Ulan Coal Mines Limited

Environmental Assessment

Modification to Ulan Coal Continued Operations

Ulan West Mine Plan

(Approved Panels 1-4) and Construction Blasting

May 2012

Umwelt
Environmental Consultants

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Modification to Ulan Coal Continued Operations

Ulan West Mine Plan (Approved Panels 1-4) and Construction Blasting

Prepared by

Umwelt (Australia) Pty Limited

on behalf of

Ulan Coal Mines Limited

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Report No.	3036/R02/V1	Date:	May 2012

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1.0 Introduction

Ulan Coal Mines Limited (UCML) seeks to modify the UCML Project Approval (PA 08_0184) under Section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act) as follows:

- **Blasting Frequency –** Minor blasts such as that associated with small scale construction projects i.e. construction of ventilation shafts, will not be limited in terms of frequency or require monitoring where UCML confirms by design and prediction prior to blasting that the overpressure and vibration levels will be less than 95dBL and 1 mm/sec at all private buildings or Heritage Sites identified in Appendix 7 of PA08_0184. These blasts are in addition to the 'one blast per day' typically associated with the operation of the open cut (i.e. overburden and coal blasts).

- **Blasting Period –** UCML seeks to extend the hours within which construction blasting activities can be undertaken to 24 hours per day 7 days per week.

- **Appendix 7 –** Remove the heritage sites with no historical significance from the figure within the Project Approval. (i.e. only show the sites PK243, Bobadeen Homestead (C107), PK3, PK5, PK422, Old Ulan Village and the Talbragar Fish Fossil Reserve).

- **Ulan West Mine Plan Amendments –** Alterations to the approved Ulan West longwall panels 1-4 as follows:

    - Increasing the number of longwall panels from three to four, within the approved Ulan West Longwall 1-3 footprint:
        - This is achieved via reducing the panel width from 400 metres to the following panel widths:
            - Longwall 1 – 250 metres; and
            - Longwalls 2-4 – between 300 and 305 metres;
    - Reducing the length of the modified Ulan West longwall panels 1-5 from that approved (i.e. reduced length within the approved footprint of Ulan West longwall panels 1-4).

2.0 Need for Proposed Modification

2.1 Blasting

Following approval of the Ulan Coal – Continued Operations Project on the 15 November 2010, UCML has continued mining within the Ulan No 3 underground mine and commenced construction of the box cut associated with the Ulan West underground mine and recommenced open cut mining operations. Development of the open cut mine involves overburden and coal blasts while construction of ancillary infrastructure, specifically the Ulan West Box Cut ventilation shaft will also be undertaken using blasting albeit significantly smaller when compared to open cut blasting.

The following sections of the 2009 Ulan Coal – Continued Operations Environmental Assessment (EA) details the overburden, coal and construction blasting activities:

> Section 2.3.3.2 – 'During construction of ventilation downcast shafts, minor blast activities may be required. These will use very low MIC levels, will be designed to meet relevant criteria at all nearest residences, and have negligible potential for impact on private residences.'
>
> Section 5.9.2.1 – 'Explosives are used in open cut mining in order to dislodge overburden and coal to enable the extraction of the resource.'
>
> Section 5.9.2.1 – 'Discrete small scale blasting activities may also occur during specific construction activities, i.e. ventilation shafts. These events typically involve low MIC volumes and may occur outside normal blasting periods if negligible impact to receivers can be demonstrated.'

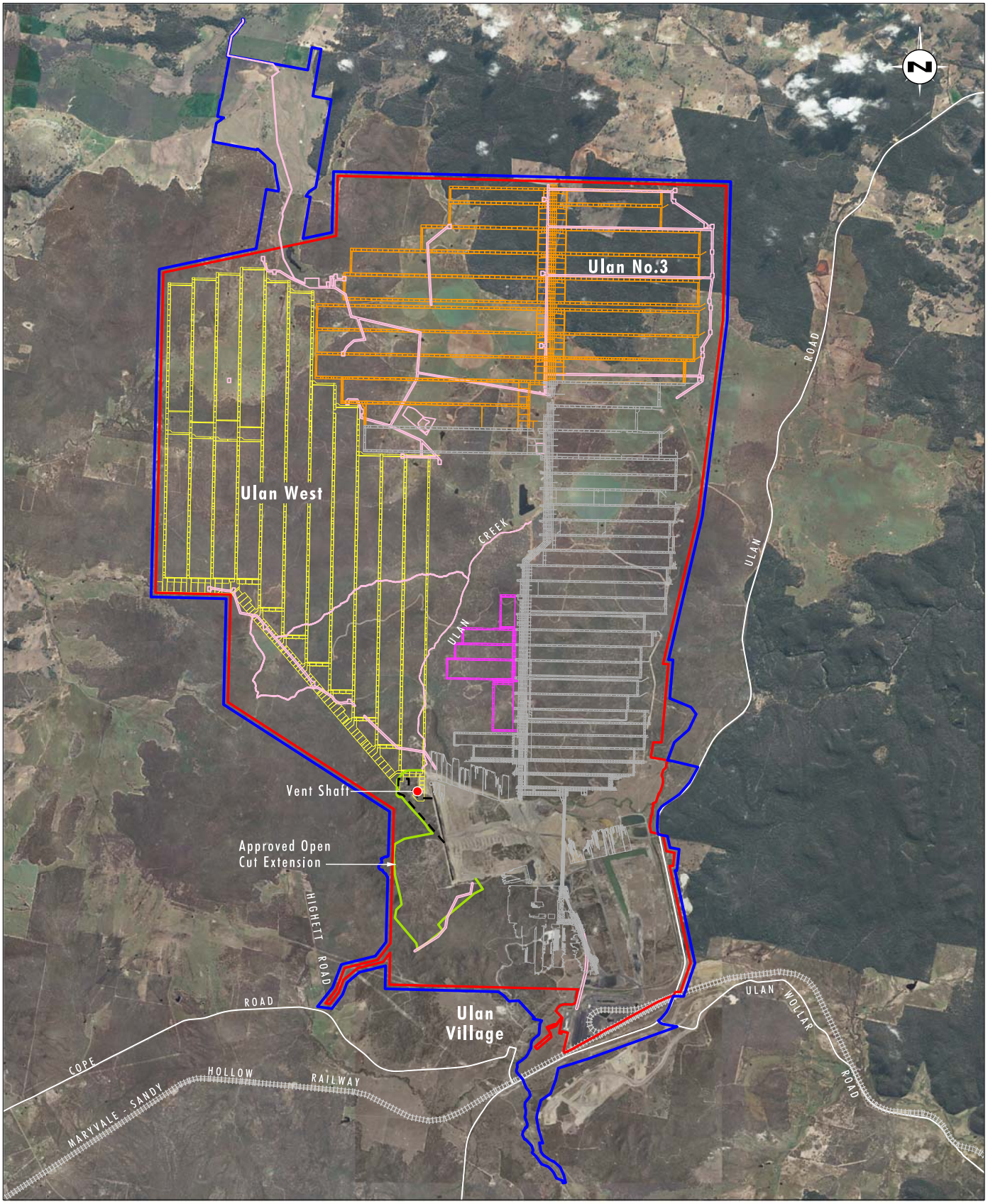
As the development of the open cut mine and the construction of the ventilation shaft (refer to **Figure 1**) are being undertaken simultaneously and both involve blasting, UCML has confirmed that there is potential for more than one blast per day to occur. In addition to this, UCML has also identified the blasting cycle for the construction of the ventilation shaft will allow multiple blasts to be undertaken per day. This is due to the size of the ventilation shaft (4.5m in diameter), the number of holes to be drilled, the small volume of shot rock to be removed and the use of machines to undertake the bulk of these activities. Should more than one blast per day occur this would result in a potential non compliance with Schedule 3 conditions 12.

> 12. The Proponent shall not carry out more than 1 blast a day on site, unless an additional blast is required following a blast misfire.
>
> *Note: A blast may involve a number of explosions within a short period, typically less than two minutes.*

We propose that the note to Condition 12 be amended to include the following statement 'this condition does not apply to minor blasts associated with the construction of ancillary infrastructure as detailed in Statement of Commitment 6.10.5'.

We also note that frequency of minor blasting as noted in Statement of Commitment 6.10.5 of the project approval is inconsistent with condition 12.

> Statement of Commitment 6.10.5 - 'Minor blasts such as that associated with small scale construction projects i.e. construction of ventilation shafts will not be limited in terms of frequency or require monitoring where UCML confirms by design and prediction prior to blasting that the overpressure and vibration levels will be less than 95dBL and 1 mm/sec at all private buildings or structures.'



Source: Ulan Coal, Aerial Photo December 2010, Mount King (2008), Umwelt (2009), Kuskie (2008)

0 1.0 2.5 5.0km
1:100 000

Legend

- Colliery Holding Boundary
- UCML Continued Operations Project Approval Area
- Approved Open Cut Extension
- Ulan West Mine Plan
- Ulan No.3 Mine Plan
- Previous Underground Mining Operations
- Proposed North 1 Underground Mining Area
- Box Cut Option
- Infrastructure Footprint
- Vent Shaft

FIGURE 1

Ulan West Vent Shaft

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Given the inconsistency, Schedule 2 condition 3 of the project approval prevails, which states that the '...conditions of the approval shall prevail to the extent of any inconsistency.' therefore condition 12 prevails over the statement of commitment and the 2009 EA and thus only one blast per day can be undertaken.

Blasting Frequency - Minor blasts such as that associated with small scale construction projects i.e. construction of ventilation shafts, will not be limited in terms of frequency or require monitoring where UCML confirms by design and prediction prior to blasting that the overpressure and vibration levels will be less than 95dBL and 1 mm/sec at all private buildings or Heritage Sites identified in Appendix 7 of PA08_0184. These blasts are in addition to the 'one blast per day' typically associated with the operation of the open cut (i.e. overburden and coal blasts)

Statement of Commitment 6.2.2 specifies the general construction hour period during which construction activities and blasting were proposed, however these were overridden by the hours specified in Schedule 3 condition 11 as they relate specifically to blasting activities. As such blasting can only be undertaken between 9.00 am and 5.00 pm Monday to Saturday inclusive.

> Statement of Commitment 6.2.2 – 'Construction will generally be undertaken between 7.00 am and 7.00 pm daily. Construction activities may occur outside these hours when UCML is satisfied that such activities are inaudible at nearest private residences.'
>
> 11. The Proponent shall only carry out blasting on site between 9am and 5pm Monday to Saturday inclusive. No blasting is allowed on Sundays, public holidays, or at any other time without the written approval of Director-General.

We propose that a note be added to Condition 11 which states 'this condition does not apply to minor blasts associated with the construction of ancillary infrastructure as detailed in Statement of Commitment 6.10.5'.

Schedule 3 Condition 10 of the Project Approval details the blasting performance measure for heritage sites and defines heritage sites as being that depicted in Appendix 7 of the Project Approval 08_0184. The majority of these sites have been assessed as having no historical significance and no research potential, with the exception being Sites PK243, Bobadeen Homestead (C107), PK3, PK5, PK422, Old Ulan Village and the Talbragar Fish Fossil Reserve. Therefore providing a level of protection to a number of European heritage sites with no historical significance and no research potential is unjustified. Therefore we propose that the current figure be replaced to show only those sites which have been assessed as having some heritage significance.

The modifications requested will also allow for infrastructure blasting for future ancillary facilities (i.e. ventilation shafts) as detailed in the Ulan Coal Continued Operations Environmental Assessment (Umwelt 2009) and subsequent modifications and approved by PA 08_0184.

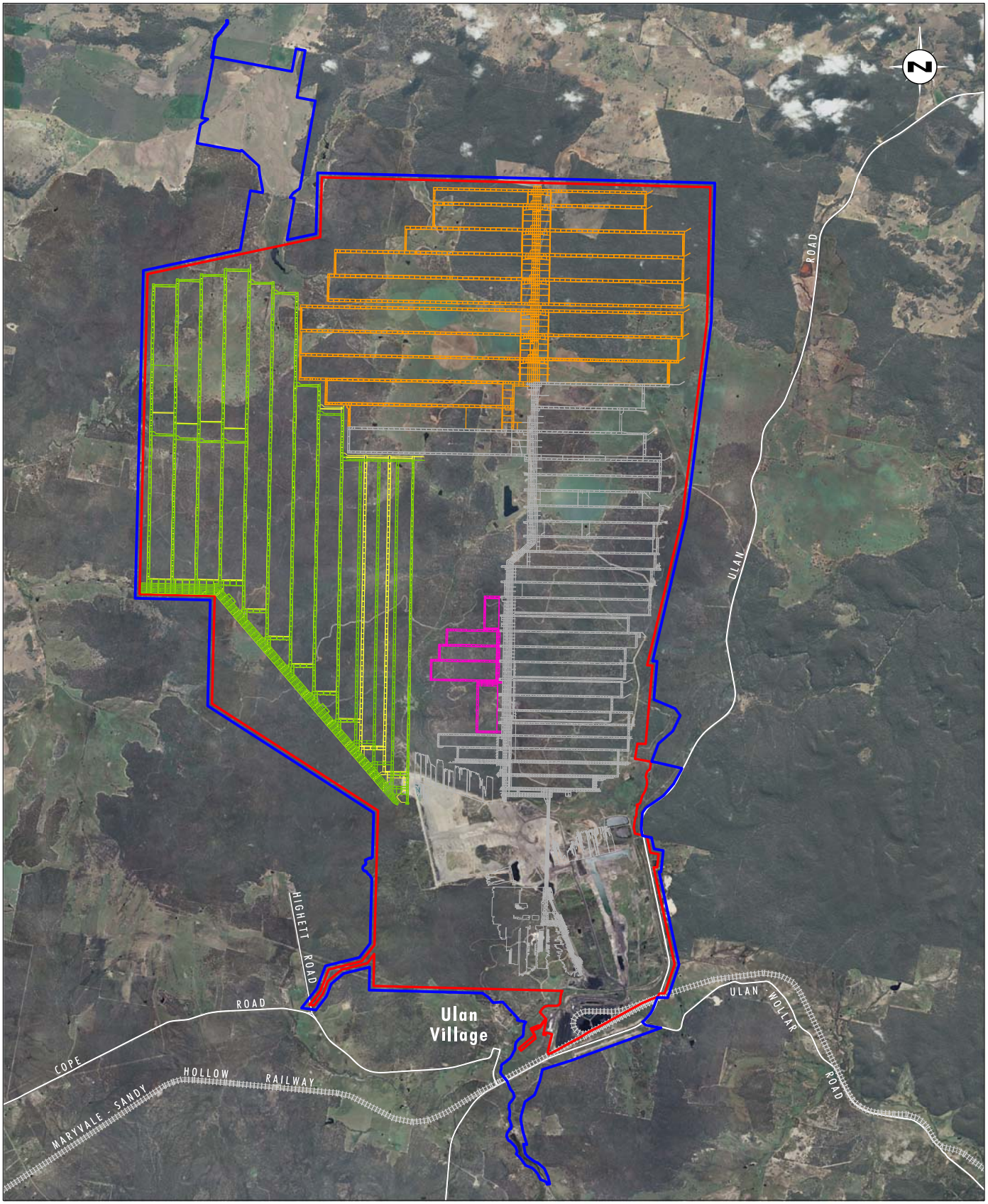
2.2 Mine Plan Amendments: Reduced Panel Widths and Lengths in Approved Ulan West Panels 1-4

Ulan Coal Mines Limited (UCML) proposes to alter the panel geometry of the approved Ulan West longwall panels 1-4, as described below:

The Ulan West longwall panel widths approved under the Ulan Coal Continued Operations Project (Umwelt 2009) and subsequently shown in the North 1 Modification (Umwelt 2011) are nominally 400 metres wide. Under this activity UCML proposes to reduce the width of the first 3 longwall panels but increase the number longwall panels located within the approved Ulan West Longwall 1–3 footprint to four longwalls panels. This is achieved via the width of the first Ulan West longwall being approximately 250 metres and panels 2-4 being between approximately 300 and 305 metres wide (refer to **Figure 2**). The revised Ulan West mine plan is located entirely within the approved footprint.

The length of the modified longwall panels 1 to 5 under the revised plan, have also been reduced by moving the northern end of the longwall blocks to the south (i.e. increase the barrier distance between the northern end of the Ulan West longwalls and the Ulan No 3 underground mine). While the geometry of the first five longwall blocks has been altered under the revised plan, the configuration and the level of protection provided to the Aboriginal archaeological and the ecological offset and conservations areas is unchanged.

UCML is still reviewing the supporting surface infrastructure needs (i.e. ventilation/service boreholes, electricity, water/pipelines, roads, water treatment plans, dams etc.) and thus the surface disturbance requirements for this arrangement. Due diligence assessments where required, will be undertaken as a result of detailed design and relocation of approved surface infrastructure at the end of these panels in accordance with UCML Environmental Management Strategy (ULN SD PLN 0050).



Source: Ulan Coal, Aerial Photo December 2007

0 1.0 2.5 5.0km
1:100 000

Legend

- Colliery Holding Boundary
- EA Project Area
- Approved Ulan West Mine Plan
- Revised Ulan West Mine Plan
- Ulan No. 3 Underground Mineplan
- North First Workings
- Previous Underground Mining Operations

FIGURE 2

Comparison of Approved and Revised Ulan West Mine Plan Geometry

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3.0 Proposed Approvals Path

In consultation with DP&I, UCML proposes to modify Project Approval 08_0184 under Section 75W of the EP&A Act.

Based on the proposed blasting amendments and the mine plan amendments, the scope and scale are not considered to be a radical transformation and is likely to result in 'minimal or consistent impacts' of the currently approved operations at UCML as:

- no additional ground disturbance is proposed as part of this modification;
- no adverse vibration impacts are predicted to occur on built or archaeological features;
- the predicted over pressure levels are significantly below guideline levels;
- the proposed activity is located on land listed in the schedule of lands of PA 08-1084;
- the blasting activities are consistent with that described in the EA; and
- the proposed Ulan West mine plan amendments are located entirely within the approved footprint and have a consistent alignment as the approved mine plan.

The completed 75W modification application form is included in **Appendix 1**.

4.0 Environmental Impact Assessment

UCML has engaged Umwelt (Australia) Pty Ltd (Umwelt) to prepare an environmental assessment for the proposed amendments. The impacts of the components of the modification are considered below.

4.1 Blasting

The potential environmental impacts of the proposed blasting amendments are confined to vibration (ground vibration (i.e. peak particle velocity) and air pressure pulse) and overpressure (i.e. blast noise). Enviro Strata Consulting Pty Ltd (ESC) has assessed the potential vibration and overpressure blasting impacts associated with the construction of the Ulan West ventilation shaft. A summary of the key findings is provided below, with the copy of their advice enclosed (refer to **Appendix 2**).

UCML has previously undertaken similar blasting activities during the construction of the Shaft No 3 (approved under DA 113-12-98). The blast monitoring data collected during this activity together with that associated with the open cut have been used to predict the vibration and overpressure impacts for the construction of the Ulan West ventilation shaft.

The Maximum Instantaneous Charge (MIC) used during the construction of Shaft No 3 was 6.9 kilograms. A similar MIC is expected to be used for the construction of the Ulan West ventilation shaft. In comparison a recent overburden blasting event in the open cut had a MIC of 2,950 kilograms. The scale and impact associated with the construction blasts are therefore significantly different to that associated with typical open cut basting activities.

UCML undertakes blast monitoring (vibration and overpressure) at five locations in accordance with its approved blast management plan (Version 2.0), being:

- Ulan school – BM 1;
- Receiver 6 – BM 3;
- Cultural Heritage Site 74 – BM 5;
- Cultural Heritage Site 431 – BM 6; and
- Cultural Heritage Site 445 – BM 7.

Minor blasts such as that associated with small scale construction projects i.e. construction of ventilation shafts, will not be limited in terms of frequency or require monitoring where UCML confirms by design and prediction prior to blasting that the overpressure and vibration levels will be less than 95dBL and 1 mm/sec at all private buildings or Heritage Sites identified in Appendix 7 of PA08_0184. These blasts are in addition to the ‘one blast per day’ typically associated with the operation of the open cut (i.e. overburden and coal blasts)

4.1.1 Vibration

Table 4.1 shows the predicted vibration impacts at each location assuming MIC’s of 2.8 and 70 kilograms respectively. The 70 kilogram scenario is a conservative worst case assumption based on all 25 holes subject to blasting being initiated simultaneously. Typically vibration levels below 0.8 mm/s are not detectable by humans and therefore assuming a 70 kilogram MIC (i.e. worst case scenario) the predicted vibration levels are not expected to be detectable at the human receptor locations. It is also unlikely that the predicted vibration

levels for a 70 kilogram MIC (i.e. worst case scenario) will result in any structural damage at any of the blast monitoring locations.

It is also noted that the air pressure pulse associated with blasting is at a frequency which is not perceptible by humans (i.e. sub audible). An air pressure pulse has the potential to result in regenerative noise (e.g. rattling windows). Assuming a worst case scenario (i.e. 70 kilogram MIC) the air pressure pulse is not expected to cause any regenerative noise impacts which can be detected at a residential location.

Table 4.1 – Predicted Vibration Levels

Blast Monitoring Site	Distance from Ulan West Ventilation shaft (m)	Predicted Vibration 2.8 kilogram MIC (mm/s)	Predicted Vibration 70 kilogram MIC (mm/s)
Ulan school – BM 1;	5265	0.001	0.02
Receiver 6 – BM 3;	4095	0.002	0.03
Cultural Heritage Site Old Ulan Village – BM 9;	1657	0.008	0.13
Cultural Heritage Site 74 – BM 5;	1196	<0.1*	<0.3*
Cultural Heritage Site 431 – BM 6; and	1068	<0.1*	<0.1*
Cultural Heritage Site 445 – BM 7.	825	<0.1*	<0.4*

Note * level of impact interpreted from ESC report.

The predicted vibration levels in **Table 4.1** are in accordance with condition 10 of Project Approval 08-0184 and the UCML Blast Management Plan (ULN 50 PLN 0082).

4.1.2 Overpressure

Table 4.2 shows the predicted overpressure impacts at each location assuming MIC's of 2.8 and 70 kilograms respectively. The maximum overpressure levels predicted at a residential location for a 2.8 and 70 kilogram MIC occurs at receiver 6 BM 3 and are 81 and 94dBL respectively. Over pressure levels of this scale are expected to be inaudible at all residential receiver locations. It is noted that these predictions are considered to be conservative as they do not take into account the effect of topographical shielding (i.e. the shaft is located at the bottom of the box cut and the shielding provide as construction of the shaft progresses), which are expected to reduce the predicted overpressure level by 3-8 dBL.

The overpressure levels at all heritages sites is less than the133dB (LinPeak) criteria and is therefore consistent with the condition 10 of Project Approval 08-0184.

Table 4.2 – Predicted Overpressure Levels

Blast Monitoring Site	Distance from Ulan West Ventilation shaft (m)	Predicted Overpressure 2.8 kilogram MIC (dBL)	Predicted Overpressure 70 kilogram MIC (dBL)
Ulan school – BM 1;	5265	78	91
Receiver 6 – BM 3;	4095	81	94
Cultural Heritage Site Old Ulan Village – BM 9;	1657	92	106
Cultural Heritage Site 74 – BM 5;	1196	<100*	<110*
Cultural Heritage Site 431 – BM 6; and	1068	<105*	<120*
Cultural Heritage Site 445 – BM 7.	825	<100*	<115*

Note * level of impact interpreted from ESC report.

The predicted overpressure levels in **Table 4.2** are in accordance with condition 10 of Project Approval 08-0184 and the UCML Blast Management Plan (ULN 50 PLN 0082)

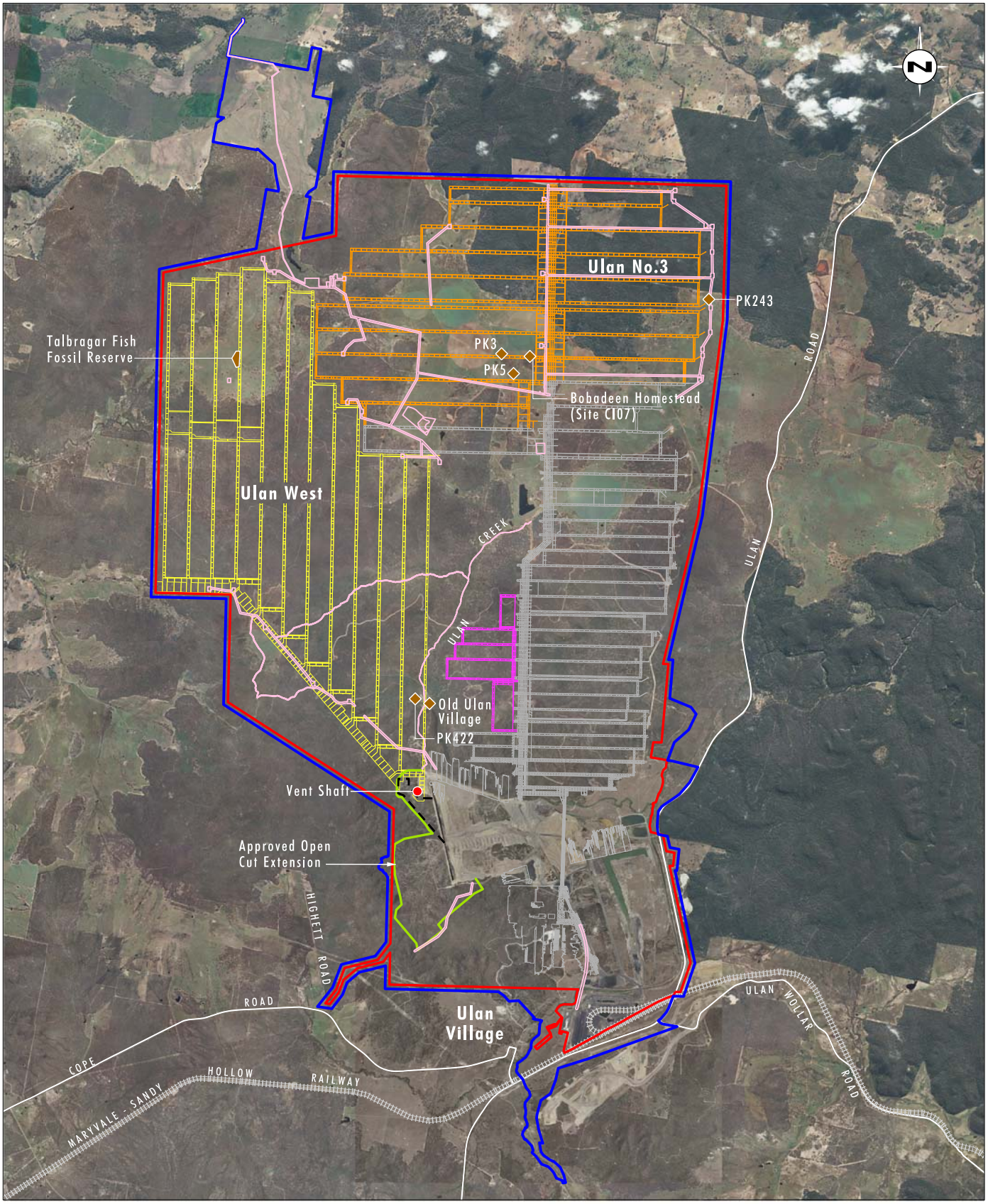
4.1.3 European and Natural Heritage Sites

The Ulan Coal - Continued Operations Environmental Assessment identified the European and Natural Heritage sites of CI127 and HS135 as having nil significance and sites RV3, CI33, RV4, HS63, CC6, MM273, OCE80/B, OCE84A, OEC86A, OEC 94A, RV1, RV2, CI198/G, PK96/B, ID191 and HS96/D as having nil – local significance. Umwelt has subsequently clarified the nil – local significance of the latter sites and confirmed that these sites are of nil significance (refer to refer to **Appendix 3**). The inclusion of the heritage sites with no historical significance on the Appendix 7 figure, therefore provides these sites with a level of protection that is unjustified and operationally restrictive. UCML therefore proposes remove the heritage sites with no historical significance from the figure (refer to **Figure 3**).

This amendment results in the blasting performance measures being applied to only the heritage sites which are susceptible to blast impacts and have a local or greater significance (i.e. sites PK243, Bobadeen Homestead (C107), PK3, PK5, PK422, Old Ulan Village and the Talbragar Fish Fossil Reserve).

4.1.4 Aboriginal Archaeology Sites

The proposed blasting to facilitate the development of the Ulan West Vent Shaft has the potential to cause vibration impacts upon previously identified Aboriginal sites (SEA 2009), which are subject to management mechanisms documented in the approved UCML Heritage Management Plan. As demonstrated in **Figure 4**, blasting to facilitate the development of the Ulan West Vent Shaft will result vibration levels less than 2 mm/s for all rock shelters i.e. all sites that are potentially susceptible to blasting impacts. The only sites located within the 2 mm/s vibration contour are four artefact scatters/isolated finds. Such sites are not susceptible to blasting damage. Further, these sites have been previously assessed as having low significance and accordingly have been assessed to not requiring impact mitigation (SEA 2009). The proposed blasting to develop the Ulan West Vent Shaft will accordingly have no impact on Aboriginal Archaeology sites and as such no resultant management mechanism requires amendment.



Source: Ulan Coal, Aerial Photo December 2010, Mount King (2008), Umwelt (2009), Kuskie (2008)

0 1.0 2.5 5.0km
1:100 000

Legend

- Colliery Holding Boundary
- UCML Continued Operations Project Approval Area
- Approved Open Cut Extension
- Ulan West Mine Plan
- Ulan No.3 Mine Plan
- Previous Underground Mining Operations
- Proposed North 1 Underground Mining Area
- Box Cut Option
- Historical Sites/Items
- Infrastructure Footprint
- Vent Shaft

FIGURE 3

European and Natural Heritage Sites/Items within Project Area Subject to Blasting Criteria

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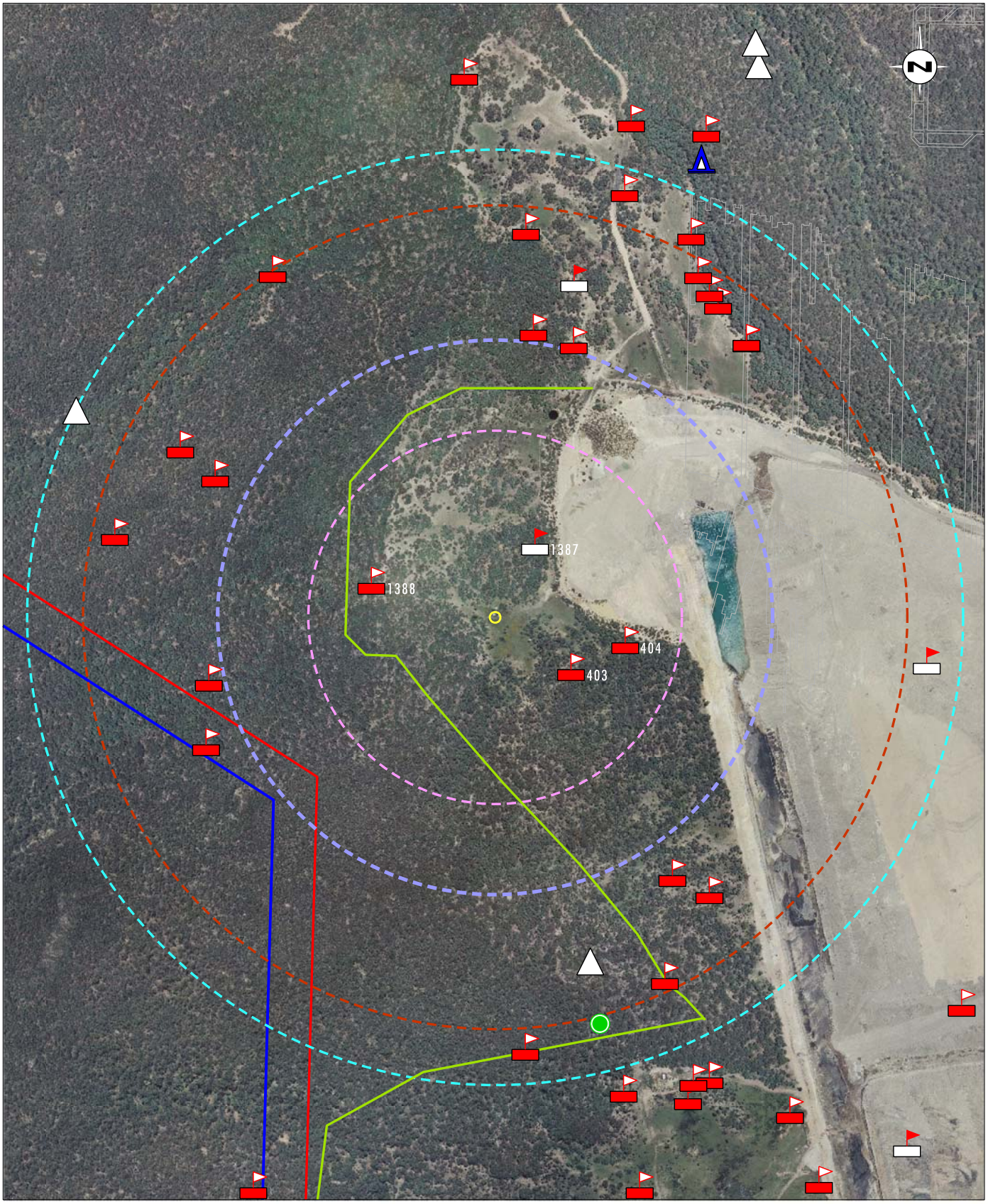

Source: Ulan Coal, Aerial Photo December 2007

0 100 300 500m
1:10 000

Legend

- Colliery Holding Boundary
- EA Project Area
- 0.4mm/s Vibration Contour
- 0.5mm/s Vibration Contour
- 1.0mm/s Vibration Contour
- 2.0mm/s Vibration Contour
- Proposed Open Cut
- Artefact Scatter
- Isolated Find
- Rockshelter with Art
- Rockshelter with PAD
- Waterhole Well
- Vent Shaft

FIGURE 4

Aboriginal Archaeological Sites and Vibration Modelling

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4.2 Mine Plan Amendments

The environmental impacts of the proposed modification to the geometry of Ulan West mine plan (Panels 1-4) are assessed in the following section.

