5.4 Surface Water Assessment

A detailed Surface Water Assessment has been undertaken for the Project to assess the potential impact on surface water quality and quantity and is included in **Appendix 7**. A summary of the key findings is included below.

The DGRs for the Project require detailed modelling of surface water impacts, a site water balance, an investigation into potential water sharing opportunities, and a description of the measures that would be implemented to:

- offset any loss of baseflow to the region's water courses;
- offset the potential salinity impact of the Project, particularly due to the ongoing operation of the Bobadeen Irrigation Scheme; and
- undertake remedial works to the Goulburn River Diversion.

The key features of the Project that have the potential to impact on surface water management requirements include:

- landform and surface water catchment changes as a result of the Project including:
  - open cut pit;
  - Ulan West Box Cut;
  - emplacement areas for ROM, product and reject stockpiles;
  - out-of-pit overburden emplacement areas;
  - clean water diversions; and
  - tailings emplacement.
- subsidence resulting from the continued underground mining of Ulan No. 3 and Ulan West;
- changes to the Ulan complex water balance;
- ongoing rehabilitation of mine disturbance areas;
- surface facilities; and
- surface water infrastructure such as the approved Rowans Dam Water Treatment Facility and the proposed Talbragar River Discharge Facility and associated Water Treatment Facility, staging dam and pipeline.

Some minor potential impacts may also result from the proposed out-of-pit mining support infrastructure, such as road upgrades, road and conveyor crossings over drainage lines and the installation of ancillary mining infrastructure such as dewatering bores, ventilation shafts, and associated services.

The impacts of these aspects of the Project are discussed further in the following sections.

5.4.1 Surface Water Catchments

The Project is located at the headwaters of both the Goulburn River system and the Talbragar River system (refer to **Figure 5.4.1**). The catchments for these river systems are separated by the Great Dividing Range with the Goulburn River system draining east into the Hunter River Catchment and the Talbragar River system draining west to the Macquarie River Catchment and eventually into the Murray-Darling Basin. All of the tributaries within the project area draining to the Goulburn River and Talbragar River are ephemeral by nature.

There are eight subcatchment areas of these river systems that lie partly within the project area. The Spring Gully, Ulan Creek, Bobadeen Creek, Curra Creek, Sportsmans Hollow Creek and Moolarben Creek catchments flow into the Goulburn River system while the Mona Creek and Cockabutta Creek catchments flow into the Talbragar River system (see **Figure 5.4.1**). The Ulan Creek catchment is the largest within the project area, comprising approximately 3720 hectares out of the total project area of approximately 13,480 hectares.

5.4.2 Water Quality – Goulburn and Talbragar Rivers

Surface water quality and quantity is monitored in the surrounding drainage systems in accordance with the *UCML Water Management Plan* (UCML, 2007). Further details on monitoring locations are provided in **Section 5.4.11**.

Water quality in the Goulburn River has been monitored in the past by DWE, UCML and the Moolarben Coal Project. Historical records indicate that the electrical conductivity in the Goulburn River has typically ranged between approximately 465 µS/cm and approximately 1200 µS/cm with an average value of approximately 770 µS/cm downstream of UCML (Wells Environmental Services 2006).

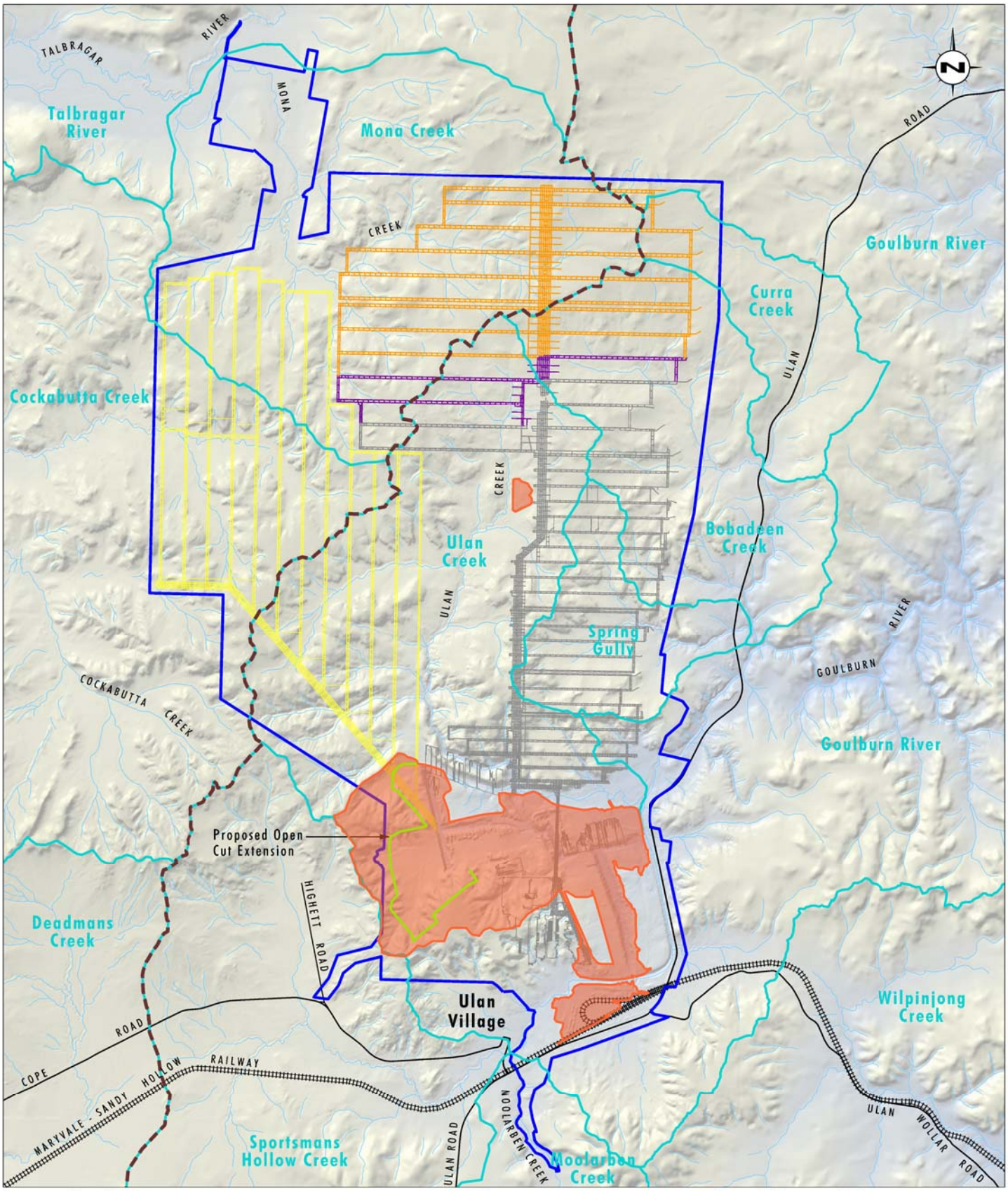
Water quality in the Talbragar River is monitored by DWE at Elong Elong, approximately 100 kilometres downstream of the project area. Analysis of the DWE records (2000 to 2006) indicates that electrical conductivity in the Talbragar River ranges typically between approximately 1360 µS/cm and approximately 3170 µS/cm, with an average electrical conductivity of approximately 2300 µS/cm. Historical records indicate that the electrical conductivity typically decreases during flood flows (i.e. in excess of 900 ML per day) to less than 1000 µS/cm.

UCML has undertaken monitoring of the electrical conductivity at two locations in the Talbragar River near the proposed discharge structure between October and December 2008. The UCML water quality monitoring indicated an average electrical conductivity range between 740 µS/cm and 920 µS/cm. As such, the Talbragar River potentially has lower electrical conductivity in the upstream reaches in the vicinity of the proposed Talbragar River discharge structure.

5.4.3 Surface Water Management System

UCML existing operations are supported by an extensive mine water management system, which includes mine dewatering systems (pumps and pipelines), water storages, the Bobadeen Irrigation Scheme, water treatment facilities, sedimentation and retention basins, settlings and tailings ponds, drains, levy banks and earth bunding around the main stockpile, laydown hardstand areas and fuelling areas.

A layout of the key components of the Ulan Mine Water Management System (existing and proposed) is shown on **Figure 5.4.2**.



Source: Ulan Coal

0 1.0 2.5 5.0km
1:100 000

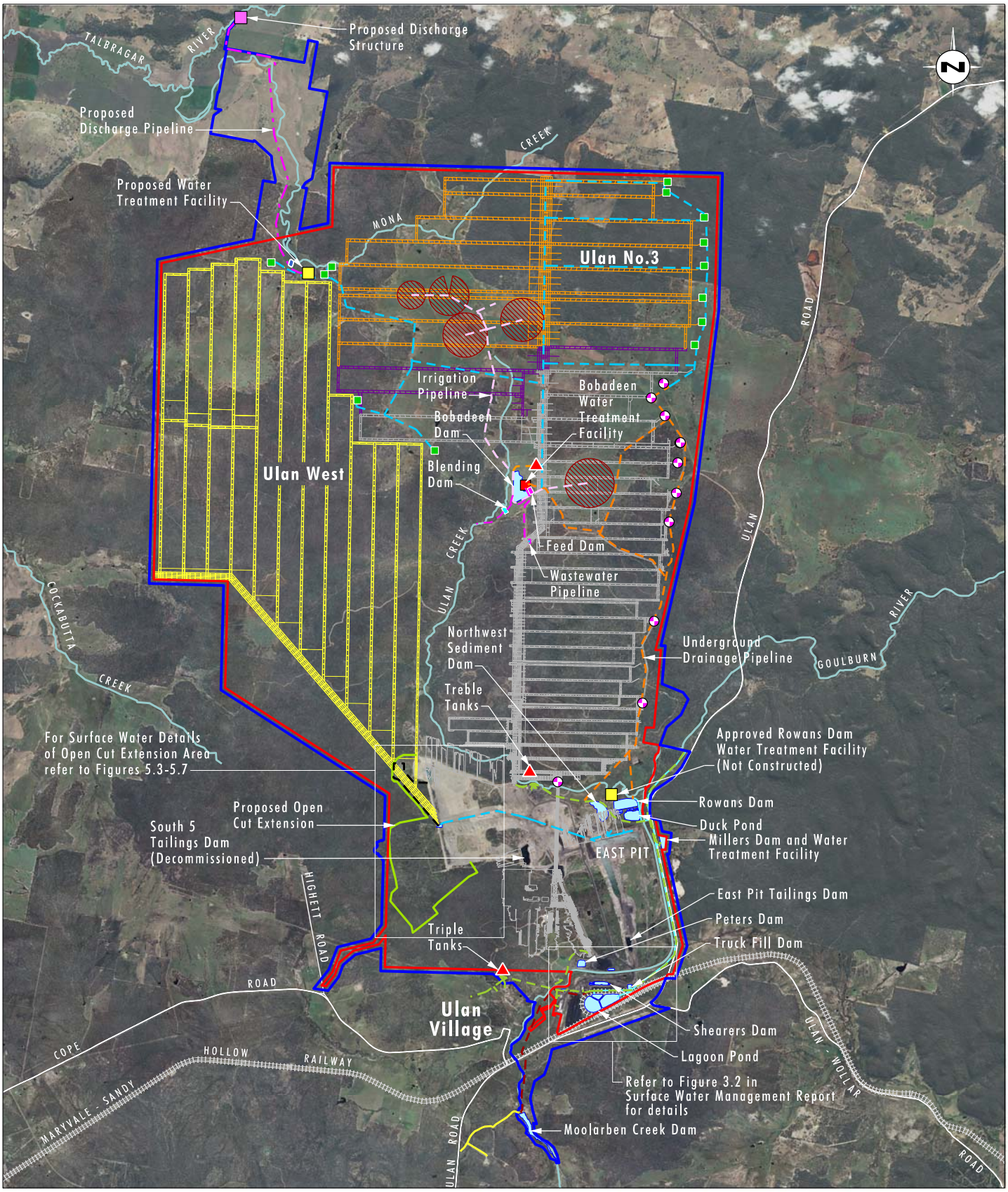
Legend

- Project Boundary
- Proposed Open Cut Extension
- Proposed Ulan West Mine Plan
- Ulan No.3 Underground Mine Plan
- Previous Underground Mining Operations
- Current Mining and SMP Approved Area
- Great Dividing Range
- Existing Mine WMS Catchment Boundary

FIGURE 5.4.1

Catchment Boundaries

File Name (A4): R05_V1/2423_295.dgn



Source: Ulan Coal, Aerial Photo December 2007

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Legend

- Colliery Holding Boundary
- Project Boundary
- Proposed Open Cut Extension
- Proposed Ulan West Mine Plan
- Ulan No.3 Underground Mine Plan
- Previous Underground Mining Operations
- Current Mining and SMP Approved Area
- Box Cut Option
- Dams
- Existing Dewatering Bore Pipeline
- Existing Irrigation Pipeline
- Existing Reverse Osmosis Pipelines
- Existing Moolarben Raw Water Pipeline
- Existing Potable Water
- Existing Water Supply
- Existing Moolarben Dam to Orica Pipeline
- Existing Dewatering Points
- Existing Irrigation Pivots
- Existing Fire Fighting Water Reservoir
- Existing Water Treatment Facility
- Proposed Pipeline
- Proposed Water Treatment Facility
- Proposed Dam
- Proposed Dewatering Bore

FIGURE 5.4.2

Existing and Proposed Water Management Infrastructure

File Name (A4): R05_V1/2423_296.dgn

The existing mine water management system will continue to be used to control and treat runoff from the site with all pit water and mine surface runoff directed to the mine water management system. The capability of the mine water management system to contain and manage water associated with the proposed project and future mining operations is addressed in **Sections 5.4.5** and **5.4.6**.

5.4.4 Sediment and Erosion Control

Construction

Construction of new infrastructure which is located within the existing mine water management system will require localised sediment and erosion controls. New infrastructure such as ventilation fans, access road and service boreholes are located outside the existing mine water management system. The construction of such infrastructure will result in short term surface disturbance. To mitigate potential impact, erosion and sediment control measures will be implemented as part of detailed construction plans and management plans for surface infrastructure works. All erosion and sediment control measures will be consistent with the objectives of the existing UCML Mine Water Management Plan (UCML 2007a) and will be carried out in accordance with relevant guidelines for erosion and sediment control, including:

- *Draft Guidelines for the Design of Stable Drainage Lines on Rehabilitated Minesites in the Hunter Coalfields* (DIPNR, undated); and

- *Managing Urban Stormwater: Soils and Construction* (the Blue Book) *Volume 1 and Volume 2E Mines and Quarries* (Landcom, 2004), where relevant.

The erosion and sediment control measures proposed to be adopted for the construction of new infrastructure to control the quality of runoff from the site include:

- establishment of erosion and sediment control measures prior to the commencement of any substantial construction works, as required;

- regular inspection of erosion and sediment control measures, to ensure controls are performing adequately;

- maintenance of erosion and sediment control measures, as required;

- applying soil ameliorant, where required, to reduce the dispersibility of the subsoils that will be disturbed and to minimise the potential for tunnel erosion and surface rilling of disturbed or reshaped areas, with the application rate to be determined by site specific soil testing as required;

- seeding and controlled fertilising of disturbed areas to provide for rapid grass cover. Areas will be seeded with an appropriate species mix specific to the needs of the area to be rehabilitated;

- provision for the immediate repair or redesign of sediment and erosion controls that are not performing adequately; and

- placement of floatation curtains (or other devices performing the same function) at the outlet of sediment dams to trap possible oil and grease spills, if required.

In addition, the construction plans will detail the specific inspection, maintenance and revegetation requirements for each works area based on the construction program schedule.

These control measures will be set out in a detailed Sediment and Erosion Control Plan for the Project.

Operations

As part of operational plans, erosion and sediment control measures will be designed and constructed to a standard consistent with:

- *Managing Urban Stormwater: Soils and Construction* (the Blue Book) *Volume 1 and Volume 2E Mines and Quarries* (Landcom, 2004 and 2008); and
- *Draft Guidelines for the Design of Stable Drainage Lines on Rehabilitated Minesites in the Hunter Coalfields* (DIPNR, undated).

Water quality and sediment and erosion control measures to be implemented for the Project include:

- constructing diversion drains upslope of areas to be disturbed to convey clean runoff away from disturbed areas;
- clearly identifying and delineating areas required to be disturbed and ensuring that disturbance is limited to those areas. Clearing vegetation only as required to achieve the works and minimising machinery disturbance outside of these areas;
- limiting the number of roads and tracks established;
- constructing catch drains downstream of disturbed areas to convey runoff to sediment dams;
- constructing sediment dams to capture, contain and treat runoff from disturbed areas;
- constructing access road and earthworks cut and fill batters at slopes of 1V:3H or less, where possible, to maximise long term stability;
- reshaping, topsoiling and vegetating road and cut and fill batters as soon as practical;
- progressively stripping and stockpiling topsoil for later use in rehabilitation;
- regular inspection and maintenance of erosion control works and rehabilitated areas;
- prompt revegetation of areas as soon as earthworks are complete; and
- placement of oil management systems downslope of key infrastructure and high traffic hardstand areas.

