UNITED WAMBO
JOINT VENTURE

GLENCORE

Erosion and Sediment Control Plan

Executive Summary

This Erosion and Sediment Control Plan (ESCP) has been developed to address erosion and sediment control related requirements of SSD 7142 and Environment Protection Licence (EPL) 3141 and EPL 529 as relevant to open cut mining operations associated with the United Wambo Open Cut Coal Mine Project (United Wambo). This ESCP is part of a set of documents that together form the Water Management Plan (WMP) for the United Wambo Joint Venture.

The key management and mitigation measures contained within the ESCP are included in Table 1-1.

Table 1-1: Water Management and Mitigation Measures

No.	Mitigation/Management Measure	Section	Timing
1	United Wambo will implement a range of general erosion and sediment controls in accordance with the Managing Urban Stormwater Volume 1 (Landcom, 2004) and Volume 2E Mines and Quarries (DECC 2008) (the Blue Book). These general controls have been designed to control and manage erosion and sediment that may result from mining and related activities. The measures that will be implemented are described in ***Section 9.1.2***.	***Section 9.1.2***	As required
2	Prior to any disturbance activities being undertaken by the site, a Ground Disturbance Permit (GDP) CAA-HSEC-PER-0004 is required to be completed. The purpose of the GDP is to identify and address any potential environmental, community, infrastructure or safety hazards associated with the proposed works. As part of completing the GDP, a site specific Erosion and Sediment Control Plan (ESCP) will be developed.	***Section 9.1.3***	Prior to disturbance
3	The sediment dams are also regularly de-silted when their storage capacity is reduced by the sediment storage zone volume (refer to sediment storage zone design criteria in Section 9.1.5.4). The de-silting frequency is based on the amount of sediment being delivered into the sediment dam.	***Section 9.1.6.1***	As required
4	Works within 40 m of watercourses will be undertaken generally in accordance with the DPI-Water Guidelines for Controlled Activities (2012). For the work within 40 m of a watercourse, the design, construction and maintenance will be generally in accordance with the *Guidelines for Controlled Activities on Waterfront Land*, Policy and *Guidelines for Fish Friendly Waterway Crossings* and *Why Do Fish Need To Cross The Road? Fish Passage Requirements for Waterway Crossings* or their latest versions.	***Section 9.1.7***	As required
5	The strategies outlined for the control of erosion and sedimentation will be inspected weekly during construction and monthly during operations. Monitoring and inspections of the site will include:	***Section 10.1***	Weekly/ Monthly

No.	Mitigation/Management Measure	Section	Timing
	• inspections of sediment basin water levels, silt build-up, scouring or erosion and the presence of hydrocarbons; and • revegetation progress of disturbed areas. If the type and/or location of ESC strategies are identified during inspections as being ineffective, the control structures will be modified. Additional inspections will be carried out after high rainfall events (greater than 25 mm of rainfall in 24 hrs) to ensure the effectiveness of the controls.		
6	Inspection results are completed and recorded in United Wambo's compliance management system, CMO. In the event a non-conformance is identified during the inspection, corrective and/or preventative actions are identified and implemented. The completion and effectiveness of the corrective and/or preventative action is then assessed during the following inspections.	***Section 10.1***	All inspections
7	Monitoring of rainfall and storm events will occur though weather forecast and warnings information for potential flooding. Regular inspections of floodways and structures will be conducted to prepare for severe weather.	***Section 10.2***	As required
8	Dam walls and other flood management structures will be inspected for damage, overtopping, structural damage, slips, slumps or movement that may compromise the integrity of the structure. Spillways will be inspected for damage or flow obstructions. If there is severe damage to the integrity of flood management structures, the damage will be mitigated or repaired and/or emergency services notified.	***Section 10.2***	Monthly
9	A summary of the effectiveness and performance of ESC measures will be reported in the Annual Review. Where relevant, the Annual Review will include ESC related incidents and complaints and initiatives for implementation in the following year.	***Section 11.1***	Annually
10	This ESCP will be reviewed, and if necessary revised with any review of the United Wambo Water Management Plan. The ESCP will reflect any changes in environmental requirements, technology and operational procedures.	***Section 11.2***	Annually

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1. Purpose

This Erosion and Sediment Control Plan (ESCP) has been developed to address erosion and sediment control related requirements of SSD 7142 and Environment Protection Licence (EPL) 3141 and EPL 529 as relevant to open cut mining operations at United Wambo Joint Venture (United Wambo).

The key objectives of erosion and sediment control at United Wambo are to:

- satisfy regulatory requirements, including meeting required performance criteria; and
- minimise adverse effects on downstream waterways (including hydraulic and water quality impacts).

2. Scope

The ESCP applies to all Phase 2 operational activities at United Wambo and addresses the relevant conditions of United Wambo's development consent SSD 7142, mining and exploration leases and licences.

The ESCP applies to all United Wambo employees and contractors working for, or on behalf of, United Wambo within the project approval boundary.

This ESCP also forms part of United Wambo's Environmental Management System (EMS) and should be read in conjunction with the United Wambo Environmental Management Strategy.

The ESCP excludes the operations at the Wambo mine (i.e. CHPP, train loading facility and underground mine). These activities will continue to be managed by Wambo in accordance with the relevant development consent conditions and associated management plans for Phase 2.

This ESCP is part of a set of documents that together form the Water Management Plan for United Wambo (refer to ***Figure 2-1***). The Water Management Plan is one of a series of Environmental Management Plans that together form the Environmental Management System (EMS) for United Wambo.

As part of Phase 2 operations, the United Wambo surface and groundwater monitoring programs have been combined with the Wambo Coal Mine surface and groundwater monitoring programs. This combined monitoring program is now contained within the new United Wambo Open Cut and Wambo Water Monitoring Program (WMProg).

Similarly, a combined United Wambo Open Cut and Wambo Site Water and Salt Balance has also been prepared.

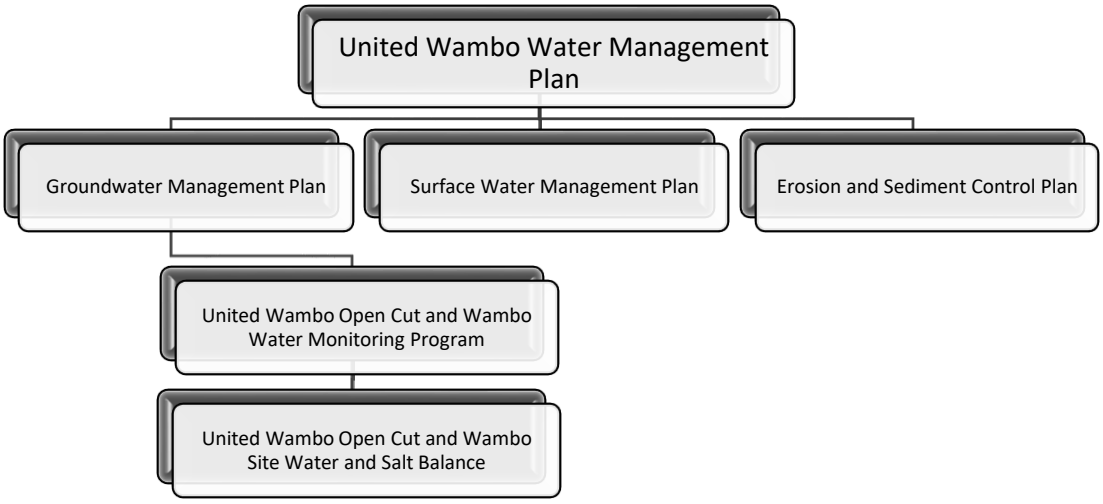

Figure 2-1: United Wambo Water Management Plan Structure

3. Objectives of the Erosion and Sediment Control Plan

The objectives of this ESCP are to ensure that appropriate structures and programs of work are in place to:

- identify activities that could cause erosion and generate sediment or affect flooding;
- describe measures to minimise soil erosion and the potential for the transport of sediment to downstream waters, and to manage flood risk;
- describe the location, function and capacity of ESC structures and flood management works;
- provide that ESC structures are appropriately maintained;
- provide methods to assess compliance with conditions of development consents, environmental protection licences and legislation relating to surface waters; and
- meet the requirements of the Blue Book (Managing Urban Stormwater: Soils and Construction Volumes 1 and Volume 2E) and the Glencore Coal Assets Australia (GCAA) ***Erosion and Sediment Control Procedure (CAA HSEC PRO 0016)***.