4.2.1 Subsidence

Strata Control Technology (SCT) has assessed the potential subsidence impacts associated with the revised Ulan West Mine plan. A summary of the key findings is provided below, with the copy of their advice included in **Appendix 4**.

The proposed amendments will result in minor localised changes to subsidence predictions made as a part of the Ulan Coal – Continued Operations Environmental Assessment (Umwelt 2009). These changes however, will not significantly change the subsidence impacts previously described in the Ulan Coal – Continued Operations Environmental Assessment (Umwelt 2009) or the Modification of Ulan Coal Continued Operations (Umwelt 2011).

Due to no changes proposed to the eastern edge of the first Longwall Panel, there are no change to the assessed impacts on Ulan Creek as a fourth order stream running parallel to the Ulan West mine plan and the European heritage site, of Old Ulan Village.

In consideration of the revised Ulan West mine plan SCT has reassessed the location of the area bounded by the 26.5 degree angle of draw and the 20 millimetre subsidence contour, with minimal changes to the impacts assessed in 2009. SCT and Umwelt have predicted that the mine plan modifications will continue to be compliant with performance measures of Project Approval 08_0184 Condition 24 (refer to **Table 4.3**).

Table 4.3 – Project Approval 08_0184 Subsidence Performance Measures

Requirement	Outcome	Comment Regarding Mine Plan Modification LW 1-4
Water		
Ulan, Mona and Cockabutta Creek	No greater environmental consequence than predicted in the EA	As discussed in Section 4.2.4, the updated Ulan West mine plan will have no additional environmental consequence to that specified in the EA.
Biodiversity		
Threatened species, populations, habitat or ecological communities	Negligible Impacts	As discussed in Section 4.2.5 the revised Ulan West mine plan will not result in any change in the level or extent of biodiversity impacts.
Land		
Cliffs in the Brokenback Conservation Area	Nil environmental consequences	The updated Ulan West mine plan is not located in the vicinity of Brokenback Conservation Area. The Brokenback Conservation Area retains its extent and protection afforded under Project Approval 08_0184.
Other Cliffs	Minor environmental consequences	The proposed modifications are consistent with Project Approval 08_0184 and will result in no more than minor environmental consequence.

Table 4.3 – Project Approval 08_0184 Subsidence Performance Measures (cont)

Requirement	Outcome	Comment Regarding Mine Plan Modification LW 1-4
Heritage		
Aboriginal Sites	Nil impact in the Brokenback Conservation Area, Grinding Groove Conservation Areas; and on Mona Creek/Cockabutta Creek Rock Shelter Sites	The extent and level of protection established by the Brokenback Conservation Area is the same as that provided by Project Approval 08_0184. No additional impacts are predicted to occur at the Grinding Grooves Conservation Areas; or the Mona Creek/Cockabutta Creek Rockshelter Sites as a result of the proposed modification.
Talbragar Fish Fossil Reserve	Negligible Impact	The updated Ulan West mine plan will not cause any additional impact upon the Talbragar Fish Fossil Reserve and will retain the performance outcome of negligible impact.
Heritage Sites	No greater impact than predicted in the EA	As discussed in Sections 4.2.3 the impacts of the proposed modifications are not greater than those predicted in the Ulan Coal – Continued Operations Environmental Assessment (Umwelt 2009).
Built Features		
All built features	Safe, serviceable and repairable unless the owner agrees otherwise in writing	There are no utilities or other manmade structures, including residences located within the revised Ulan West Longwall panels 1-5 mining footprint. Several four wheel drive tracks traverse the mining area. Minor filling of cracks and re-grading may be required. The revised mine plan will have no additional impact on built facilities to those previously addressed in the Ulan Coal – Continued Operations Environmental Assessment (Umwelt 2009).
Public Safety		
Public Safety	No additional risk due to mining	The revised mine plan will have no additional public safety impacts to those previously addressed in the Ulan Coal – Continued Operations Environmental Assessment (Umwelt 2009).

4.2.2 Groundwater

Mackie Environmental Research Pty Ltd (MER) has assessed the potential groundwater impacts associated with the revised Ulan West Mine plan. A summary of the key findings is provided below, with the copy of their advice included in **Appendix 5**.

The revised mine plan results in a minor reduction to the underground mining footprint and an alteration to the mining schedule during the early years of mining. These changes while minor, result in slight changes to the groundwater influx due to the altered mining schedule during the early years. Overall however, the groundwater impact (i.e. extent of depressurisation) of UCML's operations is unchanged, as the mine life and mining footprint from that used to assess UCML's groundwater impacts in the 2011 EA is unchanged.

4.2.3 Aboriginal Archaeology

Under the revised mine plan there are two sites being site 444 an artefact scatter and site 1387 an isolated find which are now within the subsidence affectation zone. It is noted that site 1387 has however, been removed as part of the construction of the Ulan West Box cut in accordance with UCML's approved Aboriginal Cultural Heritage Management Plan. Neither site type is particularly sensitive to subsidence impacts and as such no impacts are predicted to occur as a result of the revised mine plan. Furthermore, two Aboriginal archaeological sites (i.e. 464 and 465) will no longer be located within the subsidence affectation zone and therefore will not be exposed to subsidence impacts. Each site is a rockshelter with Potential Archaeological Deposit (PAD) with a low significance assessment ranking (refer to **Figure 5**). No change in the level of impact is predicted to occur at any of the remaining Aboriginal archaeological sites as a result of the revised mine plan.

The archaeological site 444 is unlikely to be adversely impacted by subsidence movements. No changes to the Heritage Management Plan are required to adequately address any potential subsidence impact on this site.

4.2.4 Surface Water

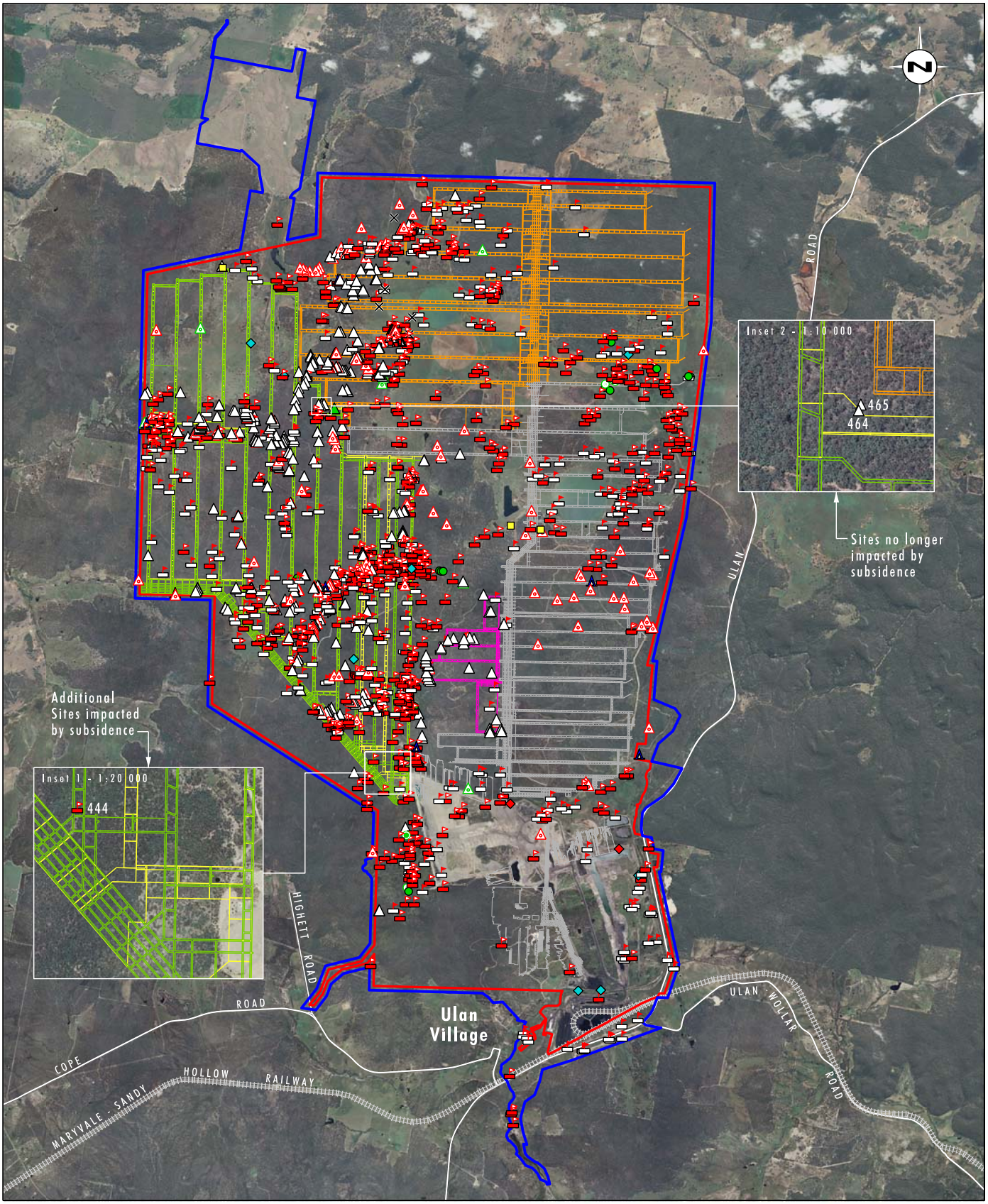
Umwelt has assessed the potential surface water impacts associated with the revised Ulan West Mine plan. A summary of the key findings is provided below, with the copy of the advice included in **Appendix 6**).

Four tributaries of Ulan Creek will be subject to altered subsidence impacts as a result of the modified Ulan West mine plan. A field inspection of these watercourses was carried out on 29 February 2012. The gradient, water velocity and tractive stress, all of which are measures of stream stability, were calculated at a number of locations along the length of each watercourse for the existing, approved and proposed landforms and four critical duration rainfall events (i.e. 1.5 year, 2 year, 10year and 20 year Average Recurrence Interval (ARI)), as relevant.

The relocation and the introduction of an addition chain pillar associated with the modified Ulan West mine plan results in localised changes in elevation over the length of the watercourses. The resulting changes in grade are however is only very minor when comparing the three landforms.

The velocities and tractive stresses for each landform and critical duration rainfall event generally show little change within the modelled extent of the watercourse, irrespective of the landform or ARI event. Localised differences along the watercourse are present, however the magnitude of the change between the existing and approved and the existing and proposed modelled velocities and tractive stresses are generally of a similar range.

These minor changes are however, unlikely to exacerbate any instabilities within Ulan Creek or its tributaries significantly beyond the existing conditions or approved impacts during any of the modelled critical duration rainfall events (i.e. if the channel is unstable in the existing landform it remains unstable in the approved and proposed landforms). It is also noted that the magnitude of these changes are generally of a similar range to that associated with the approved mine plan. As a holistic system the impact of this change is expected to be minimal and no adverse impacts are predicted to occur.



Source: Ulan Coal, Aerial Photo December 2007

Legend

- Colliery Holding Boundary
- EA Project Area
- Approved Ulan West Mine Plan
- Revised Ulan West Mine Plan
- Ulan No. 3 Underground Mineplan
- North First Workings
- Previous Underground Mining Operations
- Artefact Scatter
- Grinding Groove
- Grinding Groove and Artefact Scatter
- Isolated Find
- Ochre Quarry
- Rockshelter with Art
- Rockshelter with Art and Artefact
- Rockshelter with Art and Grinding Grooves and Artefacts
- Rockshelter with Artefact
- Rockshelter with Grinding Groove
- Rockshelter with Grinding Groove and Artefact
- Rockshelter with PAD
- Scarred Tree and Artefact Scatter
- Scarred Tree
- Stone Arrangement
- Waterhole/Well

0 1.0 2.5 5.0km
Main Scale 1:100 000
0 200 500 1km
Inset Scale 1 - 1:20 000
0 100 250 500m
Inset Scale 2 - 1:10 000

FIGURE 5

Aboriginal Archaeological Sites for the Revised Ulan West Mine Plan

File Name (A4): R02/3036_019.dgn
20120504 12.10

4.2.5 Ecology

Approximately 200 metres of cliffline are no longer located within the Ulan West mining footprint, due to the reduced length of Longwall and will therefore no longer be impacted by Ulan West mining (refer to **Figure 6)**. This results in a minor positive outcome and is generally in accordance with the project approval. No change in the level of impact on cliff lines is expected as a result of the revised mine plan.

The extent of the ecological offset and conservation areas is unchanged (refer to **Figure 7**). It is noted that the Bobadeen Vegetation Offset Area is located below the northern end of Longwalls 1–3. Relocating the panels to the south is not expected to result in any impact on the Bobadeen Vegetation Offset Area.

Any variations to the approved surface infrastructure locations will be subject to due diligence assessments as a result of detailed design in accordance with UCML Environmental Management Strategy (ULN SD PLN 0050).

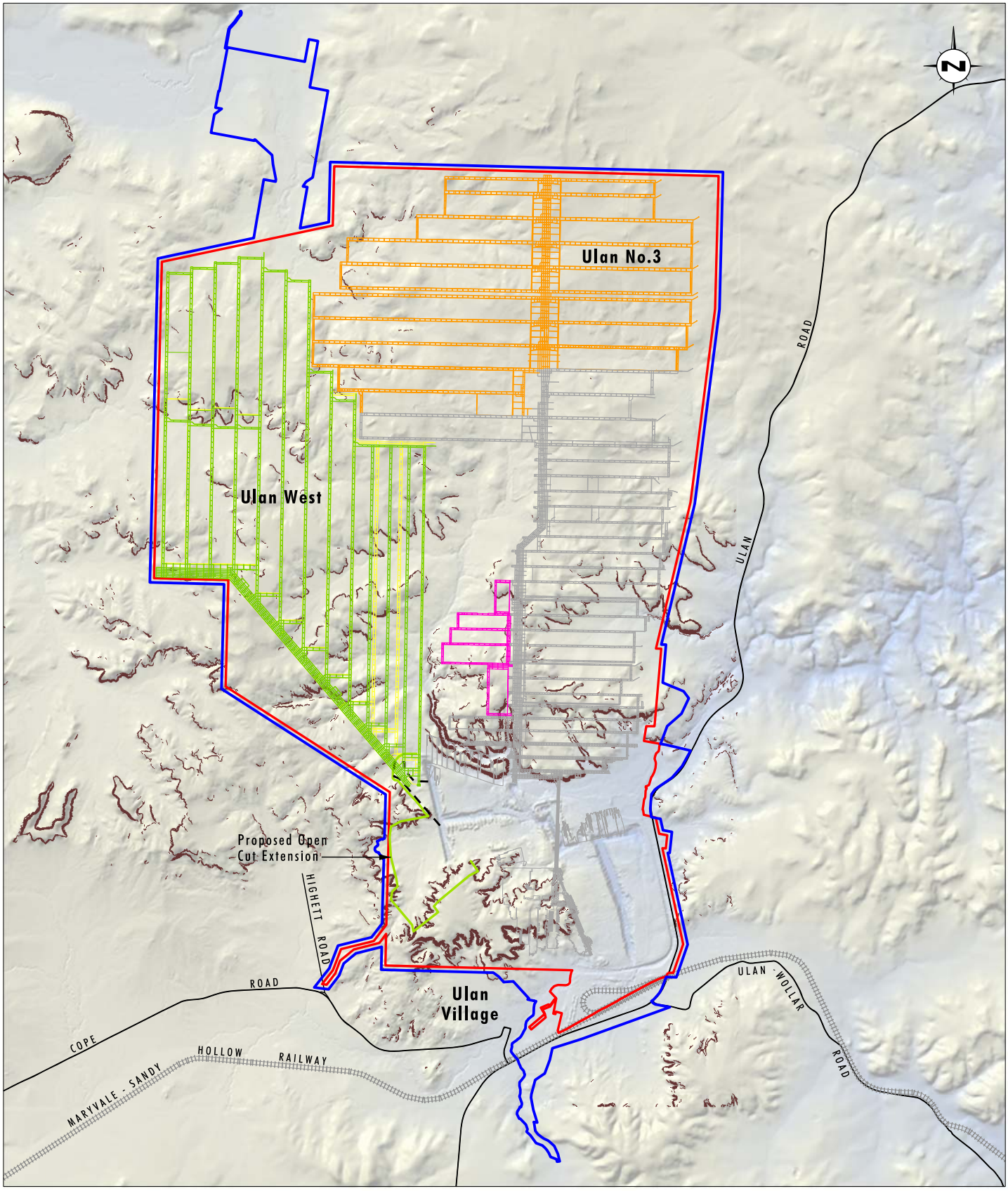
4.2.6 European and Natural Heritage

Subsidence is the only potential impact which may impact on the European heritage sites located within the revised subsidence affection zone. Within the revised subsidence affection zone there are 3 European heritage sites located (i.e. RV 3, CI198/G and PK422) (refer to **Figure 8**). **Table 4.4** provides a comparison of the approved and revised impacts for each site.

Table 4.4 – European Heritage Sites Impact Comparison

Site ID/Description	Level of Impact Predicted in the 2009 EA	Revised Impact Prediction
RV 3 – Homestead Complex	This site is located on the edge of Longwall 1 and will be subject to mining subsidence movements which are not expected to be perceptible in the context of the existing condition of this site.	The site is now located close to the chain pillar at the northern end of longwall 2 and is expected to experience less than the full range of subsidence. The impacts of which are consistent with the EA (i.e. not expected to be perceptible in the context of the existing condition of this site).
CI198/G – Rock shelter with Associated Rough Stone Built Low Wall	This site is located near the edge of Longwall 1 and will be subject to the full range subsidence movements. Due to the relatively small size of the site, impacts are likely to be limited to cracking of the floor.	Impact prediction is unchanged, as the location of the site relative to the edge of the longwall is unchanged.
PK422 – remnant Chimney bases	The full range of subsidence is expected at this site.	The full range of subsidence is expected at this site.

Overall the revised Ulan West Mine Plan results in impacts on European and natural heritage sites which are either less than or identical to that predicted in the 2009 Ulan Coal – Continued Operations Environmental Assessment.



Source: Ulan Coal - Mine Plans

0 1.0 2.5 5.0km
1:100 000

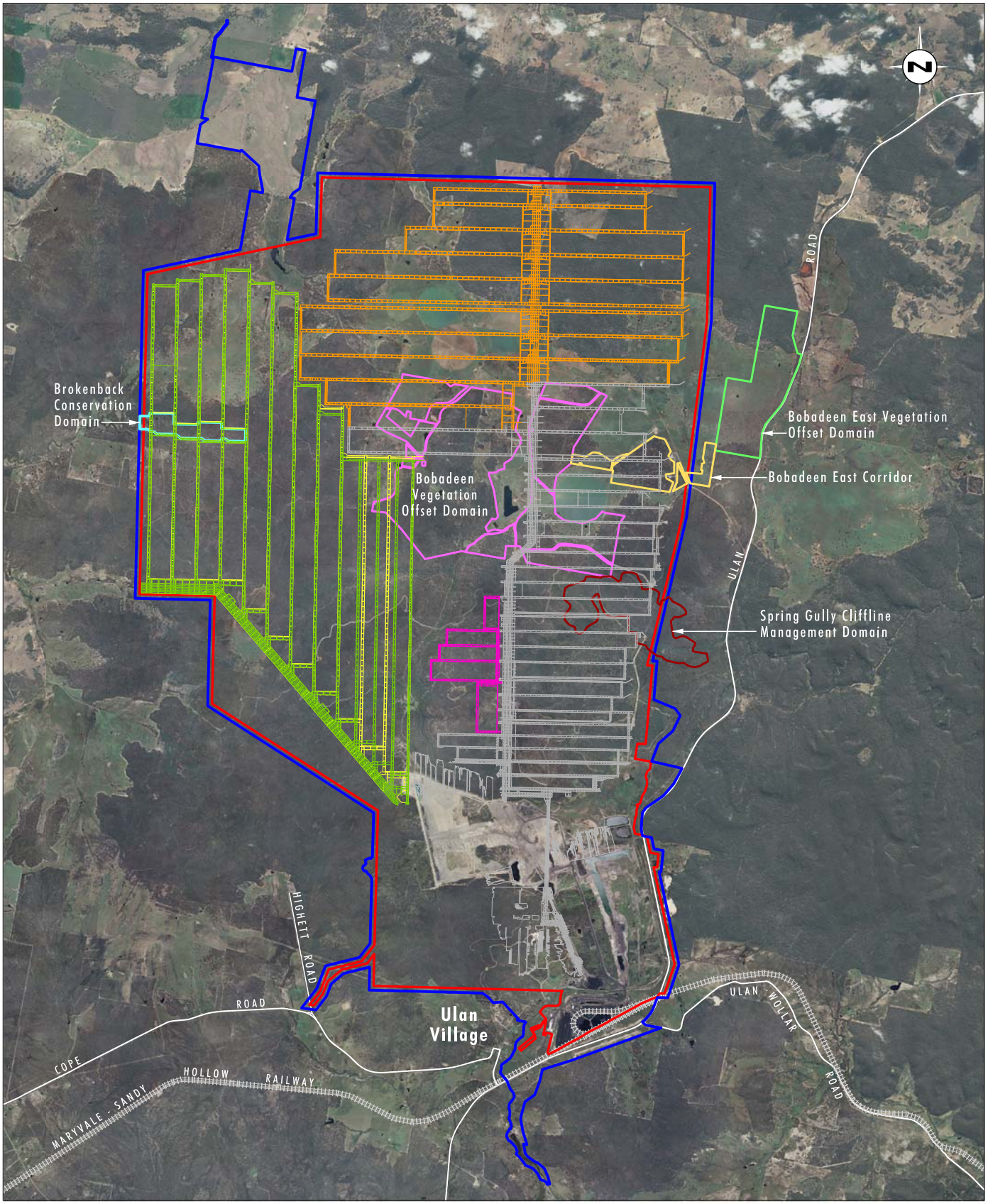
Legend

- Colliery Holding Boundary
- Project Boundary
- Proposed Open Cut Extension
- Approved Ulan West Mine Plan
- Ulan No.3 Underground Mine Plan
- Previous Underground Mining Operations
- North First Workings
- Revised Ulan West Mine Plan
- Box Cut Option
- Modelled Cliff Lines

FIGURE 6

Modelled Cliff Formations Relative to the Revised Ulan West Mine Plan

File Name (A4): R02/3036_020.dgn



Source: Ulan Coal, Aerial Photo December 2007

0 1.0 2.5 5.0km
1:100 000

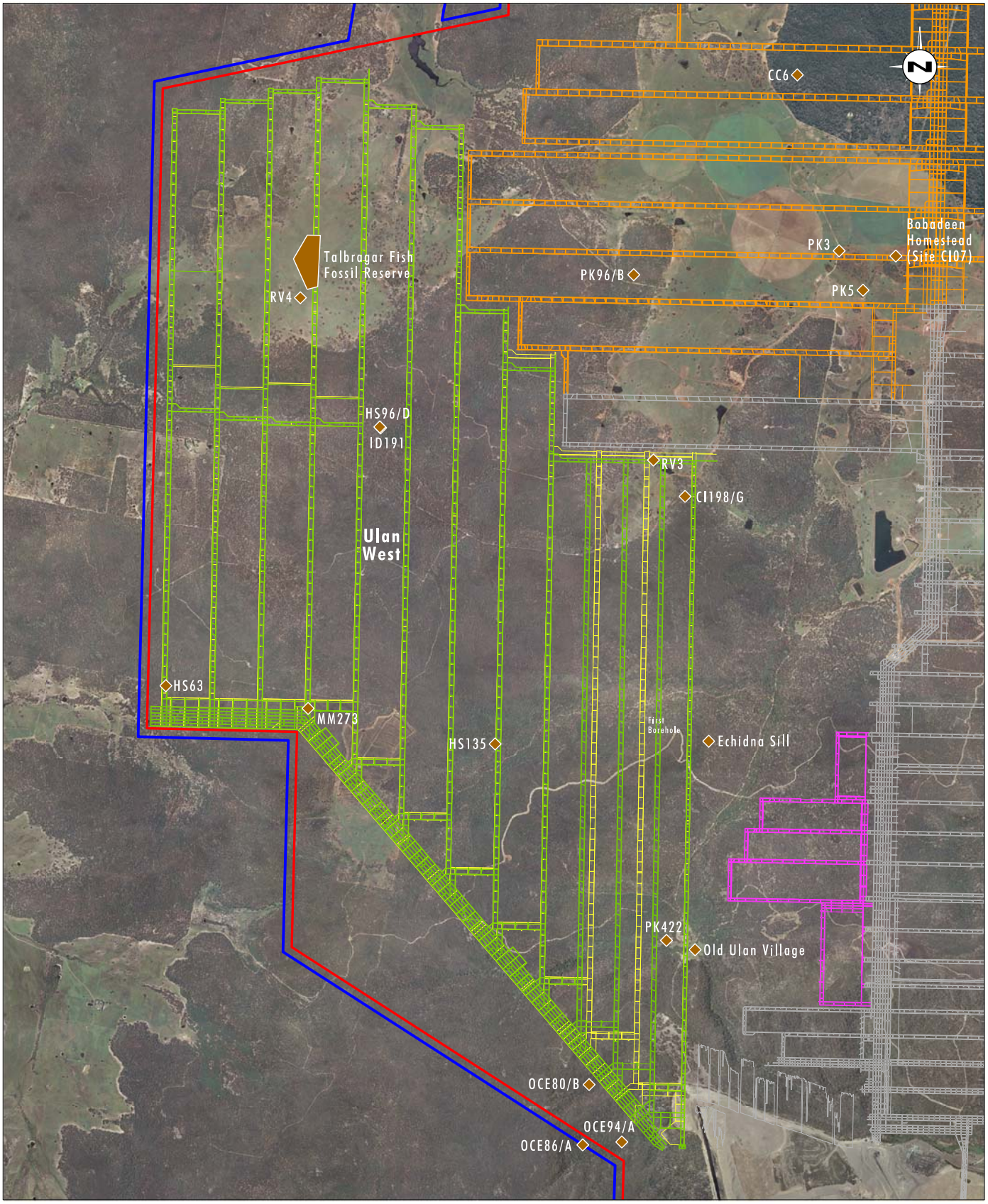
Legend

- Colliery Holding Boundary
- EA Project Area
- Approved Ulan West Mine Plan
- Revised Ulan West Mine Plan
- Ulan No. 3 Underground Mineplan
- North First Workings
- Previous Underground Mining Operations
- Bobadeen Vegetation Offset Domain
- Bobadeen East Vegetation Offset Domain
- Brokenback Conservation Domain
- Spring Gully Cliff Line Management Domain
- Bobadeen East Corridor

FIGURE 7

Biodiversity Offset and Aboriginal Archaeological Management Areas Relative to the Revised Ulan West Mine Plan

File Name (A4): R02/3036_021.dgn
20120504 12.14



Source: Ulan Coal (2009 EA) and Aerial Photo December (2010)

0 1.0 2.0 2.5km

1:50 000

Legend

- Colliery Holding Boundary
- Project Boundary
- Approved Ulan West Mine Plan
- Revised Ulan West Mine Plan
- Ulan No.3 Underground Mine Plan
- Previous Underground Mining Operations
- North First Workings
- Historical Sites/Items (South East Archaeology 2008)

FIGURE 8

European and Natural Heritage Relative to the Reduced Panel Width Ulan West

File Name (A4): R02/3036_022.dgn
20120504 12.16

5.0 Justification for Proposed Modification

5.1 Blasting

As outlined above, the environmental impacts of the proposed amendment to the blasting conditions are expected to be minimal or consistent with the project approval. The increase to the frequency and period within which construction blasts can be undertaken will provide increased operational flexibility for the construction related blasting activities associated with the Ulan West ventilation shaft.

Modifying the project approval to allow multiple blasts per day is consistent with Statement of Commitment 6.10.5 – 'Minor blasts such as that associated with small scale construction projects i.e. construction of ventilation shafts will not be limited in terms of frequency or require monitoring where UCML confirms by design and prediction prior to blasting that the overpressure and vibration levels will be less than 95 dBL'.

The construction of the ventilation shaft is critical to the continuation of underground mining, as this shaft provides the main return ventilation of the Ulan West Underground Mine. A delay associated with the construction of the shaft increases the risk and possible duration of a suspension of underground mining due to a lack of main return ventilation. A suspension of underground mining will result in operation losses.

Alternatives considered included:

- limiting the frequency so that it does not coincide with other blasting activities (i.e. open cut or quarry); or
- limiting the period of blasting; or
- mechanical excavation; and
- raised bore excavation.

None of these options were considered to be practical as it increases the duration of construction and increases the risk of suspending the underground mining operations.

The primary benefits of the proposed amendments are:

- that the potential blasting impacts are minimal or consistent with the project approval;
- improved efficiencies with regard to the construction of the ventilation shaft;
- the risk of suspending the Ulan West underground mining operations are minimised; and
- clarifies the European and natural heritage sites to be protected from blasting impacts.

Given that the proposed modification involves limited environmental consequences beyond the current Project Approval, we seek a minor modification to Project Approval 08_0184 under Section 75W of the EP&A Act to allow for the proposed activities outlined in this letter.

The modifications requested will also allow for infrastructure blasting for future ancillary facilities (i.e. ventilation shafts) as detailed in the Ulan Coal Continued Operations Environmental Assessment (Umwelt 2009) and subsequent modifications and approved by PA 08_0184.

5.2 Mine Plan Amendments

Approved Longwall 1-3 are proposed to be reduced in width from 400 metres to now include 4 longwall with widths of approximately 250, 300, 300, 305 metres. This is proposed due to the potential issues created by extracting longwalls in a 'virgin' area where there has been no stress relief either side of the first longwall. This stress has the potential to adversely affect the maingate roadways. By reducing the longwall width of the first panel the speed of extraction of that longwall is increased and as such the length of time the initial maingate is required to be maintained is reduced. The remaining longwalls have then been adjusted to fit within the approved Ulan West mining area.

The length of the original Longwalls 1-4 have also been reduced to increase the size of the barrier between the old workings of No 3 underground mine to the north.

The proposed amendments to mine plan geometry are located entirely within the approved mine footprint and are consistent with the approved mine plan alignment. Impacts as identified in **Section 4.2** are considered to be consistent with the existing approval.

APPENDIX 1

Application to Modify a Development Consent

Application to modify a development consent

NSW GOVERNMENT
Department of Planning

Date lodged: ____/____/____

DA modification no. _____
(Office use only)

1. Before you lodge

This form is to be used for applications to modify Part 4 development consents under section 96 or 96AA of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This form is also to be used for Part 4 development consents that are to be modified under section 75W of the Act.

Disclosure statement
Persons lodging modification applications are required to declare reportable political donations (including donations of or more than $1,000) made in the previous two years. For more details, including a disclosure form, go to **www.planning.nsw.gov.au/donations.**

Lodgement
Anyone wishing to lodge an application is recommended to call the Department of Planning to discuss their proposal and modification application requirements prior to lodging their application. You can lodge your completed form, together with attachments and fees at the relevant Department of Planning office listed below. Please lodge Part 4 modification applications with the Department of Planning head office or, for modification applications that are within the Kosciuszko ski resorts area, the Department's Alpine Resorts team.

NSW Department of Planning
Head Office
Ground Floor, 23–33 Bridge Street, Sydney NSW 2000
GPO Box 39 Sydney NSW 2001
Phone: 1300 305 695 Fax: (02) 9228 6555
Email: information@planning.nsw.gov.au

NSW Department of Planning
Alpine Resorts Team
Shop 5A, Snowy River Avenue
PO Box 36, Jindabyne NSW 2627
Phone: (02) 6456 1733 Fax: (02) 6456 1736
Email: alpineresorts@planning.nsw.gov.au

To minimise delay in receiving a decision about your application, please ensure you submit all relevant Information to the Department. When your application has been assessed, you will receive a notice of determination.