Topsoil stockpiles are proposed to be placed within the perimeter of the dirty water management system and will be contained within the mine water management system. Where necessary, sediment fences are to be placed around the downslope batter of all topsoil stockpiles to reduce the potential for sediment transport from the stockpile.

Stockpiles that are to remain undisturbed for periods of greater than six months are to be grassed.

5.4.5 Additional Surface Water Management Systems

Open Cut

As open cut mining progresses to the west, some existing water management infrastructure such as diversion drains, dams and pipelines will be mined through. Replacement structures will be reinstated up slope before the structures down dip are mined through. **Figures 5.4.3** to **Figure 5.4.7** show the conceptual water management infrastructure required over the life of the open cut operations and subsequent mine closure.

Overburden Emplacement Area Controls

The overburden emplacement areas will be progressively rehabilitated (earthworks, drainage control and revegetation) as part of the open cut operations. Runoff from overburden emplacement areas will be collected in catch drains and directed through sediment dams to remove suspended sediment prior to re-use or discharge from site (refer to **Figure 5.4.3** to **Figure 5.4.7**).

5.4.6 Water Balance

UCML maintains a detailed reporting water balance which comprises a series of modules that represent the catchments and major components of the mine water management system. Each module is balanced individually and then brought together to represent the total water balance for the Ulan complex. A predictive water balance has been developed by Umwelt based on the reporting water balance.

The main water sources identified for the Project are:

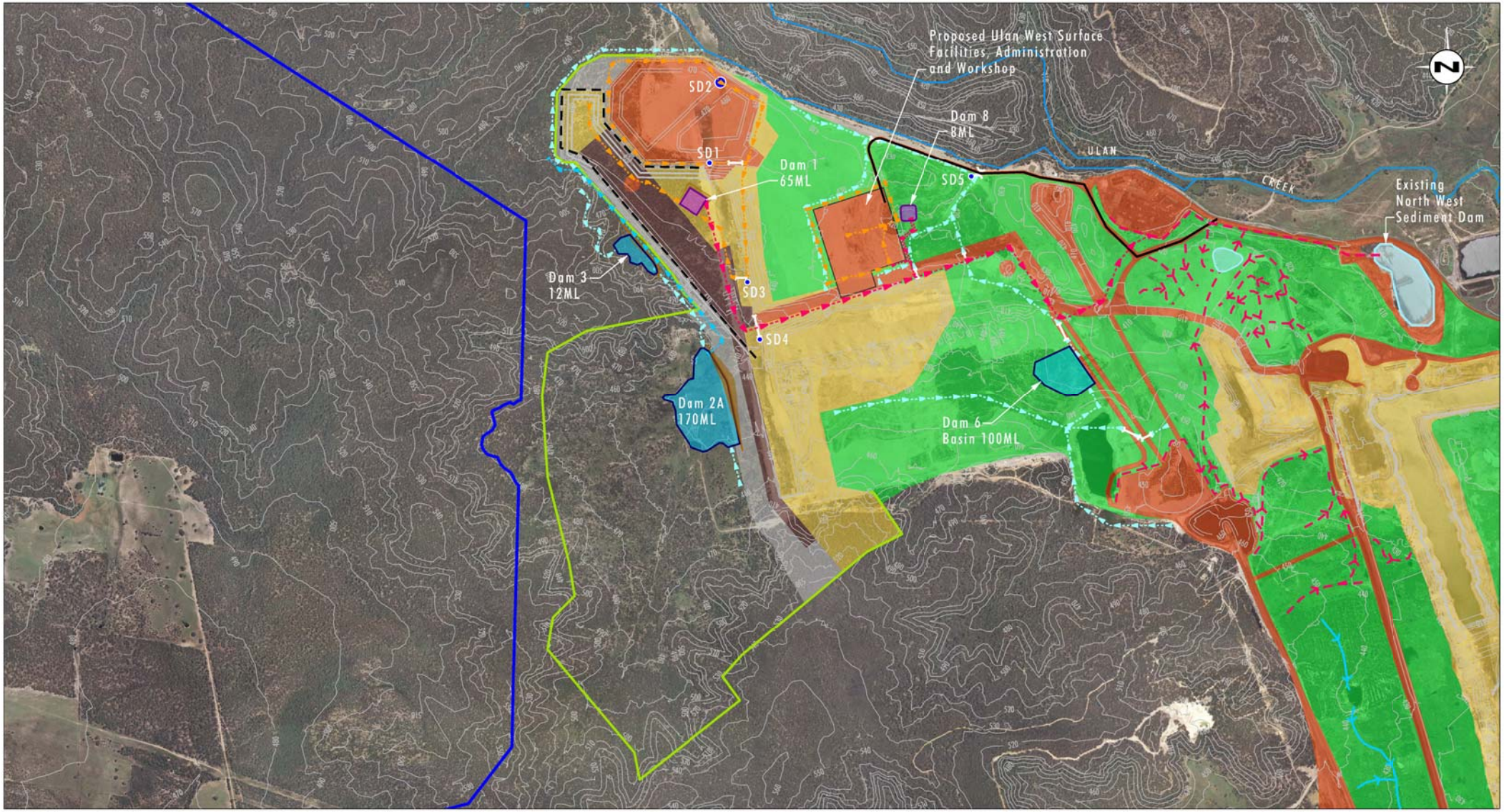
- catchment runoff;
- rainfall on dams within the mine water management system;
- groundwater inflows to the Ulan No. 3 and Ulan West underground mines; and
- the potable water supply.

Historical meteorological data was used to predict the range in potential future rainfall, run-off and evaporation characteristics for the Project. Estimates of future groundwater make in the Ulan No. 3 and Ulan West underground mines were sourced from the *Ulan Coal – Continued Operations Groundwater Assessment* (MER, 2009) (refer to **Appendix 6**).

The main water losses identified for the Project include:

- water lost to product coal;
- water lost to coarse rejects and tailings;
- water used for dust suppression;
- water lost to evaporation; and
- potable water use.

Estimates of water lost (i.e. bound) to product coal, coarse rejects and tailings are based on the production schedule for the Project and historical rates of water use/loss in coal handling and processing. Proposed haul road lengths and meteorological data were used to estimate



Source: Arkhill Engineers, Downer EDI
Note: Contour Interval 10m

0 0.25 0.5 1.0km
1:25 000

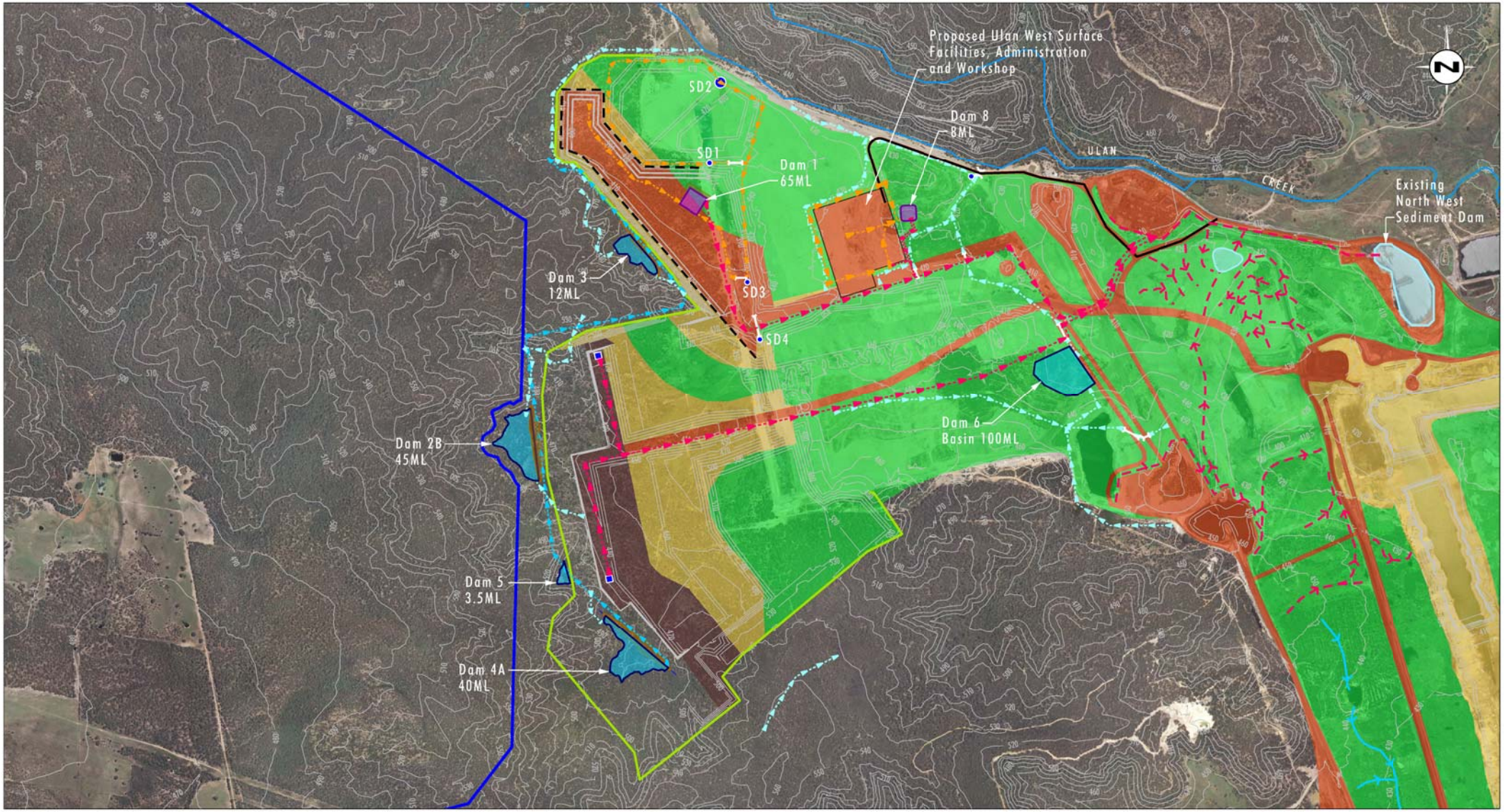
Legend

- Project Boundary
- Proposed Open Cut Extension
- Proposed Sediment Dam
- Proposed Clean Water Storage Dam
- Proposed Dirty Water Storage Dam
- Culvert
- Proposed Clean Water Pipeline
- Proposed Dirty Water Pipeline
- 20 Year A.R.I. Proposed Catch Drains
- 100 Year A.R.I. Proposed Diversion Drains
- Existing Open Channel (Dirty Water)
- Existing Open Channel (Clean Water)
- Proposed Access Road
- Active Mining
- Infrastructure/Stockpile
- Unshaped Overburden
- Rehabilitation
- Stripped
- Existing Sediment Dam
- Box Cut Option

FIGURE 5.4.3

Conceptual Surface Water Management Year 1 Plan

File Name (A4): R05_V1/2423_297.dgn



Source: Arkhill Engineers, Downer EDI
Note: Contour Interval 10m

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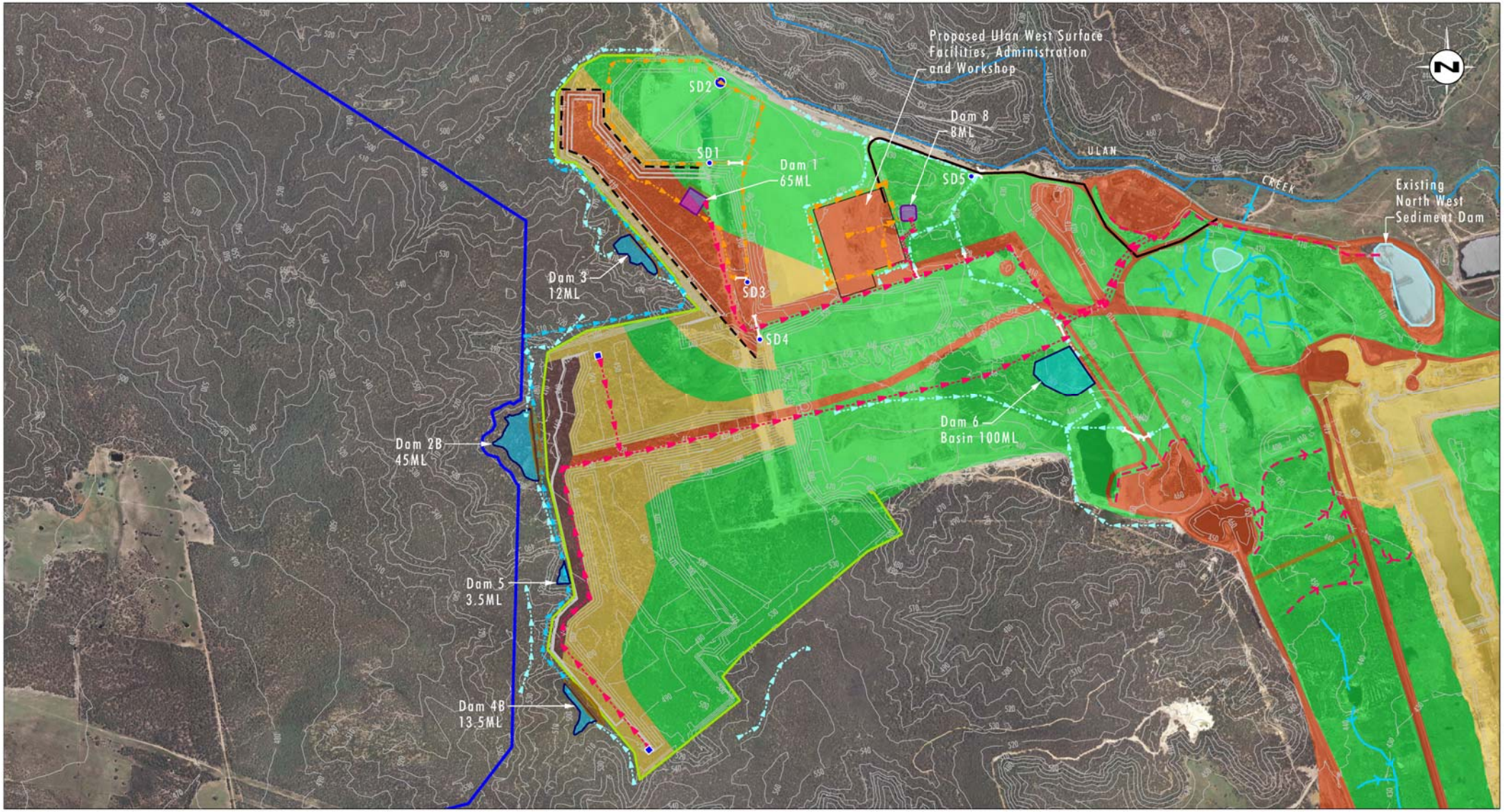
Legend

- Project Boundary
- Proposed Open Cut Extension
- Proposed Sediment Dam
- Proposed Clean Water Storage Dam
- Proposed Dirty Water Storage Dam
- Culvert
- Proposed Clean Water Pipeline
- Proposed Dirty Water Pipeline
- 20 Year A.R.I. Proposed Catch Drains
- 100 Year A.R.I. Proposed Diversion Drains
- Inpit Dewatering Sump
- Existing Open Channel (Dirty Water)
- Existing Open Channel (Clean Water)
- Proposed Access Road
- Active Mining
- Infrastructure/Stockpile
- Rehabilitation
- Unshaped Overburden
- Existing Sediment Dam
- Box Cut Option