4. Statutory Requirements

4.1 Development Consent

Condition B52 of SSD 7142 stipulates requirements with regard to this ESCP, as summarised in ***Table 4-1.*** Relevant water performance measures, as listed in SSD 7142, are shown in ***Table 4-2.***

Table 4-1 SSD 7142 Requirements for Erosion and Sediment Control Plan

Condition	Condition Details	ESCP Section
B52	The Applicant must prepare a Water Management Plan for the development to the satisfaction of the Planning Secretary. This plan must:	**Water Management Plan**
B52 (b)	• be prepared in consultation with DPIE Water and the EPA;	***Section 5***
B52 (e) (iii)	• include an Erosion and Sediment Control Plan, that:	**This document**
B52 (e) (iii)	• is consistent with the requirements of Managing Urban Stormwater: Soils and Construction – Volume 1 Blue Book (Landcom, 2004) and Volume 2E: Mines and Quarries (DECC, 2008);	***Section 9.1***
B52 (e) (iii)	• identifies activities that could cause soil erosion, generate sediment or affect flooding;	***Section 8***
B52 (e) (iii)	• describes measures to minimise soil erosion and the potential for the transport of sediment to downstream waters, and manage flood risk;	***Section 9***
B52 (e) (iii)	• describes the location, function, and capacity of erosion and sediment control structures and flood management structures; and	***Section 9***
B52 (e) (iii)	• describes what measures would be implemented to maintain (and if necessary decommission) the structures over time.	***Section 9.1.5*** and ***Section 10***

Table 4-2 - Erosion and Sediment Control Performance Measures

Feature	Performance Measure	Document Reference
Erosion and sediment control works	Design, install and maintain erosion and sediment controls in accordance with the guidance series Managing Urban Stormwater: Soils and Construction – Volume 1 (Landcom, 2004) and 2E Mines and Quarries (DECC, 2008) Design, install and maintain any infrastructure within 40 metres of watercourses in accordance with the guidance series for Controlled Activities on Waterfront Land (DPI Water, 2012) Design, install and maintain any creek crossings generally in accordance with the Fisheries NSW Policy and Guidelines for Fish Habitat Conservation and Management (DPI, 2013) and Why Do Fish Need To	***Section 9***

Feature	Performance Measure	Document Reference
	Cross The Road? Fish Passage Requirements for Waterway Crossings (NSW Fisheries, 2003)	
Sediment dams	Design, install and maintain sediment dams in accordance with the guidance series Managing Urban Stormwater: Soils and Construction – Volume 1 (Landcom, 2004) and 2E Mines and Quarries (DECC, 2008)	***Section 9.1.5.4***

4.2 Protection of the Environment Operations Act 1997

Activities that do, or may, lead to pollution of waters in NSW are regulated by the NSW Environment Protection Authority (EPA) under the *Protection of the Environment Operations Act 1997* (POEO Act). Where discharge of waters is permitted, it is strictly controlled by licence conditions, such that discharges do not result in significant impacts on water resources.

United Wambo operates under the United Environment Protection Licence (EPL) No. 3141 and the Wambo EPL No. 529 issued by the EPA under the authority of the POEO Act.

Condition L1.1 of EPL 3141 (United) and EPL 529 (Wambo) requires compliance with Section 120 of the POEO Act, which prohibits pollution of waters. This will be achieved through the implementation of the management measures outlined in **Section 8**, minimising sediment generation and transportation to downstream waterways

Uncontrolled discharge of sediment laden water from sediment basins is not considered an offence under Section 120 of the POEO Act if it occurs after receiving rain in excess of the design criteria detailed in the Blue Book within the specified timeframe.

5. GCAA Requirements

The GCAA ***Erosion and Sediment Control Procedure (CAA HSEC PRO 0016)*** outlines the following principles, which focus on minimising erosion, to guide all disturbance activities:

- minimise disturbance wherever possible;
- minimise upslope catchment and manage disturbed area runoff;
- limit erosion and manage sediment; and
- recover and save topsoil and progressively rehabilitate disturbed areas.

GCAA has adopted the design standard of the Blue Book, *specifically Managing Urban Stormwater: Soils and Construction Volume 2E* (DECC 2008). ***Section 9*** outlines how these principles are met.

6. Consultation

6.1 Consultation with External Stakeholders

As required by Condition 52(b) of SSD7142, United Wambo must prepare this ESCP in consultation with DPIE Water and the EPA, to the satisfaction of the Planning Secretary. This ESCP (including all appendices) has been supplied to DPIE Water and EPA for review and comment.

Consultation was undertaken on the draft Phase 1 ESCP (prior to submission) with DPIE Water at a meeting on 18 October 2018.

The EPA was contacted and provided with the opportunity to provide comment and feedback on the management plans prepared for SSD 7142, including the ESCMP on 21 September 2018. The EPA noted that they do not undertake consultation for management plans and, as such, offered no comment in relation to these plans apart from ensuring that the plans consider the conditions of any Environment Protection Licence conditions in force at the time. The EPL 3141 conditions relating to erosion and sediment control are described in ***Section 4.2***.

Correspondence in relation to the ESCP is attached as Appendix A.

7. Existing Environment

7.1 Environmental Setting

The area surrounding United Wambo is dominated by existing mining operations, including the existing Wambo mine, Hunter Valley Operations (HVO) and associated mine-owned land. Several other mining operations are located further south including Mount Thorley Warkworth and Bulga Mine. Outside of mine-owned land, the local area is dominated by agricultural land uses, predominantly grazing, and the Wollemi National Park to the West.

7.2 Catchments and Hydrology

The majority of the United Wambo project area is located within the catchment area of Wollombi Brook, a major tributary of the Hunter River. The Wollombi Brook catchment includes the sub-catchments of Wambo Creek, North Wambo Creek and Redbank Creek. Waterfall Creek, another minor tributary of the Hunter River, is located in the north of the project area.

The catchment boundaries for watercourses, within and surrounding the Project Area, are shown in ***Figure 7-1*** and ***Figure 7-2***. Previous mining operations within the Project Area have modified local catchments through the capture of runoff from mining areas within the existing Water Management Systems (WMS) and diversion of upslope runoff around the mining operations.