2. Applicant and contact details

Company/organisation/agency: Ulan Coal Mines Limited

ABN: 80000189248

☒ Mr ☐ Ms ☐ Mrs ☐ Dr ☐ Other

First name: Dan

Family name: Clifford

STREET ADDRESS

Unit/street no.: 4505

Street name: Ulan Road

Suburb or town: Ulan

State: NSW

Postcode: 2850

POSTAL ADDRESS (or mark 'as above')

PO Box 3006

Suburb or town: Mudgee

State: NSW

Postcode: 2850

Daytime telephone: (02)63725300

Fax: (02)63725333

Mobile:

Email: dclifford@xstratacoal.com.au

3. Property description

Unit/street no. (or lot no. for Kosciuszko ski resorts): 4505

Street or property name: Ulan Road

Suburb, town or locality: Mudgee

Postcode: 2850

Local government area: MWRC

Lot/DP or Lot/Section/DP or Lot/Strata no.
Please ensure that you put a slash (/) between lot, section, DP and strata numbers. If you have more than one piece of land, you will need to separate them with a comma e.g. 123/579, 162/2.

See attached Schedule of Lands

Note: You can find the lot, section, DP or strata number on a map of the land or on the title documents for the land, if title was provided after 30 October 1983. If you have documents older than this, you will need to contact the NSW Department of Lands for updated details. If the subject land is located within the Kosciuszko ski resorts area, DP and strata numbers do not apply.

4. Details of the original development consent

Briefly describe your approved development in the space below. If the development has been modified previously you must list all previous modifications and the relevant determination date(s).

Ulan Coal Continued Operations

What was the original development application no.?: 08_0184

What was the date consent was granted?: 5 April 2012

What was the original application fee?: $231,700

5. Type of modification

An application under section 96 of the EP&A Act is an application to modify a development consent. Modifications to a development consent can also be made under section 75W of the EP&A Act, or section 96AA for court granted consents.

There are five types of modification applications. Please tick the type of modification application that is being sought:

- ☐ Section 96(1) involving minor error, misdescription or miscalculation.
- ☐ Section 96(1A) involving minimal environmental impact, where the development as originally approved remains substantially the same.
- ☐ Section 96(2) other modification, where the development as originally approved remains substantially the same.
- ☐ Section 96AA modification of consent granted by the Land and Environment Court, where the development as originally approved remains substantially the same.
- ☒ Section 75W modification, involving use of Part 3A processes to modify the Part 4 consent.

Note: If the proposed modification will lead to the consented development being not 'substantially the same' (except in the case of a proposed modification under section 75W) then you will need to submit a new development application.

6. Extent of modification

Will the modified development be substantially the same as the development that was originally approved?

No ☐➢ Please submit a new development application.

Yes ☒➢ Please provide evidence that the development will remain substantially the same. (If you need to attach additional pages, please list below the material attached).

Environmental Assessment for modification to Ulan Coal Continued Operations Ulan West Mine Plan (Panels 1-4) realignment and amendment to blasting conditions.

Note: Question 6 does not apply to proposed modifications under section 75W.

7. Description of modification

- In the case of a section 96(1) application, indicate the nature of the minor error, misdescription or miscalculation in the space below.
- In the case of a section 96(1A), section 96(2) or section 96AA application describe the impact of the modification in the space below. A statement of environmental effects will need to accompany the application, which includes an assessment of the development as proposed to be modified in accordance with section 79C(1) of the EP&A Act. Provisions of the *Heritage Act 1977* may also apply for works to a heritage item or works adjoining a heritage item.
- In the case of a section 75W application under clause 8J(8) of the Environmental Planning and Assessment Regulation 2000, a development consent in force immediately before the commencement of Part 3A of the Act may be modified under section 75W as if the consent were an approval under that Part. However, approval from the Minister is required to lodge a section 75W application. **Applicants should contact the Department first if they are considering applying for a modification under section 75W.**

Regardless of the type of modification, please state below the specific conditions of consent to be modified, deleted or additional conditions request, and details of any other changes being sought.

Modification to Ulan West Longwall Panels 1-4 Geometry.

Amendment to blasting conditions including:

Condition 12 (Blasting Frequency): Minor blasts such as that associated with small scale construction projects i.e. construction of ventilation shafts will not be limited in terms of frequency or require monitoring where UCML confirms by design and prediction prior to blasting that the overpressure and vibration levels will be less than 95dBL and 1 mm/sec at all private buildings or Heritage Sites identified in Appendix 7 of PA08_0184. These blasts are in addition to the 'one blast per day' typically associated with the operation of the open cut (i.e. overburden and coal blasts).

Condition 11 (Blasting Period): UCML seesk to extend the hours within which construction blasting activities can be undertaken to 24 hours per day 7 days per week.

Appendix 7: Remove the heritage sites with no historical significance from the figure. (i.e. only show the sites PK243, Bobadeen Homestead (C107), PK3, PK5, PK422, Old Ulan Village and the Talbragar Fish Fossil Reserve).

Note: If your proposal is within Kosciuszko ski resorts area, please attach a copy of the Interim Lease Variation Approval received from the Department of Environment and Climate Change to your application.

8. General terms of approval from State agencies

If the original development application was classified as integrated development and required approval from one or more State agencies, list them in the space below and their respective general terms of approval. Depending on the type of modification, it may be necessary to refer the modification application to the approval body.

9. Number of jobs to be created

Please indicate the number of jobs the proposed development will create. This should be expressed as a proportion of full time jobs over a full year, (e.g. a person employed full time for 6 months would equal 0.5 of a full time equivalent job; six contractors working on and off over 2 weeks equate to 2 people working full time for 2 weeks, which equals approximately 0.08 of an FTE job).

Construction jobs (full time equivalent)	0
Operational jobs (full time equivalent)	0

10. Application fee

Part 15 of the Environmental Planning and Assessment Regulation 2000 sets out how to calculate the fees for an application for modification of a development consent. If your development needs to be advertised to the public you may also need to include an advertising fee.

Note: Advertising fees attract GST, all other fees do not.

Please contact the Department in order to calculate the fee for your modification application.

Estimated cost of the development	Original application fee	Total fees lodged

11. Political donation disclosure statement

Persons lodging modification applications are required to declare reportable political donations (including donations of or more than $1,000) made in the previous two years. Disclosure statements are to be submitted with your application.

Have you attached a disclosure statement to this application?

Yes ☐

No ☒

Note: For more details about political donation disclosure requirements, including a disclosure form, go to **www.planning.nsw.gov.au/donations**.

12. Owner's consent

The owner(s) of the land to be developed must sign the application. If you are not the owner of the land, you must have all the owners sign the application. If the land is Crown land, an authorised officer of the NSW Department of Lands must sign the application. **An original signature must be provided.**

As the owner(s) of the above property, I/we consent to this application:

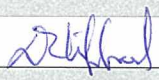
Signature	Signature
Name	Name
Date	Date

Note: For applications within the Kosciuszko ski resorts area, the approval of the lessee rather than the owner is required.

13. Applicant's signature

The applicant, or the applicant's agent, must sign the application. Only an original signature will be accepted (photocopies or faxed copies will not be accepted).

Signature



In what capacity are you signing if you are not the applicant

General Manager

Date

7/5/12

Name, if you are not the applicant

Dan Clifford

14. Privacy policy

The information you provide in this application will enable the Department, and any relevant state agency, to assess your application under the *Environmental Planning and Assessment Act 1979* and other applicable state legislation. If the information is not provided, your application may not be accepted.

If your application is for designated development or advertised development, it will be made available for public inspection and copying during a submission period. Written notification of the application will also be provided to the neighbourhood. You have the right to access and have corrected any information provided in your application. Please ensure that the information is accurate and advise the Department of any changes.

Schedule 1 – Ulan Coal – Continued Operations
Schedule of Lands

Lot	DP	Owner
3	132117	Mine Owned (UCML)
4	132117	Mine Owned (UCML)
19	132631	Mine Owned (UCML)
1	182395	Mine Owned (UCML)
2	182395	Mine Owned (UCML)
3	182395	Mine Owned (UCML)
4	182395	Mine Owned (UCML)
1	206588	Mine Owned (UCML)
2	206588	Mine Owned (UCML)
3	206588	Mine Owned (UCML)
4	206588	Mine Owned (UCML)
5	206588	Mine Owned (UCML)
6	206588	Mine Owned (UCML)
7	206588	Mine Owned (UCML)
8	206588	Mine Owned (UCML)
B	408792	Mine Owned (UCML)
C	408792	Mine Owned (UCML)
1	431692	State Rail Authority of NSW
1	432146	State Rail Authority of NSW
2	432146	Mine Owned (UCML)
1	518563	Mine Owned (UCML)
2	518563	Mine Owned (UCML)
1	534014	Crown Land
2	534014	Private
3	534014	Private
2	537477	Mine Owned (UCML)
1	552740	Mine Owned (UCML)
1	572488	Mine Owned (UCML)
101	595015	Mine Owned (UCML)
151	595016	Mine Owned (UCML)
4	615702	Mine Owned (UCML)
32	631102	Mine Owned (UCML)
31	655483	NE Wiradjuri Wilpinjong Community Fund Ltd
1	661026	Mine Owned (UCML)
1	701346	Mine Owned (UCML)
3	701346	Mine Owned (UCML)
4	701346	Mine Owned (UCML)
83	704077	Crown Land Leased (UCML)
84	704077	Private
85	704094	Mine Owned (UCML)
1	720331	Mine Owned (UCML)
1	720332	Mine Owned (UCML)
1	720333	Mine Owned (UCML)
1	720334	Mine Owned (UCML)

Lot	DP	Owner
2	720334	Crown Land Leased (UCML)
3	720334	Crown Land Leased (UCML)
4	720334	Mine Owned (UCML)
1	720335	Mine Owned (UCML)
55	722794	Crown Land Leased (UCML)
1	722880	Mine Owned (UCML)
2	722880	Mine Owned (UCML)
3	722880	Mine Owned (UCML)
4	722880	Mine Owned (UCML)
1	722881	Mine Owned (UCML)
1	722882	Mine Owned (UCML)
2	722882	Mine Owned (UCML)
43	736630	Crown Land
44	736630	Mine Owned (UCML)
45	736630	Mine Owned (UCML)
46	736630	Mine Owned (UCML)
47	736630	Mine Owned (UCML)
48	736630	Mine Owned (UCML)
49	736630	Mine Owned (UCML)
50	736630	Mine Owned (UCML)
51	736630	Mine Owned (UCML)
52	736630	Mine Owned (UCML)
53	736630	Mine Owned (UCML)
54	736630	Mine Owned (UCML)
2	750735	Crown Land Leased (UCML)
3	750735	Mine Owned (UCML)
4	750735	Mine Owned (UCML)
5	750735	Crown Land Leased (UCML)
6	750735	Mine Owned (UCML)
7	750735	Mine Owned (UCML)
8	750735	Mine Owned (UCML)
9	750735	Mine Owned (UCML)
10	750735	Mine Owned (UCML)
11	750735	Mine Owned (UCML)
12	750735	Mine Owned (UCML)
13	750735	Mine Owned (UCML)
15	750735	Mine Owned (UCML)
16	750735	Mine Owned (UCML)
17	750735	Mine Owned (UCML)
18	750735	Mine Owned (UCML)
19	750735	Mine Owned (UCML)
20	750735	Mine Owned (UCML)
22	750735	Private
23	750735	Private
24	750735	Private
27	750735	Private

Lot	DP	Owner
28	750735	Private
29	750735	Private
30	750735	Mine Owned (UCML)
31	750735	Mine Owned (UCML)
32	750735	Private
33	750735	Private
34	750735	Private
35	750735	Mine Owned (UCML)
36	750735	Mine Owned (UCML)
37	750735	Mine Owned (UCML)
38	750735	Private
39	750735	Mine Owned (UCML)
41	750735	Crown Land Leased (UCML)
42	750735	Crown Land Leased (UCML)
43	750735	Crown Land Leased (UCML)
44	750735	Private
45	750735	Mine Owned (UCML)
46	750735	Mine Owned (UCML)
47	750735	Mine Owned (UCML)
48	750735	Crown Land Leased (UCML)
49	750735	Crown Land Leased (Private)
50	750735	Mine Owned (UCML)
51	750735	Mine Owned (UCML)
52	750735	Private
53	750735	Mine Owned (UCML)
54	750735	Mine Owned (UCML)
55	750735	Private
56	750735	Mine Owned (UCML)
178	750735	Mine Owned (UCML)
179	750735	Mine Owned (UCML)
180	750735	Mine Owned (UCML)
211	750735	Mine Owned (UCML)
212	750735	Mine Owned (UCML)
213	750735	Private
2	750736	Mine Owned (UCML)
45	750736	Mine Owned (UCML)
46	750736	Mine Owned (UCML)
54	750736	Mine Owned (UCML)
60	750736	Mine Owned (UCML)
61	750736	Mine Owned (UCML)
164	750748	State Conservation Area
59	750759	Private
1	750773	Mine Owned (UCML)
2	750773	Mine Owned (UCML)
3	750773	Mine Owned (UCML)
5	750773	Mine Owned (UCML)

Lot	DP	Owner
9	750773	Mine Owned (UCML)
11	750773	Mine Owned (UCML)
13	750773	Crown Land Leased (UCML)
14	750773	Crown Land Leased (UCML)
15	750773	Crown Land
16	750773	Crown Land Leased (UCML)
17	750773	Mine Owned (UCML)
18	750773	Mine Owned (UCML)
20	750773	Mine Owned (UCML)
27	750773	Mine Owned (UCML)
28	750773	Mine Owned (UCML)
52	750773	Crown Land Leased (UCML)
54	750773	Mine Owned (UCML)
58	750773	Mine Owned (UCML)
59	750773	Mine Owned (UCML)
63	750773	Mine Owned (UCML)
64	750773	Mine Owned (UCML)
65	750773	Mine Owned (UCML)
66	750773	Mine Owned (UCML)
68	750773	Mine Owned (UCML)
70	750773	Mine Owned (UCML)
71	750773	Mine Owned (UCML)
72	750773	Crown Land Leased (UCML)
73	750773	Mine Owned (UCML)
74	750773	Mine Owned (UCML)
75	750773	Mine Owned (UCML)
76	750773	Crown Land Leased (UCML)
78	750773	Mine Owned (UCML)
79	750773	Mine Owned (UCML)
5	755439	Mine Owned (UCML)
13	755439	Mine Owned (UCML)
20	755439	Mine Owned (UCML)
27	755439	Mine Owned (UCML)
33	755439	Crown Land Leased (UCML)
14	755442	Mine Owned (UCML)
92	755442	Mine Owned (UCML)
1	840034	Mine Owned (UCML)
2	840034	Mine Owned (UCML)
1	876943	Private
7003	1025349	Crown Land Leased (UCML)
7005	1028230	Crown Land
1	1069300	Mine Owned (UCML)
800	1128041	Mine Owned (UCML)
7008	1116385	Crown Land Leased (UCML)
Various Crown Road and Land Reserves		

APPENDIX 2

Assessment of Vibration Impacts for the Proposed Underground Ventilation Shaft (ESC 2012)

ENVIRO STRATA CONSULTING Pty Ltd
A.B.N. 35 122 301 795

24 Albert Street
Valentine NSW 2280
T/F: (02) 4946 1864
Mob: (0407) 005 352
Email: enviro.strata@gmail.com

Thomas Lewandowski
B.E. (Mining), M.M.Mgt,
M.Aus.I.M.M., M.I.S.E.E.,
M.EFEE.

XSTRATA COAL – ULAN WEST UNDERGROUND MINE

ASSESSMENT OF VIBRATION IMPACTS FOR THE PROPOSED UNDERGROUND VENTILATION SHAFT

Report No: UL-1219-310312

Thomas Lewandowski
31st March 2012

XSTRATA COAL – ULAN WEST UNDERGROUND MINE

ASSESSMENT OF VIBRATION IMPACTS FOR THE PROPOSED UNDERGROUND VENTILATION SHAFT

Report No: UL-1219-310312

ENVIRO STRATA CONSULTING Pty Ltd
A.B.N. 35 122 301 795

24 Albert Street
Valentine NSW 2280
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XSTRATA COAL – ULAN WEST UNDERGROUND MINE

ASSESSMENT OF VIBRATION IMPACTS FOR THE PROPOSED UNDERGROUND VENTILATION SHAFT

Report No: UL-1219-310312

1. INTRODUCTION

Enviro Strata Consulting was requested by Xstrata Coal – Ulan West Underground Mine to undertake a blast impact study. This was to assist with identification of likely vibration levels and / or potential issues for the proposed ventilation shaft.

Xstrata Coal – Ulan West Underground is proposing to develop Ulan West Highwall Ventilation Shaft. The proposed plans include development of the ventilation shaft using standard shaft sinking method such as drill and blasting.

The report addresses the details of the proposed shaft activities including blasting with special emphasis on the impact on the surrounding environment. The proposed blasting activities are analysed in the context of the imposed Environmental Licence Conditions.

The main aims of this report are specified as follows:

- To identify the potential blast impacts on the adjacent environment with respect to the proposed blasting parameters.
- To estimate the expected air and ground vibration levels generated during the shaft sinking process.

The presented below report includes blast vibration measurements undertaken recently in 2012, as well as measurements collected in 2009 during the Ulan 3 Upcast Shaft construction.

2. CURRENT BLASTING RESTRICTIONS

Based on the Ulan Coal Blast Management Plan the current maximum vibration limits specified for overpressure and vibration for the European Heritage Site and private residences are presented in **Table 1**.

Table 1 - Blast Impact Criteria (after Ulan Coal Blast Management Plan)

Location	Airblast Overpressure Level (dBL Peak)	Ground Vibration (mm/s)	Allowable Exceedance
Residence on privately owned land	115	5	5% of total number of blasts over a period of 12 months
	120	10	0%
European Heritage Sites on Site	133	10	0%

The Ulan West Project currently operates under an Environmental Protection Licence 394 that limits blasting to one blast per day between the hours of 9am to 5pm and prohibits blasting on Sundays and public holidays.

It should be pointed that the proposed shaft sinking operation is a short term project that does require 24 hours per day operation, seven days per week.

It appears that based on the above blasting restrictions this will provide a major impediment for the proposed temporary shaft sinking operation.

3. PROPOSED SHAFT SINKING ACTIVITIES VERSUS OPEN CUT BLAST ACTIVITIES

The proposed shaft sinking (including drilling, blasting and extraction of muckpile) is an extremely small operation in comparison to standard open cut blasting activities. The operation is small due to the fact that only 3.6 metres of rock strata is to be blasted at any one time. Therefore, the explosive charges are limited to approximately 3.1 metres

in depth and 0.5 metres for the stemming column; refer to **Figure 1**. By comparison the latest open cut overburden blasting depth was in the order of 30 – 40 metres.

The area for the proposed Ulan West ventilation shaft is designed to be in the order of 4.5 metres in diameter only. Therefore, the total blasting area is limited to approximately 15.9 square metres. Blasting will be extremely limited and includes very small charge masses. For example the charge mass of explosives used for the blasting for Shaft No. 3 was only 6.9 kg (assuming 5 holes fired simultaneously).

By comparison the latest Ulan Open Cut Extension overburden shot included blasted area in the order of 27,500 square metres. The MIC for this shot was in the order of 2,950 kg (assuming 2 holes fired simultaneously); see **Figure 2**.

In summary, the above comparison highlight how completely different the scale of blasting activities are when comparing open cut blasting and shaft blasting activities and as such how the impact on the surrounding environment will be completely different.

4. VIBRATION IMPACT ON THE SURROUNDING ENVIRONMENT

The proposed Ulan West mine, the proposed Underground Ventilation Shaft and the locations of the sensitive monitoring points are highlighted in **Figure 3.**

The estimated distances from the proposed underground shaft to the vibration monitoring points are specified as follows:

- BM9 - The European Heritage – Old Ulan Village – 1657 metres
- BM3 - Receiver 6 - 4095 metres
- BM1 - Ulan School – 5265 metres

4.1 Ground Vibrations

To provide an indication about the potential impact of the proposed shaft blasting on the adjacent environment, vibration modelling was undertaken. The vibration predictive model used for this purpose was based on the existing model previously generated for Ulan Open Cut. The undertaken modelling was used to simulate the potential ground vibration impacts. It is therefore assumed that similar ground vibration behaviour will be generated when blasting for the proposed underground shaft.

The parameters summarising the site law analysis (governing ground vibration behaviour) are presented below:

$$V = k\left(\frac{D}{\sqrt{m}}\right)^{a}$$

Where: V = Peak Particle Velocity (mm/s)
D = Distance from blast (m)
m = Charge mass per delay (kg)
k = site constant (1360)
a = Site exponent (-1.75)

The generated site law analysis for Ulan conditions (i.e. Vibration Predictive Model for Ulan Conditions) is presented in **Appendix 1A**.

To ensure that the provided vibration estimations are accurate the above specified model has been tested against the vibration monitoring results. The monitoring results include results obtained from the sump blast fired on the 21.02.2012 and also from blasting for Shaft No. 3 (Report Ref. No. 09285_R01). The results from these two blasts are also summarised in **Table 2**.

Table 2 – Summary of results for Sump and Shaft Blasts

Blast Type	Date	Location	Distance (m)	Gr. Vibr. (mm/s)	Air Vibr. (dBL)
Sump	21.02.2012	BM9 – Old Ulan	2540	1.14	95.9
		BM7 – 445	1873	1.9	97.5
		BM8 – 1395	1517	1.58	100
		BM3 – Marshal1's	3634	0.33	95.2
		BM1- Ulan School	4075	0.31	88.5
Shaft	21.11.2009	Colinta property	1700	< 0.2*	< 110
		Old Homestead	700	< 0.2*	< 110
		Cattle yards	140	0.86	122

*unit did not trigger

The obtained vibration monitoring results were plotted against the existing vibration predictive model and are presented in **Appendices 1B-C**. As it can be observed, all vibration monitoring results are either close to or below the Ulan Ground Vibration Predictive Model. In view of the obtained assessment it can be concluded that the model is valid and vibration predictions using the discussed model have some degree of conservatism.

The impact of vibrations on the adjacent environment was simulated using a contour line assessment technique. This technique gives an indication about probable vibration levels. This is based on the discussed vibration predictive model. In this case, each contour is drawn from the proposed underground shaft (i.e. blasting area). The ground vibration analysis is presented as a series of contour lines overlying the area adjacent to

the mining lease. Note that up to 7 main contours of interest were drawn, i.e. 0.1, 0.2, 0.3, 0.4, 0.5, 1 and 2 mm/s.

Based on the provided blast design details there are two different cases presented. The first one includes modelling for single hole initiation (i.e. representing 2.8 kg of explosive per hole), see **Figure 4A**. The second one represents the scenario that all 25 holes will be fired simultaneously (i.e. representing 70 kg of explosives), see **Figure 4B**.

The results and the impact on the surrounding environment are also summarised in **Table 3**. Based on the undertaken modelling (even considering the worst case scenario) it can be concluded that the inferred vibration impact on the adjacent environment is minimal and can be considered inconsequential. The predicted vibration levels are well below human perception level. In fact, it is important to stress that depending upon the instrumentation used it will be difficult, or even impossible to capture such low vibration levels as the predicted levels will generally be below the trigger vibration level of the instrument used. A similar experience was encountered during the previous Shaft No. 3 blasting (Report Ref. No. 09285_R01).

Based on the author's experience, levels below 0.8 mm/s should not be detectable by humans. The author is aware of a case where a person could sense 0.5-0.6 mm/s levels. In this case, however the person was incapacitated and confined to bed; a human body is more receptive to induced vibrations when in a horizontal position. Generally levels below 0.4-0.5 mm/s are not detectable. Consequently in view of the predicted ground vibration level of 0.03 mm/s for the closest residence, the vibrations generated during the proposed shaft blasting will not be at all detectable.

4.2 Air Vibrations

Similar to the ground vibration modelling, air vibration modelling was also undertaken. For that purpose, an air vibration model generated for Ulan conditions has been used.

The parameters summarising the site law analysis (governing air vibration behaviour) are presented below:

$$P = k\left(\frac{D}{\sqrt[3]{W}}\right)^{a}$$

Where:
- P = Peak Pressure in kPa
- k = Site Constant (20)
- a = Site Exponent (-1.43)
- D = Distance from blast (m)
- W = Charge mass per delay (kg)

The generated sonic decay law analysis for Ulan conditions is also presented in graphical format in **Appendix 2A**.

To ensure that the provided vibration estimations are accurate the above specified model has been tested against the air vibration monitoring results. The monitoring results included results obtained from the sump blast fired on the 21.02.2012 and also from blasting for Shaft No. 3 (Report Ref. No. 09285_R01). The results from these two blasts are also summarised in **Table 2**

The obtained vibration monitoring results were plotted against the existing vibration predictive model and are presented in **Appendices 2B-C**. As one can observe all vibration monitoring results are either close to or below the Ulan air vibration predictive model. In view of the obtained assessment it can be concluded that the model is valid and air vibration predictions using the discussed model have some degree of conservatism.

As for ground vibrations the impact of air vibrations on the adjacent environment was simulated using a contour line assessment technique. This technique gives an indication about potential air vibration levels. This is based on the discussed air vibration predictive model. In this case, each contour is drawn from the proposed underground shaft (i.e. blasting area). The air vibration analysis is presented as a series of contour lines overlying the area adjacent to the mining lease. Note that up to 7 main contours of interest were drawn, i.e. 95, 100, 105, 110, 115, 120 and 125 dBL.

Based on the provided blast design details there are two different cases presented. The first one includes modelling for single hole initiation (i.e. representing 2.8 kg of explosive per hole), see **Figure 5A**. The second one represents the scenario that all 25 holes will be fired simultaneously (i.e. representing 70 kg of explosives), see **Figure 5B**.

The results and the impact on the surrounding environment (i.e. represented by the monitoring stations) are also summarised in **Table 3**. Based on the undertaken modelling it can be concluded that the inferred air vibration impact on the adjacent environment is minimal. The predicted vibration levels are low. For the European Heritage station (i.e. Old Ulan Village), the worst case scenario indicates 106 dBL, while the imposed air vibration limit for this station is 133 dBL. Air vibration impacts for the other stations of interest are in the order of 91-94 dBL, which is below the human perception level.

Based on the author's experience levels between 102 and 106 dBL are barely detectible by humans. Furthermore, atmospheric conditions have to be calm if these levels are to be detected. In the presence of wind these levels are not at all detectable as they are drowned in the background 'noise' caused by the wind action.
The air vibrations below 102 dBL are generally not discernible to human perception. Therefore the predicted levels of 91-94 dBL for the closest private residences (i.e. Ulan School and BM3-Receiver6) due to the proposed shaft blasting are considered undetectable. Furthermore, they are borderline of the typical monitoring instrument sensitivity, usually set to detect levels 88 dBL and above.

Lastly, it is important to note that the model is quite conservative and does not take into account the effect of topographical shielding (such as blasting at the bottom of the box cut in the initial stage of the shaft sinking and later on blasting deeper into strata i.e. within the shaft well). This will significantly assist in the reduction of air vibration levels of at least 3 – 8 dBL lower than the predicted values.

Table 3 – Summary of air and ground vibration results

Station	Distance (m)	Predicted Gr. Vibr. (mm/s)	Predicted Air Vibr. (dBL)
Blast type - Single hole initiation (2.8 kg)			
BM1 - Ulan School	5265	0.001	78
BM9 - Old Ulan Village	1657	0.008	92
BM3 - Receiver 6	4095	0.002	81
Blast type - 25 hole initiation (70 kg)			
BM1 - Ulan School	5265	0.02	91
BM9 - Old Ulan Village	1657	0.13	106
BM3 - Receiver 6	4095	0.03	94

5. CONCLUSIONS

Enviro Strata Consulting was requested by Xstrata Coal – Ulan West Underground Project to undertake a blast impact study, for the proposed Underground Ventilation Shaft development. The findings of this report can be summarised as follows:

- The method of shaft development has been identified as a standard shaft sinking method including drill and blast operations. The proposed blast design parameters for the shaft have been compared to those of a standard open cut blasting operation. During a shaft sinking process there are substantially different parameters used and include small charges in the order of 2.8 kg per hole only, 25 holes firing, with a limited blasting area (i.e. 4.5 metres in diameter).
- The air and ground vibration models have been presented and tested against the previous blast vibration measurements, including results obtained from the blasting of Shaft No. 3 in 2009 and from the Sump Blast in 2012.
- Based on the undertaken ground vibration modelling it can be concluded that the inferred vibration impact on the adjacent environment is minimal and can be considered inconsequential, i.e. vibration levels of less than 0.008 mm/s for single hole initiation and vibration levels of less than 0.13 mm/s for the worst

case scenario assuming the scenario that all 25 holes are detonated at the same time. The predicted vibration levels are well below the human perception level. Also, it is important to stress that depending upon the instrumentation used it will be difficult, or even impossible to capture such low vibration levels as the predicted levels will generally be below the trigger vibration level of the instrument used. A similar experience was encountered during the Shaft No. 3 blasting (Report Ref. No. 09285_R01).

- Based on the undertaken modelling it can be concluded that the inferred air vibration impact on the adjacent environment is minimal and can be considered inconsequential. The predicted vibration levels are low and are expected to be in the order of 106 dBL for the European Heritage (the current limit is 133 dBL), and 91-94 dBL for other stations. This is in the context of the worst case scenario (i.e. firing 25 holes simultaneously). The author acknowledges some degree of conservatism in the vibration predictions as the model does not take into account the impact of topographical shielding.
- Based on the undertaken investigation it appears that the closest private residence is BM3 – Receiver 6. The predicted vibration levels for this residence in view of the worst case scenario are 0.03 mm/s for the ground vibration and 94 dBL for the air blast. These vibration levels are well below the human perception levels generally accepted as 0.8 mm/s for ground vibration and 102 – 105 dBL for air vibration.
- It is important to note that the direct comparison between air vibration measurements for audible community noise monitoring (using dBA scale) and the air blast impact/noise monitoring (using dBL – decibels Linear) is not a straight forward concept. It should be explained that the operational frequency of the instruments in each case is significantly different i.e. instruments for audible community noise monitoring operate within 20 – 20,000 Hz, while instruments for blast monitoring generally operate within 2 - 250 Hz (including sub audible range of less than 20 Hz).

  Typically frequency of an air blast (air pressure pulse) generated during blasting is in the order of 2 – 5 Hz. At such low frequencies the human perceptibility is significantly reduced (i.e. sub-audible range). Furthermore, for audible community noise monitoring the A-weighting system is employed. Basically, the A-weighting filter substantially reduces the recorder peak pressure (i.e. the A-weighting does not respond to the low frequency pressure pulses, which are generated during air blast emission). Therefore, a comparison of say 80-90 dB level (i.e. 80-90 dBA) representing average street traffic (using standard Bruel and Kjer Instruments, 1976, diagram) and an air blast measurement of numerically comparable value of 90 dBL are completely misleading. These two measurements would have been measured with a completely different frequency reference range. Even though the two values are numerically the same they were measured by two different systems and are perceived differently by humans; 90 dB (i.e. dBA) represents loud sound while 90 dBL is not audible.
- It is concluded that the estimated blast noise level of 94 dBL is well below the human perception level (i.e. it can be compared to less than 30 dBA, where 30 dBA corresponds to a background noise level at a rural residential location). To

highlight this point further the following air blast levels and human responses are summarised as below:

- 143 - 145 dBL – a possibility of window damage (from other studies)
- 119 - 125 dBL – onset of a high level of community annoyance (high number of complaints)
- 113 - 116 dBL – an initial level of alertness for community (occasional complaints)
- < 108 dBL – a level generally accepted by the community
- 102 - 105 dBL – a level barely detectable by a person (only on a calm day)
- < 96 dBL – levels not detectable (below human perception level)
- 88 dBL – instrument limitation, below sensitivity level (Note: typical instrument linear range 88 – 148 dBL).

Thomas Lewandowski
ESC
31st March 2012

REFERENCES

Global Acoustics, 2009, Report Ref. No. 09285_R01. Ulan No. 3 Upcast Shaft Construction – Blast Monitoring Report.