FIGURE 5.4.4

Conceptual Surface Water Management Year 5 Plan

File Name (A4): R05_V1/2423_298.dgn



Source: Arkhill Engineers, Downer EDI
Note: Contour Interval 10m

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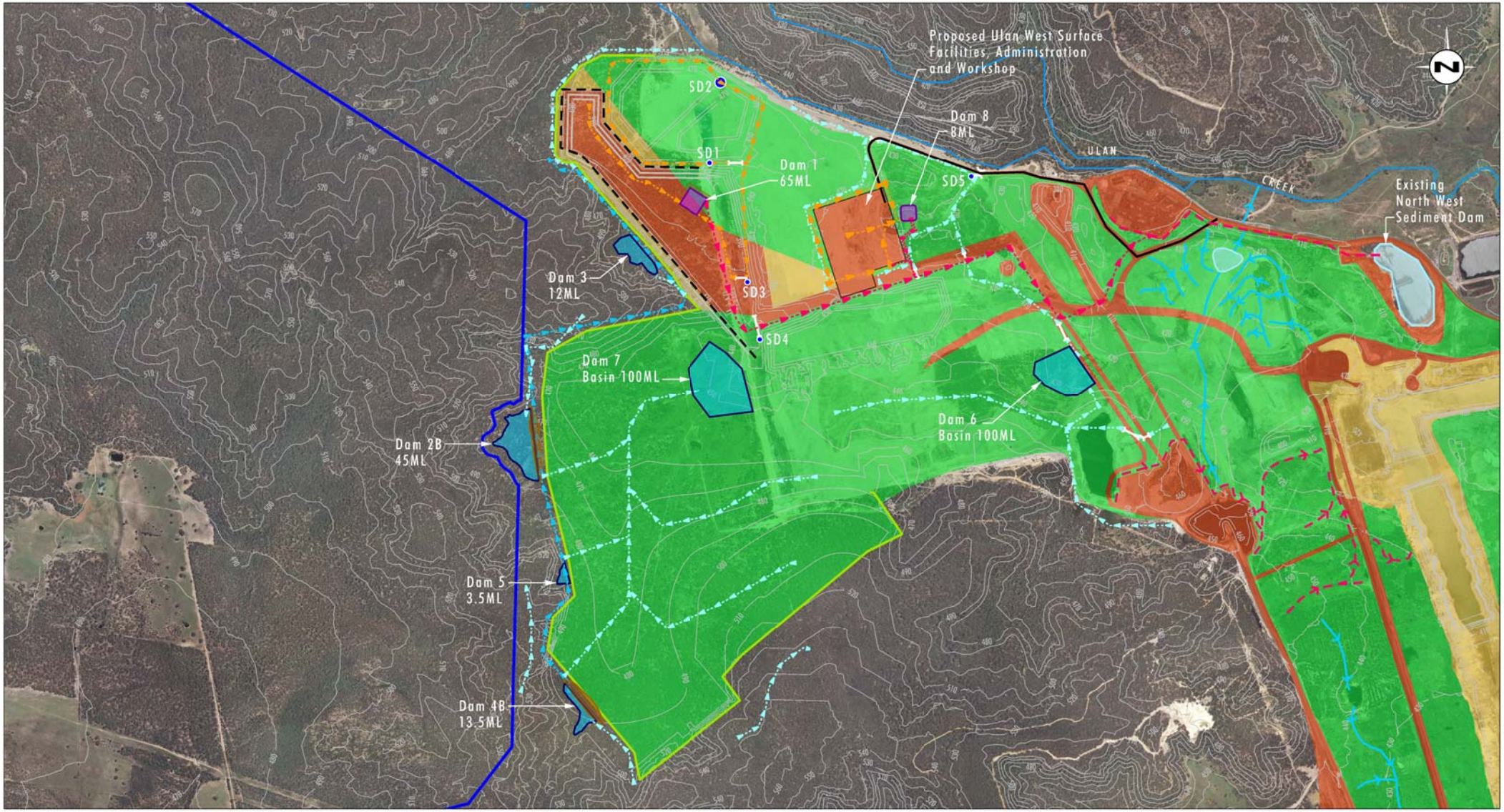
Legend

- Project Boundary
- Proposed Open Cut Extension
- Proposed Sediment Dam
- Proposed Clean Water Storage Dam
- Proposed Dirty Water Storage Dam
- Culvert
- Proposed Clean Water Pipeline
- Proposed Dirty Water Pipeline
- 20 Year A.R.I. Proposed Catch Drains
- 100 Year A.R.I. Proposed Diversion Drains
- Inpit Dewatering Sump
- Existing Open Channel (Dirty Water)
- Existing Open Channel (Clean Water)
- Proposed Access Road
- Active Mining
- Infrastructure/Stockpile
- Rehabilitation
- Unshaped Overburden
- Existing Sediment Dam
- Box Cut Option

FIGURE 5.4.5

Conceptual Surface Water Management Year 7 Plan



Source: Arkhill Engineers, Downer EDI
Note: Contour Interval 10m

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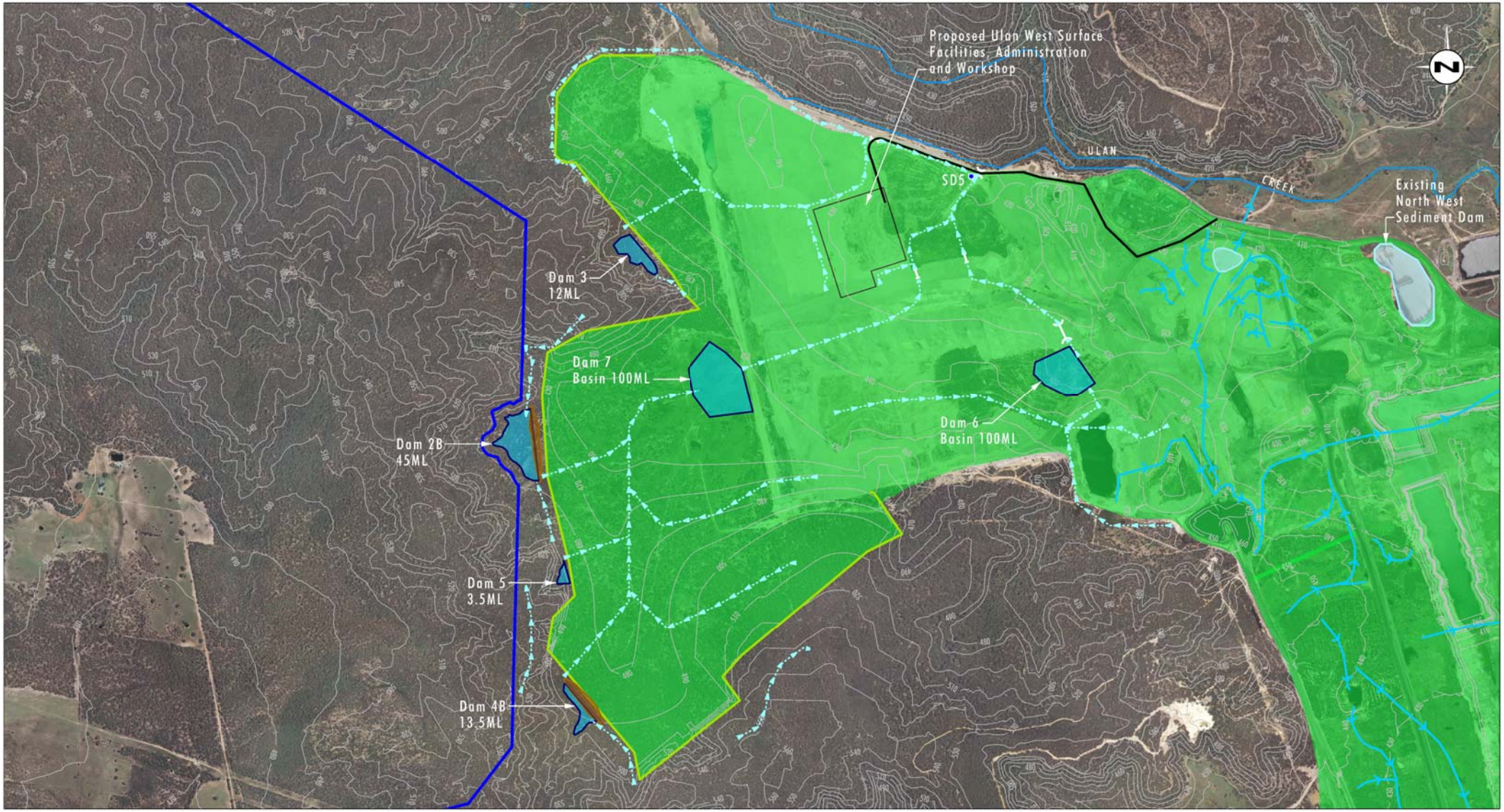
1:25 000

- Project Boundary
- Proposed Open Cut Extension
- Proposed Sediment Dam
- Proposed Clean Water Storage Dam
- Proposed Dirty Water Storage Dam
- Culvert
- Proposed Clean Water Pipeline
- Proposed Dirty Water Pipeline
- 20 Year A.R.I. Proposed Catch Drains
- 100 Year A.R.I. Proposed Diversion Drains
- Existing Open Channel (Dirty Water)
- Existing Open Channel (Clean Water)
- Proposed Access Road
- Unshaped Overburden
- Infrastructure/Stockpile
- Rehabilitation
- Existing Sediment Dam
- Box Cut Option

FIGURE 5.4.6

Conceptual Surface Water Management Year 12 Plan



Source: Arkhill Engineers, Downer EDI
Note: Contour Interval 10m

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1:25 000

Legend

- Project Boundary
- Proposed Open Cut Extension
- Proposed Sediment Dam
- Proposed Clean Water Storage Dam
- Culvert
- 100 Year A.R.I. Proposed Diversion Drains
- Existing Open Channel (Clean Water)
- Proposed Access Road
- Rehabilitation
- Existing Sediment Dam

FIGURE 5.4.7

Conceptual Surface Water Management Final Landform Plan

File Name (A4): R05_V1/2423_301.dgn

the water required for dust suppression. Historical evaporation rates were used to estimate the water lost to evaporation from dam surfaces. Future potable water use was based on historical usage and predicted staffing levels for the Project.

Given the potential variability associated with the above water sources and losses, three possible scenarios were modelled to calculate the probability of different water balance outcomes based on variability in the model input data, e.g. rainfall, runoff, production water demands, i.e. 10th percentile, 50th percentile and 90th percentile water balance predictions.

Assuming no discharge of water off site, UCML has, and will continue to have, water in excess of its operational needs and will need to discharge this water off site. It is predicted that the peak water surplus will occur in Year 8 at approximately 19.8 ML per day (50th percentile).

5.4.6.1 Management of Water Surplus

Off-site Discharge

The predicted site water balance for the Project indicates that an increased off-site discharge capacity will be required to manage the predicted water surplus for the Project.

Existing licensed discharge facilities will be maintained under UCML's EPL No. 394 and the continued use of the Bobadeen Water Treatment Facility and the Bobadeen Irrigation Scheme will be key components of the future water management strategy for the Project.

The approved Rowans Dam Water Treatment Facility will be used in conjunction with the existing licensed discharge point at Rowans Dam to facilitate the treatment and discharge of treated water from the southern portion of the operation under UCML's EPL No. 394.

The proposed Ulan West Water Treatment Facility conceptual layout, which includes staging and blending dams, pipeline and discharge structure is located in the north of the project area (refer to **Figure 5.4.2**). The proposed Ulan West Water Treatment Facility will be used to facilitate the treatment and discharge of up to 17.5 ML per day. The proposed discharge structure is to be located on the Talbragar River upstream of the confluence with Mona Creek (refer to **Figure 5.4.2**).

Water will be pumped to the Ulan West Water Treatment Facility staging dams, prior to treatment and pumped via a pipeline to the proposed discharge structure on the Talbragar River. The proposed Ulan West staging dams will be located adjacent to the proposed Ulan West Water Treatment Facility. Wastewater produced by the water treatment facility will be pumped back to Bobadeen for integration into a segregated wastewater system and used for dust suppression on coal stockpiles and in the crusher/sizing station facilities. Further discussion on wastewater management is provided in **Section 5.4.7**.

The proposed discharge pipeline to the Talbragar River is located above ground except where it crosses Uarbry Road. Between the Ulan West Water Treatment Facility and Uarbry Road the pipeline is generally adjacent to Mona Creek. The pipeline will be located under Uarbry Road. From Uarbry Road the pipeline will take a westerly alignment for approximately 1 kilometre and then take a northern alignment for approximately 500 metres where it reaches the Talbragar River (refer to **Figure 5.4.2**).

The potential impacts associated with the proposed discharge of water from the Ulan West Water Treatment Facility are:

- erosion of the Talbragar River bed and banks;
- increases in annual flow volumes in the Talbragar River;
- changes to water quality in the Talbragar River; and
- changes to flow velocities and levels with the construction of the proposed discharge structure and changes to the crossing point.

These potential impacts are discussed further below.

Potential Erosion Impacts of Proposed Discharge

The proposed discharge structure is to be located on the Talbragar River upstream of the confluence with Mona Creek (refer to **Figure 5.4.2**). The channel of the Talbragar River where the proposed discharge structure will be constructed was modelled using HEC-RAS to determine the existing flow capacity and the potential impacts of the proposed maximum discharge rate (i.e. 17.5 ML per day or 0.2 m^3/s) on the river bed and banks. Modelling indicates that the existing flow capacity is approximately 10 m^3/s (i.e. 870 ML per day) at bank full, with corresponding velocities in the order of 1.2 m/s to 1.3 m/s. A discharge of 17.5 ML per day will produce velocities in the order of 0.3 m/s and flow depths of approximately 200 millimetres in the reaches downstream of the proposed discharge structure. Velocities of 0.3 m/s are considered non-scouring and do not present an erosion risk for either the existing rock bar, reinstated crossing point or downstream of the crossing point. However, if monitoring, after discharge events, indicates that any impacts on the channel or banks of the river have occurred as a result of discharges, UCML will remediate these areas similar to pre-discharge conditions.

Potential Changes to Annual Flow Volumes

The nearest gauging station on the Talbragar River is at Elong Elong (Stream Gauge 421042) approximately 100 kilometres downstream of the proposed discharge structure. The historical annual flow volumes for the Talbragar River at the proposed discharge structure were estimated by comparing the relative catchment areas at Elong Elong and the catchment area at the proposed Talbragar River discharge structure. The analysis indicates that the proposed discharge of up to 17.5 ML per day may increase average annual flow volumes (50^{th} percentile) by up to 56 per cent at the proposed discharge structure and by up to 12 per cent at Elong Elong.

Where possible, UCML proposes to vary the discharge regimes by varying the water flow rates between the various discharge locations based on the environmental and water requirements of the Project. This will enable UCML to replicate some of the wetting and drying cycles that occur naturally within the Talbragar River.

Potential Changes to Water Quality

Analysis of the DECCW records (2000 to 2006) indicates that electrical conductivity in the Talbragar River at Elong Elong gauging station ranges typically between approximately 1360 µS/cm and approximately 3170 µS/cm, with an average electrical conductivity of approximately 2300 µS/cm. Historical records indicate that the electrical conductivity typically decreases during flood flows (i.e. in excess of 900 ML per day) to less than 1000 µS/cm.

The UCML water quality monitoring undertaken at two locations near the proposed discharge structure indicates that average electrical conductivities range between 740 µS/cm and 920 µS/cm. This indicates that the Talbragar River potentially has lower electrical conductivities in the upstream reaches in the vicinity of the proposed Talbragar discharge structure.

It is proposed to discharge water from the discharge point with an average electrical conductivity within the range of historical electrical conductivity levels recorded within the Talbragar River at Elong Elong and the proposed discharge structure and in accordance with ANZECC Guidelines (ANZECC, 2006).

The discharged water will be treated (using similar tried and tested technologies (i.e. reverse osmosis)) and blended using similar methods to that used at the existing Bobadeen Water Treatment Facility. Water quality limits for discharges to Ulan Creek via the Bobadeen Water Treatment Facility are set to 900 µS/cm. UCML proposes to utilise a similar system at the Ulan West Water Treatment Facility. UCML will undertake further consultation with DECC to determine appropriate discharge criteria.

As such, the proposed discharge of water will be designed to have negligible effect on water quality in the Talbragar River.

Potential Changes with Reinstatement of Crossing Point

The proposed Talbragar River discharge structure will utilise an existing rock bar structure on the Talbragar River to assist in minimising the potential for scour and erosion at the discharge point. This location also includes an existing culvert and crossing point over the Talbragar River. It is proposed to upgrade the culvert and reinstate the crossing point, which was damaged during the June 2007 storm, in order to facilitate the discharge point. It is proposed to maintain a similar top elevation of the crossing point roadway as the original crossing point.

A HEC-RAS model was used to assess the potential impact that the reinstated/upgraded crossing point might have on flow velocities and flood levels in the Talbragar River and Mona Creek.

The model confirmed that the reinstated/upgraded crossing point is predicted to have negligible impacts on flow velocities and flood levels downstream of the crossing point.

Modelling also indicates that the proposed reinstated/upgraded crossing point may influence flood levels upstream of the rock bar for approximately 40 metres. The modelled influence includes increases in potential flood levels for flow rates of up to approximately 80 m^3/s (i.e. 6900 ML per day). This modelled increase in flood levels will be contained within the existing pond immediately upstream of the natural rock bar structure.

The proposed reinstated/upgraded crossing point is also expected to have a reduced impact on low level flows within the Talbragar River compared to the original crossing point. It is proposed to upgrade the single pipe culvert to five 375 millimetre diameter pipes. Modelling indicates that the five 375 millimetre diameter pipes will provide flow conveyance for up to approximately 1.5 m^3/s (i.e. 130 ML per day) prior to the crossing point being overtopped.

Potential Impacts Associated with Pipeline Location

The proposed discharge pipeline is typically located outside the 100 year ARI flood extent, except in specific locations where the pipeline must cross either tributaries of, or the main channel of, Mona Creek (i.e. upstream of Uarbry Road). The proposed pipeline crosses the floodplain of the Talbragar River from Uarbry Road to the proposed discharge structure. At

locations where the proposed pipeline must cross either a tributary of Mona Creek or the main channel the creek, crossing points will be designed to have no adverse impact on flood levels, flows or velocities.