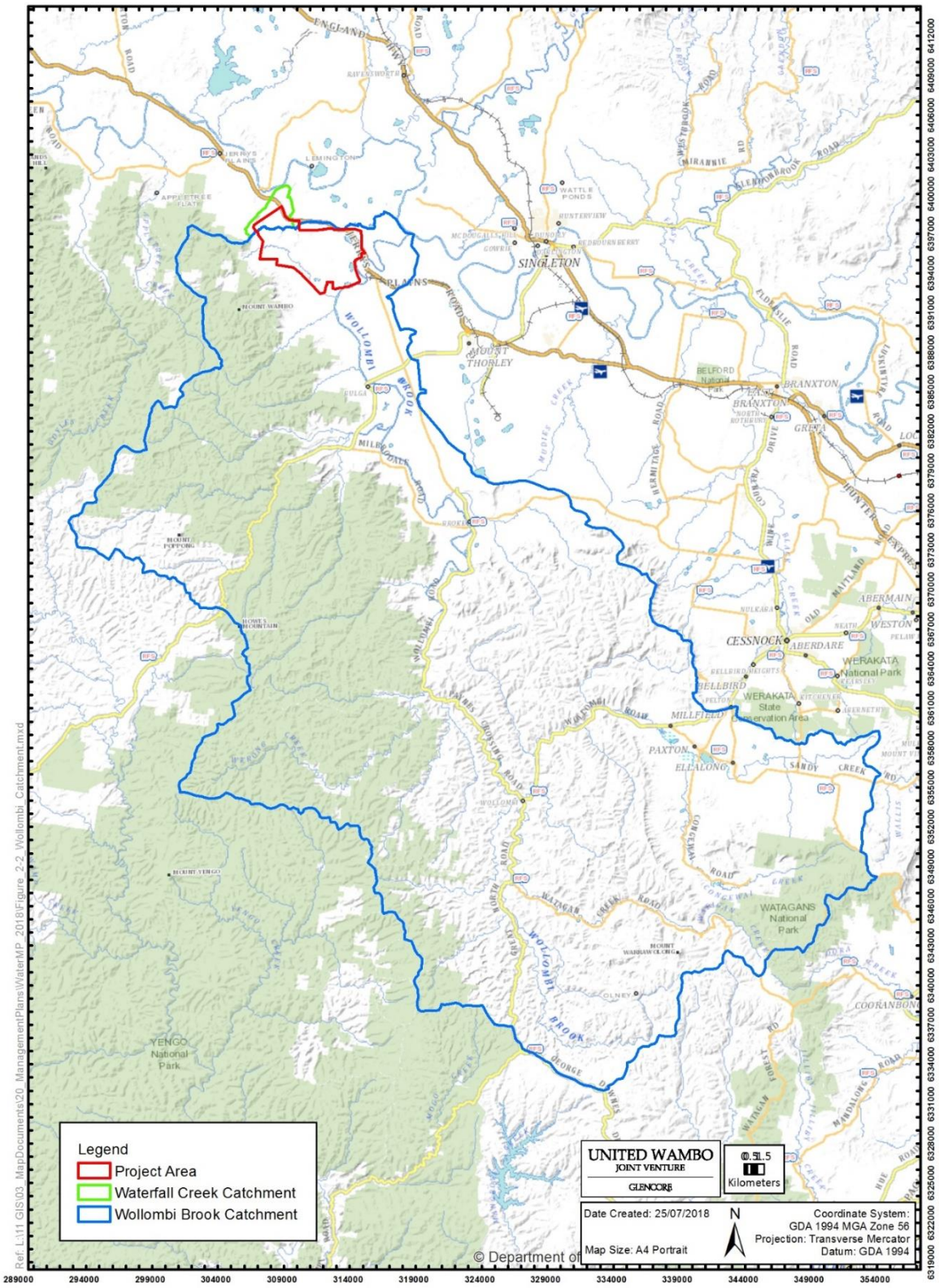

Figure 7-1: Catchment Context

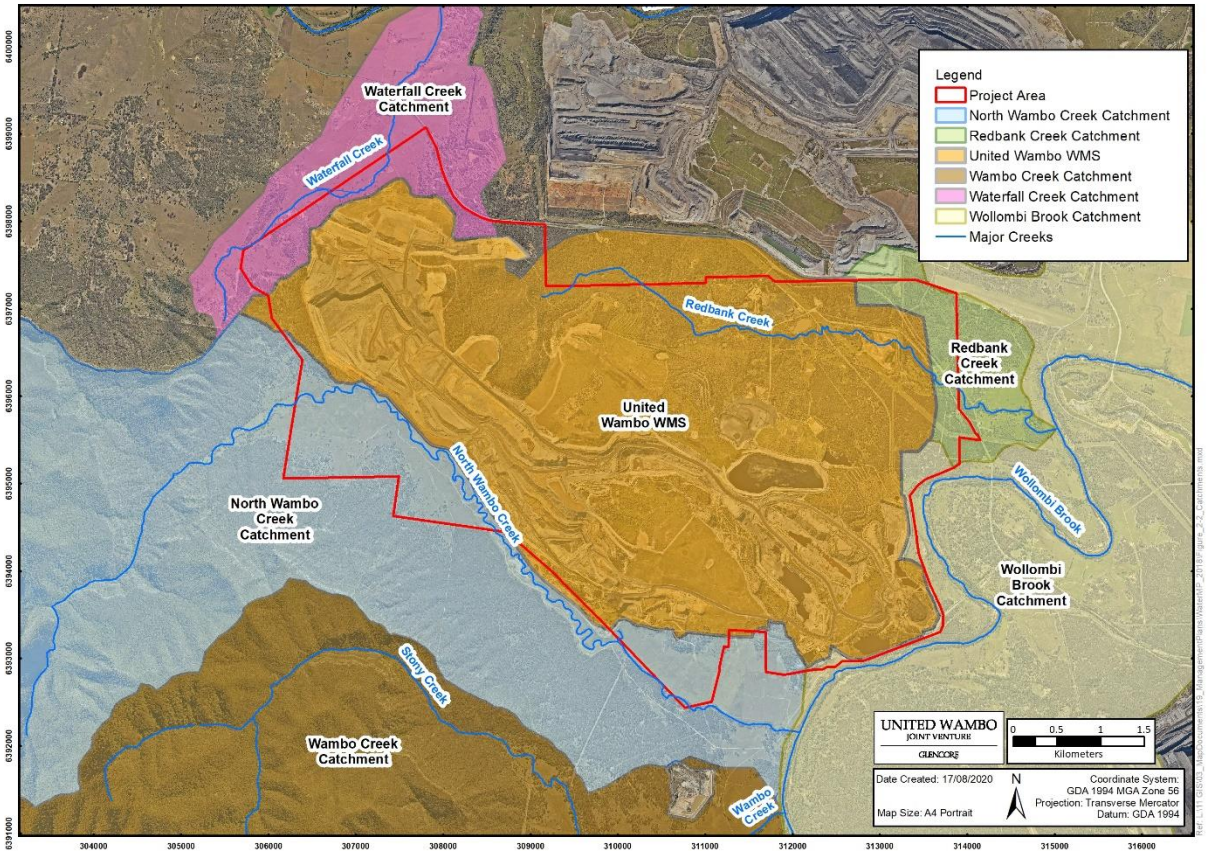

Figure 7-2: Project Area Catchment Context

7.3 Soil Resources

Several soil landscapes are present within the Project Area. The Jerrys Plains Landscape dominates the Project Area, with smaller areas of Bulga and Benjang landscapes in the west. The Jerrys Plains soil landscape comprises of mostly sandy soils (red and yellow soloths) of moderate erodibility with solodic soils on the lower slopes and in drainage depressions (Umwelt 2016).

Descriptions of the soil landscape characteristics, including terrain, depth and soil profiles, are summarised in ***Table 7-1*** below. The locations of the soil landscapes are shown on ***Figure 7-3*****.**

Table 7-1: Soil Landscape Characteristics

Soil Landscape	Soil Profile Types	Other Characteristics
Jerrys Plains	Predominantly comprised of Soloths on the crests to midslopes. Solodic Soils on the lower slopes and in drainage depressions.	Susceptible to severe gully erosion in some drainage lines with occasional salt scalds. Minor sheet erosion can occur on some disturbed areas of hillslopes. Erodibility of topsoils ranges from moderate to low; subsoils range from high to low. Soil salinity ranges from high to low

Soil Landscape	Soil Profile Types	Other Characteristics
Bulga	Predominantly comprised of Yellow Soloths on the upper to mid slopes with associated Yellow and Brown Solodic Soils. Brown Earths on lower slopes.	Susceptible to minor to moderate sheet erosion. Recently disturbed areas show minor rilling. Erodibility of topsoils ranges from moderate to low; subsoils range from high to low.
Benjang	Predominantly comprised of Red, Yellow and Brown Solodic Soils on the steeper benched country. Brown Podzolic Soils on upper slopes. Non-calcic Brown Soils on lower portions of longer flat slopes. Siliceous Sands midslope on quartz sandstone	Susceptible to minor to severe sheet erosion on cleared hillslopes with Solodic Soils. Minor rill and gully erosion on mind to lower slopes. Erodibility of topsoils ranges from high to moderate; subsoils range from moderate to low. Soil salinity ranges from high to low
Warkworth	Predominantly comprised of Siliceous Sands.	Susceptible to minor sheet erosion when disturbed. Erodibility and salinity of both topsoil and subsoil is low.
Hunter	The main soils of this landscape are all formed in alluvium. These are mapped as BSAL in the Upper Hunter SLRUP.	Susceptible to minor stream bank erosion on present watercourses with minor sheet and gully erosion on adjacent terraces. Erodibility and salinity of both topsoil and subsoil is ranges from moderate to low.

