI storm event and 1 year ARI storm event for the pre mining landform (refer to **Section 5.2**) were used in the flood modelling of the subsided landforms.

The modelling results from the Stage 3 Mining Area post mining scenarios (listed above) were compared to the pre Stage 2 mining operations and pre Stage 3 mining scenarios (refer to **Section 8.4**).

8.3 Predicted Drainage Impacts

An analysis of the overland flowpaths associated with flood model mesh for the pre Stage 3 mining landform and for the maximum predicted subsidence and upper bound subsidence landforms was undertaken to assess potential impacts on overland flowpaths due to the proposed underground mining.

There is potential for changes to overland flowpaths to occur near the edges of longwalls and chain pillar regions. However, the analysis indicates that only negligible changes to the overland flowpaths are likely occur as a result of both the maximum predicted subsidence and upper bound subsidence cases.

Longsections showing the bed elevation of Cony Creek, Sandy Creek and Quorrobolong Creek are shown on **Figures 8.1** and **8.2**. The corresponding chainage locations are also shown on **Figure 7.2**.

The in-channel grades along Cony/Quorrobolong Creek (refer to **Figure 8.1**) typically are within the range of 0.0% to 0.8%, with an average in-channel grade of 0.4%. Following mining within the proposed Stage 3 area, the creek channel grades are predicted to be within the range of 0.1% and 0.8% due to both maximum predicted subsidence and upper bound subsidence. Average in-channel grade is predicted to remain at approximately 0.4% indicating that no significant changes in overall stream power along these reaches is expected.

The in-channel grades along Sandy Creek (refer to **Figure 8.2**) typically are within the range of 0.1% to 0.6%, with an average in-channel grade of 0.3%. Following mining within the proposed Stage 3 area, the creek channel grades are predicted to be within the range of 0.0% and 0.8% as a result of maximum predicted subsidence and 0.0% to 0.9% as a result of upper bound subsidence. Average in-channel grade is predicted to remain at approximately 0.3% as a result of maximum predicted subsidence and 0.4% as a result of upper bound subsidence indicating that no significant changes in overall stream power is expected in the Stage 3 area of Sandy Creek.

Analysis of the in-channel grade changes for both the predicted subsidence and upper bound subsidence indicates that very localised increases in in-channel grade may occur within the area above proposed Stage 3 mining operations. Analysis also indicates that the predicted subsidence and upper bound subsidence will have negligible impact on in-channel and out of channel ponding.

As the predicted changes in in-channel grade are small and are considered to lie within the natural variations in grade of the creeklines of the Quorrobolong Valley, it is considered that the Stage 3 mining operations will not significantly alter the flow capacity or stream velocities within the existing channels. It is also considered that there is minimal potential for channel realignment to occur as a result of the proposed Stage 3 mining operations.