Where the pipeline crosses the Talbragar River floodplain, installation will be designed so as to not adversely influence flood levels, flows or velocities on the Talbragar River floodplain, or pose pipeline integrity issues. Where impact cannot be avoided the pipeline will be buried.

Water Sharing

UCML has recently established two water sharing agreements with the adjacent mines, which has a positive impact in terms of reducing potential cumulative water demand in the region. These agreements include:

- Wilpinjong Coal Mine is located approximately 7 kilometres to the south-east of the project area. A Heads of Agreement has been reached with Wilpinjong Coal Mine for the supply of water on an 'as required' basis.

- Moolarben Coal Project (MCP), located to the south and east of the project area, has recently commenced operations. A water transfer agreement is in place between UCML and MCP for a minimum of 1000 ML per year. Licensing requirements for the proposed water transfer are discussed in **Section 7.6**.

Progression of these water sharing projects will be in accordance with relevant statutory provisions in relation to establishment of the water sharing infrastructure and transfer of water between the operations.

In addition to these water sharing agreements, UCML maintains an agreement for minor water sharing with the adjacent Orica operation and sandstone processing operation.

Water Management Strategy

The existing and proposed discharge and water sharing facilities are summarised in **Table 5.3**.

Table 5.3 – Proposed Discharge Facilities

Discharge Facility	Status	Rate (ML/day)
Bobadeen Irrigation Scheme	Existing	4*
Wilpinjong Coal Mine	Proposed	to be determined
Moolarben Coal Project	Proposed	>= 2.74**
Bobadeen Water Treatment Facility (Ulan Creek)	Existing	15
Rowans Dam Water Treatment Facility (Ulan Creek)	Approved	10
Ulan West Water Treatment Facility (Talbragar River)	Proposed	17.5

* Based on historical rates

** Potential to transfer additional water if agreed

UCML has a defined hierarchy of water usage and discharges. Surplus water required to be discharged from site after operational requirements have been met will be based on the following hierarchy:

- Bobadeen Irrigation Scheme; then
- Water sharing with adjacent coal mines and other users; then
- Off-site discharge:
  - Ulan Creek sites;
  - Talbragar River.

The configuration of the proposed discharge strategy provides flexibility and redundancy within the water management system, which allows UCML to vary its discharge regimes by varying the water flow rates between the various discharge structures based on environmental and water requirements of the Project.

5.4.7 Water Quality Impact

In terms of water quality, the only discharges from the Ulan complex mine water management system other than clean water diversions will be from licensed DECC discharge points which are monitored and controlled. Consequently, potential water quality impacts will be limited to those associated with the EPL. As a result, it is considered that the Project will not significantly alter water quality or ecology of downstream systems. It is also considered that the Project will not adversely impact on the potential use of water for downstream users on the local creek systems or rivers.

As part of the implementation of the Bobadeen Irrigation Scheme in 2003, a salinity offset area was established to offset the salt load within the catchment due to irrigation in consultation with DECC and the Department of Land and Water Conservation (now DWE). The Department of Land and Water Conservation identified that 4460 hectares of land was required to offset the salt load associated with the operation of the Bobadeen Irrigation Scheme (DLWC 2003). This land will be subject to altered land use and management in order to increase its salt holding potential and thereby compensate for the increased salt loadings within the irrigated pivots.

It is noted that the Moolarben Coal Mines mining leases overlap with the lands available for salinity offset. To compensate for this reduction in capacity Moolarben has committed as part of their Stage 1 EA and project approval to either:

- take from Ulan that volume of water that would otherwise have been used in the Bobadeen Irrigation Scheme; or
- provide an area of land with equivalent salt removal capacity.

As noted in **Section 5.4.6.1**, there is a water sharing agreement in place to enable transfer of water from Ulan Coal Mines to Moolarben Coal Mine. As a result of Moolarben mining through the southern area, there will be a need to modify the Salinity Offset provisions in consultation with DECC. There are ongoing negotiations between UCML and MCP regarding an arrangement in relation to compensation in regard to the second dot point of this commitment.

UCML proposes to continue the current operating regimes and irrigation volumes at the Bobadeen Irrigation Scheme and as such no changes are predicted to occur to the salinity impacts related to this scheme. As a result, no changes are required to the Bobadeen Salinity Offset Scheme.

The operation of the water treatment facilities will generate a concentrated saline wastewaterby-product. The wastewater will be maintained in a segregated system and used for dust suppression for coal stockpiles and crushing/sizing station facilities. Based on the proposed water management strategy, the volume of wastewater generated in the water treatment facilities will range between approximately 50 ML per year and approximately 360 ML per year. Analysis indicates that for all years, except for Year 7, the water demands for the crusher process (based on proposed production schedules) will exceed the potential wastewater generated based on the proposed water management and discharge strategy (refer to **Appendix 7**). During Year 7 the crusher water demands are estimated to be approximately 350 ML compared to a wastewater production of 360 ML. The volume of wastewater produced and its quality (typically 5000 – 10,000 µS) is dependent on several variables including feed water quality, plant efficiency and blending ratio. Based on these variables and the analysis undertaken to date, it is considered that UCML can manage the water management system and associated discharges and wastewater production to ensure that wastewater can be managed via the crusher and coal stockpile dust suppression during the Project life.

Any potential saline runoff from the coal stockpile areas will be captured by the existing mine water management system for re-use and/or discharge off site following treatment. In summary, wastewater can be adequately re-used and managed to ensure no adverse impact on the environment.

5.4.8 Subsidence Impacts and Management

The subsidence affectation area includes numerous ephemeral drainage lines. As discussed in **Section 5.2**, the mine plan has been configured to avoid subsidence impacts on the main channel of Ulan Creek. Detailed terrain analysis to compare pre and post mining topography has confirmed that the predicted subsidence impacts will not result in any substantial ponding or drainage realignment within the project area. Susceptible areas have been identified where, based on the topography, potential impacts are more likely. The monitoring regime for these areas is outlined below:

- monitoring of vertical and horizontal subsidence along second and third order drainage lines as determined in consultation with DPI;

- monitoring, measurement and recording (e.g. photographic records) of extent and magnitude of any surface cracking along second and third order drainage lines that may occur during and post mining operations. If works are required these may include sealing of cracks, using methods approved by DWE and DPI; and

- visual inspection and recording (including photographic records at least every 50 metres) of stream bed and bank condition and riparian vegetation along second and third order drainage lines, including collection of baseline data and monitoring during and post mining operations.

If monitoring indicates that remediation works are required, these works will need to maintain channel grades and take into consideration channel stabilities and existing channel characteristics. Experience from the historical operations indicates that only minor works will be required. Due to the limited remediation works undertaken as part of the existing operations, any future remediation works are expected to also be limited in extent and be able to be undertaken either by hand or small earthmoving equipment, e.g. bobcat.

To minimise the potential impact on water quality associated with undertaking remediation works, erosion and sediment control measures as detailed in **Section 5.4.4** will be implemented. The implementation of the proposed erosion and sediment control measures

will ensure that underground mining and surface remediation works do not have a significant adverse impact on downstream water users or on downstream ecosystems.

5.4.9 Remediation of the Goulburn River Diversion

The construction of the Goulburn River Diversion was undertaken in accordance with a 1981 development consent associated with the commencement of open cut operations. It diverts a 3.6 kilometre length of the Goulburn River along the southern and eastern boundaries of the Project.

The diversion has been undertaken in accordance with the development consent and the methodologies and standards of that time. UCML recognises that while it has satisfied its legal obligations, the current condition of the diversion could be improved to address a number of concerns raised by government and community stakeholders regarding the adverse impacts on water quality from sediment and erosion of the river banks, interaction with previously mined areas and potential loss of river base flows. Through a project referred to as the Goulburn River Diversion Baseline Assessment, UCML has been working with the community and government agencies over the last three years to better understand the issues and identify potential measures and recommendations. Following on from the findings of the baseline assessments, a detailed investigation was undertaken to identify the preferred works to be undertaken, i.e. the long term stability strategy.

The strategy was developed as part of an options analysis prepared by URS on behalf of UCML, and based on technical analyses as follows:

- geomorphic assessment of the existing diversion;
- geotechnical assessment of existing materials to guide engineering design of stability works;
- assessment of flood hydraulics of the existing diversion and options for stability;
- design of works to capture overland drainage and discharge it in a controlled manner into the rehabilitated channel;
- engineering analysis and costing of various options to consider in strategy development; and
- design of bed and bank rehabilitation works (through revegetation and in-stream measures) to complement the engineering works for stability where reasonable and feasible.

The overriding objectives of the strategy are as follows:

- improve the overall aesthetic appearance of the diversion, particularly for sections of the diversion which are highly visible from Ulan Road;
- improve the surface drainage controls and vegetation establishment;
- increase the geomorphic features and ecological integrity of the diversion where feasible;
- implement appropriate erosion control;
- strive for a positive improvement on water quality exiting the diversion; and
- community and government acceptance of the proposed stability works.

A summary of the existing condition/characteristics of the diversion identified by URS (2009), and UCML's proposed remediation process, is provided below.

Existing Condition/Characteristics of the Diversion

- Geotechnical – the banks of the diversion are comprised of bedrock or saprolite. Saprolite is highly dispersive/erodible as evidenced by the formation of rills and gullies at several locations within the diversion.

- Hydraulic – HEC-RAS hydraulic modelling software indicates that the stream power in the diversion has been slightly increased from the original alignment and channel has sufficient capacity to contain the 100 year Average Recurrence Interval (ARI) storm event flood flows.

- Surface Drainage – overland flow and road drainage has caused severe rill erosion along the banks and slopes of the diversion.

- Vegetation – there is minimal diversity of native species and high densities of weeds within the riparian zone. A lack of canopy species was also identified along the toe, face and top of banks, particularly the left bank.

Proposed Remediation of Goulburn River Diversion

To address the objectives outlined above, UCML proposes to:

- re-profile the banks to reduce flow velocity of rainfall runoff, bed shear and stream power;

- implement rock lined channels to convey road drainage from the existing culverts to the diversion;

- construct engineered rock chute drop structures with a design capacity of a 50 year ARI to convey flows from the rock lined channels into the bed of the diversion;

- revegetate the banks of the diversion using a variety of techniques including hydromulching / direct seeding and tube stock planting. Local (endemic) species with deep rooting characteristics are preferred given the dispersive nature of the soils. Native soils and mulches will be utilised where possible. A weed control, monitoring and maintenance program will also be implemented. The density of plantings proposed within the diversion ranges from one tree per square metre within 5 metres of the water's edge to 0.5 trees per square metre between the narrow riparian fringe and the terrestrial areas dominated by more terrestrial vegetation, e.g. 5 to 25 metres from the water's edge to 0.25 trees per square metre where terrestrial vegetation types dominate, that is, more than 25 metres from the water's edge.

The strategy has divided the diversion into six reaches with the works to be undertaken on each reach (see **Table 5.4**) informed by the findings of the technical analysis outlined above.

Table 5.4 - Proposed Remediation Works and Indicative Program

Reach	Proposed Remediation Works	Indicative Proposed works Program
Reach 1	Batter, benching and revegetation of bank slopes Improved overland drainage above slopes Control overland flows with rock overland drains, road drains and rock chutes	Year 3-6
Reach 2	Batter, benching and revegetation of bank slopes Improved overland drainage above slopes Control overland flows with rock overland drains, road drains and rock chutes	Year 6-9
Reach 3	Batter, benching and revegetation of bank slopes Improved overland drainage above slopes Control overland flows with overland drains and rock chutes	Year 1-3
Reach 4a	Batter and revegetation of the upper bank slopes Improved overland drainage above slopes Control overland flows with overland drains, road drains and rock chutes	Year 6-9
Reach 4b	Batter, benching and revegetation of bank slopes Improved overland drainage above slopes Control overland flows with overland drains, road drains and rock chutes	Year 3-6
Reach 5	Batter, benching and revegetation of bank slopes Improved overland drainage above slopes Control overland flows with grass and rock overland drains, road drains and rock chutes	Year 1-3

Source URS (2009)

As shown in **Table 5.4**, it is proposed to complete the works in stages with the location of each reach shown on **Figure 5.4.8**. Staged construction of the proposed remediation works will ensure successful establishment of vegetation within each stage, prior to further disturbance for remediation works. Further refinement of the staging of the work may be undertaken in response to the condition at that time. **Figures 5.4.9** to **5.4.14** show schematic examples of cross-sections of the proposed rehabilitated diversion. It is noted that the surface drainage, bank rehabilitation and revegetation works are specific for each reach.

Construction activities will be staggered within each reach, and will be limited to approximately 500 metres (consistent with surface drainage constraints). It is planned to have a minimum of 500 metres maintained between construction activities.

5.4.10 Cumulative Impacts

Potential cumulative surface water impacts associated with the Project relate to:

- surface disturbance associated with construction and operational works potentially resulting in increased sediment generation and deposition in surrounding catchments;
- subsidence potentially resulting in increased ponding and reduced runoff within the subsidence affectation area and a resultant reduction in runoff to surrounding catchments; and

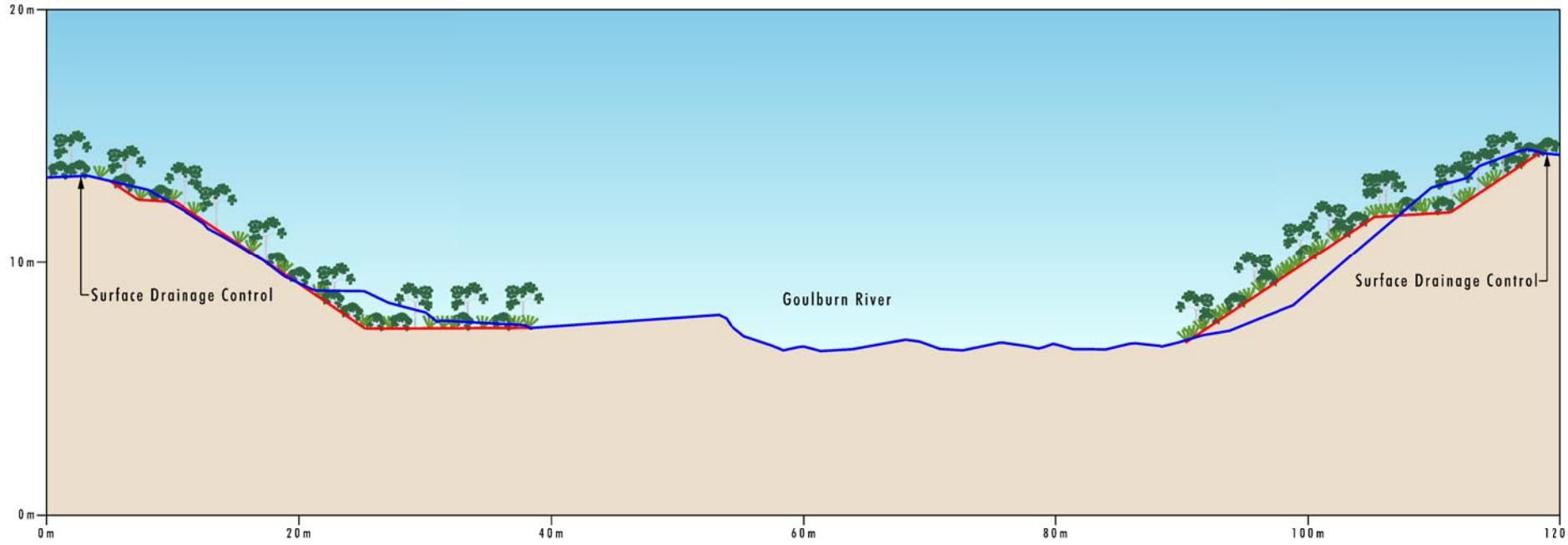
Source: URS Australia Pty Ltd (2009)
Note: Cross-section labels refer to Cross-section Number (top) and Figure Number (bottom)