Ulan Coal Mines Limited, 2011. Blast Management Plan – Environmental Management System. ULN SD PLN 0082

FIGURES

Figure 1 - Schematic of Shaft Blast

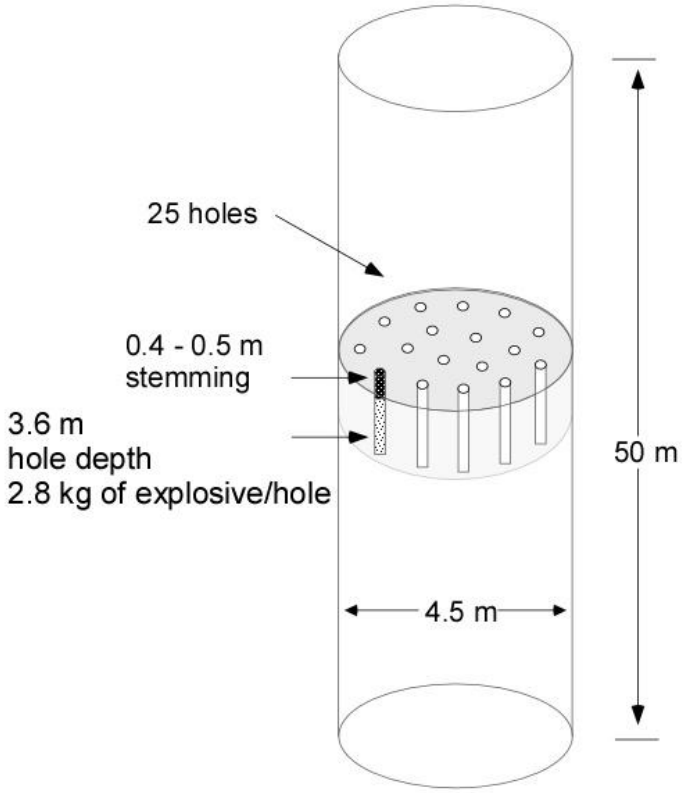


Figure 2 - Schematic of Open Cut Blast

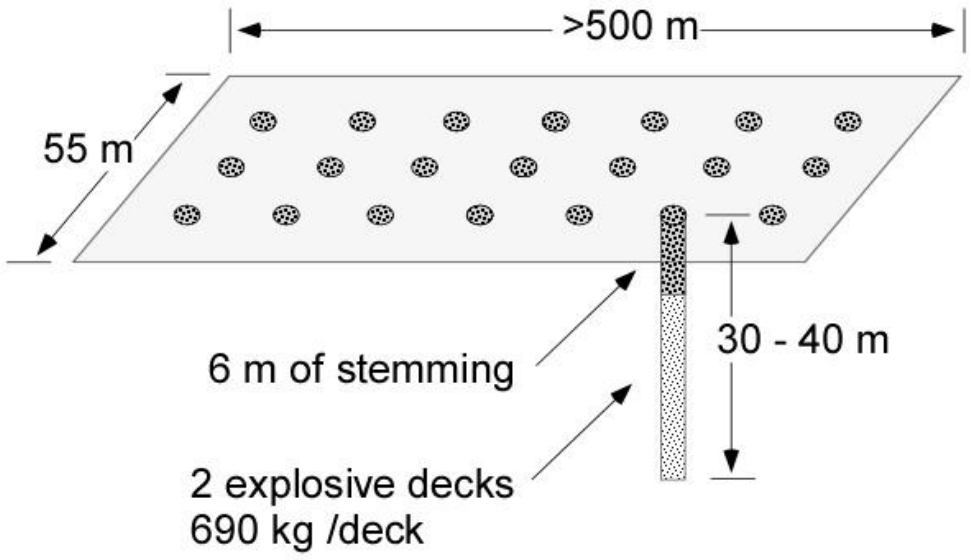


Figure 3 – Location of Proposed ventilation Shaft and Critical Places of Concern

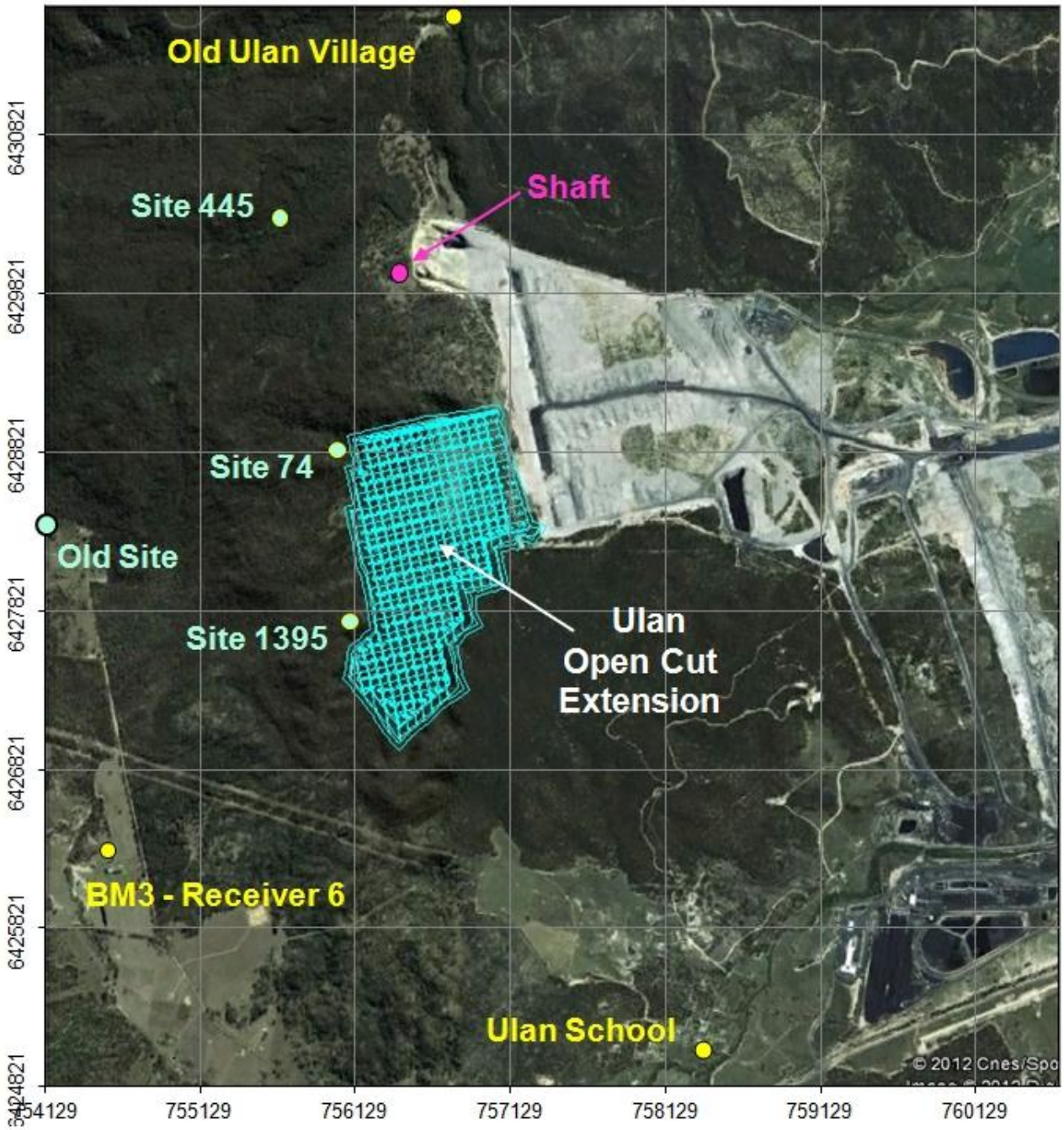


Figure 4A - Vibration Modelling for Ground Vibration – 1 hole

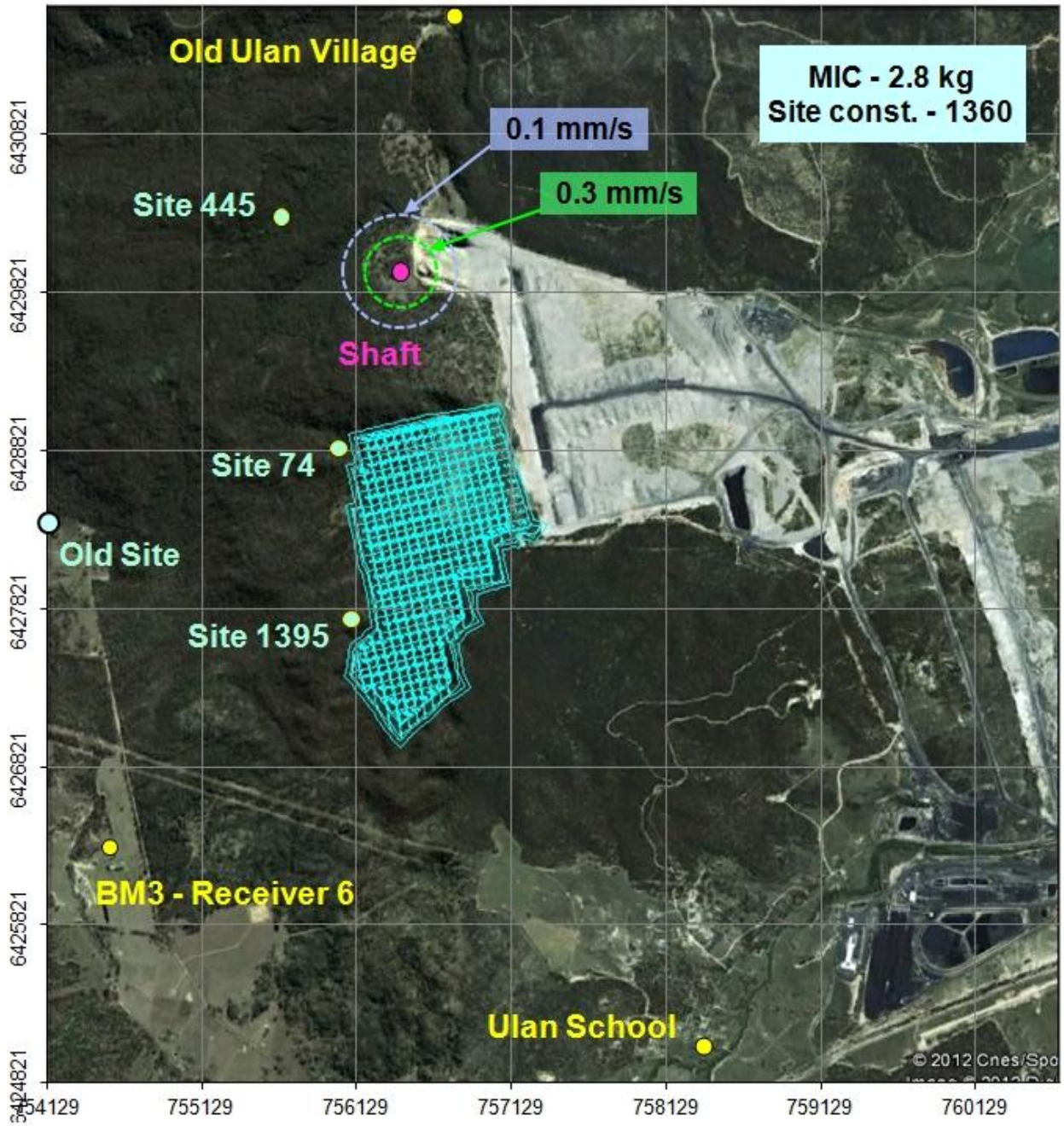


Figure 4B - Vibration Modelling for Ground Vibration – 25 holes

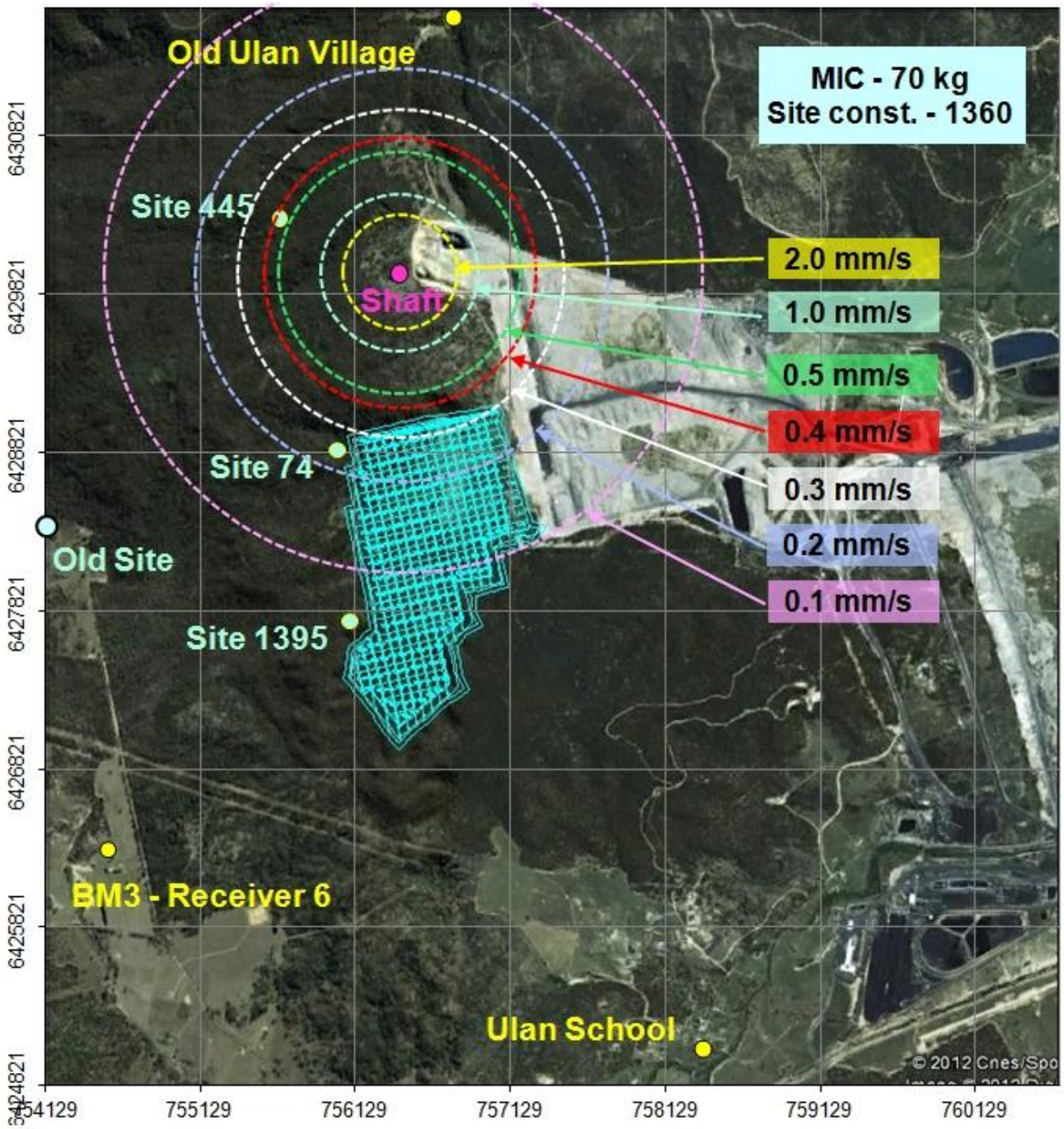


Figure 5A - Vibration Modelling for Air Vibration – 1 hole

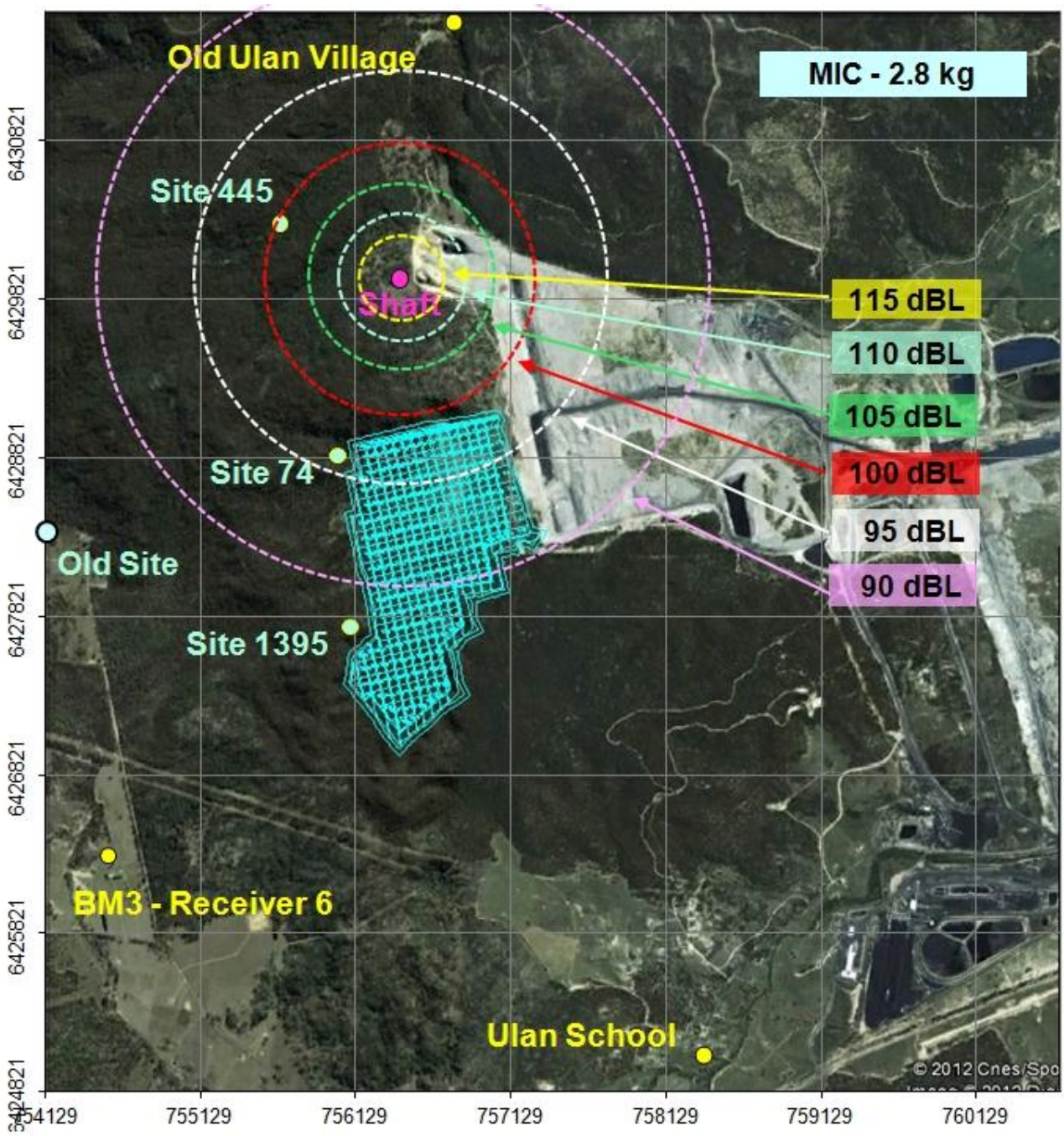
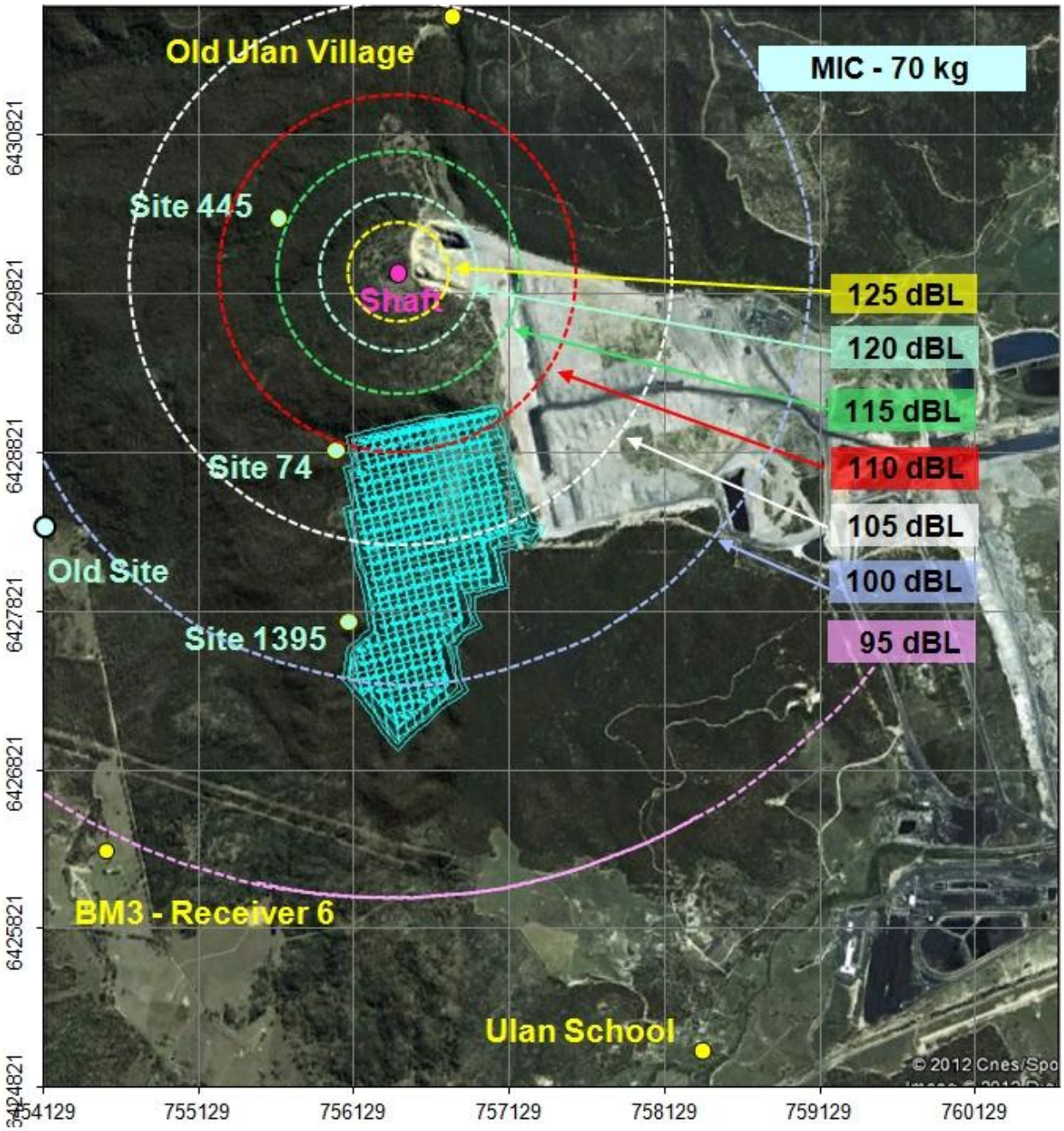
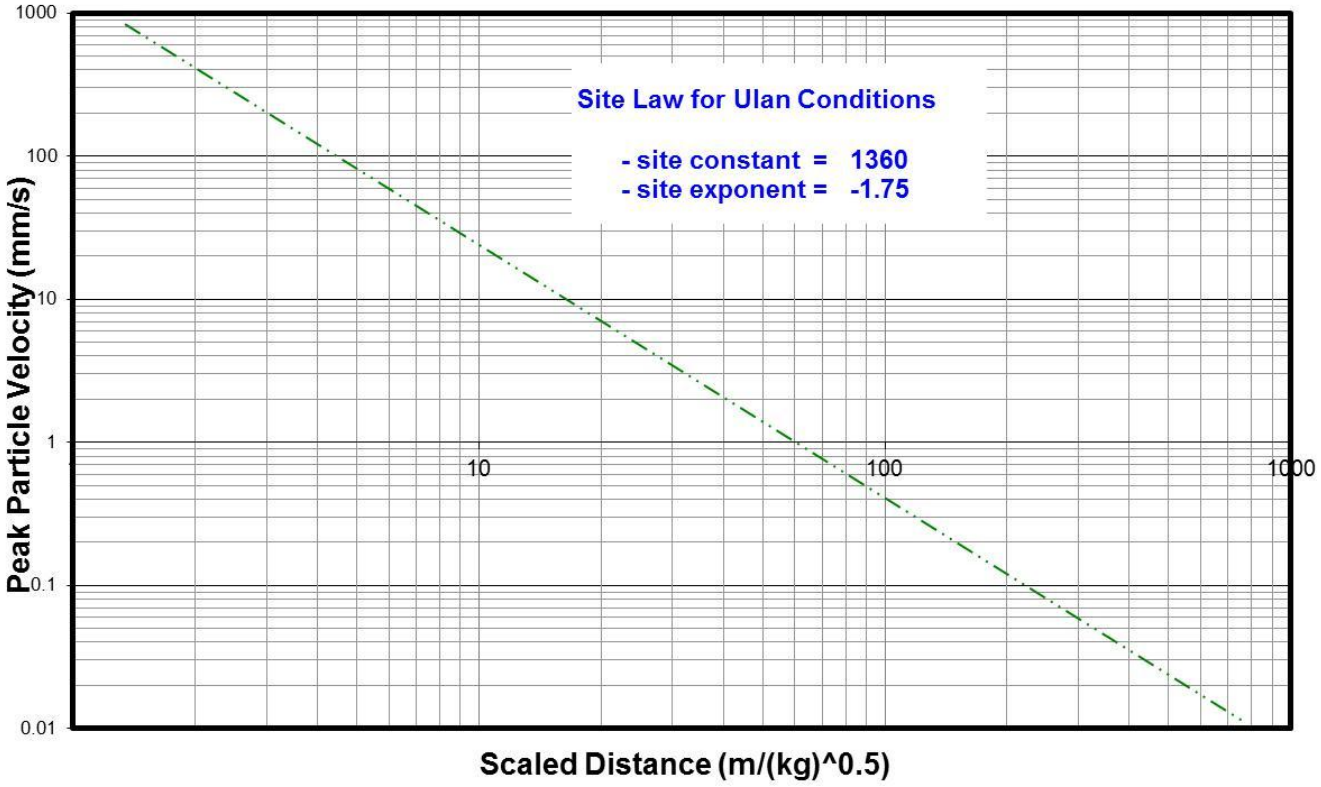