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

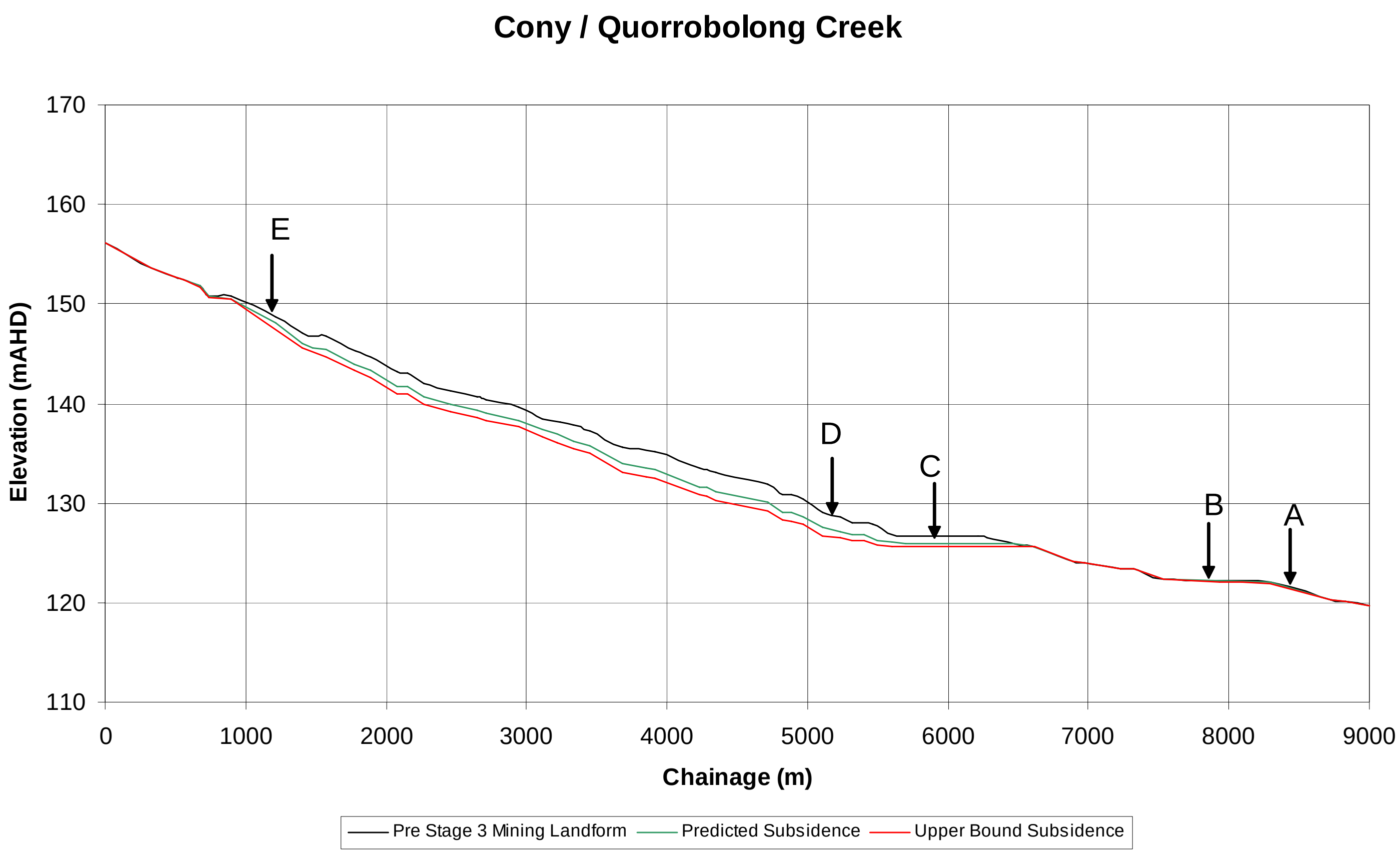


FIGURE 8.1

Cony / Quorrobolong Creek Profile

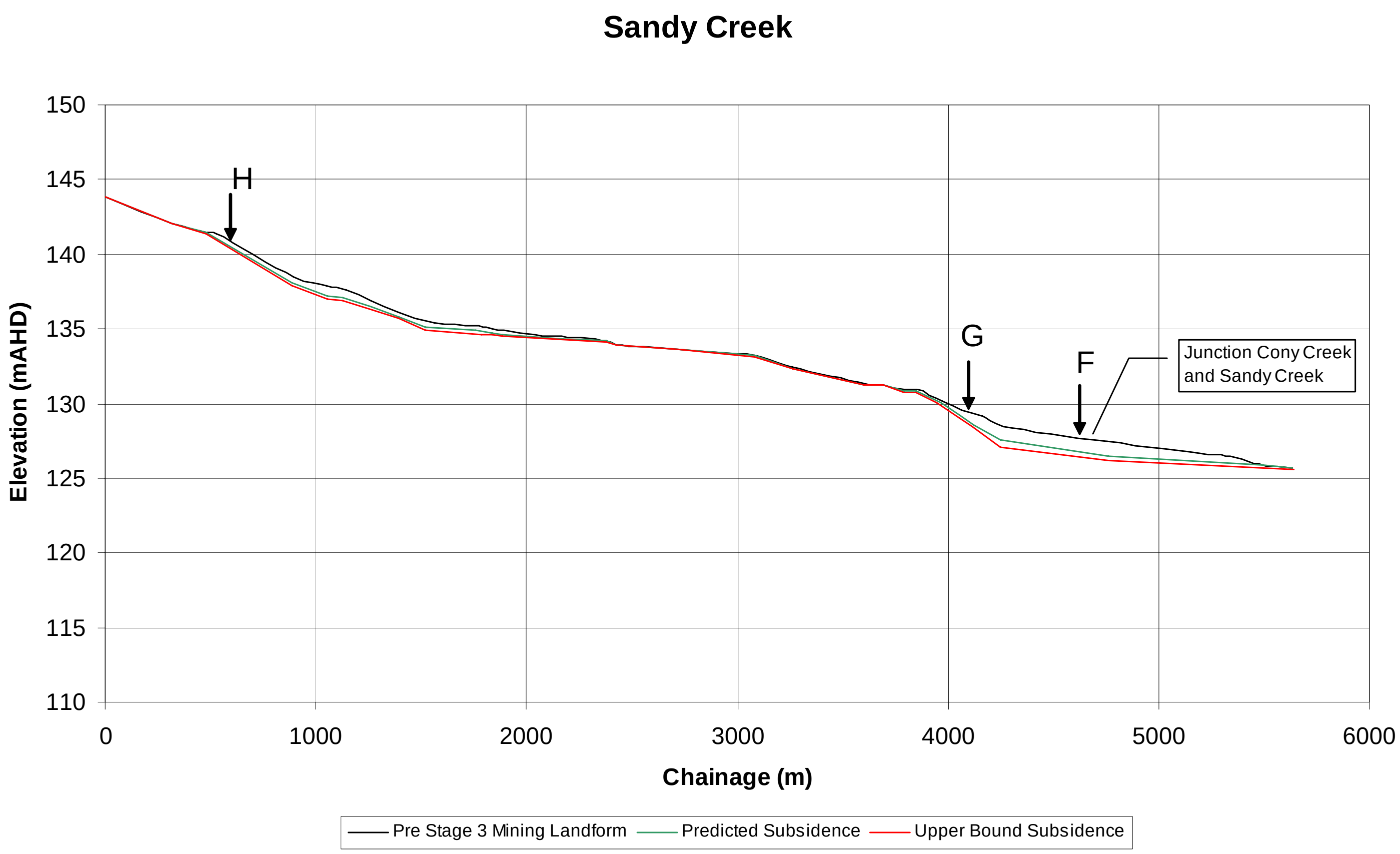


FIGURE 8.2

Sandy Creek Profile

8.4 Predicted Flooding Impacts

For each of the scenarios modelled, the maximum water depths, maximum water velocities and maximum flood hazards were determined. The analysis also included an assessment of potential changes to duration of flooding in key areas as a result of proposed underground mining activities.

The predicted impacts on flooding as a result of the upper bound subsidence for Longwalls A6 to A17 are discussed in **Sections 8.4.1** to **8.4.4**.

Figures 8.3 to **8.12** show the predicted maximum flood depths, flow velocities and flood durations for the scenarios described in **Section 8.2**.

8.4.1 Flood Depths

The modelling indicates that during the 100 year ARI storm event for pre Stage 3 mining conditions (i.e. with predicted subsidence for the Stage 2 Mining Area having occurred) the Stage 3 Mining Area may experience in channel flood depths of up to 950 mm. The modelled flood depths in this area with the upper bound subsidence landform are predicted to increase to a maximum of 1560 mm (refer to **Figure 8.4**). This predicted increase is localised on Sandy Creek over the western section of Longwall A16 for approximately 300 metres upstream of the confluence of Sandy Creek and Cony Creek. Modelling indicates that flood depths may increase on average by approximately 90 mm over the floodplain area to be undermined by Longwall A6 and 40 mm over the floodplain area to be undermined by Longwalls A7 to A17 with the upper bound subsidence predictions.