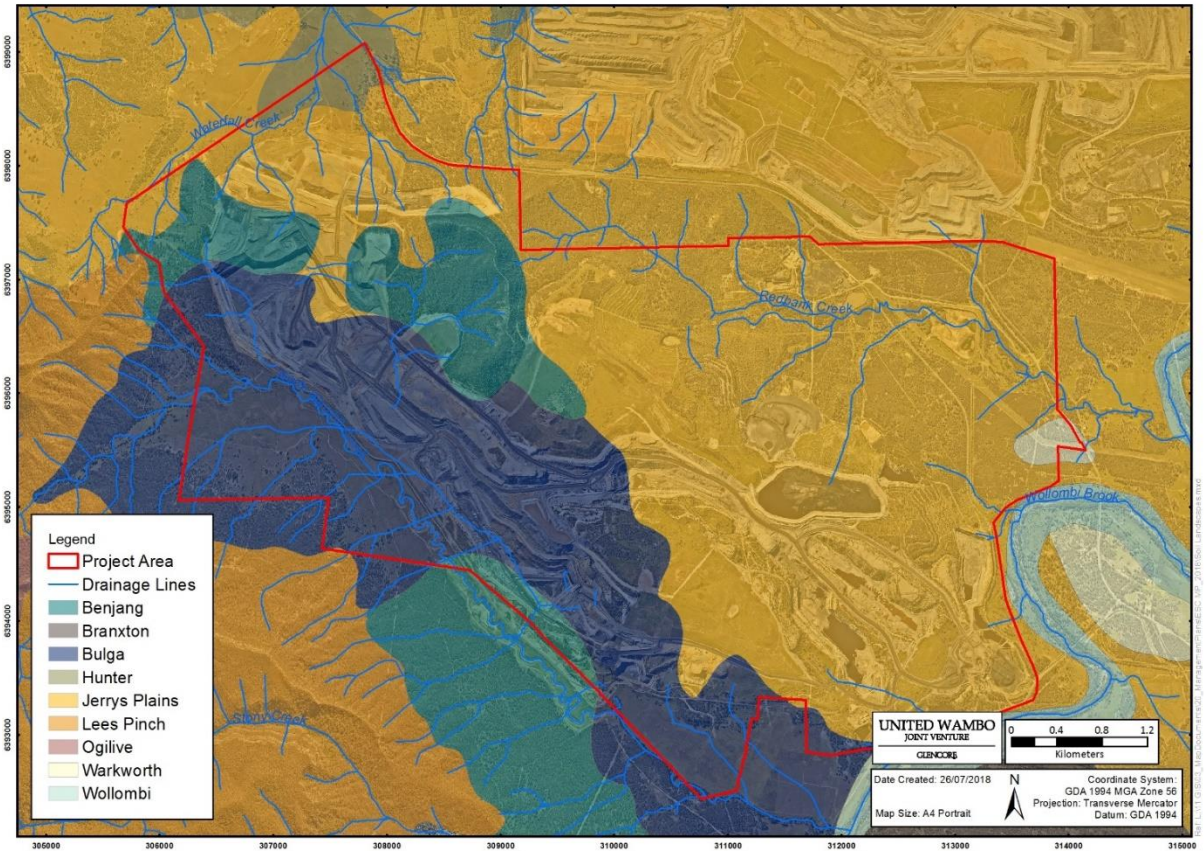

Figure 7-3: Soil Landscapes

7.3.1 Vulnerable Land

The Office of Environment and Heritage online mapping service maps Redbank Creek and Dam 1 within the existing mining areas as 'vulnerable land', based on its erodibility or steepness of slopes as shown in ***Figure 7-4***. Mapped 'steep or highly erodible soils' are shown as occurring over parts of the Project Area, however, these areas have historically been included in approved disturbance areas and/or operational areas.

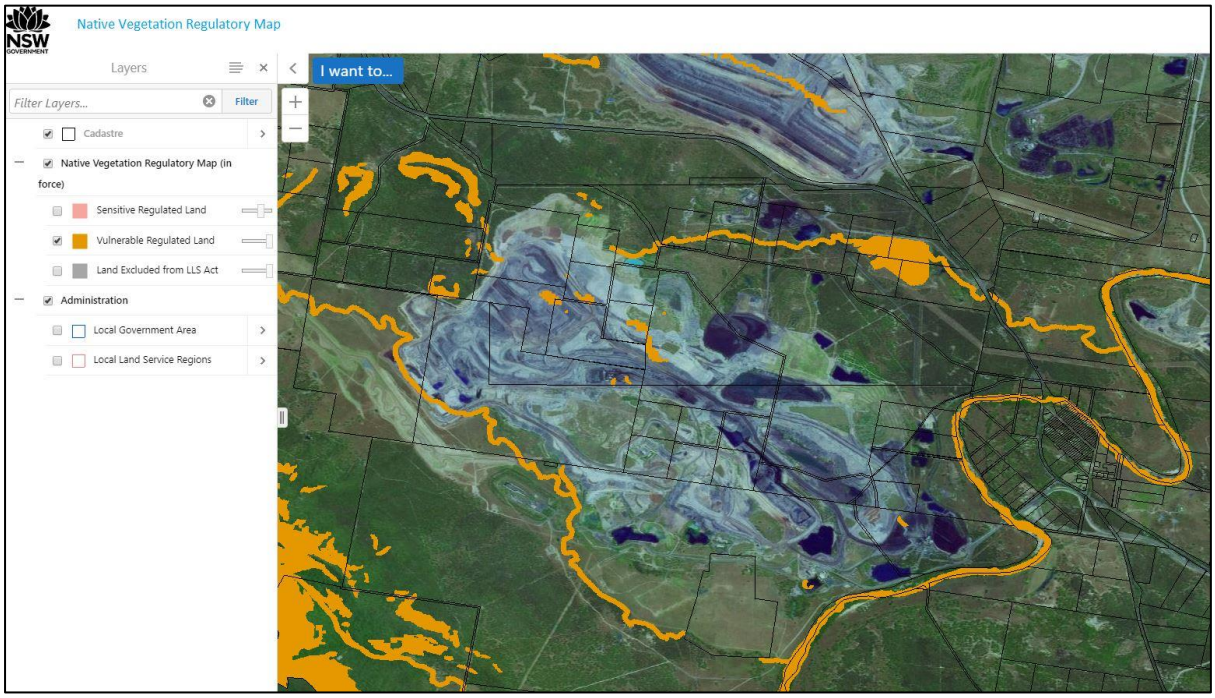

Figure 7-4: Mapped Vulnerable Lands

7.4 Vegetation

The majority of the existing Wambo Open Cut has been cleared by previous mining operations. There is approximately 540 hectares of native vegetation within the United Wambo additional disturbance area. The remnant vegetation at United Wambo is made up of six vegetation community types: Bull Oak grassy woodland of the central Hunter Valley, Forest Red Gum grassy open forest on floodplains of the lower Hunter, Grey Box - Slaty Box shrub - grass woodland on sandstone slopes of the upper Hunter and Sydney Basin, Narrow-leaved Ironbark - Grey Box grassy woodland of the central and upper Hunter, Spotted Gum - Narrow-leaved Ironbark shrub - grass open forest slopes of the upper Hunter and Sydney Basin and Swamp Oak - Weeping Grass grassy riparian forest of the Hunter Valley.