Figure 5B - Vibration Modelling for Air Vibration – 25 holes

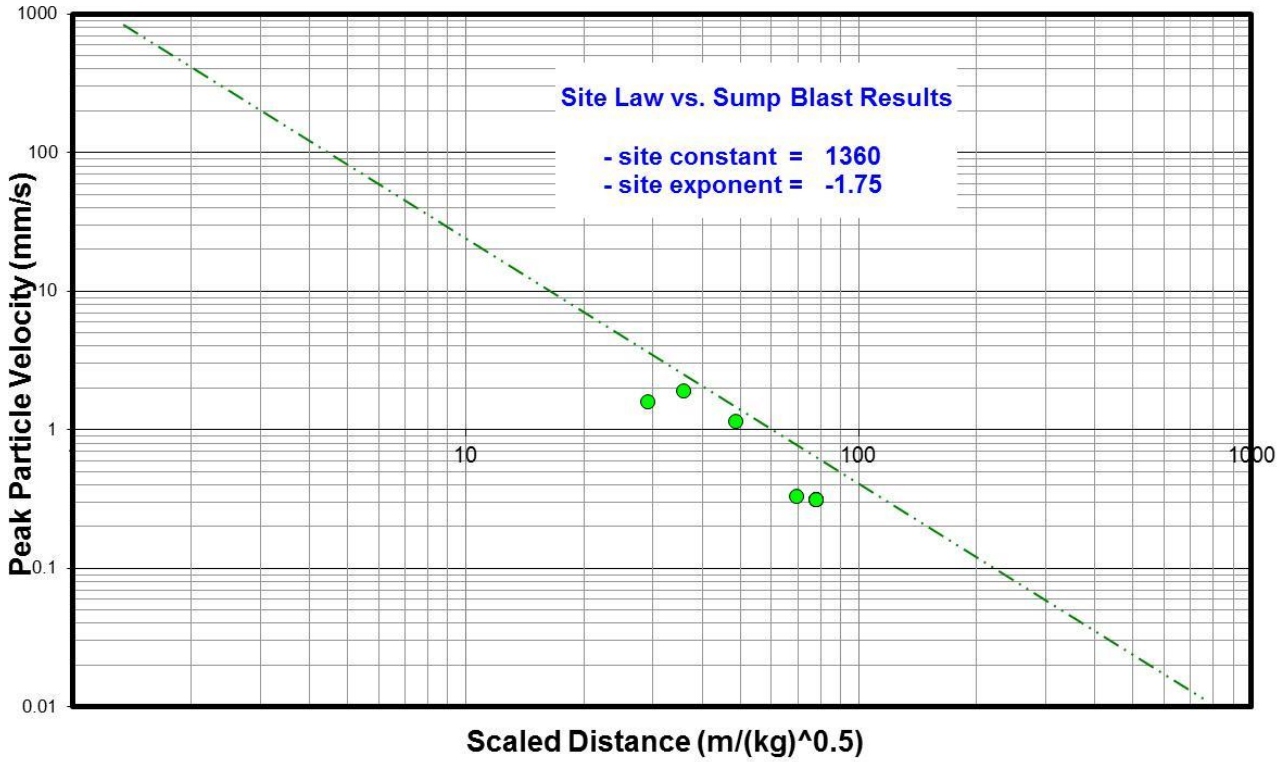


APPENDICES

Appendix 1A – Site Law for Ulan Conditions

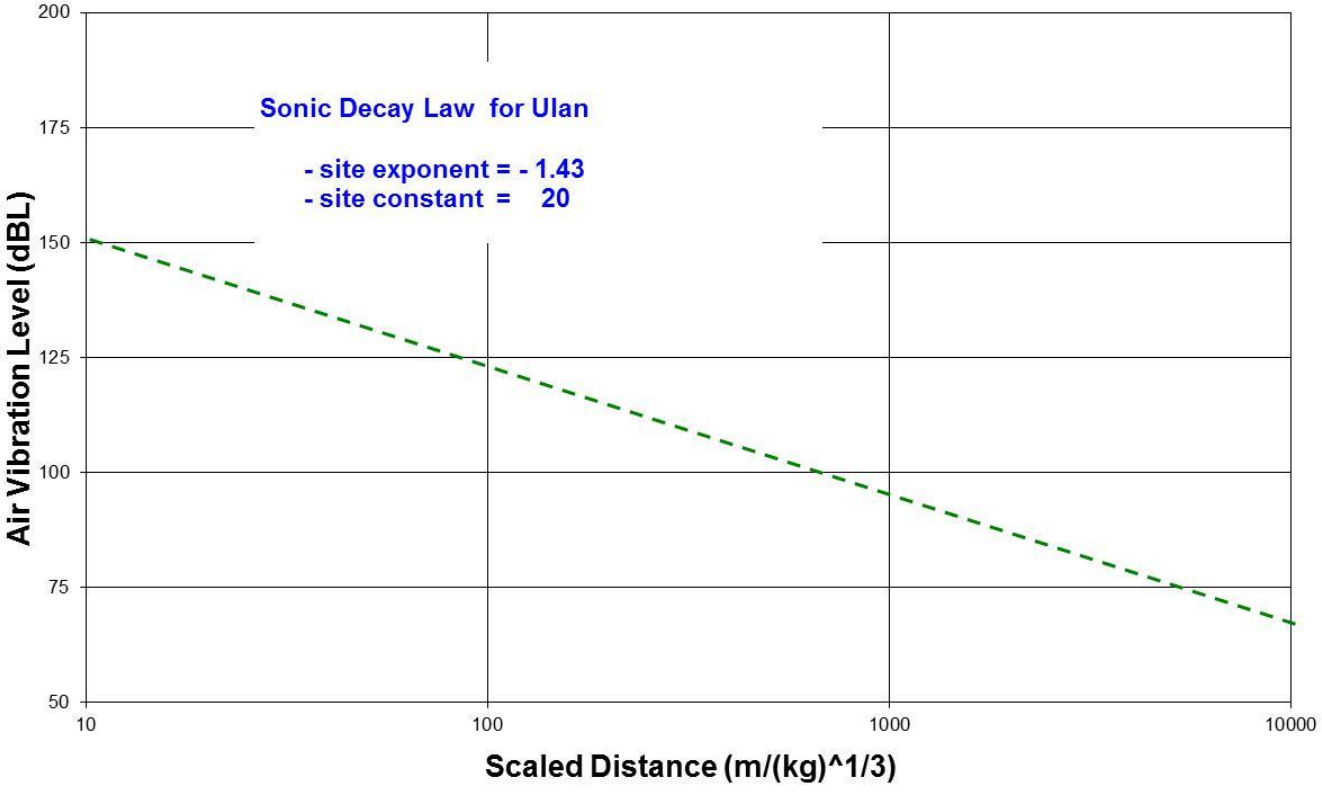


Appendix 1B – Site Law versus Sump Blast Results

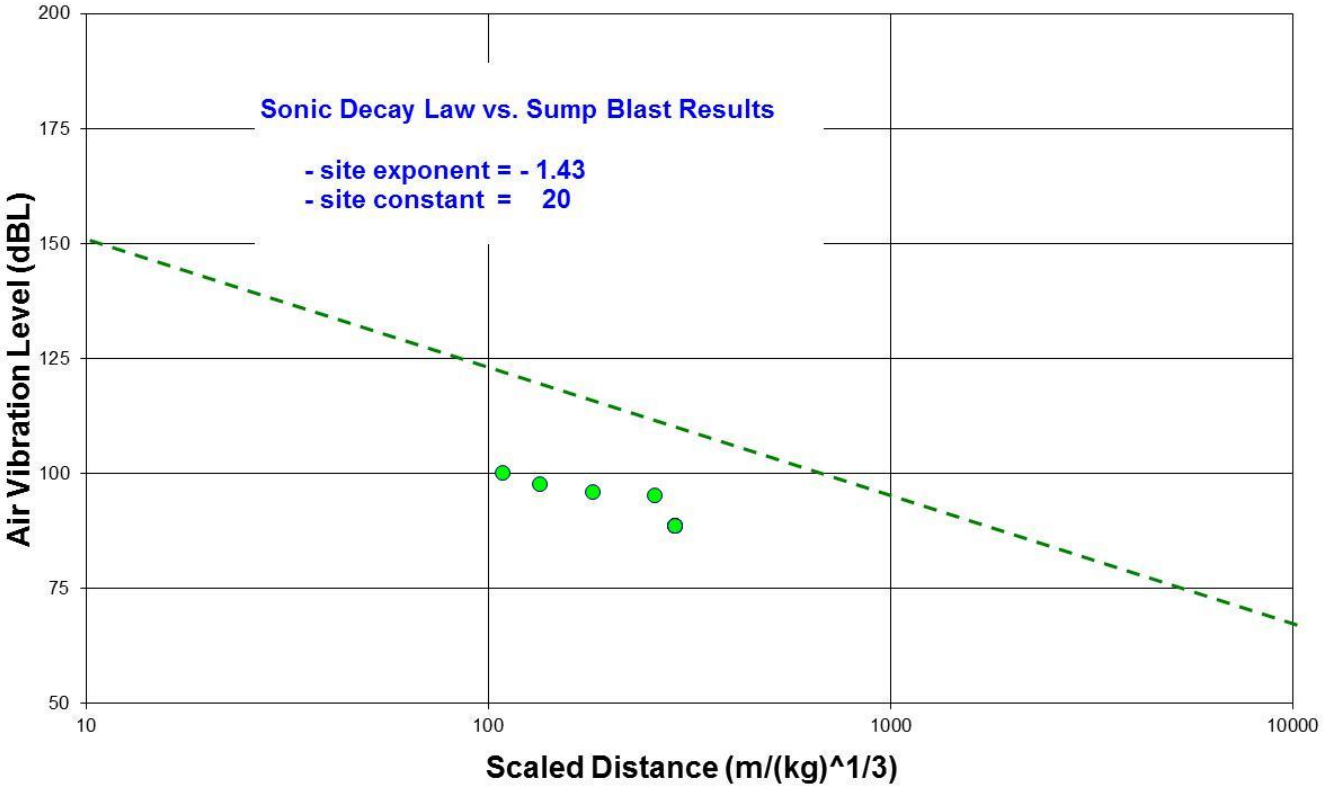


Appendix 1C – Site Law versus Shaft Blast Results

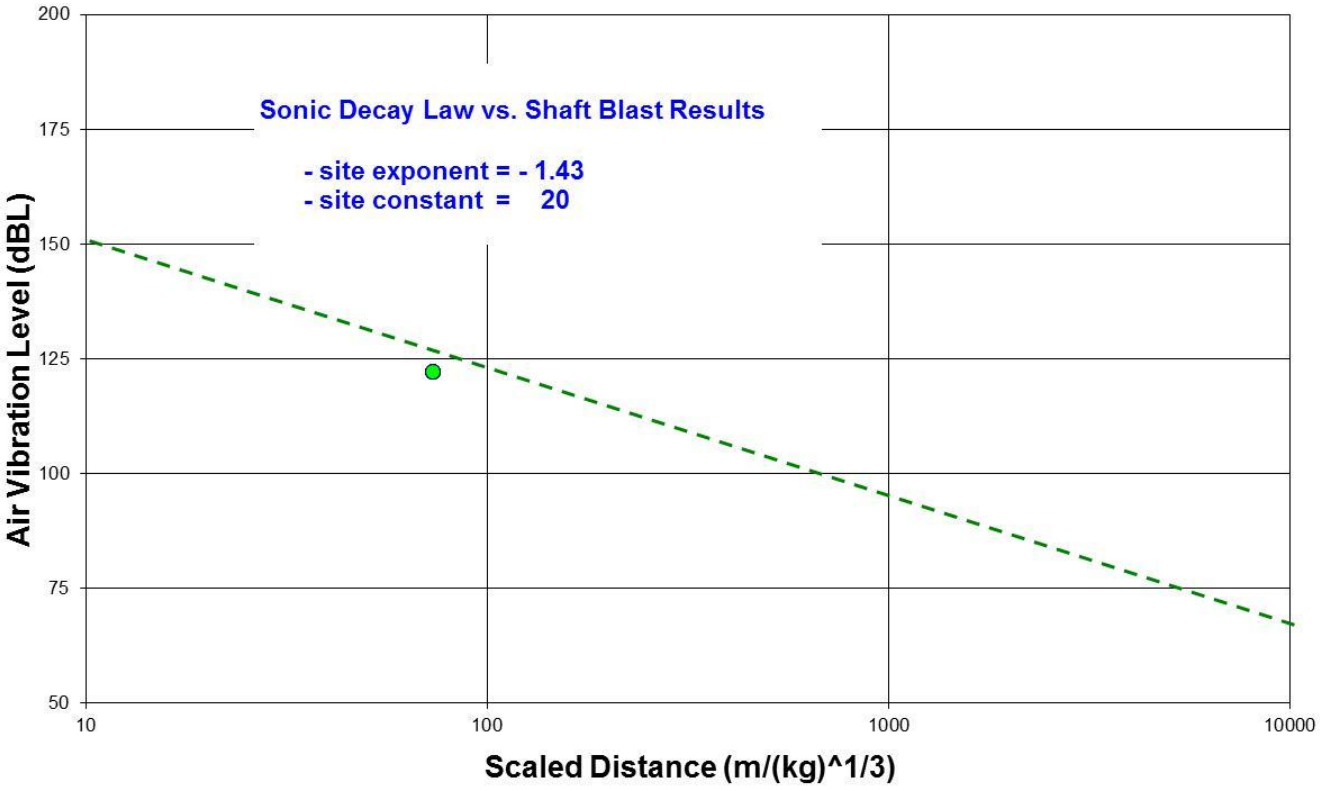
Appendix 2A – Sonic Decay Law for Ulan Conditions



Appendix 2B – Sonic Decay Law versus Sump Blast Results



Appendix 2C – Sonic Decay Law versus Shaft Blast Results



APPENDIX 3

European and Natural Heritage Sites – Significance Assessment (Umwelt 2012)

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17 January 2012

Jamie Lees
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Dear Jamie

Re: European and Natural Heritage Sites — Significance Assessment

As discussed with Matthew Newton in December 2011 please find the following information regarding the recent comments from the Heritage Branch, OEH and DP&I in relation to European Heritage sites.

Significance Assessment

In regards to the European and Natural Heritage sites (RV3, CI33, RV4, HS63, CC6, MM273, OCE80/B, OCE84A, OEC86A, OEC 94A, RV1, RV2, CI198/G, PK96/B, ID191 and HS96/D) which were classified as having nil – local significance in the Ulan Coal Continued Operations (UCCO) European and Natural Heritage Assessment (2009) and which have been subsequently clarified in the HMP (in accordance with Heritage Branch, OEH comments dated May 2011) as being of Nil significance we make the following comments:

- Throughout the UCCO assessment process these sites have not been considered as being locally significant sites, but as noted in correspondence from OEH, have been identified as being of Nil – Local significance.

- In accordance with comments provided by the Heritage Branch, OEH and DP&I (December 2011) clarification and justification for assessing these sites as being of nil significance is provided in **Table 1**. **Table 1** assesses each site in accordance with the Heritage Branch, OEH standard criteria and also Bickford and Sullivan's work on archaeological significance. A summary statement of significance, with reference to all of the potential European and Natural Heritage sites/items in the UCCO Project area is also provided.

Table 1 Significance Assessment

Site Name	Description	Significance Assessment
RV3	Derelict cottage site	Criterion (a) Historical: is unlikely to provide information not already known from the historical record; Criterion (b) Associative: is unlikely to provide evidence of any strong or special associations, for example with the McDonald, Robinson and Crossing families; Criterion (c) Aesthetic: does not generally demonstrate distinctive aesthetic qualities or technical innovations; Criterion (d) Social: is unlikely that the site would have a strong association with any previous or contemporary community or group; Criterion (e) Scientific: is unlikely to have significant archaeological remains with any research potential associated with any of the extant structures on the site; Criterion (f) Rarity: is typical of structures and other sites/items typically found within rural landscapes; and Criterion (g) Representativeness: is representative of the sites typically found in a rural landscape with a history of pastoral and agricultural activities. In regards to archaeological significance (Bickford and Sullivan 1984): 1) Can the site contribute knowledge that no other resource can? 2) Can the site contribute knowledge that no other site can? 3) Is this knowledge relevant to general questions about human history or other substantive questions regarding human history, or does it contribute to other major research questions? Bickford and Sullivan's questions are answered in the negative and in conjunction with the Heritage Branch assessment criteria the site is therefore considered to have nil heritage significance.
CI33	Derelict weatherboard cottage (Calbunya)	Criterion (a) Historical: is unlikely to provide information not already known from the historical record; Criterion (b) Associative: is unlikely to provide evidence of any strong or special associations, for example with the McDonald, Robinson and Crossing families; Criterion (c) Aesthetic: does not generally demonstrate distinctive aesthetic qualities or technical innovations; Criterion (d) Social: is unlikely that the site would have a strong association with any previous or contemporary community or group; Criterion (e) Scientific: is unlikely to have significant archaeological remains with any research potential associated with any of the extant structures on the site; Criterion (f) Rarity: is typical of structures and other sites/items typically found within rural landscapes; and

Site Name	Description	Significance Assessment
		Criterion (g) Representativeness: is representative of the sites typically found in a rural landscape with a history of pastoral and agricultural activities. In regards to archaeological significance (Bickford and Sullivan 1984): 1) Can the site contribute knowledge that no other resource can? 2) Can the site contribute knowledge that no other site can? 3) Is this knowledge relevant to general questions about human history or other substantive questions regarding human history, or does it contribute to other major research questions? Bickford and Sullivan's questions are answered in the negative and in conjunction with the Heritage Branch assessment criteria the site is therefore considered to have nil heritage significance.
RV4	Former stockyard	Criterion (a) Historical: is unlikely to provide information not already known from the historical record; Criterion (b) Associative: is unlikely to provide evidence of any strong or special associations; Criterion (c) Aesthetic: does not generally demonstrate distinctive aesthetic qualities or technical innovations; Criterion (d) Social: is unlikely that the site would have a strong association with any previous or contemporary community or group; Criterion (e) Scientific: is unlikely to have significant archaeological remains with any research potential; Criterion (f) Rarity: is typical of yard complexes typically found within rural landscapes; and Criterion (g) Representativeness: is representative of yard complexes typically found in a rural landscape with a history of pastoral and agricultural activities. In regards to archaeological significance (Bickford and Sullivan 1984): 1) Can the site contribute knowledge that no other resource can? 2) Can the site contribute knowledge that no other site can? 3) Is this knowledge relevant to general questions about human history or other substantive questions regarding human history, or does it contribute to other major research questions? Bickford and Sullivan's questions are answered in the negative and in conjunction with the Heritage Branch assessment criteria the site is therefore considered to have nil heritage significance.
HS63, CC6, MM273, OCE80/B,	Timber getting/Sleeper cutting sites	Criterion (a) Historical: are unlikely to provide information not already known from the historical record; Criterion (b) Associative: are unlikely to provide evidence of any strong or special associations, for example with any Aboriginal people who may have been involved in timber getting or with the McDonald, Robinson and Crossing families;

Site Name	Description	Significance Assessment
OCE84/A, OCE86/A, OCE94/A, RV1, RV2		Criterion (c) Aesthetic: do not generally demonstrate distinctive aesthetic qualities or technical innovations; Criterion (d) Social: are unlikely to have a strong association with any previous or contemporary community or group, including any Aboriginal people who may have been involved in timber getting; Criterion (e) Scientific: are unlikely to have significant archaeological remains with any research potential; Criterion (f) Rarity: are typical of other sites/items typically found within rural landscapes; and Criterion (g) Representativeness: are representative of the sites typically found in a rural landscape with a history of timber getting activities. In regards to archaeological significance (Bickford and Sullivan 1984): 1) Can the site contribute knowledge that no other resource can? 2) Can the site contribute knowledge that no other site can? 3) Is this knowledge relevant to general questions about human history or other substantive questions regarding human history, or does it contribute to other major research questions? Bickford and Sullivan's questions are answered in the negative and in conjunction with the Heritage Branch assessment criteria these sites are therefore considered to have nil heritage significance.
CI198/G	Rock shelter with potential stone wall	Criterion (a) Historical: is unlikely to provide information not already known from the historical record; Criterion (b) Associative: is unlikely to provide evidence of any strong or special associations, for example with the McDonald, Robinson and Crossing families; Criterion (c) Aesthetic: does not generally demonstrate distinctive aesthetic qualities or technical innovations; Criterion (d) Social: is unlikely to have a strong association with any previous or contemporary community or group; Criterion (e) Scientific: is unlikely to have significant archaeological remains with any research potential Criterion (f) Rarity: is likely an example of a makeshift temporary shelter utilising a natural tilted rock typically found within the rock outcrops of the area; and Criterion (g) Representativeness: is likely representative of a makeshift temporary shelter found within the typical rock outcrops of the area. In regards to archaeological significance (Bickford and Sullivan 1984): 1) Can the site contribute knowledge that no other resource can? 2) Can the site contribute knowledge that no other site can? 3) Is this knowledge relevant to general questions about human history or other substantive questions

Site Name	Description	Significance Assessment
		regarding human history, or does it contribute to other major research questions? Bickford and Sullivan's questions are answered in the negative and in conjunction with the Heritage Branch assessment criteria the site is therefore considered to have nil heritage significance.
PK96/B	Rock shelter with potential collapsed stone wall	Criterion (a) Historical: is unlikely to provide information not already known from the historical record; Criterion (b) Associative: is unlikely to provide evidence of any strong or special associations, for example with the McDonald, Robinson and Crossing families; Criterion (c) Aesthetic: does not generally demonstrate distinctive aesthetic qualities or technical innovations; Criterion (d) Social: is unlikely that the site would have a strong association with any previous or contemporary community or group; Criterion (e) Scientific: is unlikely to have significant archaeological remains with any research potential Criterion (f) Rarity: is likely an example of a makeshift temporary shelter utilising a natural rock overhang typically found within the rock outcrops of the area; and Criterion (g) Representativeness: is likely representative of a makeshift temporary shelter found within the typical rock overhangs of the area. In regards to archaeological significance (Bickford and Sullivan 1984): 1) Can the site contribute knowledge that no other resource can? 2) Can the site contribute knowledge that no other site can? 3) Is this knowledge relevant to general questions about human history or other substantive questions regarding human history, or does it contribute to other major research questions? Bickford and Sullivan's questions are answered in the negative and in conjunction with the Heritage Branch assessment criteria the site is therefore considered to have nil heritage significance.
ID191	Large natural rock overhang with historical artefacts	Criterion (a) Historical: unlikely to provide information not already known from the historical record; Criterion (b) Associative: is unlikely to provide evidence of any strong or special associations, for example with the McDonald, Robinson and Crossing families; Criterion (c) Aesthetic: does not generally demonstrate distinctive aesthetic qualities or technical innovations; Criterion (d) Social: is unlikely to have a strong association with any previous or contemporary community or group; Criterion (e) Scientific: is unlikely to have significant archaeological remains with any research potential Criterion (f) Rarity: is typical of groups of isolated out of context artefacts found within rural landscapes; and

Site Name	Description	Significance Assessment
		Criterion (g) Representativeness: is representative of groups of artefacts that might typically be found in the landscape with a history of pastoral and agricultural activities. In regards to archaeological significance (Bickford and Sullivan 1984): 1) Can the site contribute knowledge that no other resource can? 2) Can the site contribute knowledge that no other site can? 3) Is this knowledge relevant to general questions about human history or other substantive questions regarding human history, or does it contribute to other major research questions? Bickford and Sullivan's questions are answered in the negative as the evidence at the site is related to surface artefacts (remains of buggy) and are unlikely to include significant archaeological deposits or be able to answer substantive research questions. In conjunction with the Heritage Branch assessment criteria the site is considered to have limited archaeological potential and is therefore assessed as having nil heritage significance.
HS96/D	Natural rock overhang with historical artefacts	Natural rock overhang with historical artefacts - associated with site/item ID191. Site is associated with ID191 and considered to have nil significance for the same reasons.

Summary Statement of Significance

The project area is typical of a rural landscape within the Central Tablelands of NSW. The history of the area from the mid nineteenth century, including its settlement by Europeans and subsequent use as cleared pastoral and agricultural land, through to its exploitation for timber and mineral resources, is reflected in the low potential of the archaeological resource and in the evidence of houses and other structures/shelters and former timber getting sites present within the project area.

With the exception of Old Ulan Village and the Talbragar Fish Fossil Reserve, potential heritage sites/items extant in the project area are typical of the area as a large rural landscape and are unlikely to provide further unknown information regarding the area's history and development. There are unlikely to be any intact archaeological remains associated with any of the extant structures on the site, with the exception of Old Ulan Village.

Evidence of extant derelict houses (with the exception of the original portion of the house at Apple Tree Flat (site/item PK243) which could date to as early as the mid 1800s, timber getting camps, shelters and out of context dumps of objects/artefacts demonstrate the typical pattern of land use and historical development of the area and are unlikely to provide information not already known from the historical record.

In general terms, with the exception of Old Ulan Village, Bobadeen Station/Homestead (CI07), Apple Tree Flat farm complex (PK 243) and the Talbragar Fish Fossil Reserve, the identified and potential heritage components of the project area are of no significance with no research potential. Old Ulan Village, Bobadeen Station/Homestead and the Apple Tree Flat farm complex have been assessed as being of local significance. Talbragar Fish Fossil Reserve has been assessed as being of State or National significance.

If you have any questions or require any additional information relating to the information discussed in this letter please contact me on (02) 4950 5322

Yours faithfully

Tim Adams.

Tim Adams
Senior Archaeologist

APPENDIX 4

Subsidence Assessment of Ulan West Mine Plan Amendments

SCT Operations Pty Ltd
ABN 23 078 328 953
www.sct.gs

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22 March 2012

Jamie Lees
Environment & Community Manager
Ulan Complex
Ulan Coal Mines Limited
PMB 3006
MUDGEE NSW 2850

Dear Jamie,

ASSESSMENT OF SUBSIDENCE IMPACT CHANGES FOR REVISED ULAN WEST MINE PLAN

As requested, we have reviewed the change in Ulan West mine plan which involves reducing the width of the first four longwall panels and determined that there is no significant change to the subsidence impacts compared to those described in SCT Report ULA3367.

The footprint of the revised mine plan is within the boundaries of the previously assessed area except at the southern ends of the first three panels of the new layout where there is a slight increase in area. Within this increased area, there are two additional archaeological sites, 444 and 1387, which are described respectively as an artefact scatter and isolated find. There are also a few minor sandstone formations. The scattered artefacts and minor sandstone formations are not expected to be significantly impacted by mining subsidence.

There are several archaeological sites at the northern end of the first few panels that will no longer be impacted because of the shortening of longwall panels in this area. No increase in the level of impact is predicted to occur at any of the archaeological sites within the Ulan West as a result of the revised mine plan.

Sandstone cliff formations within the longwall mining area were previously assessed on the basis that they were within the outer boundaries of the longwall area and therefore subject to the sorts of changes in geometry currently under consideration. No change in assessed impact for these cliff formations is expected from the proposed change in geometry.

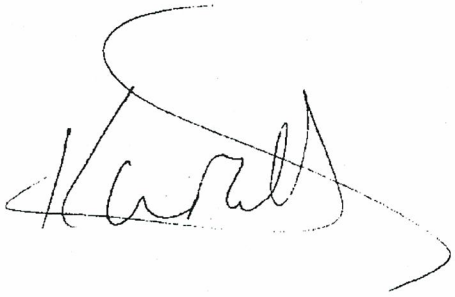
No additional subsidence impacts on European heritage and built features are predicted to occur as a result of the revised mine plan.

The revised mine plan is not expected to contribute to additional subsidence related safety issues.

On this basis, there is not considered to be any significant change to the subsidence impacts associated with the proposed change in Ulan West mine geometry and no greater level of impact than predicted in SCT report ULA3367 and the Ulan Continued Operations Environment Assessment.

If you have any queries or require further clarification of any of these issues, please do not hesitate to contact me directly.

Regards



Ken Mills
Senior Geotechnical Engineer

APPENDIX 5

Groundwater Statement Regarding Ulan West Mine Plan Amendments

Mackie Environmental Research Pty. Ltd.
ABN 62077235164

193 Plateau Rd.
Bilgola NSW 2107

Telephone: **(02) 89190182**

Umwelt (Australia) Pty. Limited
P.O. Box 838
Toronto NSW, 2283

22/03/2012

Att. R. Williams

Re: Change to Longwall Panels – Ulan West Mine Plan

We refer to discussions relating to changes to the Ulan West Mine Plan and the potential for changed impacts on the groundwater systems in the region. We understand that the proposed changes to the recently assessed mine plan (MER, 2011) include:

1. Increasing the number of panels from 3 to 4 within the approved Ulan West longwall panels LW1 to LW3 footprint by reducing longwall LW1 from 400m to 250m width, and LW2 to LW4 to between 300m and 305m width;
2. Reducing the length of the modified panels and LW5.

These changes are shown on the attached Figure 1 (sourced from Umwelt) where the proposed modified panel layout (green) overlies the approved mine panel layout (yellow).

Based on our experience and prior assessments of mining related impacts on the groundwater hydrology of the region (MER 2009, MER 2011), we consider the impacts that are likely to arise from the amended layout would be the same as, or slightly reduced when compared to the approved mine plan due to the southward migration of the start lines of panels LW1 to LW5. The narrower width of panels LW1 to LW4 is also likely to lead to a reduced daily rate of mine water influx to goaves but ultimately the cumulative volumetric release of groundwater from the overlying strata is expected to be the same as has been assessed for the approved mine plan.

Trusting the above satisfies your request, we remain

Yours sincerely
Mackie Environmental Research Pty. Ltd.

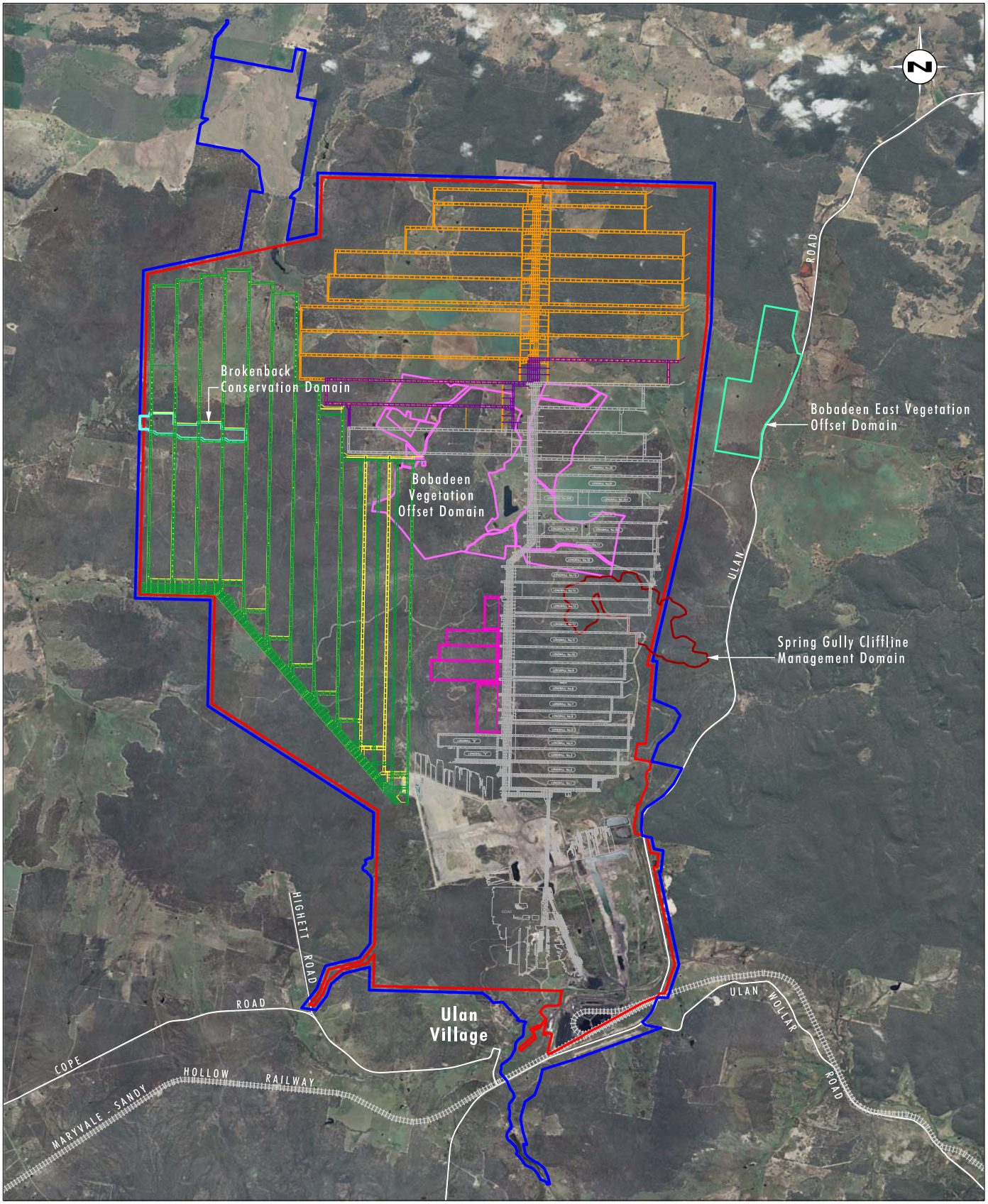
Dr. C. Mackie

Attachment Figure 1 - Comparison of mine plans on 'Biodiversity Offset and Aboriginal Archeological Management Areas Relative to Reduced Panel Width Ulan West.

References:

Mackie Environmental Research, 2009. Ulan continued operations – groundwater assessment. Report prepared for UCML Environmental Assessment, July 2009.

Mackie Environmental Research, 2011. North 1 modifications – groundwater assessment. Report prepared for UCML Environmental Assessment, December 2011.



Source: Ulan Coal, Aerial Photo December 2007

0 1.0 2.5 5.0km

1:100 000

Legend

- Colliery Holding Boundary
- EA Project Area
- Bobadeen Vegetation Offset Domain
- Bobadeen East Vegetation Offset Domain
- Brokenback Conservation Domain
- Spring Gully Cliff Line Management Domain
- Ulan West Mine Plan
- Proposed Ulan West Mine Plan
- Ulan No. 3 Underground Mineplan
- Current Mining and SMP Approved Area
- Proposed North First Workings
- Previous Underground Mining Operations

FIGURE 1

Biodiversity Offset and Aboriginal Archaeological Management Areas Relative to Reduced Panel Width Ulan West

File Name (A4): R01_V1/3036_001.dgn
20120306 16.01

APPENDIX 6

Surface Water Assessment of Ulan West Mine Plan Amendments

Umwelt (Australia) Pty Limited
2/20 The Boulevarde
PO Box 838
Toronto NSW 2283

Umwelt
Environmental Consultants

Ph. 02 4950 5322
Fax. 02 4950 5737

ABN 18 059 519 041

Briefing Note

To:	Jamie Lees – Ulan Coal Mines Limited (UCML)
Reviewed:	Barbara Crossley – Umwelt (Australia) Pty Ltd
From:	Rod Williams – Umwelt (Australia) Pty Ltd
Author:	Dr Adam Wyatt – Umwelt (Australia) Pty Ltd
Date:	13 April 2012
Subject:	Potential Subsidence Impacts on Surface Drainage of the Proposed Modification to the Ulan West Mine Plan

Purpose

Determine the potential influence of the proposed changes to the Ulan West Longwall Layout on the stability of the watercourses within the affected area.

Outcomes/Key Messages

The proposed changes are likely to result in minor changes to the watercourses within the impacted area. These changes are unlikely to exacerbate any instabilities within Ulan Creek or its tributaries significantly beyond the existing conditions or approved impacts during any of the modelled critical duration rainfall events (i.e. if the channel is unstable in the existing landform it remains unstable in the approved and proposed landforms). It is also noted that the magnitude of these changes are generally of a similar range to that associated with the approved mine plan. As a holistic system the impact of this change is expected to be minimal and no adverse impacts are predicted to occur.

In this document

Figures

Plates

1.0 Introduction

Umwelt has undertaken a review of the potential creek stability impacts associated with the proposed modification of the Ulan West mine plan. We understand that the proposed changes to the approved mine plan include:

- increasing the number of panels from 3 to 4 within the approved Ulan West longwall panels LW1 to LW3 footprint by reducing longwall LW1 from 400 metres to 250 metres width, and LW2 to LW4 to between 300 metres and 305 metres width; and

- reducing the length of the modified panels and LW5 (refer to **Figure 1.1**).

2.0 Field Inspection

A field inspection of four watercourses located in the longwall footprint of the Ulan West Longwall 1-5 modified mine plan was carried out 29 February 2012. The watercourses inspected included Watercourse TF, Watercourse TGa, Watercourse TM and Watercourse TL (refer to **Figure 2.1**).

Watercourse TF is typically wide, sandy and stable, with V-shaped cross sections containing some native tuft-grass and small to medium trees throughout the watercourse. Evidence of recent flooding, including flood debris (refer to **Plate 1**) was observed. Minor scouring of a central channel within sections of Watercourse TF (refer to **Plate 2**) was observed.

The upper reaches of Watercourse TM are similar in appearance to those of Watercourse TF, with wide V-shaped cross sections with light grass coverage and small to medium trees (refer to **Plate 3**). The lower reaches of Watercourse TM have been subject of an active head cut (refer to **Plate 4**) that has migrated from the Ulan Creek confluence, creating a well defined channel for some sections of the lower reaches (refer to **Plate 5**). The lower reaches of Watercourse TM that have been subjected to scouring reveal numerous natural control structures that have limited the depth of scouring of the watercourse (refer to **Plate 6**).

Watercourse TGa and TL were deeply scoured (up to approximately 3 metres deep) through the entire subsidence affected area (refer to **Plate 7**). The scouring is the result of a deep head cut which appears to have been driven by the lowering of Ulan Creek following the December 2010 flood event. It is expected that these head cuts will continue migrating upstream through each of the watercourses until they reach a natural control point, such as a rock bar. As Ulan Creek continues to infill, these watercourses will also begin to infill.

The presence of these active head cuts demonstrates the marginal stability of the watercourses in this area. Whilst initiated by a larger flood event, it would appear that the scouring processes have continued since the initialising event (December 2010).

The observations made during the field inspection were used to inform the selection of the stability thresholds for the assessment of the potential changes in the stability of the watercourses in the affected area.

3.0 Watercourse Long Sections

A comparison of potential subsidence impacts on longitudinal profiles of major watercourses in impacted area was made. The location and extent of the watercourses studied is shown in **Figure 2.1**.

Long sections were taken of each watercourse reflecting the:

- pre-mining conditions;
- predicted subsidence impacts due to approved mine plan; and
- predicted subsidence impacts due to the proposed modification to the mine plan.

By comparing changes in the longitudinal profiles of each of the three surface states, areas that may be at risk due to changes in the extent of ponding and increase in scour potential due to increases in channel slope can be identified.

3.1 Watercourse TF

The longsection obtained for Watercourse TF is included in **Chart 3.1**. The relocation and the introduction of an addition chain pillar associated with the modified Ulan West mine plan results in localised changes in elevation over the length of the long section (refer to **Chart 3.1**).

Within Watercourse TF, the maximum increase (i.e. steepening) of longitudinal grade for the Proposed mine plan (compared to the existing terrain) was found to be approximately 17 mm/m. This is approximately 1.5 x the increase in maximum longitudinal grade for the approved landform (11 mm/m).

Further analysis of the estimated grades over the entire length of the longsection of the three terrain states are shown in **Table 3.1**. From **Table 3.1**, it can be seen that the longitudinal grades for the three terrain conditions vary only slightly.

Table 3.1 – Longsection Summary Statistics for the Existing, Approved and Proposed Landform – Watercourse TF

Statistical Measure	Stream Gradient (mm/m) (Negative = Downslope)		
	Existing	Approved	Proposed
Minimum	-26.0	-24.9	-26.9
5 Percentile	-8.2	-8.1	-8.1
10 Percentile	-5.8	-5.8	-6.0
Average	-1.6	-1.6	-1.6
90 Percentile	2.5	2.7	2.7
95 Percentile	4.2	4.0	4.0
Maximum	10.1	10.5	10.4

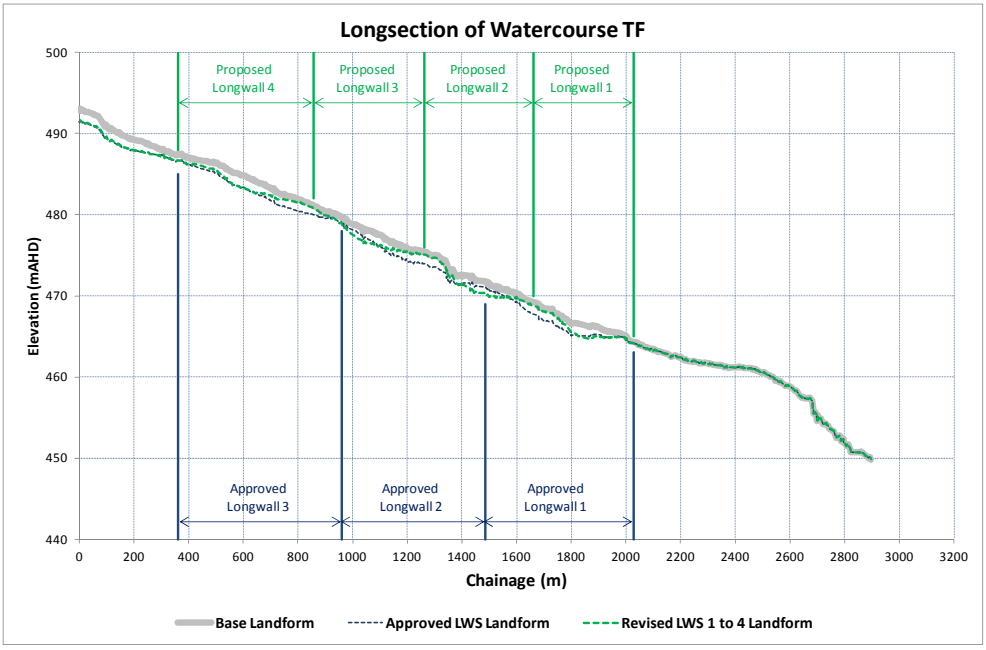


Chart 3.1 – Longsection, Watercourse TF

3.2 Watercourse TGa

The longsection obtained for Watercourse TGa is included in **Chart 3.2**. The relocation and the introduction of an addition chain pillar associated with the modified Ulan West mine plan results in localised changes in elevation over the length of the long section (refer to **Chart 3.2**).