0 100 250 500m
1:10 000

Legend
- Reach
- Batter
- Channel
- Overland Drainage
- Rock Chute

FIGURE 5.4.8

Goulburn River Diversion
Reaches and Cross-sections



0 2 5 10m
1:25 Vertical Scale

0 5 10 20m
1:50 Horizontal Scale

Legend

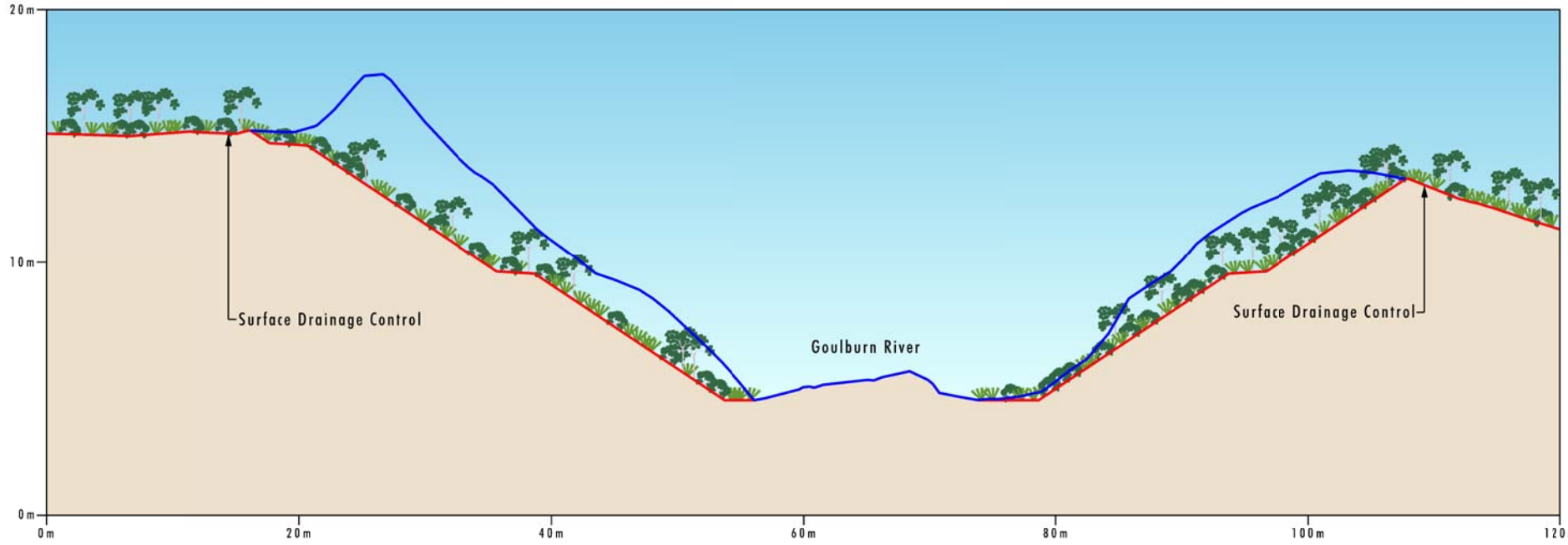
- Proposed Ground Level
- Existing Ground Level
- Rehabilitation

Note: The cross-section profile will vary depending on the specific requirements of each reach of the diversion
Source: URS Australia Pty Ltd (2009)

File Name (A4): R05_V1/2423_342.dgn

FIGURE 5.4.9

Conceptual Goulburn River Diversion Rehabilitation Cross-section 200 Reach 1



0 2 5 10m
1:25 Vertical Scale

0 5 10 20m
1:50 Horizontal Scale

Legend

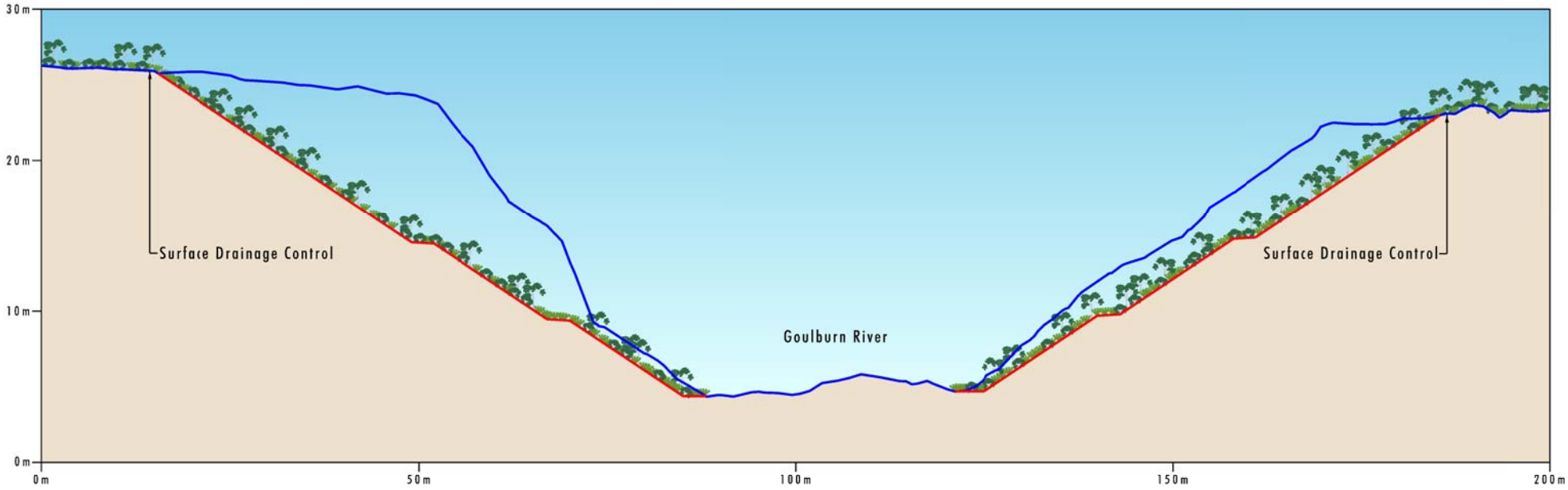
- Proposed Ground Level
- Existing Ground Level
- Rehabilitation

Note: The cross-section profile will vary depending on the specific requirements of each reach of the diversion
Source: URS Australia Pty Ltd (2009)

File Name (A4): R05_V1/2423_343.dgn

FIGURE 5.4.10

Conceptual Goulburn River Diversion Rehabilitation Cross-section 1000 Reach 2



0 5 10 15m
1:40 Vertical Scale

0 10 20 30m
1:80 Horizontal Scale

Legend

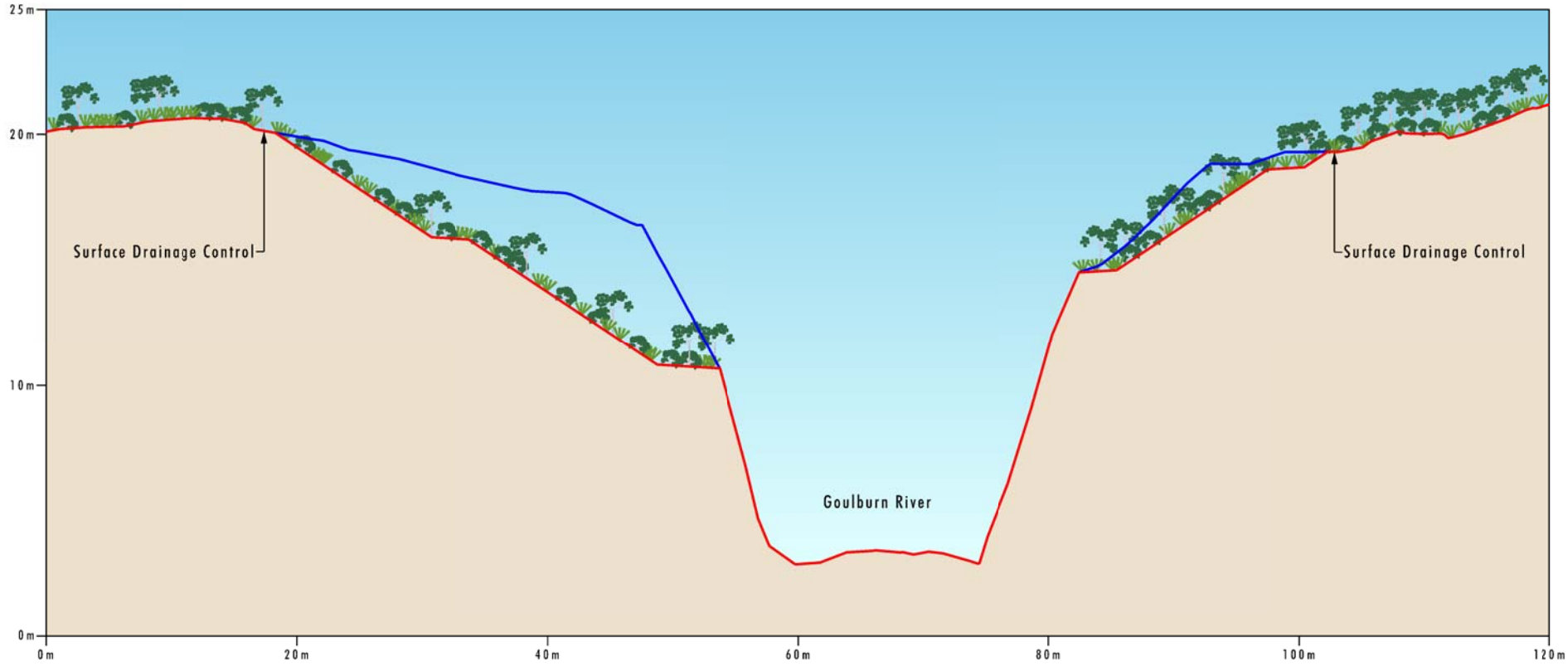
- Proposed Ground Level
- Existing Ground Level
- Rehabilitation

Note: The cross-section profile will vary depending on the specific requirements of each reach of the diversion
Source: URS Australia Pty Ltd (2009)

File Name (A4): R05_V1/2423_344.dgn

FIGURE 5.4.11

Conceptual Goulburn River Diversion Rehabilitation Cross-section 1500 Reach 3



0 2 5 10m
1:25 Vertical Scale

0 5 10 20m
1:50 Horizontal Scale

Legend

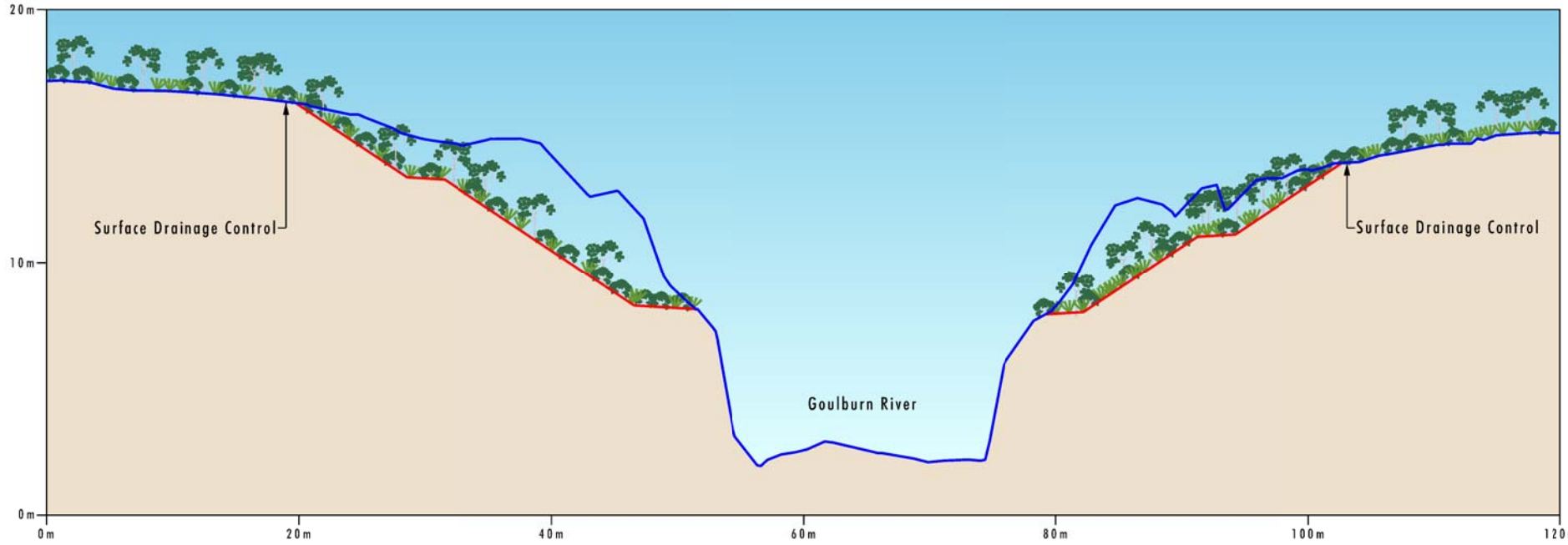
- Proposed Ground Level
- Existing Ground Level
- Rehabilitation

FIGURE 5.4.12

Conceptual Goulburn River Diversion Rehabilitation Cross-section 2200 Reach 4a

Note: The cross-section profile will vary depending on the specific requirements of each reach of the diversion
Source: URS Australia Pty Ltd (2009)

File Name (A4): R05_V1/2423_345.dgn



0 2 5 10m
1:25 Vertical Scale

0 5 10 20m
1:50 Horizontal Scale

Legend

- Proposed Ground Level
- Existing Ground Level
- Rehabilitation

FIGURE 5.4.13

Conceptual Goulburn River Diversion Rehabilitation Cross-section 2800 Reach 4b

Note: The cross-section profile will vary depending on the specific requirements of each reach of the diversion
Source: URS Australia Pty Ltd (2009)

File Name (A4): R05_V1/2423_346.dgn

0 2 5 10m
1:25 Vertical Scale

0 5 10 20m
1:50 Horizontal Scale

Legend

- Proposed Ground Level
- Existing Ground Level
- Rehabilitation

Note: The cross-section profile will vary depending on the specific requirements of each reach of the diversion
Source: URS Australia Pty Ltd (2009)

File Name (A4): R05_V1/2423_347.dgn

FIGURE 5.4.14

Conceptual Goulburn River Diversion Rehabilitation Cross-section 3800 Reach 5

- discharge of excess mine water to Ulan Creek and the Talbragar River.

UCML will continue to discharge surplus water to the Goulburn River system and propose to also discharge surplus water to the Talbragar River system. Any discharges from the site will continue to be managed under the EPL. The proposed discharges from the site will assist in offsetting predicted losses to baseflows to the Goulburn and Talbragar River systems for the duration of the Project (refer to **Section 5.3**).

The surface water assessment of the predicted subsidence impacts has determined that the catchment boundaries of the creek systems to be undermined will not change significantly. It has also concluded that there is unlikely to be any significant ponding or storage of surface runoff. A series of monitoring points have been identified to monitor potential drainage grade changes, ponding and dam spillway changes.

Sediment and erosion control measures are proposed to ensure that there will be no significant impact on downstream water qualities if subsidence remediation works are required.

On this basis it is considered that the Project will not result in adverse cumulative impacts on water use, flow or quality in the surrounding areas.

5.4.11 Surface Water Monitoring

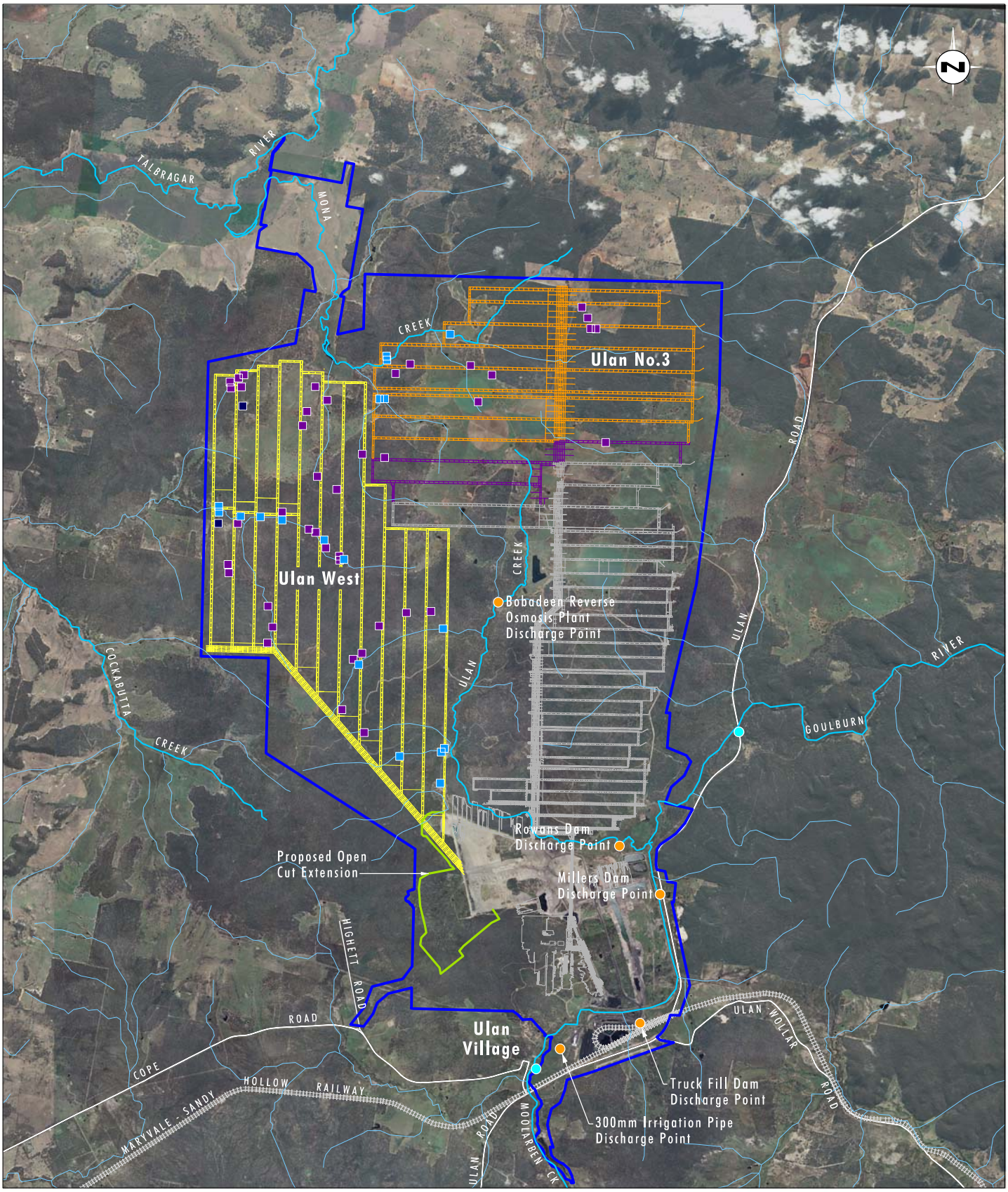
Surface water quality and quantity is monitored in the surrounding drainage system in accordance with the *UCML Water Management Plan* (UCML 2007a).