In terms of out of channel flooding, modelling indicates during the 1 year ARI storm event for the pre Stage 3 mining landform flood depths are typically in the order of up to 300 mm. These levels are predicted to increase by up to 180 mm for the post-mining condition with the upper bound subsidence (refer to **Figure 8.9**).

8.4.1.1 Flood Depths at Dwellings

The modelling results indicate that during the 100 year ARI storm event longwall mining of Longwalls A6 to A17 will not increase flood depths at dwellings within the Quorrobolong Valley.

One dwelling, A102a (refer to **Figure 6.2**), in the Quorrobolong Valley has been identified where flooding is predicted to reach a depth of up to 70 mm at a dwelling (refer to **Section 7.1**). However, the floor level of this dwelling is estimated to be at least 400 mm above the ground level at this location. The Stage 3 flood assessment indicates that flood depths above ground level at this dwelling will remain at 70 mm for both the predicted subsidence and upper bound subsidence landforms.

8.4.2 Velocities

Flood modelling indicates that maximum out of channel flow velocities for the 100 year ARI storm event for the maximum predicted subsidence case generally vary within +/- 0.1 m/s of the pre Stage 3 mining operations modelled maximum velocities. The modelled change for maximum in channel flows is in the order of +/- 0.3 m/s.

Flood modelling indicates that maximum out of channel flow velocities for the 100 year ARI storm event for the upper bound subsidence landform case generally vary within +/- 0.2 m/s