These communities in parts form one critically endangered ecological community (CEEC) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) and four threatened ecological communities listed under the state *Biodiversity Conservation Act, 2016* (BC Act) being:

- Central Hunter Valley Eucalypt Forest and Woodland CEEC (EPBC Act)
- Hunter Floodplain Red Gum Woodland EEC (BC Act)
- Central Hunter Ironbark – Spotted Gum – Grey Box Forest EEC (BC Act)
- Hunter Valley Footslopes Slaty Gum Woodland Vulnerable Ecological Community (VEC) (BC Act)
- Central Hunter Grey Box – Ironbark Woodland EEC (BC Act).

The vegetation communities at United are shown in ***Figure 7-5***.

The vegetation at United Wambo will be progressively cleared through the life of the Project. United Wambo has committed to progressive rehabilitation of post-mining areas to be completed as soon as practicable after shaped areas become available.

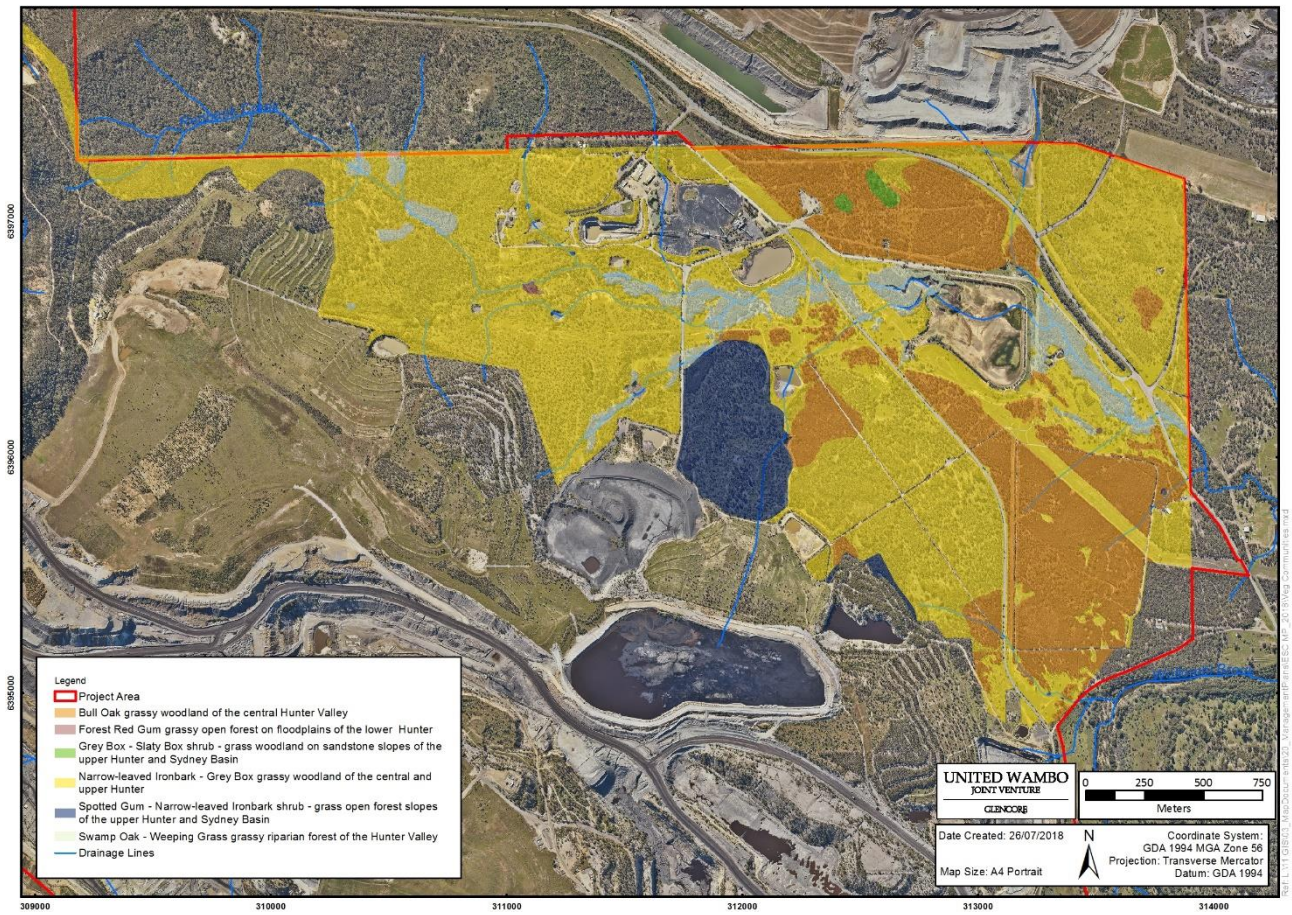

Figure 7-5: United Wambo Vegetation Communities

7.4.1 Proposed Vegetation Management

United Wambo has sought to avoid and minimise potential impacts on the ecological values of the surrounding lands throughout the project planning process. Further to this, United Wambo has committed to the design and implementation of a comprehensive strategy to mitigate the residual impacts of the approved mining operations. These strategies are currently detailed in the ***United Wambo Biodiversity Management Plan*** and Biodiversity Offset Strategy. Some of the strategies and controls, which support the objectives of this ESCP, include:

- feral animal and weed control;
- rehabilitation/revegetation of disturbed areas with species characteristic of extant vegetation communities;
- management of erosion and sedimentation to ensure that adjoining vegetation communities and aquatic systems are not adversely impacted; and
- ongoing monitoring and maintenance of revegetation works and habitat enhancement activities

7.4.2 Progressive Rehabilitation

United Wambo has committed to progressive rehabilitation of post-mining areas to be completed as soon as practicable after shaped areas become available. The majority of the site will be rehabilitated to woodland vegetation, including a large portion of ecological rehabilitation targeting the Central Hunter Valley Eucalypt Forest and Woodland CEEC and the Central Hunter Ironbark – Spotted Gum – Grey Box Forest EEC. All rehabilitation works will be scheduled to commence as soon as practicable after disturbance and reformation of the landscape. Refer to the United Wambo ***Water Management Plan*** for an overview of the proposed rehabilitation for United Wambo.

8. Planning

8.1 Potential Sources of Erosion and Sedimentation

Mining operations that have the potential to cause erosion or generate sediment and impact the surrounding catchment areas are:

- continued mining operations and construction activities;
- clearing or disturbance of land for mining or other activities;
- construction of operational sediment control measures;
- construction of overburden and emplacement areas and haul routes;
- placement of overburden and topsoil;
- vehicle and equipment movements;
- coal stockpiles and coal handling equipment areas; and
- mine site rehabilitation.

8.2 Potential Erosion and Sedimentation Impacts

Erosion and sedimentation impacts which may result from United Wambo include:

- increased runoff volumes and velocities from the removal of vegetation, land disturbance and the introduction of impervious surfaces on hardstand areas;
- increased potential for sedimentation to occur from increased erosion and runoff associated with open cut mining, stockpiling of material and the construction of surface facilities, access roads/tracks and exploration drilling;
- potential for increased scouring during the construction of surface facilities adjacent to watercourses; and
- potential decline in water quality and degradation of local amenities through sediment transport to nearby watercourses.

8.3 Flooding

Flood modelling undertaken of the Wollombi Brook during the preparation of the Surface Water Impact Assessment (Umwelt 2016) indicated that the inundation extent of a one per cent Annual Exceedance Probability (AEP) flood event includes an area of the footprint of the United Open Cut

(***Figure 8-1***). The flood inundation within the footprint is due to backwater from Wollombi Brook entering the lower reaches of Redbank Creek during flood events.

To protect the United open cut from flooding i a flood levee has been constructed. The levee has been designed to provide flood protection for flood events up to and including the 0.1 per cent AEP flood event (i.e. the 1,000 year Average Recurrence Interval (ARI) flood event).