Within Watercourse TGa, the maximum increase (i.e. steepening) of longitudinal grade for the Proposed mine plan (compared to the existing terrain) was found to be approximately 17 mm/m. This is approximately 1.5 x the increase in maximum longitudinal grade for the approved landform (11 mm/m).

Further analysis of the estimated grades over the entire length of the longsection of the three terrain states are shown in **Table 3.2**. From **Table 3.2**, it can be seen that the longitudinal grades for the three terrain conditions vary only slightly.

Table 3.2 – Longsection Summary Statistics for the Existing, Approved and Proposed Landform – Watercourse TGa

Statistical Measure	Stream Gradient (mm/m) (Negative = Downslope)		
	Existing	Approved	Proposed
Minimum	-31.6	-31.7	-31.6
5 Percentile	-9.5	-9.0	-9.8
10 Percentile	-7.2	-7.1	-7.4
Average	-2.4	-2.3	-2.3
90 Percentile	2.6	2.8	2.6
95 Percentile	5.0	5.0	5.0
Maximum	24.8	24.9	25.6

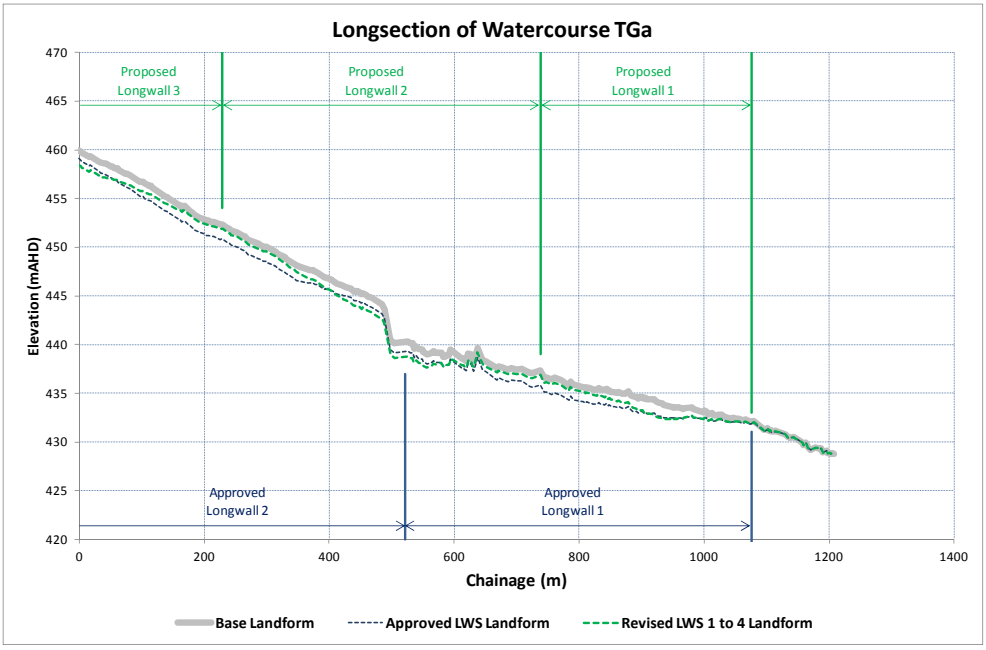


Chart 3.2 – Longsection, Watercourse TGa

3.3 Watercourse TM

The longsection obtained for Watercourse TM is included in **Chart 3.3**. The relocation and the introduction of an addition chain pillar associated with the modified Ulan West mine plan results in localised changes in elevation over the length of the long section (refer to **Chart 3.3**).

Within Watercourse TM, the maximum increase (i.e. steepening) of longitudinal grade for the Proposed mine plan (compared to the existing terrain) was found to be approximately 16 mm/m. This is approximately 1.5 x the increase in maximum longitudinal grade for the approved landform (11 mm/m).

Further analysis of the estimated grades over the entire length of the longsection of the three terrain states are shown in **Table 3.3**. From **Table 3.3**, it can be seen that the longitudinal grades for the three terrain conditions vary only slightly.

Table 3.3 – Longsection Summary Statistics for the Existing, Approved and Proposed Landform – Watercourse TM

Statistical Measure	Stream Gradient (mm/m) (Negative = Downslope)		
	Existing	Approved	Proposed
Minimum	-17.2	-16.3	-17.2
5 Percentile	-8.4	-8.9	-8.6
10 Percentile	-6.6	-6.5	-6.4
Average	-2.4	-2.4	-2.4
90 Percentile	0.8	0.9	1.0
95 Percentile	1.9	2.0	2.0
Maximum	9.4	8.4	10.7

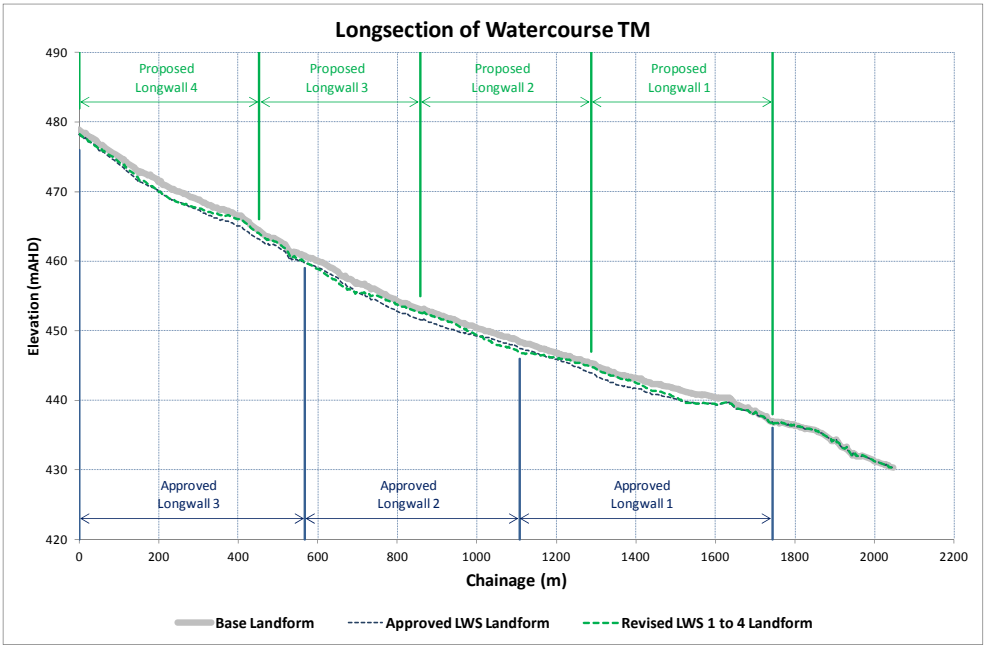


Chart 3.3 – Longsection, Watercourse TM

3.4 Watercourse TL

The longsection obtained for Watercourse TL is included in **Chart 3.4**. The relocation and the introduction of an addition chain pillar associated with the modified Ulan West mine plan results in localised changes in elevation over the length of the long section (refer to **Chart 3.4**).

Within Watercourse TM, the maximum increase (i.e. steepening) of longitudinal grade for the Proposed mine plan (compared to the existing terrain) was found to be approximately 1.3 mm/m. This is 1.3 x the increase in maximum longitudinal grade for the approved landform (1.0 mm/m).

Further analysis of the estimated grades over the entire length of the longsection of the three terrain states are shown in **Table 3.4**. From **Table 3.4**, it can be seen that the longitudinal grades for the three terrain conditions vary only slightly.

Table 3.4 – Longsection Summary Statistics for the Existing, Approved and Proposed Landform – Watercourse TL

Statistical Measure	Stream Gradient (mm/m) (Negative = Downslope)		
	Existing	Approved	Proposed
Minimum	-22.9	-23.2	-22.9
5 Percentile	-11.4	-11.6	-12.1
10 Percentile	-7.9	-8.4	-8.1
Average	-2.0	-2.0	-2.2
90 Percentile	4.2	4.0	4.3
95 Percentile	5.9	6.5	5.4
Maximum	18.1	17.7	17.1

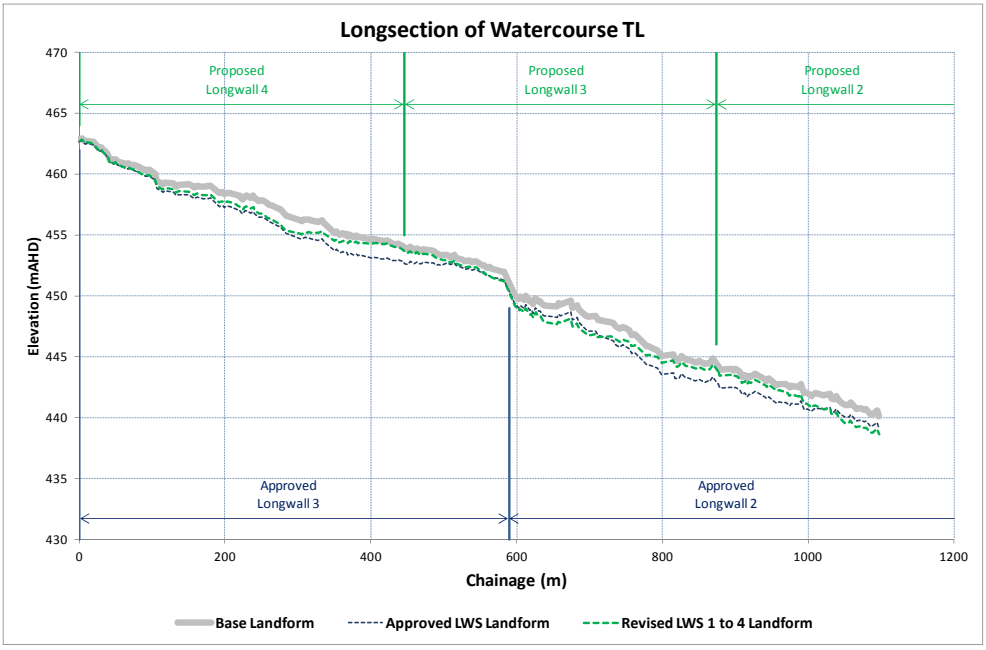


Chart 3.4 – Longsection, Watercourse TM

4.0 Hydraulic Modelling

4.1 XP-Storm Model Layout

A one dimensional hydrodynamic XP storm model was developed for each of the four watercourses as shown in **Figure 2.1**.

4.2 Velocities

4.2.1 Threshold Selection

Selection of velocity stability thresholds was based on bed material and historical knowledge of the area. The stability thresholds adopted for this assessment are as follows:

- Stable <0.8m/s;
- Moderately stable 0.8 to 1.5m/s; and
- Unstable >1.5m/s.

It is noted that the thresholds are indicative estimates only and should not be interpreted as absolute values or indications of stability.

4.2.2 Watercourse TF

The modelled velocities through Watercourse TF for the three landforms (existing; approved and proposed) and four critical duration rainfall events (1.5 year, 2 year, 10 year and 20 year Average Recurrence Interval (ARI)) are shown in **Charts 4.1**, **4.2**, **4.3** and **4.4**. A comparison of these charts indicates that there is little change in the channel stability of Watercourse TF in terms of velocity, as evidenced by a similar saw-tooth pattern of stability throughout the modelled watercourse for all three states and ARI's. Overall the channel stability of the watercourse remains either marginally stable or unstable for over most of the modelled extent, irrespective of the landform or ARI event.

The relative changes in the modelled velocity for the 1.5 year ARI storm of the three landforms are also included in **Table 4.1**. The magnitude of the change between the existing and approved and the existing and proposed modelled velocities are generally of a similar range, however localised differences at specific locations are present (refer to **Table 4.1**).

Table 4.1 – Modelled Changes to Maximum Flow Velocities (1.5 year ARI storm event) – Watercourse TF

XP-Storm Link ID	Longwall		Modelled Maximum Velocity (m/s)			
	Approved	Proposed	Existing	Approved	Proposed	Change (approved vs. proposed)
L05	LW4	LW5	1.49	1.40 (-6.0%)	1.41 (-5.4%)	0.7%
L06	LW3	LW4	0.68	0.70 (+2.9%)	0.64 (-5.9%)	-8.6%
L07			1.21	1.14 (-5.8%)	1.30 (+7.4%)	14.0%
L08	LW3, LW2	LW3	1.78	1.75 (-1.7%)	1.94 (+9.0%)	10.9%
L09	LW2		1.05	0.98 (-6.7%)	1.07 (+1.9%)	9.2%
L10		LW2	2.25	2.04 (-9.3%)	2.48 (+10.2%)	21.6%
L11	LW1		0.74	0.81 (+9.5%)	0.75 (+1.4%)	-7.4%
L12		LW1	1.43	1.35 (-5.6%)	1.57 (+9.8%)	16.3%
L13			0.69	0.62 (-10.1%)	0.60 (-13.0%)	-3.2%
L14	Downstream of mined area		1.29	1.28 (-0.8%)	1.28 (-0.8%)	0.0%
L15			0.88	0.88 (0.0%)	0.88 (0.0%)	0.0%
L16			5.37	5.37 (0.0%)	5.37 (0.0%)	0.0%
L17			2.69	2.69 (0.0%)	2.69 (0.0%)	0.0%

Note the number shown in the brackets is the percentage change relative to the existing landform.

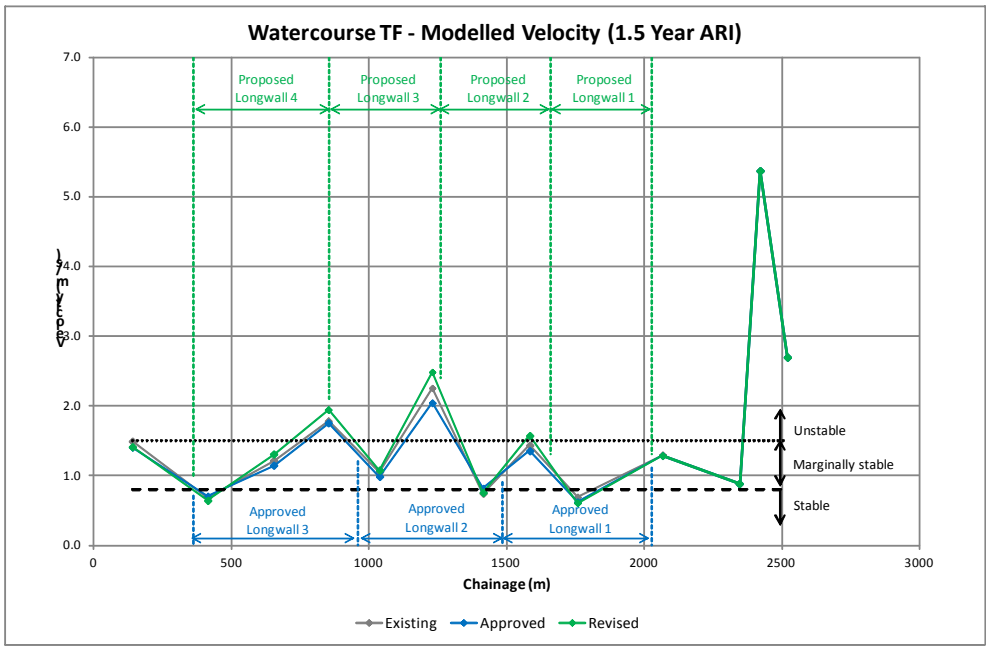


Chart 4.1 – Modelled Maximum Velocity, 1.5 Year ARI, Watercourse TF

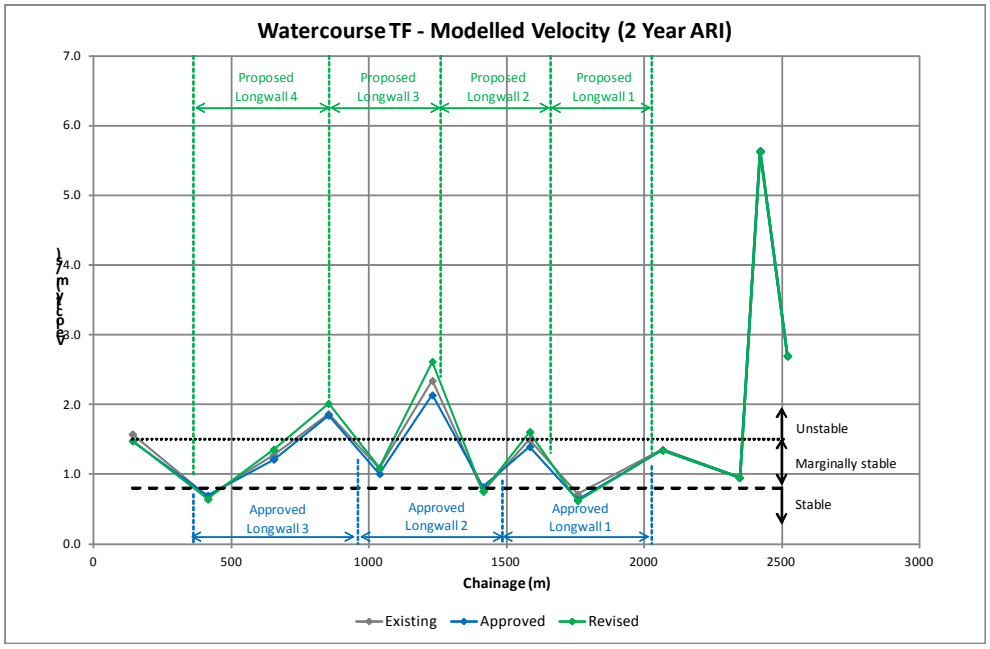


Chart 4.2 – Modelled Maximum Velocity, 2 Year ARI, Watercourse TF

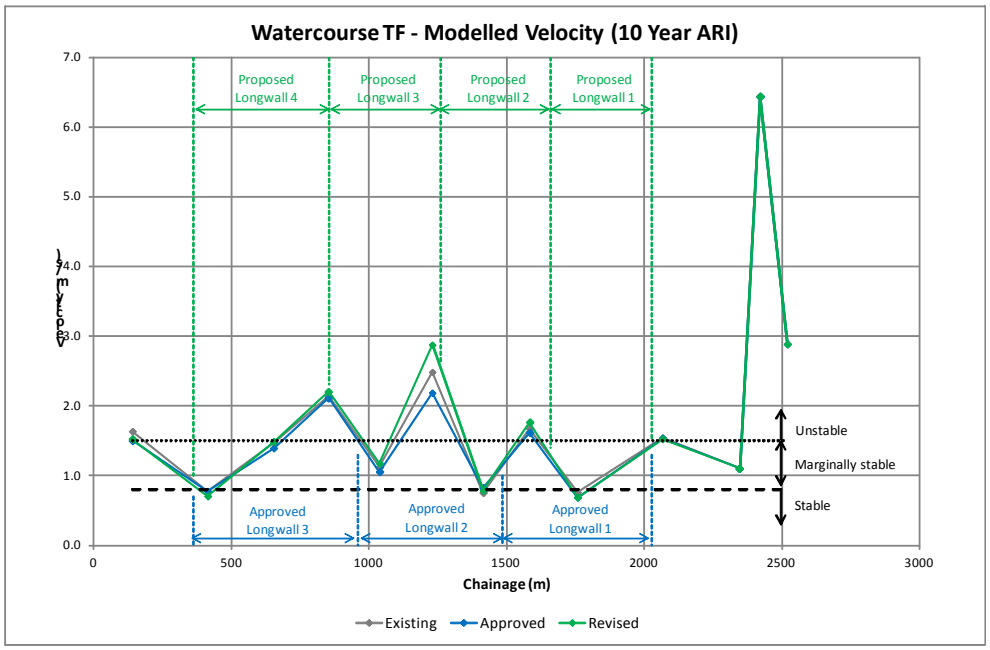


Chart 4.3 – Modelled Maximum Velocity, 10 Year ARI, Watercourse TF

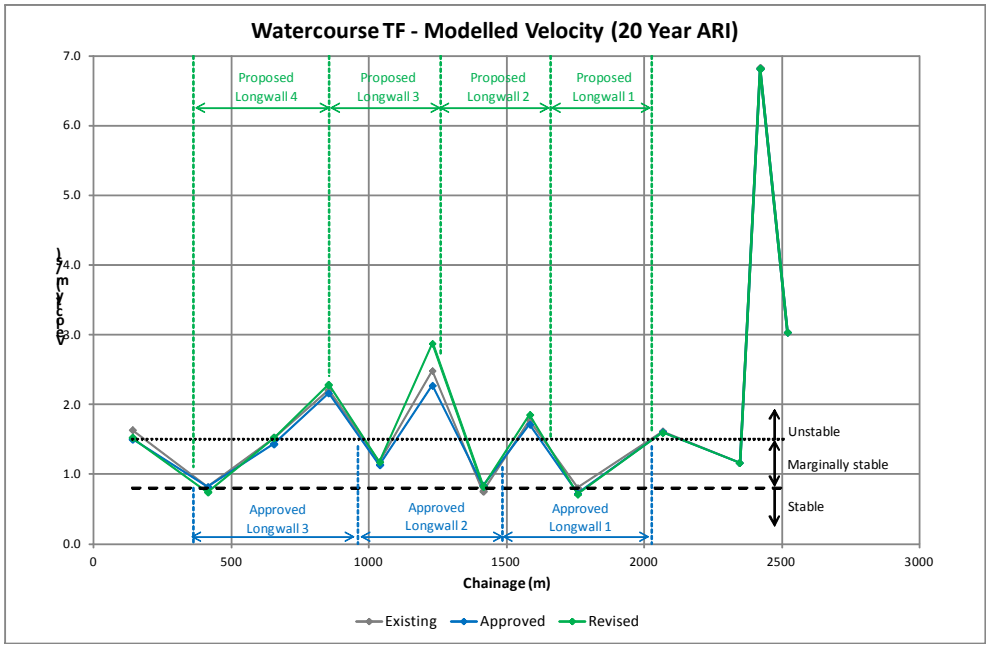


Chart 4.4 – Modelled Maximum Velocity, 20 Year ARI, Watercourse TF

4.2.3 Watercourse TGa

The modelled velocities through Watercourse TGa for the three landforms (existing; approved and proposed) and four critical duration rainfall events (1.5 year, 2 year, 10 year and 20 year Average Recurrence Interval (ARI)) are shown in **Charts 4.5**, **4.6**, **4.7** and **4.8**. A comparison of these charts indicates that there is little change in the channel stability of Watercourse TGa in terms of velocity, with some potential improvements in instabilities within the lower sections of the modelled watercourse (i.e. moving from unstable to marginally unstable state within the proposed Ulan West Longwall 1 footprint). Overall the channel stability of the watercourse remains either marginally stable or unstable for over most of the modelled extent, irrespective of the landform or ARI event.

The relative changes in modelled velocity for the 1.5 year ARI storm of the three landforms are also included in **Table 4.2**. The magnitude of the change between the existing and approved and the existing and proposed modelled velocities are generally of a similar range, however localised differences at specific locations are present (refer to **Table 4.2**).

Table 4.2 – Modelled Changes to Maximum Flow Velocities (1.5 year ARI storm event) – Watercourse TGa

XP-Storm Link ID	Longwall		Modelled Maximum Velocity (m/s)			
	Approved	Proposed	Existing	Approved	Proposed	Change (approved vs. proposed)
L28	LW2	LW3	0.72	0.77 (+6.9%)	0.72 (0.0%)	-6.5%
L27		LW2	1.19	1.16 (-2.5%)	1.25 (+5.0%)	7.8%
L01	LW1		1.91	2.02 (+5.8%)	1.66 (-13.1%)	-17.8%
L02		LW1	1.75	1.59 (-9.1%)	1.63 (-6.9%)	2.5%
L03			1.54	1.27 (-17.5%)	1.22 (-20.8%)	-3.9%
L04	Downstream of mine area		2.12	2.08 (-1.9%)	1.99 (-6.1%)	-4.3%

Note the number shown in the brackets is the percentage change relative to the existing landform.

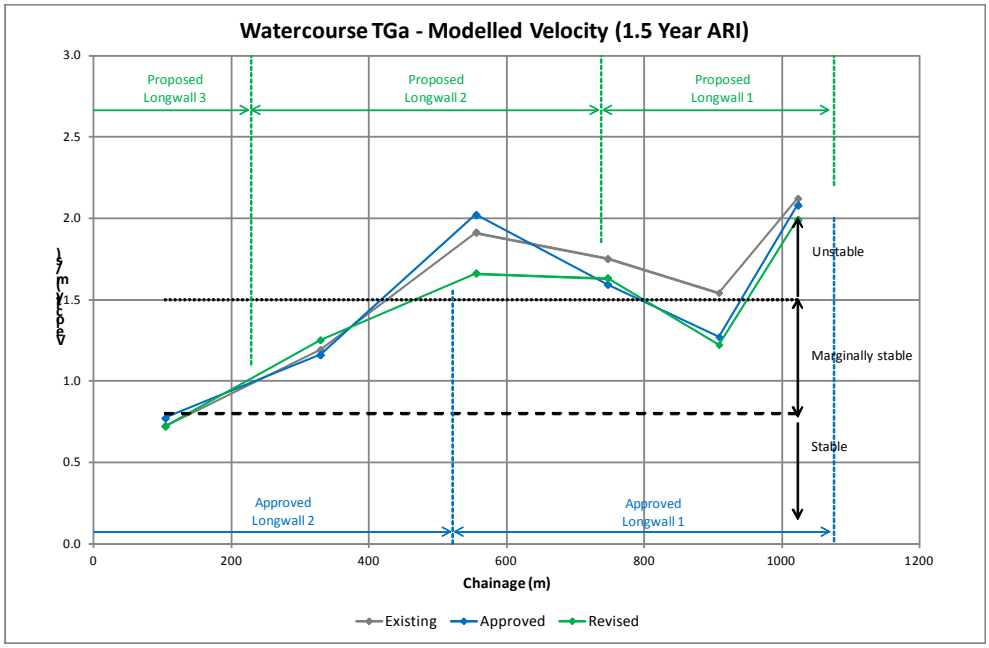


Chart 4.5 – Modelled Maximum Velocity, 1.5 Year ARI, Watercourse TGa

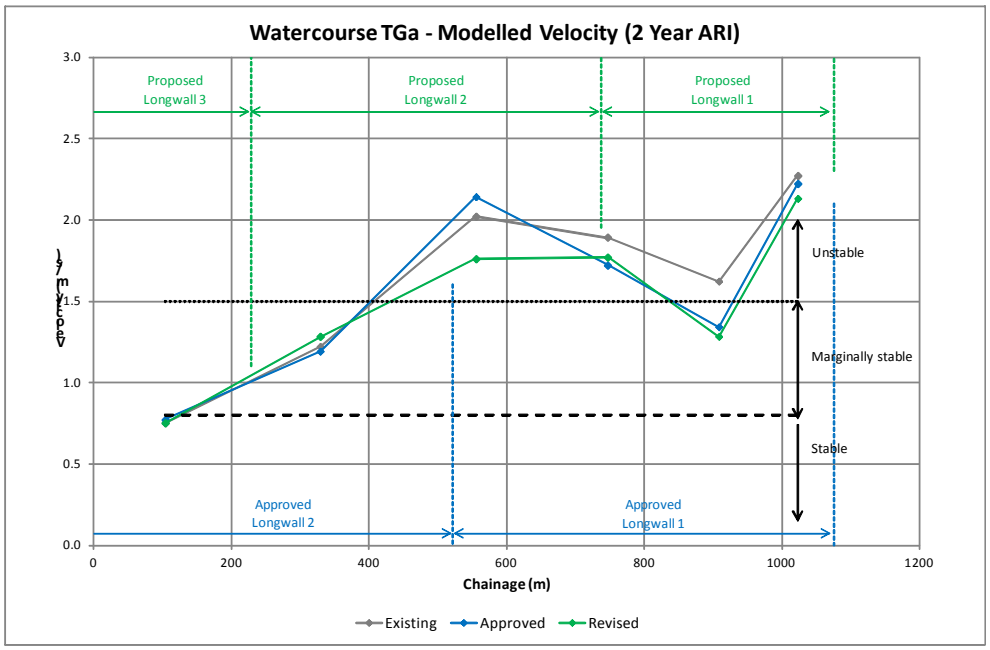


Chart 4.6 – Modelled Maximum Velocity, 2 Year ARI, Watercourse TGa

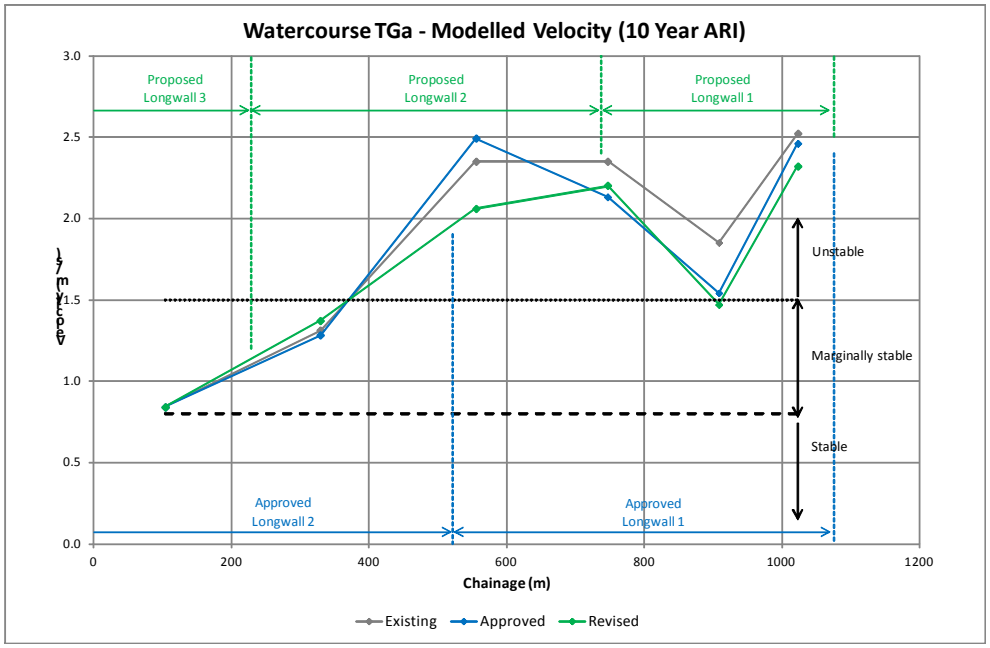


Chart 4.7 – Modelled Maximum Velocity, 10 Year ARI, Watercourse TGa

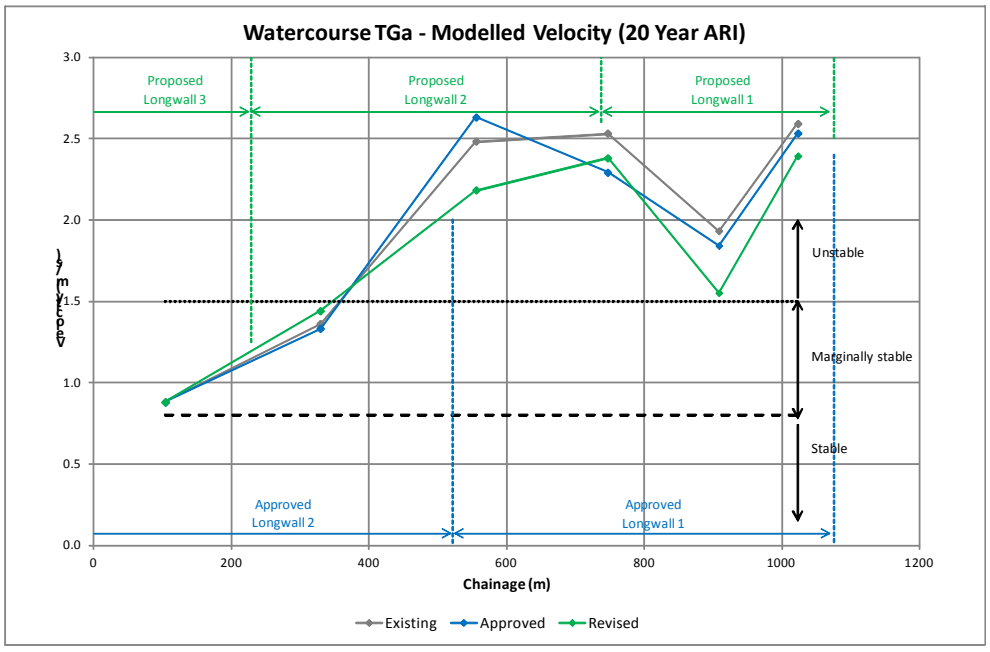


Chart 4.8 – Modelled Maximum Velocity, 20 Year ARI, Watercourse TGa

4.2.4 Watercourse TM

The modelled velocities through Watercourse TM for the three landforms (existing; approved and proposed) and four critical duration rainfall events (1.5 year, 2 year, 10 year and 20 year Average Recurrence Interval (ARI)) are shown in **Charts 4.9**, **4.10**, **4.11** and **4.12**. A comparison of these charts indicates that there is little change in the channel stability of Watercourse TM in terms of velocity, as evidenced by a similar saw-tooth pattern of stability throughout the modelled watercourse for all three states and ARI's. Overall the channel stability of the watercourse remains either marginally stable or unstable for most of the modelled extent, irrespective of the landform or ARI event.