The statutory surface water monitoring locations, including flow gauging stations on the Goulburn River, are shown on **Figure 5.4.15**.

The surface water monitoring routine at UCML is derived from the licence criteria as outlined in EPL No. 394 and listed in **Table 5.5** below.

Table 5.5 – UCML Licensed Discharge Points – EPL No. 394

Location	Licence Point	Discharge Limits					
		Iron (mg/L)	Conductivity (µS/cm)	Oil & Grease (mg/L)	pH	Zinc (mg/L)	Volume (kL/day)
Millers Dam	1						85
Effluent Storage Dam	2		810	10	6.5 – 8.5		600
Overflow from Rowans Dam to Ulan Creek	3	5		10	6.5 – 8.5	5	Not specified
Discharge to Ulan Creek from Rowans Dam Water Treatment Facility	3		900		6.5 – 8.5		10,000
Drainage Outlet from Truckfill Dam to unnamed watercourse	4	5		10	6.5 – 8.5	5	2000
Discharge to Ulan Creek from the Bobadeen Water Treatment Facility	6		900		6.5 – 8.5		15,000



Source: Ulan Coal, Aerial Photo December 2007

0 1.0 2.5 5.0km
1:110 000

Legend

- Project Boundary
- Proposed Open Cut Extension
- Proposed Ulan West Mine Plan
- Ulan No.3 Underground Mine Plan
- Previous Underground Mining Operations
- Current Mining and SMP Approved Area

Subsidence Related Monitors:
- Dam Monitoring
- Erosion Monitoring
- Ponding Monitoring

Water Quality Monitoring:
- Monitoring and Discharge Location
- Gauging Station Location

FIGURE 5.4.15

Surface Water Monitoring Locations

UCML also undertakes monitoring for operational purposes which is in addition to that outlined in the various licences. This monitoring is undertaken "on a as needs basis" to assist the mine in its day to day management of its mine water operations. The frequency of monitoring and the parameters monitored for operational purposes is undertaken at the discretion of UCML.

Where no water quality criteria have been set under the various licences, the monitoring data is compared against:

- the previous range of data at that location; and/or
- the trend associated with the previous data collected (i.e. seasonal movements, historical trends etc); and/or
- forecast predictions or estimates.

As required by EPL No. 394, all monitoring records are kept for at least four years for reference on request by DECC.

The following surface water monitoring program will also be implemented to minimise the impact to the local water quality and quantity during ongoing operations:

- the presence of surface cracking, surface ponding or out of channel flows will be monitored at the locations identified in **Figure 5.4.8**; and
- the quantity and quality (pH and electrical conductivity) of water discharged from the water treatment facilities will be measured.

5.5 Ecology

A comprehensive ecological survey and assessment was undertaken for the Project by Umwelt. Biodiversity impacts were identified as a key issue, and in accordance with the DGRs, this assessment has included:

- accurate predictions of any vegetation clearing on site;
- a detailed assessment of the potential impacts of the project on any terrestrial and aquatic threatened species, populations, ecological communities or their habitats; and
- a detailed description of the measures that would be implemented to maintain or improve the biodiversity values of the surrounding region in the medium to long term;

Ecological survey was undertaken over a number of seasons between spring 2006 and spring 2008 across the project area. In total, 86 ten-hour person-days were used to comprehensively sample the vegetation communities and flora species, and 67 ten-hour person-days were used to comprehensively sample the fauna assemblages of the project area. The survey area included all areas potentially impacted by the open cut and the proposed surface infrastructure areas, however considerable survey has also been completed in the other parts of the project area. The survey area also included areas identified as potential opportunities for management and long term conservation.

The survey work for the Project builds on previous surveys which provide a 29 year record of data from previous environmental assessments and ongoing monitoring.

The complete ecological assessment is included in **Appendix 8**, with a summary of the main findings outlined below.

5.5.1 Regional Ecological Context

The Ulan Coal Mine is located within both the Sydney Basin and Brigalow Belt South Bioregions (refer to **Figure 5.5.1**). The NSW South Western Slopes Bioregion lies to the immediate south-west of the project area. The proximity of a number of bioregion boundaries so close to the project area means that a diverse range of flora and fauna assemblages are likely to occur in the local area, with a mixture of coastal and inland influences.

The project area is located in a region that is generally well-vegetated, with a broad regional corridor running from Goulburn River National Park (refer to **Figure 1.4**) which occupies an area of approximately 71,000 hectares to the east of the project area, to the Wollemi National Park which occupies an area of approximately 500,000 hectares and Blue Mountains National Park located further to the south. To the north-west of the Project there is a fragmented corridor to Goonoo State Forest near Dubbo.

The areas surrounding the project area are predominantly composed of three broad vegetation types, being:

- forest, woodlands and heaths on Narrabeen sandstone-derived soils;
- valley floor woodlands and derived pastures on colluvium; and
- riparian woodlands occurring on Permian and Quaternary sediments exposed along creek and river flats.

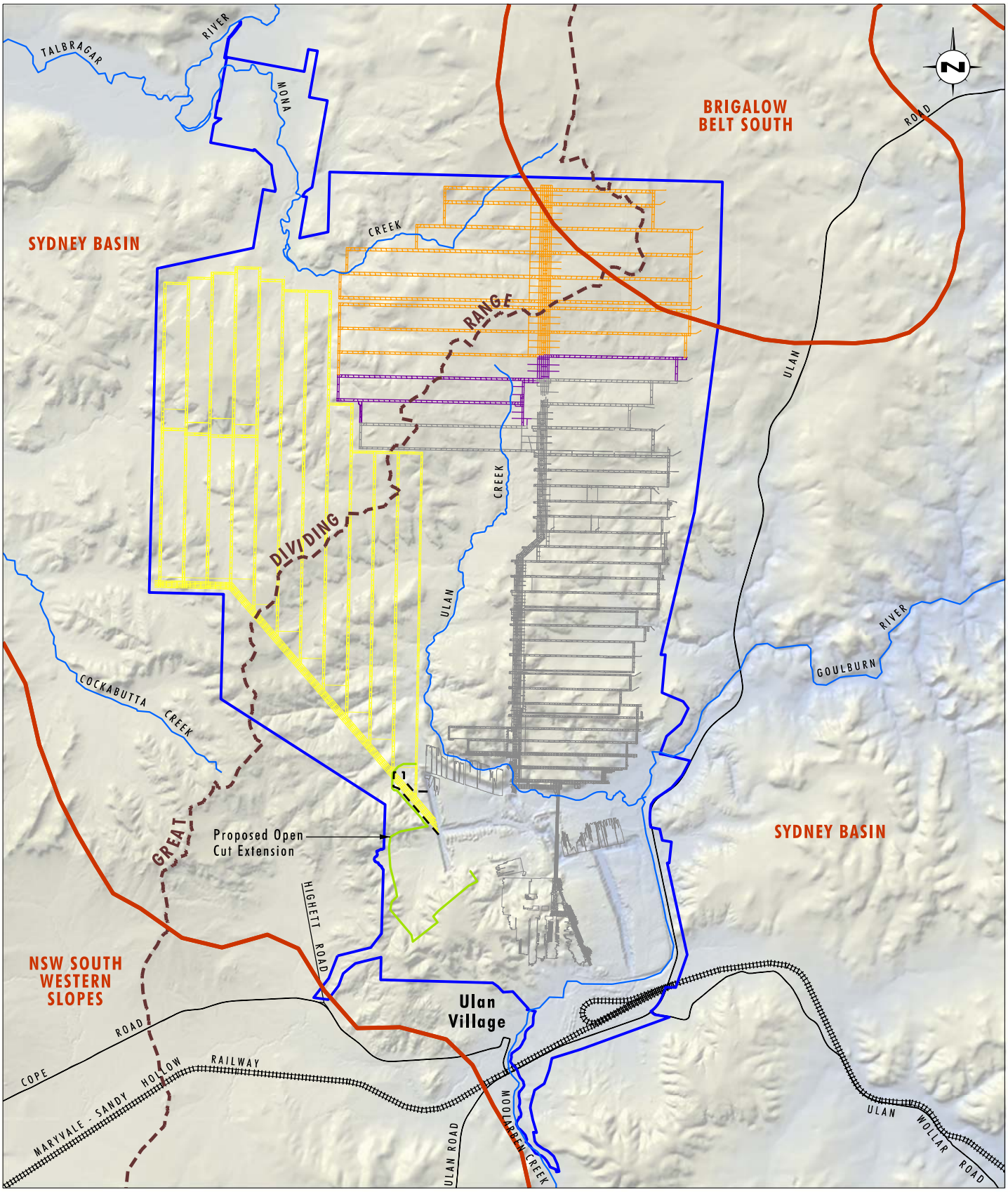
These general vegetation types are also present within the project area.

Coal mining also features in the region, with Wilpinjong open cut mining operations to the south-east of the project area, and the approved Moolarben Mine (open cut and underground operations) to the immediate south of the project area. Clay, sandstone and road base quarries also occur adjacent to and within the vicinity of the project area.

5.5.2 Methods

A detailed survey methodology was designed and completed in order to gain a thorough understanding of the ecological features of the project area. The methods commenced with a detailed literature review, including searches of all relevant ecological databases. Information gathered from the literature reviews and database searches was then used to design an extensive field survey program to map and survey vegetation communities, and to target threatened species, endangered populations, endangered ecological communities, or their habitats, including aquatic features.

The flora survey program comprised 116 rapid vegetation assessments, 59 vegetation survey plots, 22 targeted transects and numerous hours of opportunistic observation and recordings while completing other tasks within the project area. The fauna survey program included the use of all standard survey techniques, including terrestrial and arboreal trapping and hair tube sampling, harp trapping, pitfall trapping, spotlighting, call playback, Anabat echolocation call detection and analysis, reptile searches, amphibian searches, bird searches, and analysis of scats, scratches, tracks and characteristic calls. Koala habitat was assessed at 94 sites. Surveys of the aquatic environments were undertaken at 11 sites through the use of dip nets, baited fish traps, habitat assessments and aquatic flora sampling, where suitable habitat allowed.



Source: Ulan Coal, NPWS (2003)

0 1.0 2.5 5.0km
1:100 000

Legend

- Project Boundary
- Proposed Open Cut Extension
- Proposed Ulan West Mine Plan
- Ulan No.3 Underground Mine Plan
- Previous Underground Mining Operations
- Current Mining and SMP Approved Area
- Great Dividing Range
- IBRA Bioregion
- Box Cut Option

FIGURE 5.5.1

IBRA Bioregion Boundary

File Name (A4): R05_V1/2423_303.dgn

Following the completion of the field survey, 36 detailed ecological habitat assessments were conducted across the project area to assist in the description of fauna habitat types and the development of the comprehensive Biodiversity Offsets Strategy. This habitat assessment was designed to enable the direct comparison of habitat types and overall ecological condition between the areas proposed for surface disturbance and the proposed offset area discussed in **Section 5.5.6.2**.

The ecological surveys were undertaken over a period of three years and covered various seasons.

5.5.3 Flora Results

5.5.3.1 Vegetation Communities

Thirty seven vegetation communities were recorded in the project area. All of the mapped vegetation communities except six (Planted, Improved Pasture, Derived Native Grasslands, Unimproved Pasture and the two Rehabilitation categories) are naturally-occurring, although most have been significantly modified during the past 200 years through extensive management, including clearing and regeneration. Most vegetation communities are widespread in the local area, while some occur much more extensively across a broader range of over 100 kilometres. Some communities, however, have a more restricted local occurrence. The location and extent of these communities is shown on **Figure 5.5.2**.

Nineteen of the recorded vegetation communities fall within the areas proposed for surface disturbance and the proposed Bobadeen Vegetation Offset Area (refer to **Section 5.5.6**) contains 17 of the vegetation communities mapped within the project area.

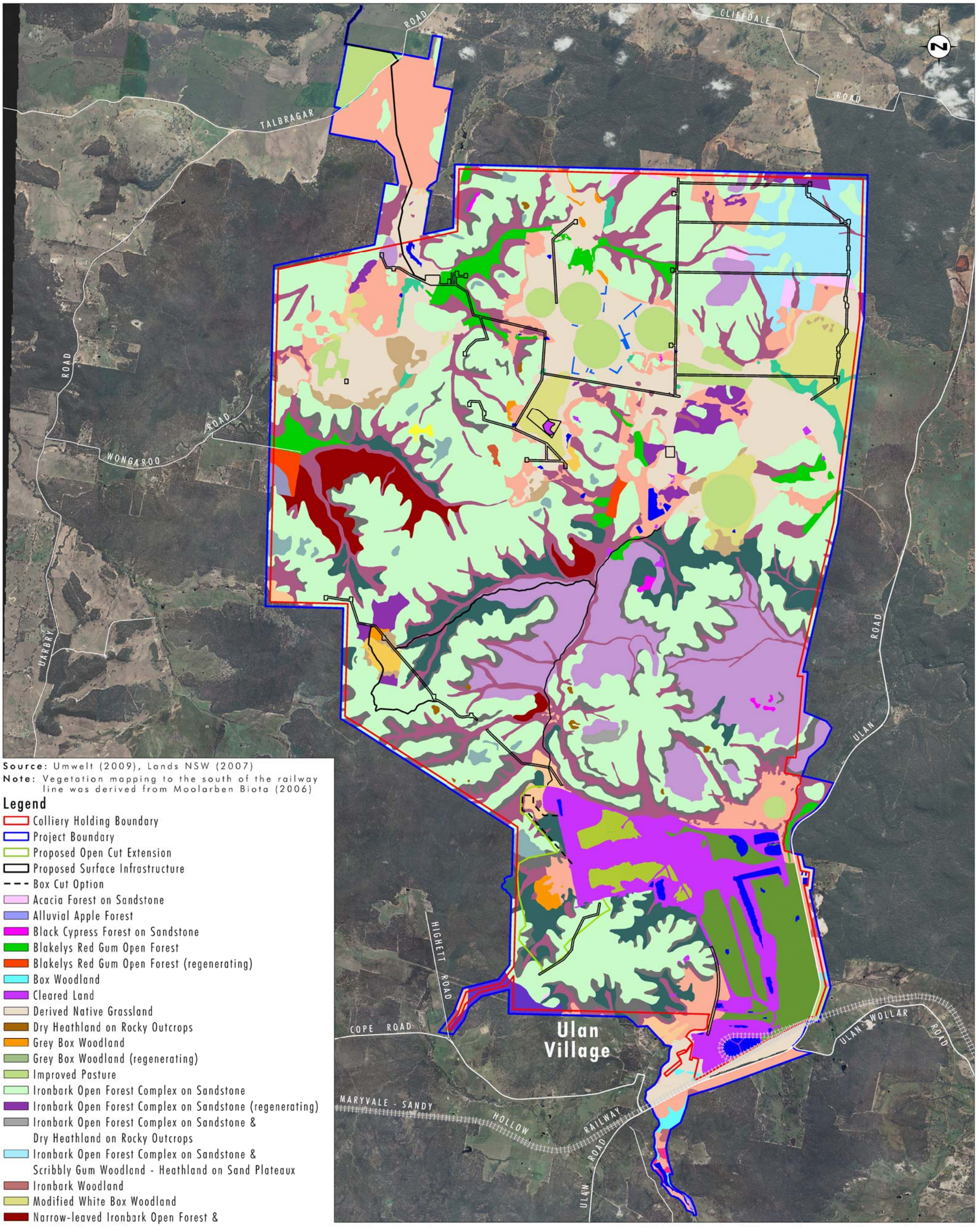
5.5.3.2 Threatened Species and Endangered Ecological Communities

Two flora species listed under the *Threatened Species Conservation Act 1995* (TSC Act) were recorded in the project area. One additional threatened flora species, listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), was also recorded within the project area. Of these records, only one species (*Acacia ausfeldii*) is expected to be impacted by the Project (refer to **Figure 5.5.3**). No endangered populations were recorded within the project area. One endangered ecological community (EEC) was recorded within the project area, being the White Box – Yellow Box – Blakely's Red Gum Woodland/White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grasslands (hereafter referred to as the White Box Woodland EEC). Potential impacts on these threatened species and endangered ecological communities are further discussed in **Section 5.5.5**.