Figure 8-1: 1% AEP Flood Extent

9. Implementation

9.1 Erosion and Sediment Control

9.1.1 Erosion and Sediment Control Strategy

United Wambo categorises water into three types to effectively manage water and to mitigate any potential for environmental harm to occur. Each type of water requires different management measures to minimise the risk of contamination of downstream drainage systems. A description of the water quality and potential sources for the three categories of water are summarised in ***Table 9-1***.

Table 9-1: Water Categories and Design Criteria

Water Category	Description	Target Design Criteria
Clean Water	Runoff from undisturbed or rehabilitated areas.	Intercept, convey and/or release, where practicable, to downstream environment.
Dirty Water	Runoff from disturbed areas, such as active overburden emplacement areas or overburden emplacement areas where vegetation is not fully established.	Managed in line with the Blue Book (Managing Urban Stormwater: Soils and Construction Volume 1 and Volume 2E).
Mine Water	Water exposed to coal or used in coal processing and runoff within mining infrastructure areas or coal stockpile areas. Mine water includes water associated with groundwater inflows into open cut pits.	Mine water storages to have sufficient freeboard to contain runoff for events up to and including the 1% 24-hour AEP storm event.

The intent of the WMS is to convey clean water around the mining operations, where practicable, or, when runoff from rehabilitated areas becomes clean (in accordance with the site-specific trigger values outlined in the ***Surface Water Management Plan***), enabling the runoff from these areas to flow directly to the downstream environment instead of being managed as part of the WMS.

This ESCP is concerned with the management of 'dirty' water as described in ***Table 9-1***. Standard ESC techniques and management principles are utilised in accordance with ***the Managing Urban Stormwater: Soils and Construction Volume 1*** (Landcom, 2004) and ***Volumes 2A, 2C, 2D and 2E*** (DECC, 2008) (the Blue Book) and ***GCAA Erosion and Sediment Control Procedure (CAA HSEC PRO 0016 11.06)***.

9.1.2 General Erosion and Sediment Control Principles

United Wambo will implement a range of general erosion and sediment controls in accordance with the Blue Book (DECC 2008). These general controls have been designed to control and manage erosion and sediment that may result from mining and related activities. The measures that will be implemented include the following:

- prior to site disturbance, site specific Erosion and Sediment Control Plans must be established and approved by the Environment and Community Department via the Ground Disturbance Permit (GDP) (Refer to ***Section 9.1.3***);
- install erosion and sediment control measures as the first step in the process for land disturbance;
- minimise the extent of disturbance and stabilise disturbed areas by progressive rehabilitation as soon as practicable in accordance with the Mining Operations Plan;
- clearly identifying and delineating areas required to be disturbed and ensuring that disturbance is limited to those areas, clearing as little vegetation as required and minimising machinery disturbance outside of these areas;
- construction of diversion drains upslope of areas to be disturbed to direct clean runoff away from disturbed areas, where practicable. The diversion drains will be designed to ensure effective segregation of sediment-laden runoff and allow clean surface water to return to natural watercourses;
- construction of other ESC works, such as silt fences and sediment dams, prior to works commencing within the area;
- construction of catch drains to capture runoff from disturbed areas and rehabilitation areas and direct runoff into sediment dams;
- progressively stripping and stockpiling topsoil for later use in rehabilitation;
- topsoil stockpiles stored for more than three months will be fertilised and grassed to reduce the potential for weed contamination and erosion;
- stockpiles will generally be less than three metres high and will be set out in windrows to maximise surface exposure and biological activity;
- level or gently sloping areas will be selected as stockpile sites to minimise erosion and potential soil loss where possible;
- appropriate drainage controls will be installed upslope of stockpiles to divert water around the stockpiles and downslope of stockpiles to prevent soil loss;
- construction of all temporary drains as earthen drains at typical grades no steeper than 5% (giving maximum peak velocities in the order of 1.5 m/s) to minimise scouring, otherwise ensuring that adequate scour protection is provided. All drains are to be grassed to minimise erosion;
- placement of rock check dams in drains to reduce water velocities in steeper grade channels and provision of additional scour protection by lining as required,
- construction of graded banks on reshaped overburden areas reducing slope lengths to minimise erosion and re-direct runoff to catch drains and water disposal areas;
- location of stockpiled material away from concentrated water flows;
- construction of road and earthworks cut and fill batters at slopes of 1V:3H (vertical: horizontal) or less (where possible) to maximise long term stability;
- inspection and maintenance of all sedimentation controls and rehabilitation areas after storm events (greater than 25 mm of rainfall in 24 hours) to ensure ESC's are performing adequately; and follow up repair or redesign of ESC's that are not performing adequately;
- maintenance of design capacity of sediment dams by removing built-up sediment;

- regular maintenance of silt traps in the truckwash area;
- establishment of vegetative cover on all rehabilitation areas as a priority to minimise the duration of soil exposure and the control of weeds through selective herbicide application and the reseeding of areas that fail to establish as soon as practicable;
- restricting access to rehabilitated areas through the use of fencing and/or sign-posting;
- flocculation of sediment dams as necessary to improve settlement of entrained sediment and to reduce total suspended solids (TSS) concentrations to less than 50 mg/L prior to release offsite;
- construction of drainage controls, such as table drains at roadsides and on hardstand areas and toe drains on stockpiles; and
- immediate repair or redesign of erosion and sediment controls that are not performing adequately, as identified in field inspections.

9.1.3 Ground Disturbance Permit and Erosion and Sediment Control Plans

Prior to any disturbance activities being undertaken by the site, a ***Ground Disturbance Permit (GDP) CAA-HSEC-PER-0004*** is required to be completed. The purpose of the GDP is to identify and address any potential environmental, community, infrastructure or safety hazards associated with the proposed works. As part of completing the GDP, a site-specific Erosion and Sediment Control Plan (ESCP) will be developed.

The site-specific ESCP is to consider the following elements:

- the proposed staging of the works and the proposed controls. Subject to operational constraints, the works should be staged to minimise the area disturbed at any period during the works;
- the limit of disturbance is to be shown. This area is to include sufficient buffers for construction access, stockpiles, offices and crib rooms, refuelling and service areas, laydown and park-up areas and access tracks/roads. The disturbance areas are to be marked on the ground and all works restricted to these areas;
- designated access zones and controls including wheel washes, shaker mats and weed control stations;
- areas of environmental sensitivity and known cultural heritage sites are to be shown;
- watercourses, catchments and licensed discharge points. Vegetation provides an effective buffer zone between watercourses and ground disturbing works, and where feasible, should not be reduced to incorporate constructed controls such as sediment basins;
- the location and extent of all stockpiles and the controls proposed to divert clean water around the stockpiles and the containment system;
- clean water diversions drains and energy dissipaters. The details to be included in the plan are the design storm, peak flow rates, catchment area, channel velocities and any proposed channel linings (grass, rock or jute mat);
- the proposed staged erosion and sediments controls. The plans need to include the location, dimensions, details and staging of all works for all stages of the activity;
- details of the operation of the controls including any water treatment measures for sediment basins or any other controls. The plan is also to detail the required water transfers necessary to restore containment capacity of sediment traps and basins;

- details of release criteria and the proposed monitoring program, including any notifications required by regulatory authorities;
- potential for stormwater reuse to limit discharge. Note, reuse from the sediment basins should only be considered when all options to reuse mine water have been utilised;
- details of the proposed topsoil stripping, stockpiling and respreading;
- the revegetation strategy including any proposed temporary works to establish a cover and the proposed long term rehabilitation strategy.

The site-specific ESCP needs to be included with the Ground Disturbance Permit.

9.1.4 Selection of Control Techniques

In order to effectively plan for the design and installation of control measures that will have minimal erosion and sediment associated impacts upon the surrounding environment, the following steps should be followed:

- identify if the problem is associated with erosion or sedimentation:
  - where erosion is the issue, identify if particles are being detached by raindrop impact or flowing water; or
  - where sedimentation is the issue, identify if particles are being transported by sheet flow or concentrated flow; and
- select appropriate erosion and sediment control techniques as outlined in ***Figure 9-1***.