The relative changes in modelled velocity for the 1.5 year ARI storm of the three landforms are also included in **Table 4.3**. The magnitude of the change between the existing and approved and the existing and proposed modelled velocities are generally of a similar range, however localised differences at specific locations are present (refer to **Table 4.3**).

Table 4.3 – Modelled Changes to Maximum Flow Velocities (1.5 Year ARI storm event) – Watercourse TM

XP-Storm Link ID	Longwall		Modelled Maximum Velocity (m/s)			
	Approved	Proposed	Existing	Approved	Proposed	Change (approved vs. proposed)
L43	LW3	LW4	1.34	1.40 (+4.5%)	1.40 (+4.5%)	0.0%
L42			0.27	0.26 (-3.7%)	0.29 (+7.4%)	11.5%
L41	LW3,LW2	LW3	1.68	1.67 (-0.6%)	1.79 (+6.5%)	7.2%
L40	LW2		1.05	1.09 (+3.8%)	0.95 (-9.5%)	-12.8%
L39		LW2	1.07	1.07 (0.0%)	1.06 (-0.9%)	-0.9%
L38	LW1		0.55	0.56 (+1.8%)	0.57 (+3.6%)	1.8%
L37		LW1	1.24	1.22 (-1.6%)	1.33 (+7.3%)	9.0%
L36			1.20	1.11 (-7.5%)	1.11 (-7.5%)	0.0%
L35	Downstream of mine area		1.28	1.27 (-0.8%)	1.26 (-1.6%)	-0.8%
L34			2.17	2.17 (0.0%)	2.14 (-1.4%)	-1.4%

Note the number shown in the brackets is the percentage change relative to the existing landform.

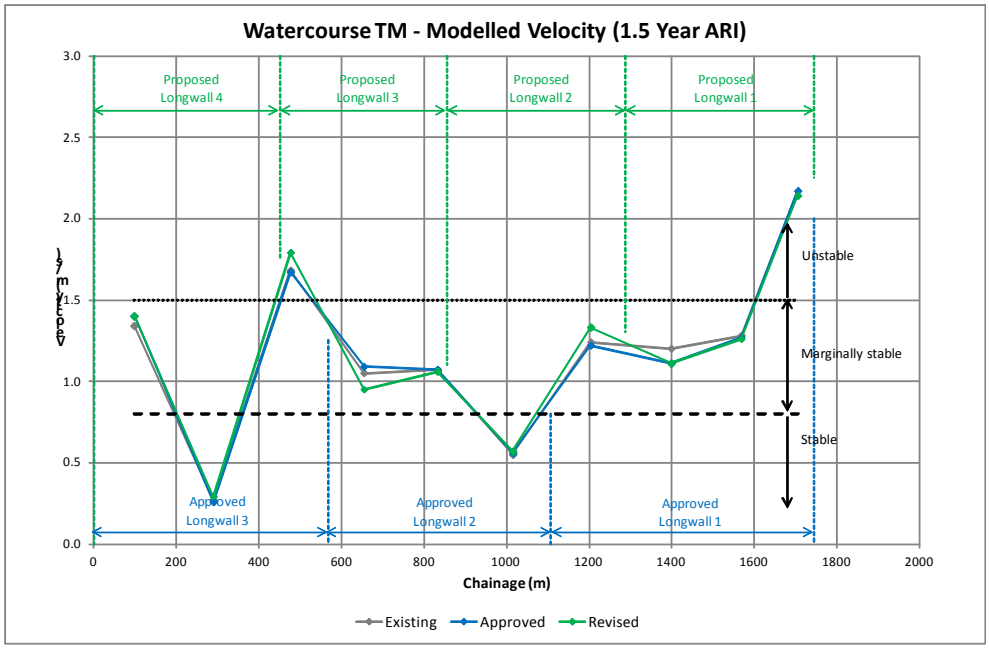


Chart 4.9 – Modelled Maximum Velocity, 1.5 Year ARI, Watercourse TM

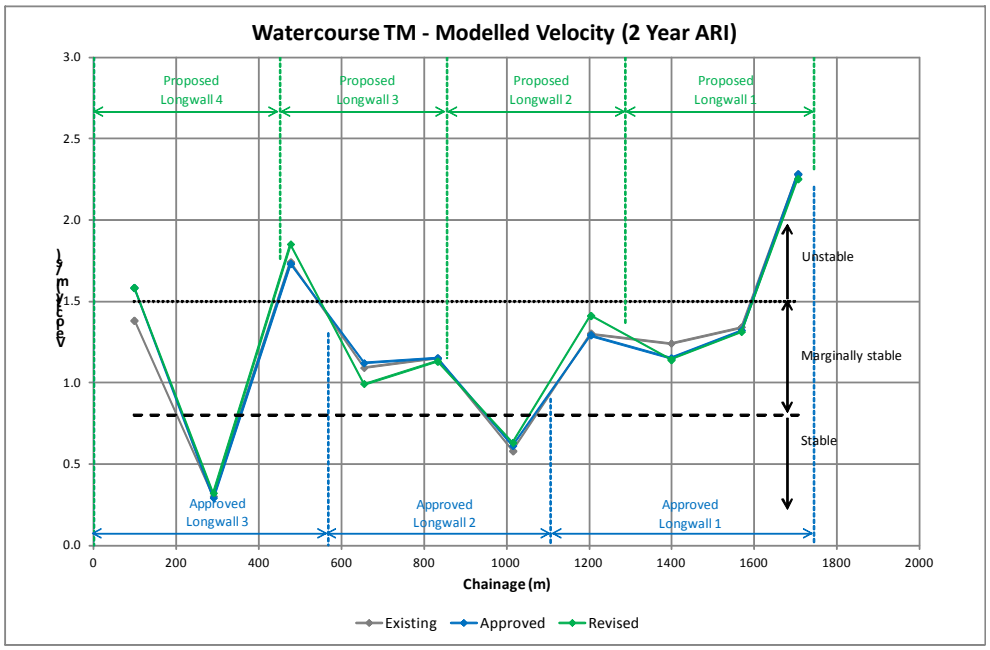


Chart 4.10 – Modelled Maximum Velocity, 2 Year ARI, Watercourse TM

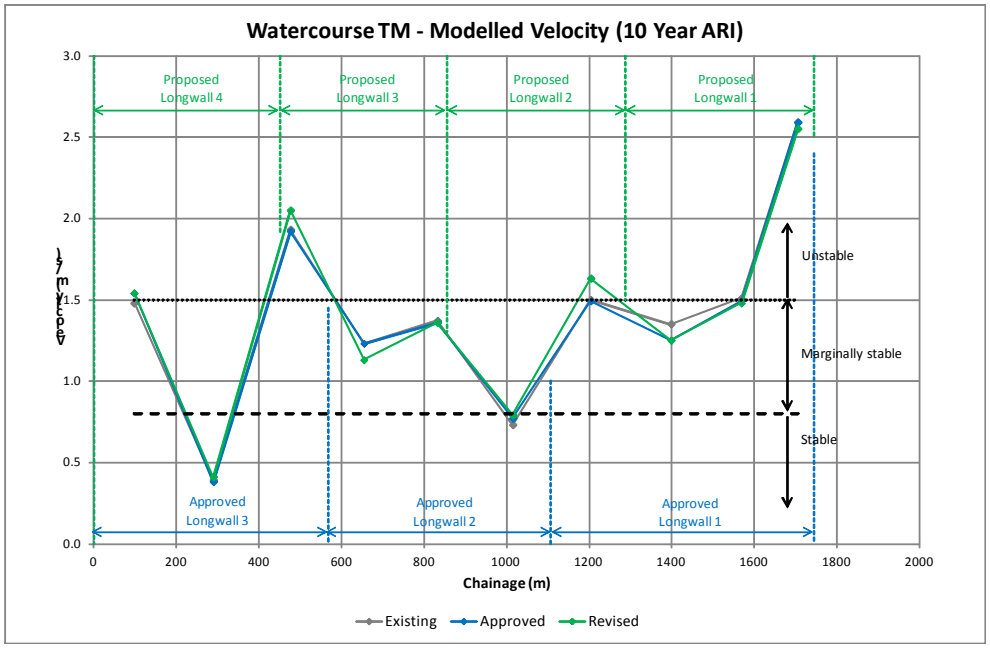


Chart 4.11 – Modelled Maximum Velocity, 10 Year ARI, Watercourse TM

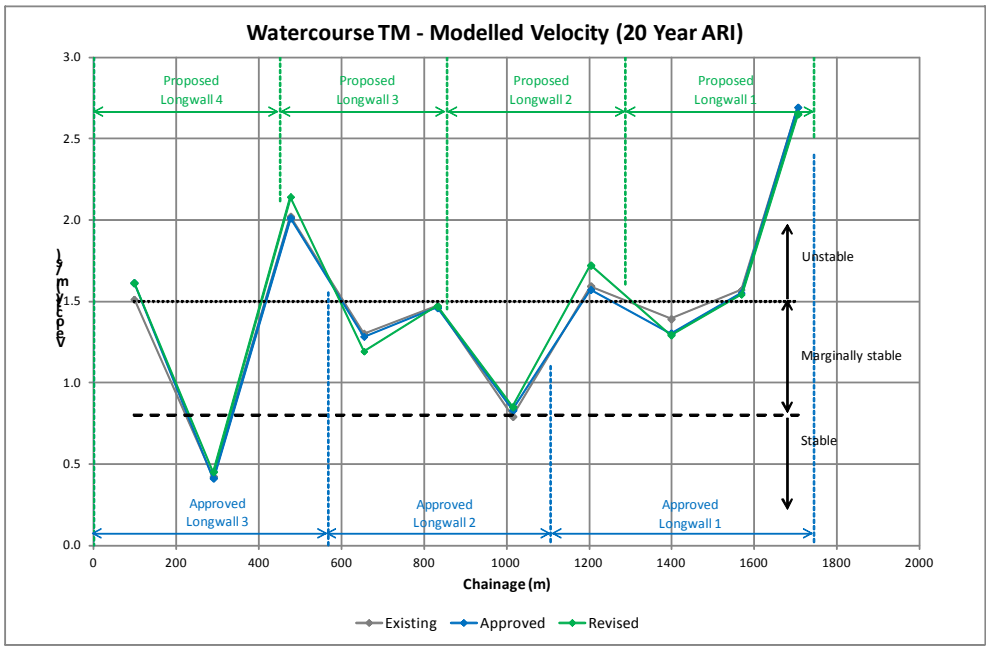


Chart 4.12 – Modelled Maximum Velocity, 20 Year ARI, Watercourse TM

4.2.5 Watercourse TL

The modelled velocities through Watercourse TL for the three landforms (existing; approved and proposed) and four critical duration rainfall events (1.5 year, 2 year, 10 year and 20 year Average Recurrence Interval (ARI)) are shown in **Charts 4.13**, **4.14**, **4.15** and **4.16**. A comparison of these charts indicates that there is little change in the channel stability of Watercourse TL in terms of velocity, as evidenced by a similar saw-tooth pattern of stability throughout the modelled watercourse for all three states and ARI's. Overall the channel stability of the watercourse remains either marginally stable or unstable for the modelled extent, irrespective of the landform or ARI event.

The relative changes in modelled velocity for the 1.5 year ARI storm of the three landforms are also included in **Table 4.4**. The magnitude of the change between the existing and approved and the existing and proposed modelled velocities are generally of a similar range, however localised differences at specific locations are present (refer to **Table 4.4**).

Table 4.4 – Modelled Changes to Maximum Flow Velocities (1.5 Year ARI storm event) - Watercourse TL

XP-Storm Link ID	Longwall		Modelled Maximum Velocity (m/s)			
	Approved	Proposed	Existing	Approved	Proposed	Change (approved vs. proposed)
L33	LW3	LW4	1.03	1.09 (+5.8%)	1.00 (-2.9%)	-8.3%
L32			2.11	2.14 (+1.4%)	2.02 (-4.3%)	-5.6%
L31		LW3	0.87	0.81 (-6.9%)	0.91 (+4.6%)	12.3%
L46	LW2		4.67	4.99 (+6.9%)	5.16 (+10.5%)	3.4%
L47			1.61	1.74 (+8.1%)	1.59 (-1.2%)	-8.6%
L45			2.57	2.66 (+3.5%)	2.36 (-8.2%)	-11.3%
L29		LW2	1.29	1.35 (+4.7%)	1.14 (-11.6%)	-15.6%

Note the number shown in the brackets is the percentage change relative to the existing landform.

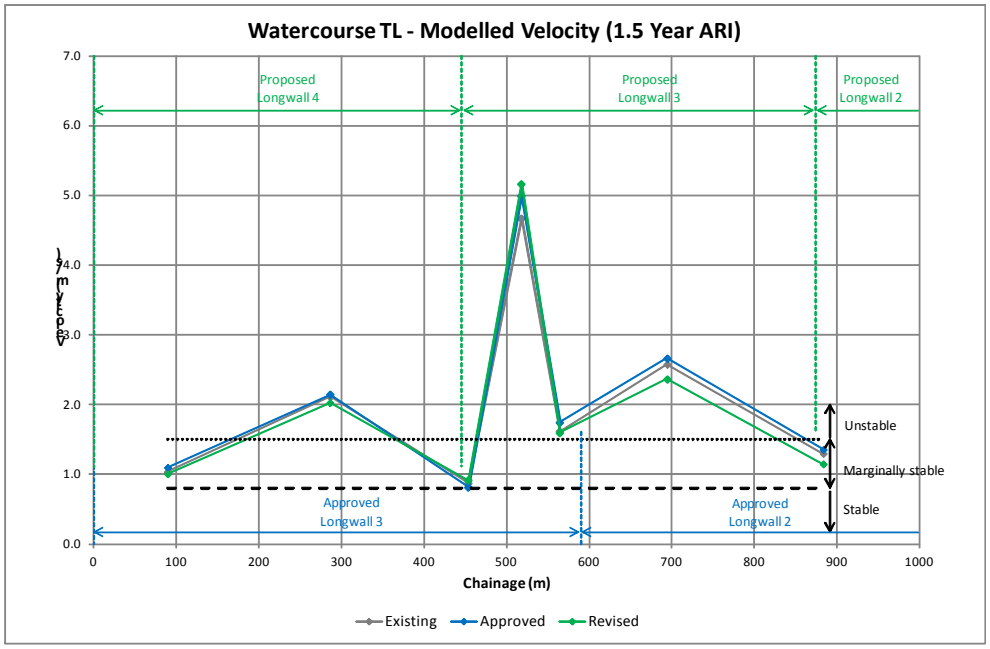


Chart 4.13 – Modelled Maximum Velocity, 1.5 Year ARI, Watercourse TL

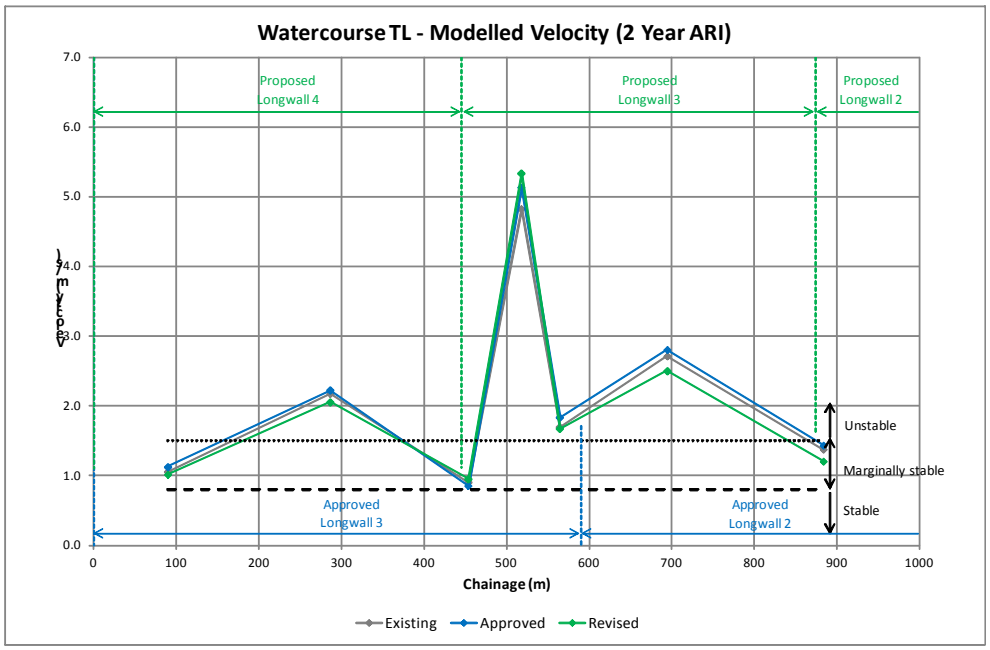


Chart 4.14 – Modelled Maximum Velocity, 2 Year ARI, Watercourse TL

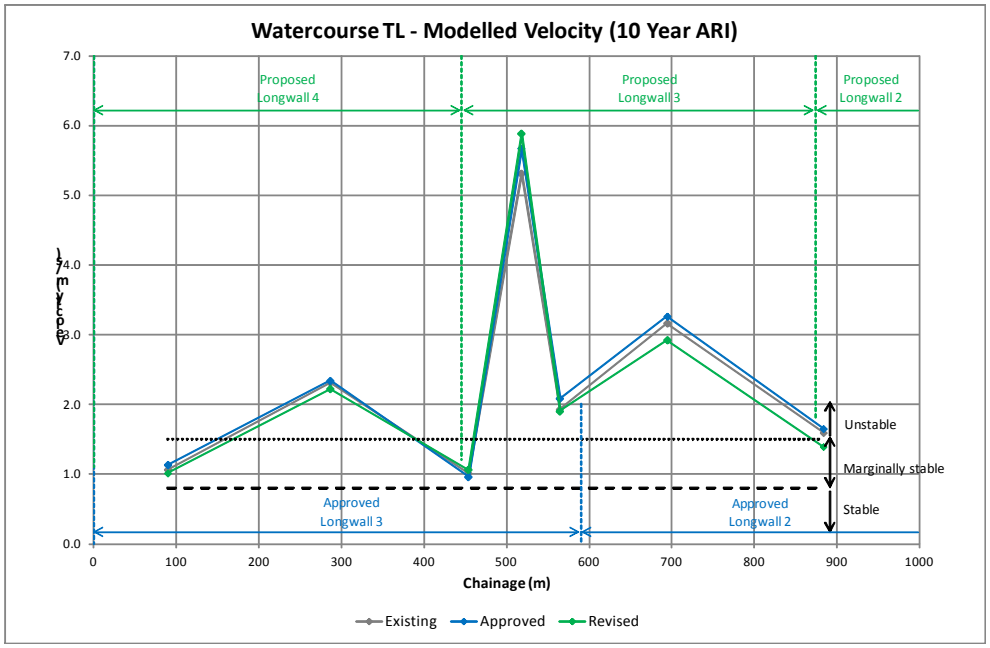


Chart 4.15 – Modelled Maximum Velocity, 10 Year ARI, Watercourse TL

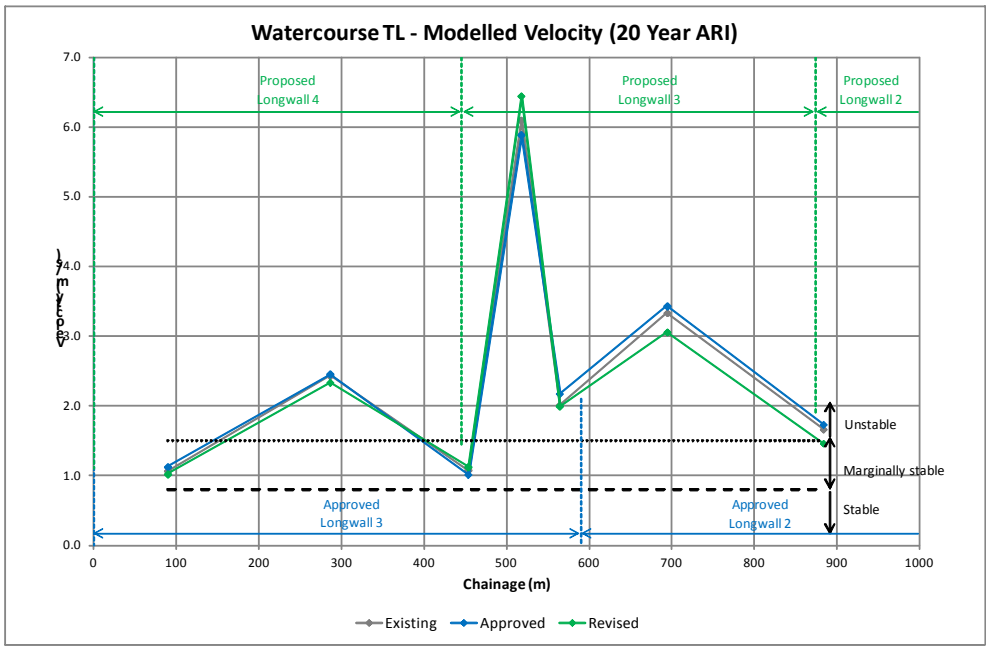


Chart 4.16 – Modelled Maximum Velocity, 20 Year ARI, Watercourse TL

4.3 Tractive Stress

4.3.1 Threshold Selection

The selection of tractive stress stability thresholds was based on bed material observed during the field inspection and historical knowledge of the area. The tractive stress stability thresholds adopted for this assessment are as follows:

- firm loam and fine gravel 3.6n/m^2; and
- 1 inch diameter gravel 15.36n/m^2.

It is noted that the thresholds are indicative estimates only and should not be interpreted as absolute values or indications of stability.

4.3.2 Watercourse TF

The modelled tractive stresses through Watercourse TF for the three landforms (existing; approved and proposed) and four critical duration rainfall events (1.5 year, 2 year, 10 year and 20 year Average Recurrence Interval (ARI)) are shown in **Charts 4.17**, **4.18**, **4.19** and **4.20**. A comparison of these charts indicates that there is little change in the channel stability classification of Watercourse TF in terms of tractive stress, the modelled watercourse is presently (i.e. the modelled watercourse is already unstable and the modified mine plan will not change this classification, irrespective of the landform or ARI event).

The relative changes in modelled tractive stress for the 1.5 year ARI storm of the three landforms are also included in **Table 4.5**. The magnitude of the change between the existing and approved and the existing and proposed modelled tractive stress's are generally of a similar range, however localised differences at specific locations are present (refer to **Table 4.5**).

Table 4.5 – Modelled Changes to Maximum Tractive Stress (1.5 year ARI storm event) – Watercourse TF

XP-Storm Link ID	Longwall		Modelled Maximum Tractive Stress (N/m^2)			
	Approved	Proposed	Existing	Approved	Proposed	Change (approved vs. proposed)
L05	LW4	LW5	47.48	41.26 (-13.1%)	42.10 (-11.3%)	2.0%
L06	LW3	LW4	29.37	36.18 (+23.2%)	37.13 (+26.4%)	2.6%
L07			46.32	42.50 (-8.2%)	32.24 (-30.4%)	-24.1%
L08	LW3, LW2	LW3	57.95	56.65 (-2.2%)	69.48 (+19.9%)	22.6%
L09	LW2		45.54	56.00 (+23.0%)	26.36 (-42.1%)	-52.9%
L10		LW2	83.41	70.09 (-16.0%)	102.15 (+22.5%)	45.7%
L11	LW1		26.29	31.72 (+20.7%)	13.45 (-48.8%)	-57.6%
L12		LW1	46.13	39.99 (-13.3%)	53.59 (+16.2%)	34.0%
L13			33.37	15.93 (-52.3%)	13.59 (-59.3%)	-14.7%
L14	Downstream of mined area		35.12	34.25 (-2.5%)	34.08 (-3.0%)	-0.5%
L15			71.30	71.30 (0.0%)	71.27 (0.0%)	0.0%
L16			353.99	353.99 (0.0%)	354.13 (0.0%)	0.0%
L17			118.90	118.92 (0.0%)	118.90 (0.0%)	0.0%

Note the number shown in the brackets is the percentage change relative to the existing landform.

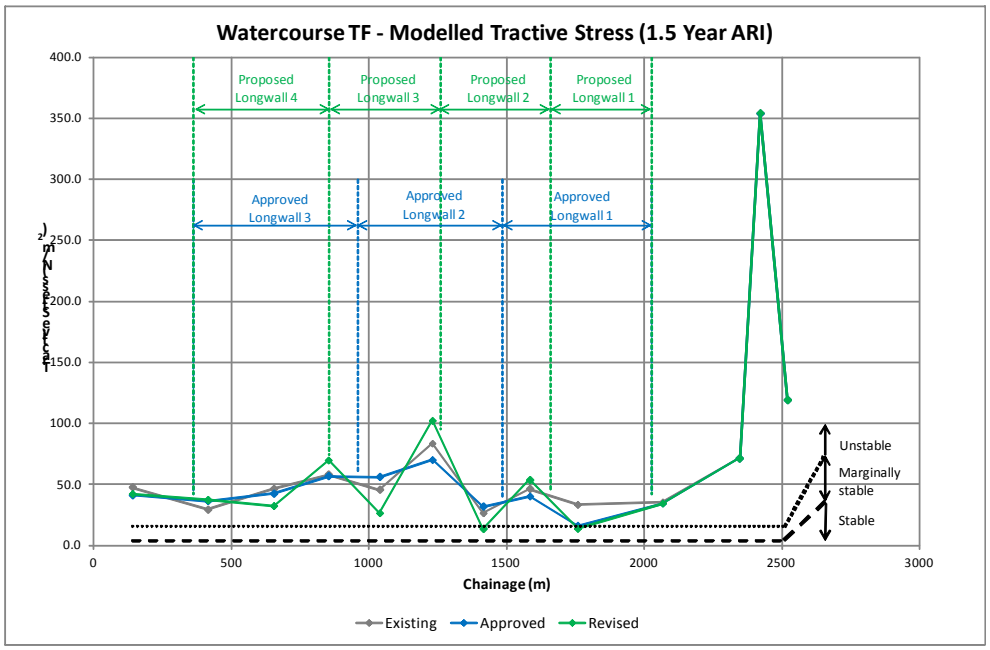


Chart 4.17 – Modelled Maximum Tractive Stress, 1.5 Year ARI, Watercourse TF

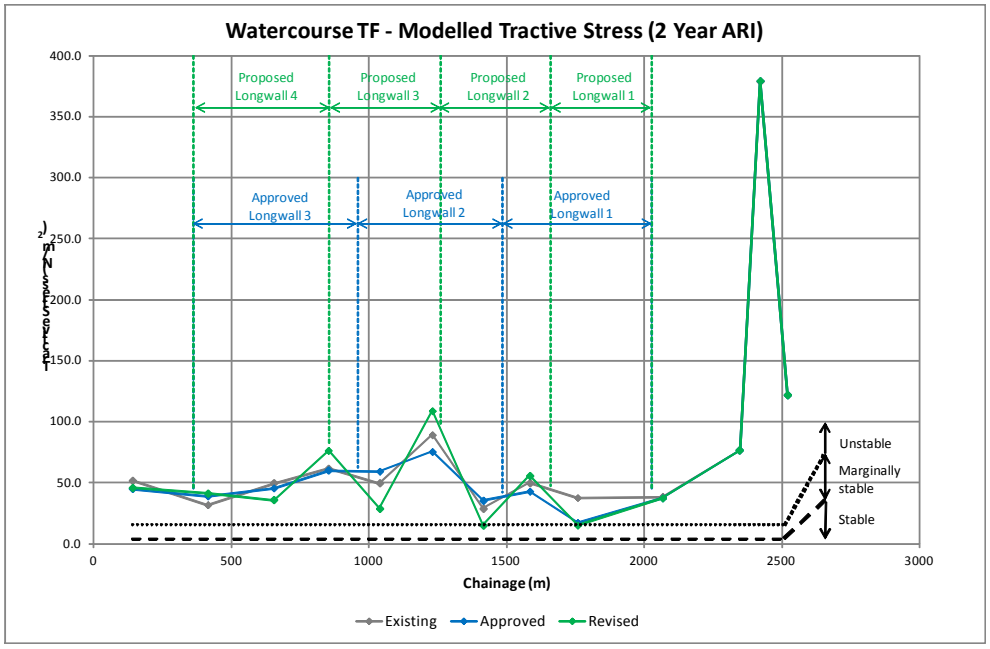


Chart 4.18 – Modelled Maximum Tractive Stress, 2 Year ARI, Watercourse TF

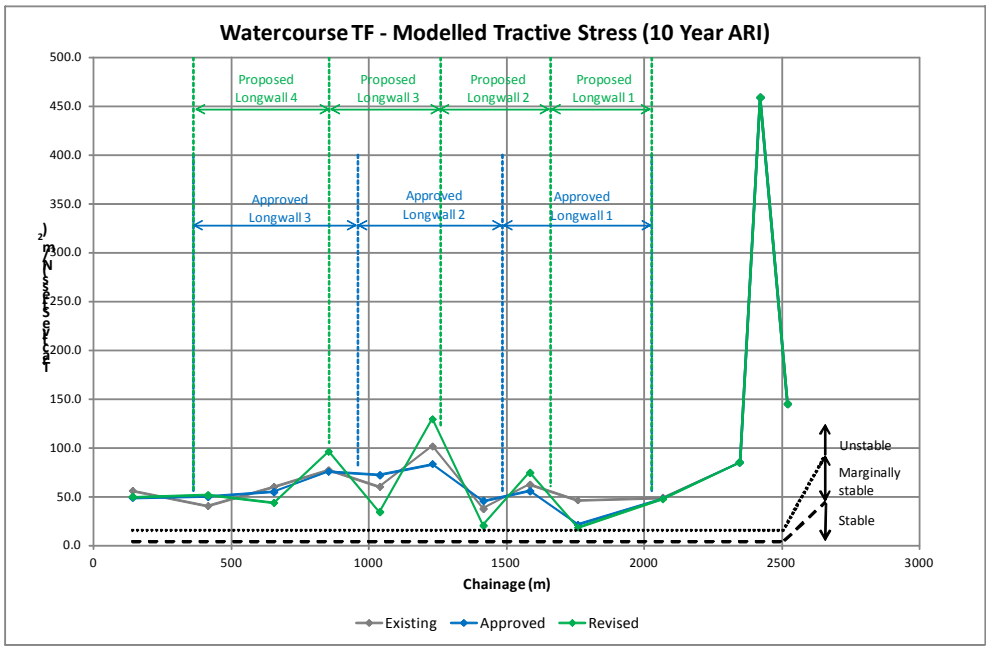


Chart 4.19 – Modelled Maximum Tractive Stress, 10 Year ARI, Watercourse TF

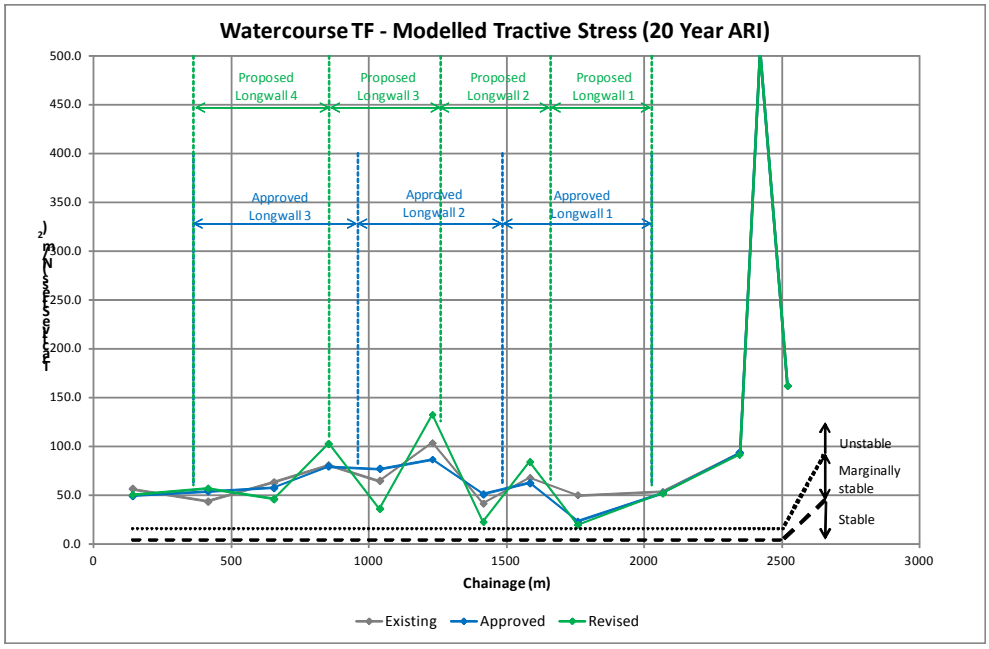


Chart 4.20 – Modelled Maximum Tractive Stress, 20 Year ARI, Watercourse TF

4.3.3 Watercourse TGa

The modelled tractive stresses through Watercourse TGa for the three landforms (existing; approved and proposed) and four critical duration rainfall events (1.5 year, 2 year, 10 year and 20 year Average Recurrence Interval (ARI)) are shown in **Charts 4.21**, **4.22**, **4.23** and **4.24**. A comparison of these charts indicates that there is little change in the channel stability of Watercourse TGa in terms of tractive stress (i.e. the modelled watercourse is already unstable and the modified mine plan will not change this classification, irrespective of the landform or ARI event).