5.5.4 Fauna Results for the Project Area

A total of 328 vertebrate fauna species were recorded during surveys of the project area. Thirty three of the fauna species recorded are listed as threatened under the TSC Act, including seven species under Preliminary Listings for Vulnerable status. Nine migratory species listed under the EPBC Act were recorded within the project area. Of the threatened species, 23 were birds, 7 were micro-bats and 3 were other mammals (refer to **Figure 5.5.4**). An additional 5 fauna species also listed as threatened under the TSC Act, may potentially occur on the site. These species have, however, not been recorded on the site.

A total of 115 aquatic fauna taxa were recorded during the aquatic survey of the project area and adjoining areas, comprising two vertebrate and 113 invertebrate taxa. No threatened aquatic taxa were recorded during the assessment and none are expected to occur.



Source: Umwelt (2009), Lands NSW (2007)

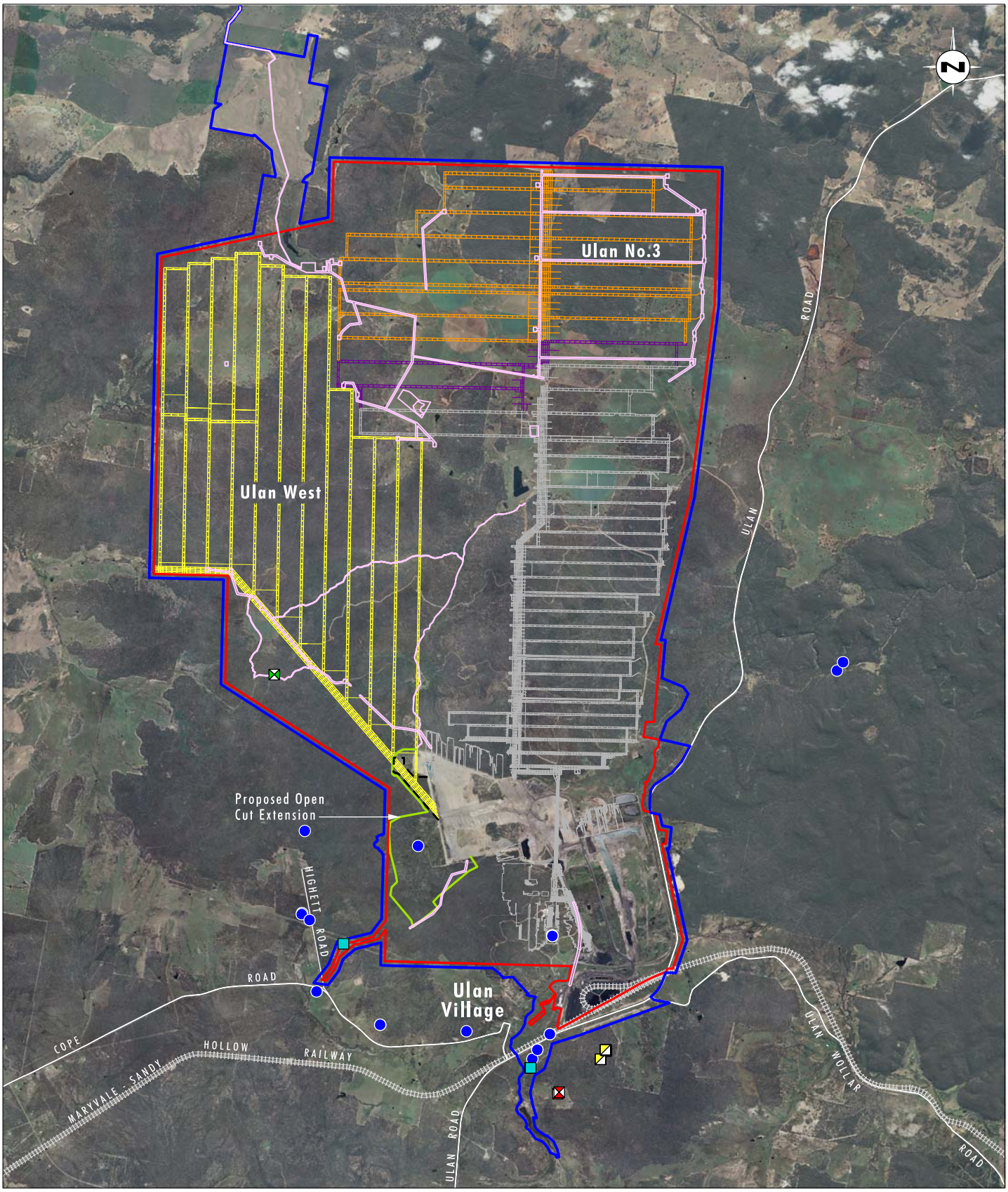
Note: Vegetation mapping to the south of the railway line was derived from Moolarben Biota (2006)

Legend

- Colliery Holding Boundary
- Project Boundary
- Proposed Open Cut Extension
- Proposed Surface Infrastructure
- Box Cut Option
- Acacia Forest on Sandstone
- Alluvial Apple Forest
- Black Cypress Forest on Sandstone
- Blakelys Red Gum Open Forest
- Blakelys Red Gum Open Forest (regenerating)
- Box Woodland
- Cleared Land
- Derived Native Grassland
- Dry Heathland on Rocky Outcrops
- Grey Box Woodland
- Grey Box Woodland (regenerating)
- Improved Pasture
- Ironbark Open Forest Complex on Sandstone
- Ironbark Open Forest Complex on Sandstone (regenerating)
- Ironbark Open Forest Complex on Sandstone & Dry Heathland on Rocky Outcrops
- Ironbark Open Forest Complex on Sandstone & Scribbly Gum Woodland - Heathland on Sand Plateaux
- Ironbark Woodland
- Modified White Box Woodland
- Narrow-leaved Ironbark Open Forest & Scribbly Gum Woodland – Heathland on Sand Plateaux
- Narrow-leaved Ironbark Open Forest on Alluvium/Colluvium
- Narrow-leaved Ironbark Open Forest on Alluvium/Colluvium (regenerating)
- Planted Area
- Rough-barked Apple Open Forest
- Rough-barked Apple Open Forest (regenerating)
- Scribbly Gum Woodland
- Scribbly Gum Woodland – Heathland on Sand Plateaux
- Water Body
- She-oak Low Forest
- She-oak Low Forest on Sandstone Crests
- She-oak Low Forest on Sandstone Crests & Dry Heathland on Rocky Outcrops
- Stringybark-Ironbark Open Forest on Sandstone Slopes
- Tablelands Red Gum Woodland
- Tumbledown Red Gum – Callitris Open Forest on Granite
- Unimproved Pasture
- White Box Woodland
- White Box Woodland (regenerating)
- Yellow Box - Red Gum Woodland
- Rehabilitation Pre 1997
- Rehabilitation Post 1997

FIGURE 5.5.2

Ulan Vegetation Communities and Disturbance Areas



Source: Umwelt (2009), Lands NSW (2007)

0 1.0 2.5 5.0km
1:100 000

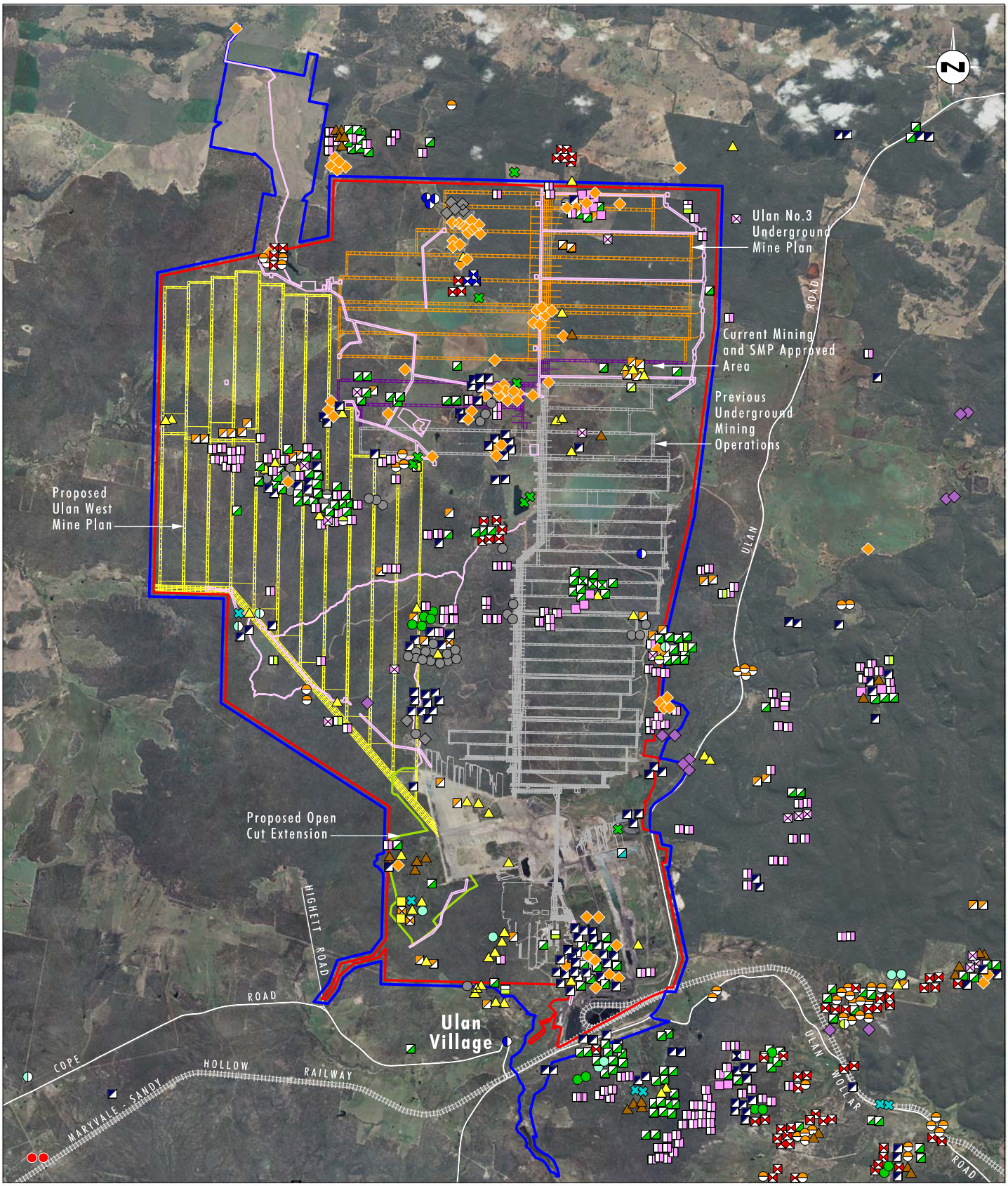
Legend

- Colliery Holding Boundary
- Project Boundary
- Proposed Open Cut Extension
- Proposed Ulan West Mine Plan
- Ulan No.3 Underground Mine Plan
- Previous Underground Mining Operations
- Current Mining and SMP Approved Area
- Surface Infrastructure
- Box Cut Option
- *Acacia ausfeldii*
- *Diuris tricolor*
- *Eucalyptus cannonii*
- *Leucochrysum albicans* var.*tricolor*
- *Homoranthus darwinioides*

FIGURE 5.5.3

Threatened Flora Species Recorded in Project Area and Surrounds

File Name (A4): R05_V1/2423_306.dgn



Source: Lands NSW 2007, Aerial Photo Dec. 2007, Birds Australia 2009, Australia Museum 2008, Hoye 2009, Ecovision 2008, Atlas of NSW Wildlife 2007 & 2009, Mount King 2008, Moolarben Biota 2006

0 1 2 4km
1:100 000

Legend

- Colliery Holding Boundary
- Project Boundary
- Proposed Open Cut Extension
- Surface Infrastructure
- Barking Owl
- Black-breasted Buzzard
- Black-chinned Honeyeater
- Blue-billed Duck
- Brown Treecreeper
- Brush-tailed Rock-wallaby
- Bush Stone-curlew
- Diamond Firetail
- Eastern Bentwing-bat
- Eastern Cave Bat
- Flame Robin
- Gang-gang Cockatoo
- Glossy Black-Cockatoo
- Greater Long-eared Bat
- Grey-crowned Babbler
- Hooded Robin
- Koala
- Large-eared Pied Bat
- Large-footed Myotis
- Little Lorikeet
- Little Pied Bat
- Magpie Goose
- Painted Honeyeater
- Powerful Owl
- Regent Honeyeater
- Speckled Warbler
- Square-tailed Kite
- Scarlet Robin
- Spotted Harrier
- Squirrel Glider
- Swift Parrot
- Turquoise Parrot
- Yellow-bellied Sheathtail-bat
- Varied Sittella

FIGURE 5.5.4

Threatened Fauna Species Recorded in Project Area and Surrounds

File Name (A4): R05_V1/2423_307.dgn

The habitat assessment showed that the woodland and forest/open forest vegetation formations provided a high quality range of fauna habitats, suitable for the majority of threatened fauna species recorded within the project area. The grassland habitats contain fewer habitat niches, however provide valuable foraging habitat for a variety of fauna species. The cleared and planted habitats provide reduced fauna habitat value.

There are no Endangered Fauna Populations listed for the region, and none occur or are expected to occur within the project area. There are also no areas of declared critical habitat within the project area.

5.5.5 Ecological Impact Assessment

Without mitigation, the Project has the potential to result in a variety of impacts on the ecological features of the project area. The majority of these impacts will be direct impacts from the open cut mine and underground mining surface infrastructure, however there are also subsidence-related impacts on cliff line areas located within the underground mining footprint. Extensive ecological monitoring of previous longwall mining areas at Ulan has confirmed that subsidence caused negligible impact to vegetation in this area. There are no groundwater dependent ecosystems located in the future underground mining area and therefore no potential impact on these ecosystems.

During the planning phase of the Project, a number of refinements were made in order to reduce the overall impact on particular threatened species and ecological features. These included:

- maximising use of existing disturbed areas within the project area for the placement of surface infrastructure and to minimise impact on significant ecological features such as the White Box Woodland EEC. A large portion of the infrastructure required for the Project will be located within areas that have been disturbed by the previous open cut mining operations. This includes the Ulan West office complex, the Ulan West conveyors, the ROM Hub stockpile and product stockpile, CHPP upgrade, etc.;

- avoidance of mining below the Brokenback Conservation Area. This area was initially established to protect rockshelters that are significant from a cultural heritage perspective, but also results in substantial ecological benefit in terms of reducing the extent of impact on cliff lines which have been confirmed to provide habitat for threatened cave dwelling bats;

- the relocation of the pipeline discharge point to rock bar within the Talbragar River, to avoid impact on the bank and channel stability;

- minimisation of disturbance footprints for surface infrastructure by co-locating utilities within defined infrastructure corridors; and

- survey and assessment of a disturbance corridor envelope to identify any significant ecological constraints for the placement of surface infrastructure, to enable flexibility of placement of infrastructure in a manner that optimises operational efficiency, whilst seeking to minimise ecological impacts.

The Project will result in the following disturbances:

- 239 hectares of vegetation to be removed due to open cut operations. This includes:
  - removal of a population of Acacia ausfeldii (approximately 150 plants) due to the open cut operations;
  - removal of up to 5.7 kilometres of cliffline within the open cut disturbance area;
- 169 hectares of vegetation to be removed due to the construction of infrastructure on the surface to support the underground operations. This vegetation impact includes removal of approximately 69 hectares of White Box Woodland EEC, due to the construction of infrastructure on the surface to support the underground operations. The majority of this area includes the Derived Native Grassland or Modified White Box Woodland variants of the EEC. The total impacted area of the EEC represents 3.1 per cent of the 2201 hectares of the White Box Woodland EEC that occurs in the project area;
- up to approximately 6.0 kilometres of the cliff line located above the underground mining footprint is predicted to experience rockfall, due to subsidence. This is approximately 20 per cent of the total modelled cliff lines that exist within the future underground mining area and represents a relatively minor portion of the total length of cliff line located within the project area (i.e. 132 kilometres); and
- removal of fauna habitat (particularly tree hollows and specific foraging resources) as a result of the removal of vegetation.