The United Wambo WMS has been designed to control and manage erosion and sedimentation through the construction and maintenance of a range of permanent and temporary structures designed to prevent the discharge of sediment laden water offsite.

The location of major existing and proposed erosion and sediment control structures at United Wambo are presented in ***Figure 9-2***.

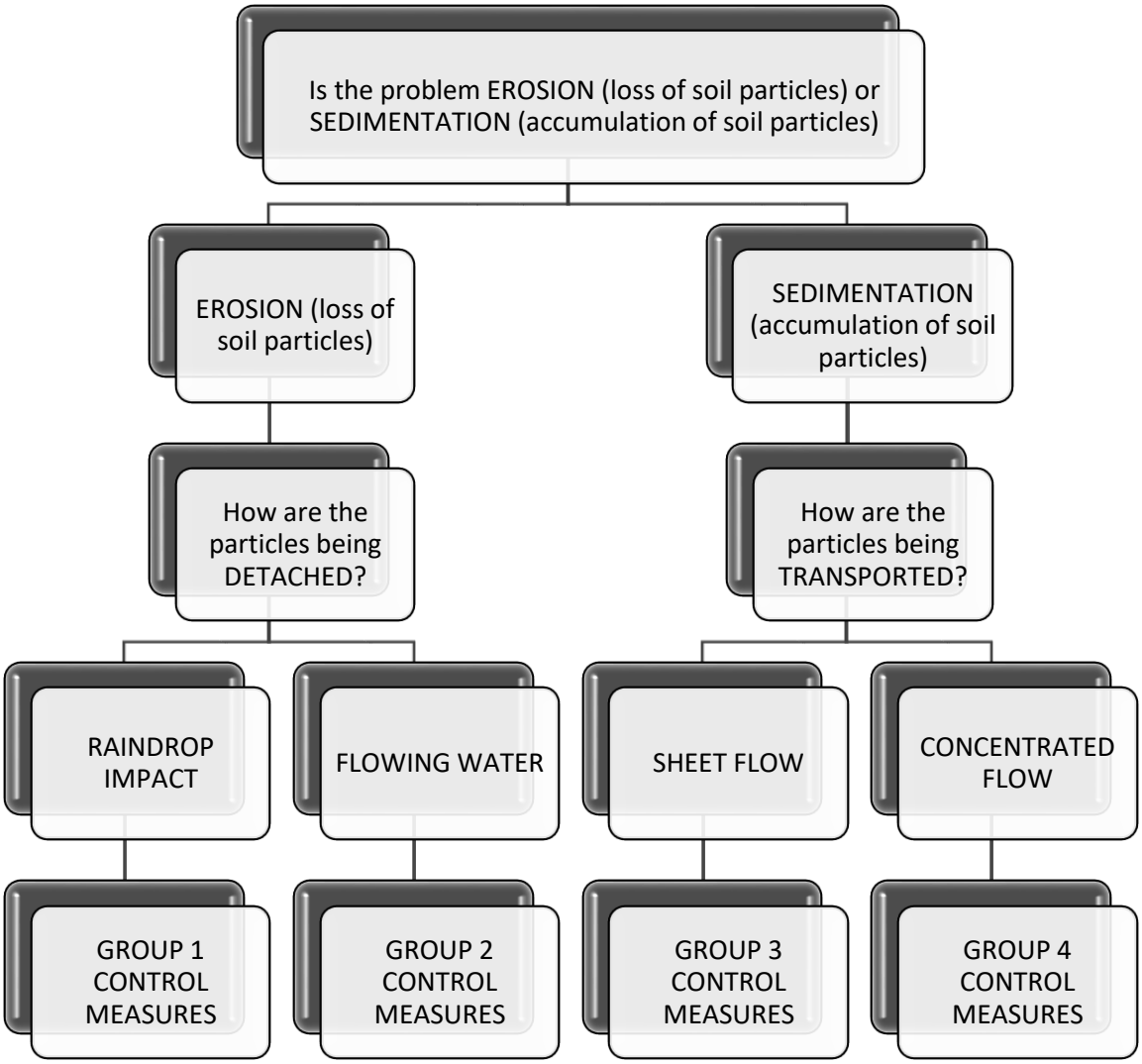

Figure 9-1: Erosion and Sediment Control Selection Procedure

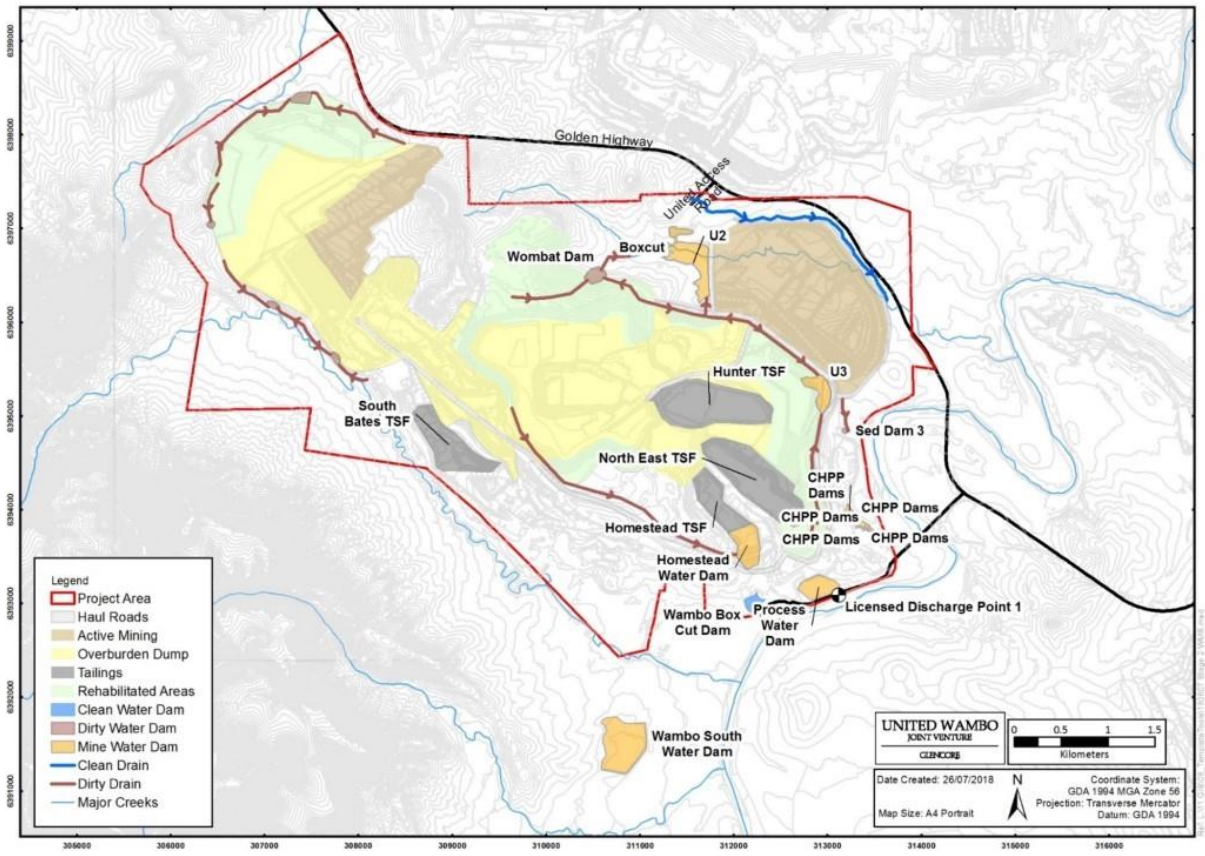

Figure 9-2: Proposed Stage 2 Water Management Structures

9.1.4.1 Group 1 – Erosion Control (Raindrop Impact)

The following erosion control techniques are recommended for implementation where soil particles are being detached by raindrop impacts:

- vegetation;
- batter blankets;
- soil surface mulching;
- surface roughening; and
- geobinders.