The relative changes in modelled tractive stress for the 1.5 year ARI storm of the three landforms are also included in **Table 4.6**. The magnitude of the change between the existing and approved and the existing and proposed modelled tractive stress's are generally of a similar range, however localised differences at specific locations are present (refer to **Table 4.6**).

Table 4.6 – Modelled Changes to Maximum Tractive Stress (1.5 year ARI storm event) – Watercourse TGa

XP-Storm Link ID	Longwall		Modelled Maximum Tractive Stress (N/m^2)			
	Approved	Proposed	Existing	Approved	Proposed	Change (approved vs. proposed)
L28	LW2	LW3	32.14	34.94 (+8.7%)	27.73 (-13.7%)	-20.6%
L27		LW2	35.91	33.83 (-5.8%)	39.93 (+11.2%)	18.0%
L01	LW1		58.35	66.23 (+13.5%)	45.23 (-22.5%)	-31.7%
L02		LW1	72.74	71.17 (-2.2%)	94.76 (+30.3%)	33.1%
L03			47.89	32.70 (31.7%)	29.97 (-37.4%)	-8.3%
L04	Downstream of mine area		81.27	79.21 (-2.5%)	73.01 (-10.2%)	-7.8%

Note the number shown in the brackets is the percentage change relative to the existing landform.

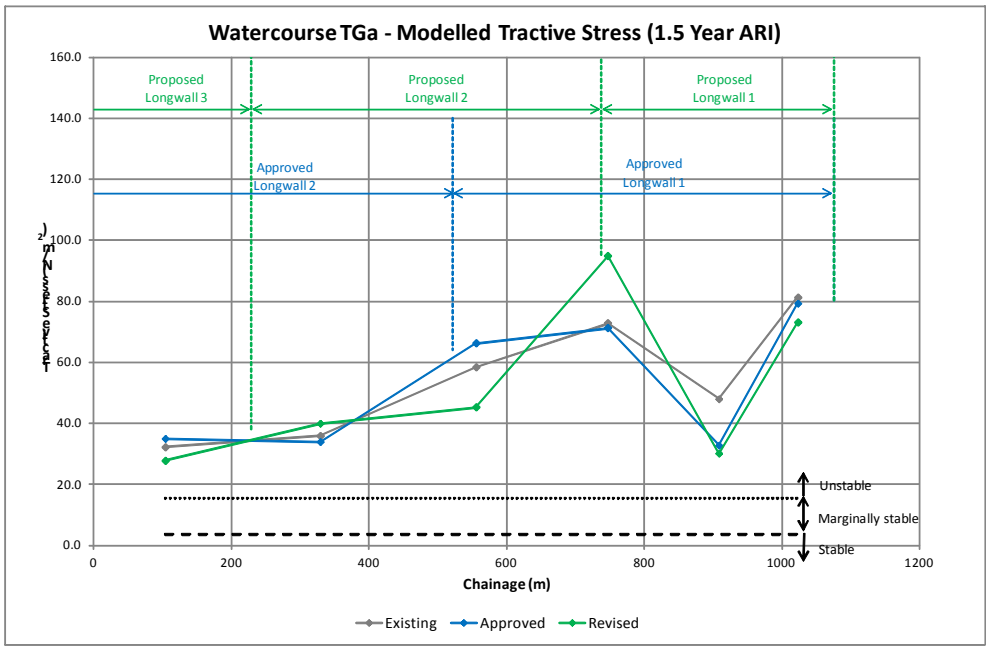


Chart 4.21 – Modelled Maximum Tractive Stress, 1.5 Year ARI, Watercourse TGa

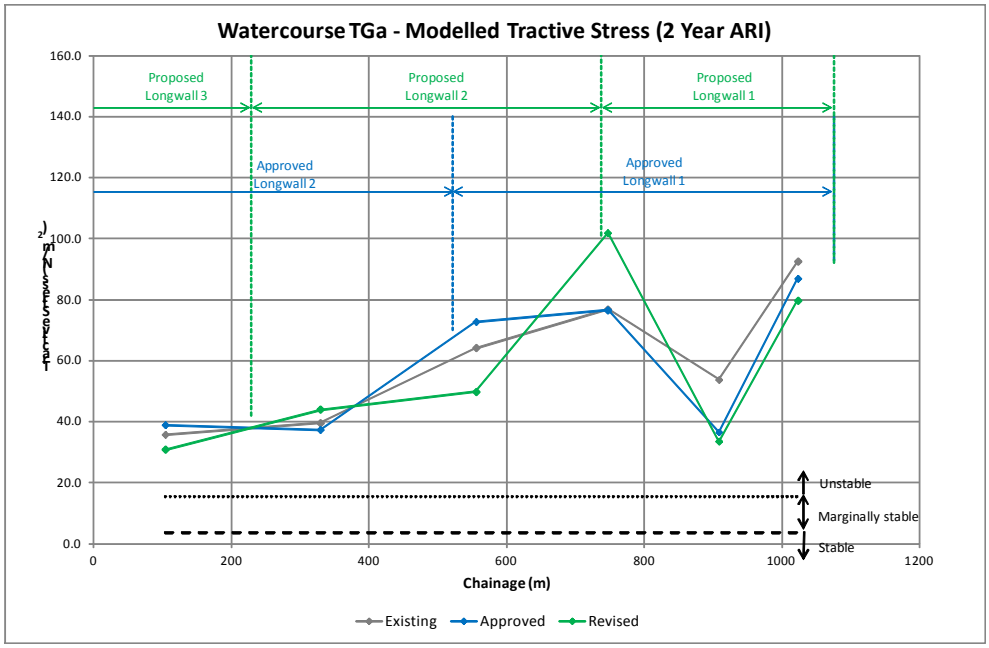


Chart 4.22 – Modelled Maximum Tractive Stress, 2 Year ARI, Watercourse TGa

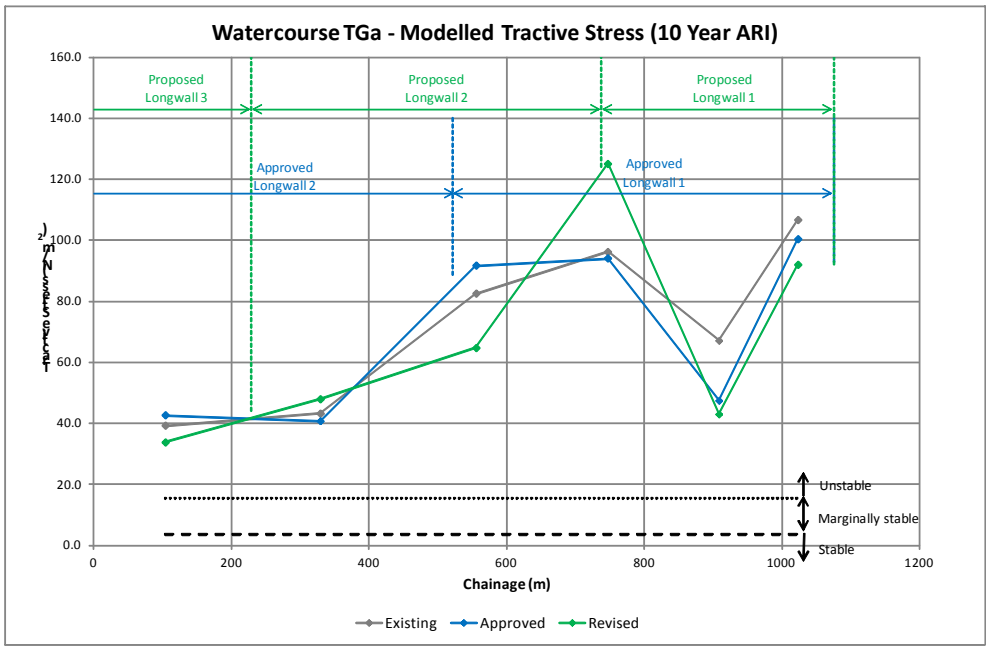


Chart 4.23 – Modelled Maximum Tractive Stress, 10 Year ARI, Watercourse TGa

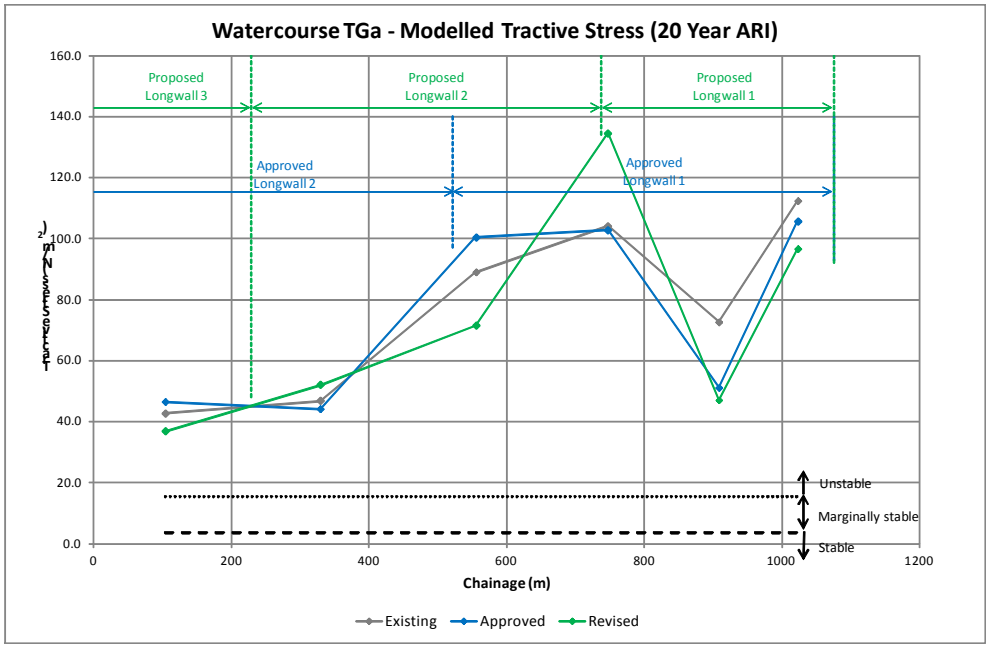


Chart 4.24 – Modelled Maximum Tractive Stress, 20 Year ARI, Watercourse TGa

4.3.4 Watercourse TM

The modelled tractive stresses through Watercourse TM for the three landforms (existing; approved and proposed) and four critical duration rainfall events (1.5 year, 2 year, 10 year and 20 year Average Recurrence Interval (ARI)) are shown in **Charts 4.25**, **4.26**, **4.27** and **4.28**. A comparison of these charts indicates that there is little change in the channel stability of Watercourse TM in terms of tractive stress, (i.e. the modelled watercourse is already unstable and the modified mine plan will not change this classification, irrespective of the landform or ARI event).

The relative changes in modelled tractive stress for the 1.5 year ARI storm of the three landforms are also included in **Table 4.7**. The magnitude of the change between the existing and approved and the existing and proposed modelled tractive stress's are generally of a similar range, however localised differences at specific locations are present (refer to **Table 4.7**).

Table 4.7 – Modelled Changes to Maximum Tractive Stress (1.5 year ARI storm event) – \Watercourse TM

XP-Storm Link ID	Longwall		Modelled Maximum Tractive Stress (N/m^2)			
	Approved	Proposed	Existing	Approved	Proposed	Change (approved vs. proposed)
L43	LW3	LW4	44.78	49.29 (+10.1%)	49.27 (+10.0%)	0.0%
L42			66.09	62.68 (-5.2%)	51.25 (-22.5%)	-18.2%
L41	LW3,LW2	LW3	68.10	67.12 (-1.4%)	74.10 (+8.8%)	10.4%
L40	LW2		36.13	39.31 (+8.8%)	30.32 (-16.1%)	-22.9%
L39		LW2	40.40	35.22 (-12.8%)	49.48 (+22.5%)	40.5%
L38	LW1		49.29	54.86 (+11.3%)	34.81 (-29.4%)	-36.5%
L37		LW1	43.81	42.35 (-3.3%)	51.40 (+17.3%)	21.4%
L36			49.84	35.73 (-28.3%)	34.18 (-31.4%)	-4.3%
L35	Downstream of mine area		55.16	51.42 (-6.8%)	52.03 (-5.7%)	1.2%
L34			100.31	100.31 (0.0%)	108.92 (+8.6%)	8.6%

Note the number shown in the brackets is the percentage change relative to the existing landform.

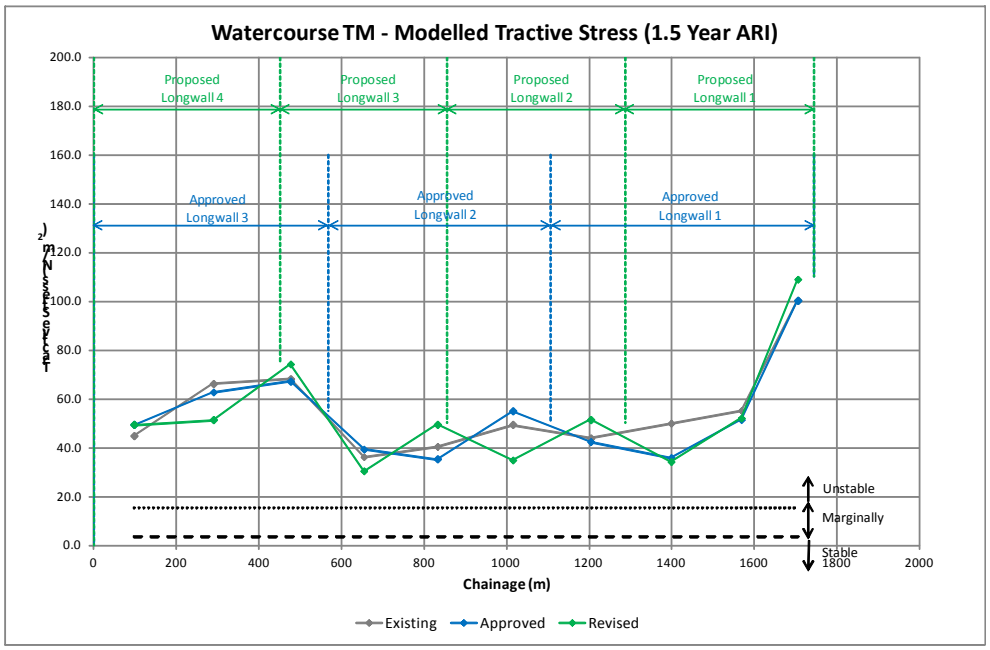


Chart 4.25 – Modelled Maximum Tractive Stress, 1.5 Year ARI, Watercourse TM

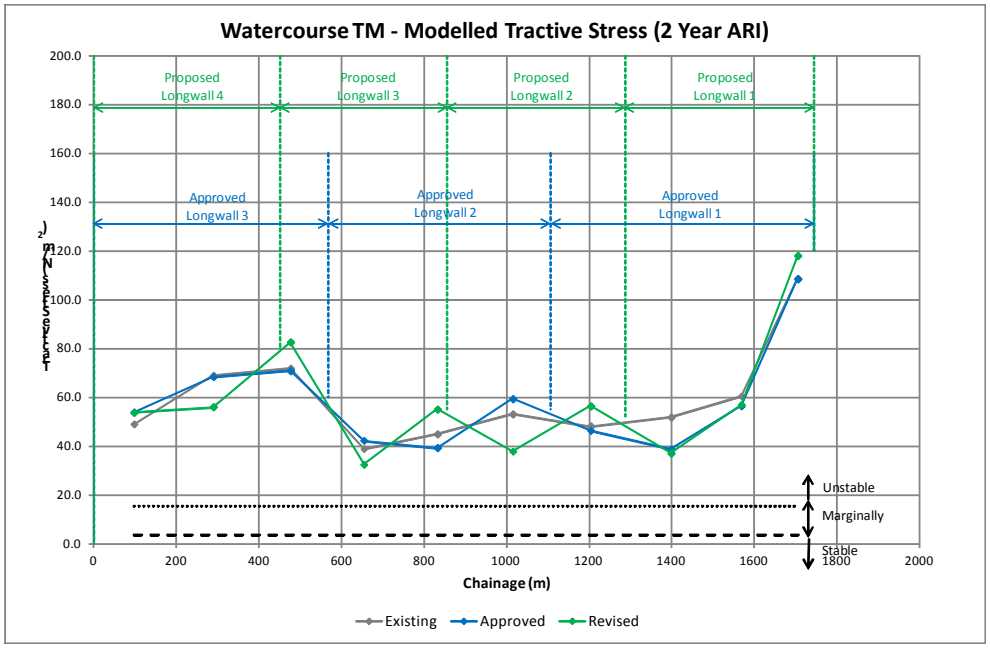


Chart 4.26 – Modelled Maximum Tractive Stress, 2 Year ARI, Watercourse TM

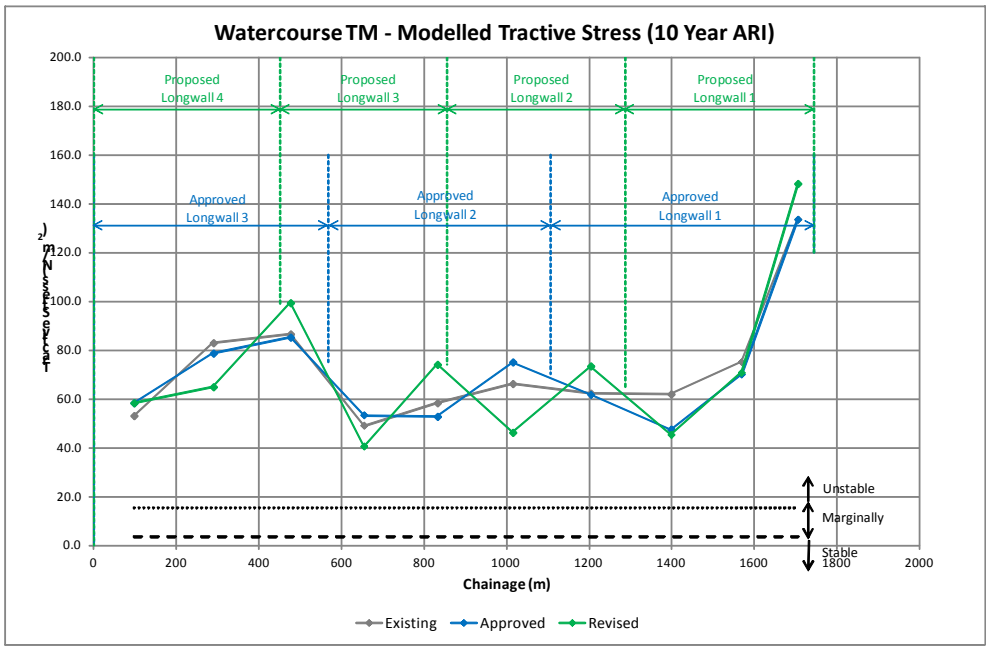


Chart 4.27 – Modelled Maximum Tractive Stress, 10 Year ARI, Watercourse TM

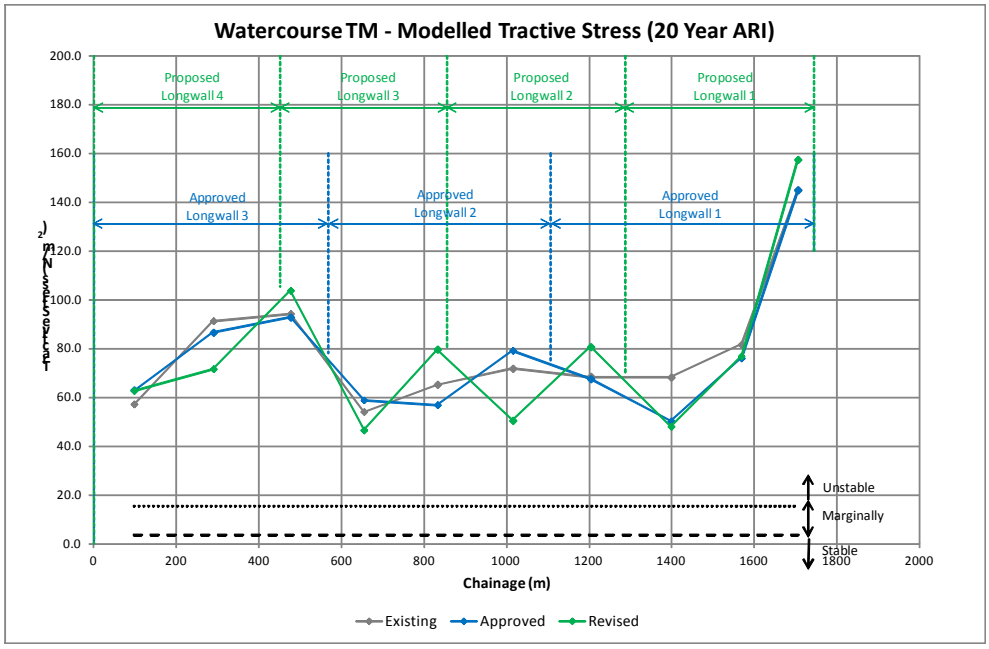


Chart 4.28 – Modelled Maximum Tractive Stress, 20 Year ARI, Watercourse TM

4.3.5 Watercourse TL

The modelled tractive stresses through Watercourse TL for the three landforms (existing; approved and proposed) and four critical duration rainfall events (1.5 year, 2 year, 10 year and 20 year Average Recurrence Interval (ARI)) are shown in **Charts 4.29**, **4.30**, **4.31** and **4.32**. A comparison of these charts indicates that there is little change in the channel stability of Watercourse TL in terms of tractive stress, as evidenced by a similar saw-tooth pattern of stability throughout the modelled watercourse for all three states and ARI's. It is also noted that the modelled watercourse is already unstable and the modified mine plan will not change this classification, irrespective of the landform or ARI event).

The relative changes in modelled tractive stress for the 1.5 year ARI storm of the three landforms are also included in **Table 4.8**. The magnitude of the change between the existing and approved and the existing and proposed modelled tractive stress's are generally of a similar range, however localised differences at specific locations are present (refer to **Table 4.8**).

Table 4.8 – Modelled Changes to Maximum Tractive Stress (1.5 Year ARI storm event) – Watercourse TL

XP-Storm Link ID	Longwall		Modelled Maximum Tractive Stress (N/m^2)			
	Approved	Proposed	Existing	Approved	Proposed	Change (approved vs. proposed)
L33	LW3	LW4	72.49	88.56 (+22.2%)	80.00 (+10.4%)	-9.7%
L32			78.49	80.08 (+2.0%)	71.87 (-8.4%)	-10.3%
L31		LW3	32.17	23.39 (-27.3%)	41.97 (+30.5%)	79.4%
L46	LW2		766.62	765.31 (-0.2%)	792.13 (+3.3%)	3.5%
L47			55.67	70.51 (+26.7%)	78.99 (+41.9%)	12.0%
L45			106.48	115.66 (+8.6%)	89.90 (-15.6%)	-22.3%
L29		LW2	83.39	72.51 (-13.0%)	105.09 (+26.0%)	44.9%

Note the number shown in the brackets is the percentage change between when compared to the existing landform.

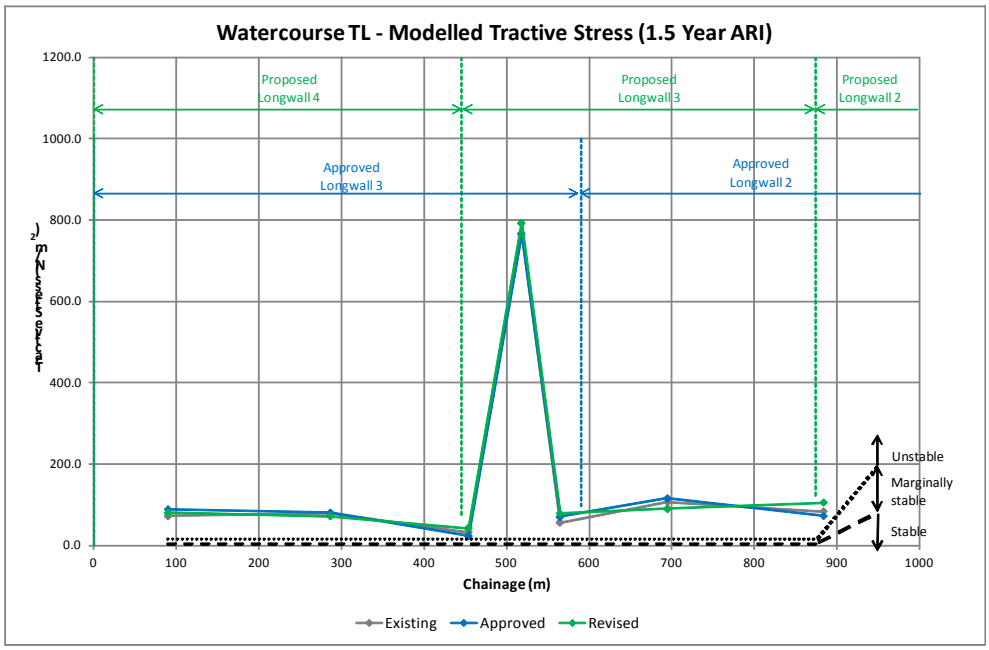


Chart 4.29 - Modelled Maximum Tractive Stress, 1.5 Year ARI, Watercourse TL

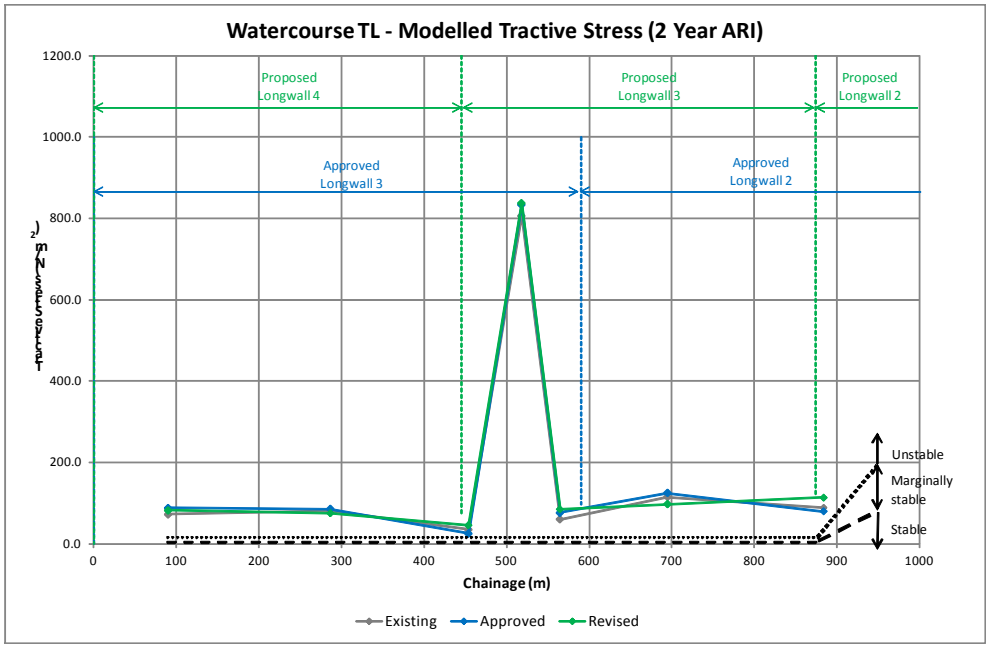


Chart 4.30 - Modelled Maximum Tractive Stress, 2 Year ARI, Watercourse TL

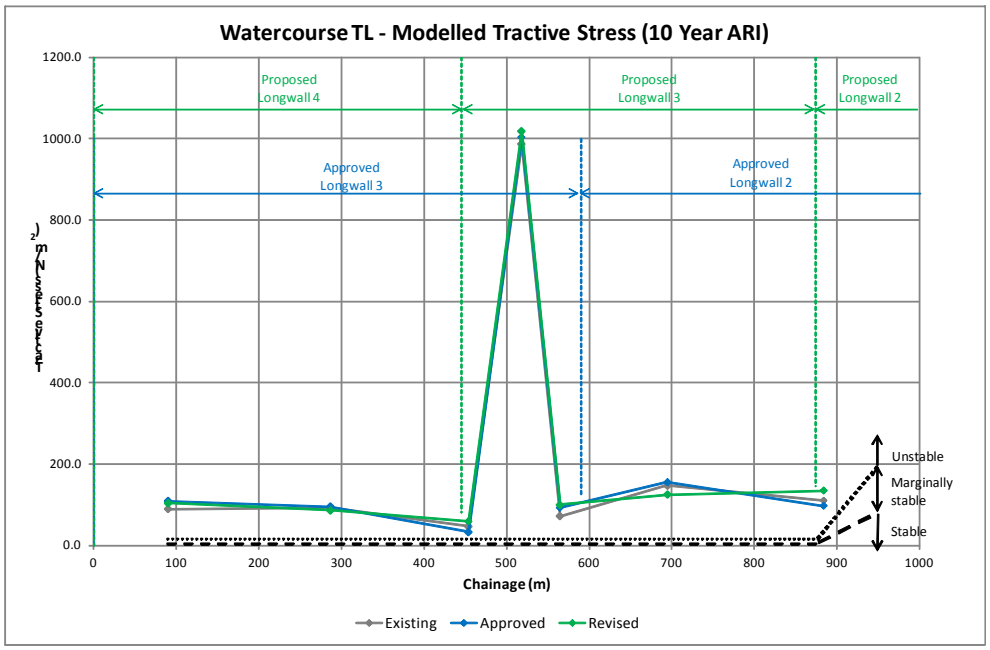


Chart 4.31 - Modelled Maximum Tractive Stress, 10 Year ARI, Watercourse TL

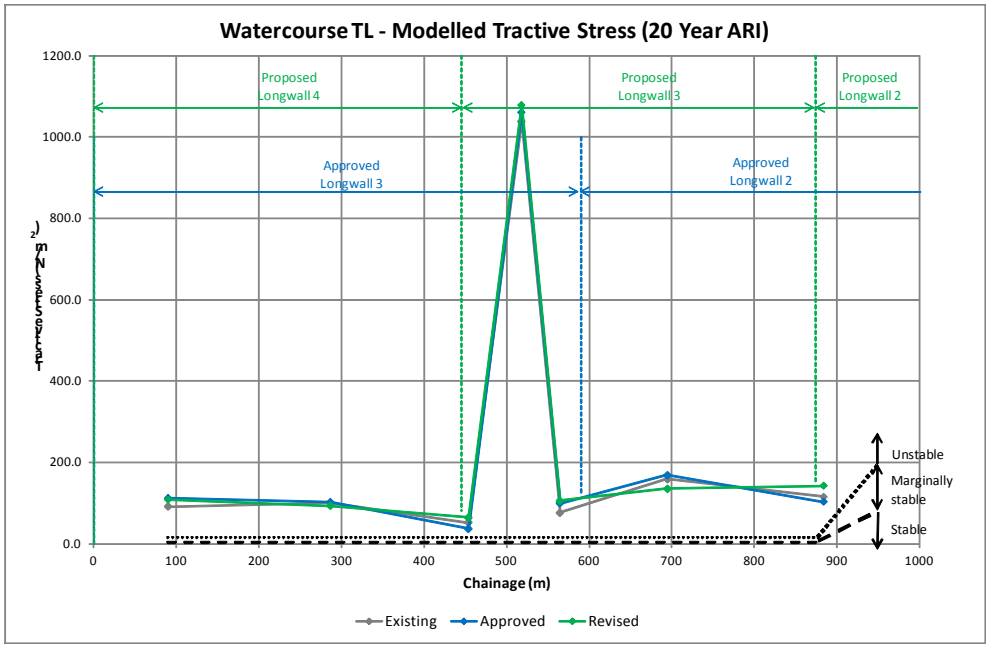


Chart 4.32 – Modelled Maximum Tractive Stress, 20 Year ARI, Watercourse TL

4.4 Conclusion

The proposed changes are likely to result in minor changes to the watercourses within the impacted area. These changes are unlikely to exacerbate any instabilities within Ulan Creek or its tributaries significantly beyond the existing conditions or approved impacts during any of the modelled critical duration rainfall events (i.e. if the channel is unstable in the existing landform it remains unstable in the approved and proposed landforms). It is also noted that the magnitude of these changes are generally of a similar range to that associated with the approved mine plan. As a holistic system the impact of this change is expected to be minimal and no adverse impacts are predicted to occur.

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