Without any mitigation, the Project has the potential to impact significantly on *Acacia ausfeldii*, White Box Woodland EEC, and cave-dependent micro-bat species (being eastern bentwing-bat (*Miniopterus schreibersii oceanensis*), large-eared pied bat (*Chalinolobus dwyeri*), large-footed myotis (*Myotis adversus*), little pied bat (*Chalinolobus picatus*) and eastern cave bat (*Vespadelus troughtoni*)). For this reason, a comprehensive Biodiversity Impact Mitigation and Offset Strategy has been prepared (refer to **Section 5.5.6**). The remaining threatened flora and fauna species are not expected to be significantly impacted by the Project, as they are not recorded within the proposed disturbance areas, or will only be impacted to a minor level.

In the absence of appropriate management and mitigation measures, it is concluded that the impacts of the Project will be moderate for most species within a local context, but relatively low within a regional context. Regionally the flora and fauna within the project area is well represented in conservation areas including Goulburn River National Park, Munghorn Gap Nature Reserve and Wollemi National Park.

5.5.6 Ecological Management Commitments

5.5.6.1 Biodiversity Impact Mitigation and Offset Strategy

In order to address the overall goal to maintain or improve the biodiversity values of the surrounding region in the medium to long term, UCML committed to a range of impact mitigation strategies being developed to minimise the overall impact of the Project on EECs, threatened species and their habitats. Specifically, a Biodiversity Impact Mitigation and Offset Strategy was developed to reduce the severity of the predicted impacts on threatened species and EECs within the project area, such that the level of impact over time will be as minimal as possible. The Biodiversity Offset and Impact Mitigation Strategy consists of a number of components that collectively aim to:

- compensate for the loss of vegetation (and habitat) from the Open Cut Disturbance Area and Surface Infrastructure Disturbance Area by providing the Bobadeen Vegetation Offset Area (refer to **Figure 5.5.5**), being of comparable vegetation and habitat type and quality;

- mitigate the loss of cliff line areas (and habitat) from the Open Cut Disturbance Area and potential subsidence-related impacts through the establishment of the Brokenback Conservation Area and Spring Gully Cliffline Management Area (refer to **Figure 5.5.5**);

- create a stable final landform within the post mining open cut disturbance area consisting of self sustaining native vegetation communities characteristic of the pre mining environment;

- progressively conduct rehabilitation and revegetation of the post mining area over the life of the mine;

- increase the quality of habitat within the Biodiversity Offset and Management Areas in order to compensate (in part) for the loss of habitat from clearing for construction and operational purposes;

- increase the representation of native vegetation communities; and

- provide for suitable ongoing monitoring and management to ensure the goals for these areas are met.

These components will be detailed in a comprehensive ROMP (Rehabilitation and Offset Management Plan) (or similar) and will include:

- establishment and protection of the Biodiversity Offset and Management Areas (being the Bobadeen Vegetation Offset Area, Brokenback Conservation Area and Spring Gully Cliffline Management Area) (refer to further details below);

- targeted revegetation/regeneration of ecological communities, particularly the target EEC, within the Bobadeen Vegetation Offset Area;

- augmentation of fauna habitat to improve habitat quality within the Bobadeen Vegetation Offset Area;

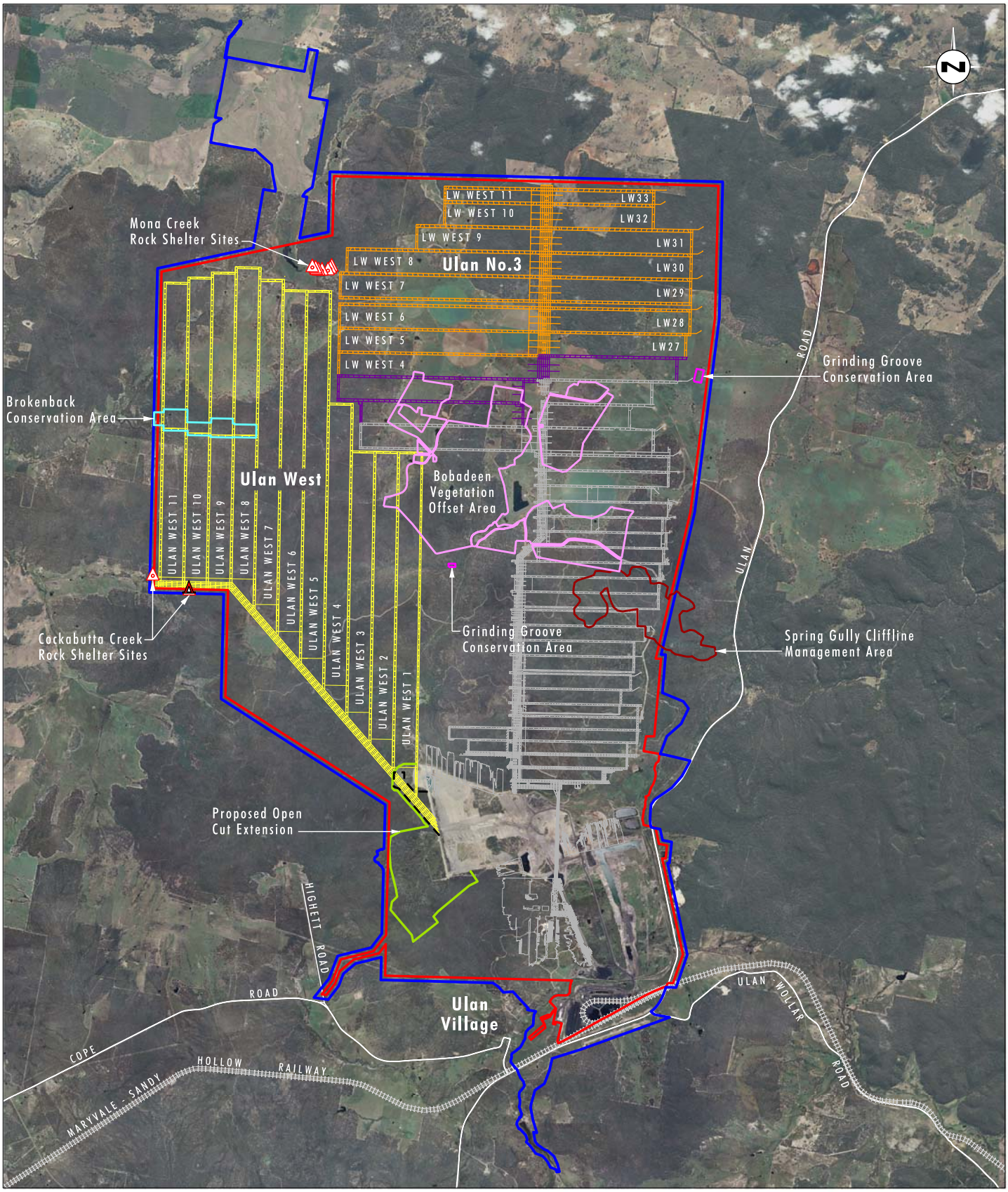
- inclusion of *Acacia ausfeldii* within rehabilitation of post-mining open cut;

- use of local provenance species for revegetation works, unless conditions such as seed availability or climate demand the use of species from a wider region;

- implementation of a robust tree felling procedure (including detailed pre-clearing surveys) designed to minimise impacts on hollow-dependent species. This procedure will maximise the salvage and re-use of felled tree hollows, as well as other specific habitat resources, such as fallen timber, hollow logs and boulders;

- replacement of felled tree hollows, through the relocation of salvaged tree hollows and use of nest boxes in surrounding remnant vegetation or in Biodiversity Offset and Management Areas (where appropriate);

- fencing/access control to the Bobadeen Vegetation Offset Area, the Brokenback Conservation Area and Spring Gully Cliffline Management Area (where appropriate);



Source: Ulan Coal, Aerial Photo December 2007

0 1.0 2.5 5.0km
1:100 000

Legend

- Colliery Holding Boundary
- Project Boundary
- Proposed Open Cut Extension
- Proposed Ulan West Mine Plan
- Ulan No.3 Underground Mine Plan
- Previous Underground Mining Operations
- Current Mining and SMP Approved Area
- Box Cut Option
- Bobadeen Vegetation Offset Area
- Brokenback Conservation Area
- Spring Gully Cliffline Management Area
- Grinding Groove Conservation Area

FIGURE 5.5.5

Offset and Management Area

File Name (A4): R05_V1/2423_331.dgn

- weed management controls for the project area, i.e. types of weeds known to be present, required control methods and frequencies, as well as monitoring frequencies;

- feral animal control, i.e. target species present, required control methods and frequencies, as well as monitoring frequencies across the project area;

- bushfire management to protect life and property, while providing necessary protection to the significant ecological features of the area. Bushfire planning will consider:

  - exclusion of planned bushfire from revegetation and regeneration to allow vegetation to mature to a stage where it can withstand bushfire;
  - known records of threatened species and TECs;
  - fire regimes, e.g. intensity and frequency; and
  - livestock protection.

- an adaptive management process which considers monitoring results and Biodiversity Offset and Impact Mitigation Strategy objectives;

- a due diligence process which considers all environmental issues prior to clearing of vegetation or surface works; and

- detailed ecological monitoring program across the Biodiversity Offset and Management Areas, and the larger project area.

The protection of the Bobadeen Vegetation Offset Area, the Brokenback Conservation Area and Spring Gully Cliffline Management Area are proposed as an immediate ecological outcome to offset the impacts of the Project. This will assist in the protection of a diverse range of habitat for numerous threatened fauna species, vegetation communities and the White Box Woodland EEC. The protection of these areas, as well as the augmentation, management and monitoring actions proposed as part of the Strategy will ensure the ongoing viability of the biodiversity of the local area.

The Bobadeen Vegetation Offset Area covers an area of 886 hectares, of which 742 hectares are covered by treed vegetation. It is proposed that the entire Bobadeen Vegetation Offset Area will be protected and managed in the long-term for biodiversity conservation. The objectives of the Bobadeen Vegetation Offset Area are:

- to provide long-term and direct offset for vegetation lost as a result of the clearing activities of the Project. This includes EEC vegetation to be offset at a ratio of 4:1 for high quality variants, 3:1 for the moderate quality variant, and 2.5:1 for the grassland variant;

- to protect and improve areas of EEC vegetation within the project area;

- to protect and improve vegetation and habitat connectivity throughout the project area;

- to protect and enhance fauna habitat, particularly for threatened fauna species;

- to ensure all management actions within this area are supplementary, and add to the existing commitments to the Salinity Offset Area established as part of the Bobadeen Irrigation Scheme; and

- to provide appropriate monitoring to ensure mitigation strategies are effective.

The Brokenback Conservation Area and Spring Gully Cliffline Management Area will mitigate the loss of cliffline and cave habitat from the Open Cut Disturbance Area, together with potential damage to cliffline and cave habitat from subsidence in the proposed underground mining areas.

These Management Areas cover a total of 269 hectares (Brokenback Conservation Area being 58 hectares and Spring Gully Cliffline Management Area being 211 hectares in area), and contain approximately 12 kilometres of cliff line length, including numerous caves or other structures that are likely to provide habitat for micro-bats.

The objectives of the Brokenback Conservation Area in respect of ecological values and Spring Gully Cliffline Management Area are:

- to provide for the protection and management of cliffline areas (including associated cave habitat) to mitigate the impact from the open cut operation and subsidence-related impacts, such as rockfall;
- to protect and enhance fauna habitat within the management areas for cave dependent fauna species; and
- to provide appropriate monitoring to ensure mitigation strategies are effective.

5.5.6.2 Monitoring

A comprehensive ecological monitoring program will be established as part of the ROMP (or similar), and will include, but not be limited to:

- the collection of systematic floristic data from permanent plots;
- photo monitoring at permanent plots;
- assessment of flora and fauna species diversity and abundance;
- assessment of habitat losses or gains;
- incidence of weeds and feral animals;
- the security of protected areas; and
- the ongoing revegetation and regeneration of vegetation communities within the landscape.

As part of the development of the post-approval monitoring program, the existing monitoring in the project area will be reviewed in order to provide an integrated, robust monitoring program for the whole project area. This review will consider all existing commitments, and will consider the existing monitoring program to develop a consolidated, cost effective and integrated approach to ecological monitoring across the project area. Attention will be paid to making best use of the existing long-term data sets for the project area, while ensuring all monitoring is targeted and informative.

The ecological monitoring program, which will occur pre- and post-mining across the project area, will involve the monitoring of retained vegetation, revegetation and regeneration, threatened flora and fauna species and their habitat, and aquatic habitat.

A detailed set of preliminary completion criteria has been developed in order to provide an assessment framework for the success of the ecological and rehabilitation management

measures. These criteria are provided in **Table 5.6** below and further discussed in Section 12.2 of **Appendix 8**). These criteria relate to the objectives of the retention of existing vegetation, revegetation and regeneration activities, pest species management, fauna habitat, habitat augmentation, bushfire hazard, landform, soil and water. The preliminary completion criteria will be further refined in consultation with relevant agencies during the preparation of the ROMP.

Table 5.6 – Preliminary Ecological Completion Criteria

Impact Mitigation Strategy	Completion Criteria
Revegetation and Regeneration Areas (Post-mining Open Cut and Bobadeen Vegetation Offset Area, where applicable)	• The area of revegetated and regenerated natural vegetation is equal to or greater than the pre-mining extent. • Revegetation and regeneration areas will be progressing toward self-sustaining native vegetation communities characteristic of those currently present. • The revegetated and regenerated vegetation communities will comprise appropriate representations of target vegetation communities in similar proportions to the pre-mining extent, or to other agreed target levels. • There are no significant weed infestations and weeds do not comprise a significant proportion of the species in any stratum. • Revegetated and regenerated vegetation communities provide habitat for a suite of fauna species similar to the pre-mining fauna communities. Alternatively, fauna assemblages in such areas are similar to those recorded from non-impacted (control) sites. • Revegetation and regeneration areas will contain a range of flora species characteristic of the desired native vegetation community. • Second generation tree seedlings are present or likely to be, based on monitoring in comparable older rehabilitation sites. • More than 75% of trees are healthy and growing as indicated by long term monitoring.
Retained Vegetation (remainder of project area, Brokenback Conservation Area and Spring Gully Cliff Line Management Area and Bobadeen Vegetation Offset Area, where applicable)	• Retained vegetation is managed to remove disturbance, and improve condition of existing flora and fauna habitat values. • There are no significant weed infestations and weeds do not comprise a significant proportion of the species in any stratum. • There are no significant feral fauna populations causing unacceptable damage to these areas.
Pest Species Management	• Management procedures are developed, and acted upon in order to manage and control (where possible) pest flora and fauna species. • Any identified increases in weeds are addressed as part of the Rehabilitation and Offsets Management Plan (or equivalent).
Habitat Augmentation	• Nest boxes will be maintained in suitable abundance, position and condition throughout the life of the mine. • Other agreed habitat augmentation activities have been completed, as agreed. • Habitat condition will be similar to that found in non-impacted (control) areas.

Table 5.6 – Preliminary Ecological Completion Criteria (cont)

Impact Mitigation Strategy	Completion Criteria
Bushfire Hazard	• Appropriate bushfire hazard controls have been implemented on the advice of the NSW Rural Fire Service. • Bushfire planning has considered the protection of significant ecological features, revegetation and habitat augmentation features, where possible.
Landform	• Rehabilitated slopes are generally less than 10 degrees with a maximum of 18 degrees (subject to approval). It is acknowledged that rehabilitated slopes may be established outside this criteria, however, subject to approval and demonstration of slope stability. • No significant erosion is present that would constitute a safety hazard or compromise the capability of supporting the end land use. • Contour banks are stable and there is no evidence of overtopping or significant scouring as a result of runoff. • Surface layer is free of any hazardous materials. • Any final void has been assessed by a qualified geotechnical engineer to validate that it is stable and does not pose a safety risk.
Soil	• Topsoil or a suitable alternative has been spread uniformly over the rehabilitation surface. • Soil pH to be in the range of analogue sites after 5 years. • Monitoring demonstrates soil profile development in rehabilitated areas (e.g. development of organic layer, litter layer).
Water	• Runoff water quality from rehabilitation areas is within an acceptable tolerance of the range of water quality data recorded from analogue sites and does not pose a threat to downstream water quality.

5.5.7 Key Outcomes

In conclusion, the ecological survey identified the presence of a diversity of threatened flora and fauna species and one EEC within the project area. These occur variously within the Open Cut and Surface Infrastructure Disturbance Areas and the Biodiversity Offset, Conservation Management Areas. A high diversity of vegetation communities and both highly intact and highly fragmented fauna habitats were recorded.

Without the application of mitigation measures it is possible or likely that one threatened flora, one EEC and five threatened fauna species would be significantly impacted by the Project. A comprehensive Biodiversity Impact Mitigation Strategy was developed to mitigate the possible impacts on threatened species and the EEC, through long-term protection of vegetation and life-of-mine management of cliffline habitat, revegetation and regeneration, habitat augmentation and maintenance of vegetated connectivity. Based on the measures proposed to mitigate impacts, it is expected that the Project will achieve the goal to maintain or improve the biodiversity values of the surrounding region in the medium to long term.