9.1.4.2 Group 2 – Erosion Control (Flowing Water Impact)

The following erosion control techniques are recommended for implementation where soil particles are being detached by the impacts of flowing water:

- up-slope diversions;
- mid-slope diversions;
- soft armour channels;
- hard armour channels;
- in-stream diversions;
- check dams;

- batter drains;
- grade control structures and flumes; and
- outlet dissipation structures.

9.1.4.3 Group 3 – Sedimentation Control (Sheet Flow)

The following sediment control techniques are recommended for implementation where soil particles are being transported by sheet flow:

- vegetative buffers;
- sediment barriers/filters;
- catch drains to direct sediment laden runoff to an appropriate sediment trap; and
- site exit points.

9.1.4.4 Group 4 – Sedimentation Control (Concentrated Flow)

The following sediment control techniques are recommended for implementation where soil particles are being transported by concentrated flow:

- sediment curtains/turbidity barriers;
- sediment traps; and
- sediment dams.

9.1.5 Control Techniques Design Criteria

9.1.5.1 Drainage Channels (Dirty Water)

Dirty water drains are used to convey dirty water runoff to sediment dams. Dirty water drains are designed in accordance with GCAA standards and Best Practice Erosion and Sediment Control Guidelines, IECA – Books 1-4 and Managing Urban Stormwater – Soils and Construction Vol 1, 4th Ed (Landcom, March 2004) and Vol 2E Mines and Quarries (DECC, 2008) and the design criteria provided in Appendix B -. In general, the drains are trapezoidal in shape with maximum side slopes of 1V:2H and grass lined. Where the grade of the drain will result in water velocities that exceed 1.5 m/s, rock check dams are to be installed every 100 metres to limit velocities to 1.5 m/s or less. Rock protection and energy dissipation structures will be installed at the downstream outlets, where required, to prevent runoff causing scour or erosion in downstream drainage systems.

9.1.5.2 Drainage Channels (Clean Water)

Suitably designed and constructed clean water drains will be implemented, where practical, around United Wambo in accordance with GCAA standards and Best Practice Erosion and Sediment Control Guidelines, IECA – Books 1-4 and Managing Urban Stormwater – Soils and Construction Vol 1, 4th Ed (Landcom, March 2004) and Vol 2E Mines and Quarries (DECC, 2008) and the design criteria provided in Appendix B. Clean water drains are designed to convey the peak flows from the required design rainfall event. In general, the drains are trapezoidal in shape with maximum side slopes of 1V:2H and vegetated and/or rock lined banks. Where peak design water velocities exceed 1.5 m/s in a 5% AEP storm event, the drains are protected from scour using rock bars every 100 metres. Rock protection and energy dissipation structures will be installed at the downstream outlets, where required, to prevent runoff causing scour or erosion in downstream drainage systems.

9.1.5.3 Sediment Fences and Other Temporary Sedimentation Control Methods

Sediment fences, sediment traps, rock check dams and other temporary erosion and sediment control measures described in the Blue Book will be installed in advance of, or in conjunction with, earthworks to prevent sediment laden water leaving the site or entering clean water systems. These temporary controls are intended to be used for short periods whilst more permanent erosion and sediment control structures are being constructed or during emergency scenarios where permanent structures are not deemed appropriate.

Where necessary, sediment fences or other temporary controls are constructed immediately downslope of areas to be disturbed to minimise the potential for sediment transport into receiving waterways.

Sediment filter fences are constructed in line with the design criteria provided in Appendix B. They are generally comprised of a woven fabric that will trap coarse particles with structural posts. Where practicable, the fences are erected along contours with small returns at approximately 20 metre intervals to limit the catchment size. This is necessary as sediment fences and other temporary controls are prone to failure in larger storm events and should be designed to ensure a maximum of 50 L/s passes through the sediment fence during a storm event. Sediment fences are not to be installed in concentrated flows where the effectiveness of the fences may be impeded (e.g. perpendicular across waterways or drains).

9.1.5.4 Sediment Dams

Sediment dams are constructed within dirty water catchments to capture and treat sediment laden water for treatment prior to discharge or reuse. Sediment dams will be installed where appropriate prior to any land disturbance activities occurring and maintained following completion of land disturbance activities. The design of each sediment dam will take into consideration the topsoil characteristics of the catchment, as well as the presence of any other potential pollutants.

The design basis for sediment dams is as follows:

- settling zone design to comply with the following:
  - Soil Hydrological Group – D;
  - 95% - 5 day rainfall depth = 54.7 mm;
  - Runoff coefficient – 0.74 (pervious areas);
  - Runoff coefficient – 0.90 (impervious, hardstand & road areas);
- sediment zone capacity to be sized based on:
  - 12 months of soil loss calculated using the Revised Universal Soil Loss Equation (RUSLE) method; OR
  - Undisturbed catchment areas – 10% of settling zone;
  - Disturbed catchment areas – 50% of settling zone; and
  - Rehabilitated catchment areas – 30% of settling zone.

To calculate the Sediment Zone using RUSLE, the following calculation is utilised:

Sediment Zone (m3) = A (R x K x LS x P x C) / 1.3 (assumes 12 months soil loss)

The variables within the RUSLE are:

- A = Area (ha) (Disturbed Catchment Area only)

- R = Rainfall erosivity factor (Obtained from maps in Vol. 1 App B)
- K = Soil erodibility factor (Based on soil laboratory testing data)
- LS = Slope length gradient factor (Table A-1, Blue Book Vol 1 - App A)
- P = Erosion control practice factor (Table A2, Blue Book Vol 1 - App A)
- C = Ground cover factor (Figure A5, Blue Book Vol 1 – App A)

The RUSLE method is the more comprehensive as it utilises site specific catchment data to calculate the sediment zone volume. The RUSLE method as presented above is also more realistic to most mine site sediment dams as it assumes 12 months soils loss, which means that dams on average are de-silted every 12 months, whereas the earlier method assumes 2 months soils loss, which means that dams on average are de-silted every 2 months.

Where the dams form part of permanent infrastructure, they will be designed with spillways suitable for conveyance of the 1% AEP peak flow event, with 300 mm freeboard above the maximum water level in the sediment basin (i.e. the predicted water level during the design storm event) provided, assuming dams are full.

The settling zone volumes will be managed by dewatering following runoff generating rain events with the objective of restoring design settling zone capacity within five days of the rainfall event. The sediment zones will also be actively managed with periodic removal of accumulated sediment to maintain the required design settling zone capacity.

Where sediment is known/expected to be dispersive, United Wambo will investigate flocculation options to assist in settling fine particles. All sediment dams will be maintained in a drawn down state as far as practicable. Any water with less than adequate water quality (with TSS concentration greater than 50 mg/L) will be pumped back to the mine WMS and reused onsite.

An assessment of dam design and capacity for the active sediment dams at United Wambo is provided in ***Table 9-1,*** which confirms overall sediment dam capacity is sufficient at United Wambo.

Table 9-2: United Wambo Sediment Dam Capacity Assessment Data

Sediment Dam	Disturbed Catchment Area (ha)	Impervious Catchment Area (ha)	Clean Water Catchment Area (ha)	5 Day Dam Design Criteria	Settling Zone Volume Required (ML)	Sediment Zone Volume Required (ML)	Total Dam Storage Volume Requried (ML)	Existing Dam Storage Capacity (ML)	Sufficient Capacity in Dam?[1]
MIA Sediment Dam	3.5	1.07	2.45	95th %ile	2.93	0.20	3.13	3.47	YES
Plover Dam	7.7	0.22	2.52	95th %ile	3.63	1.81	5.44	13.639	YES
ME1[2]	0	0	35.96	95th %ile	5.9	0.70	6.60	6.70	YES
ME2[2]	0	0	14.64	95th %ile	2.4	0.28	2.68	2.90	YES

[1] The assessment is based on whether the dam has an overall capacity that is sufficient to contain runoff from the upslope catchment. It does not consider any water held in the dams for operations purposes and whether the dams have a sufficient effective storage capacity above this stored water.

[2] The catchments of ME1 and ME2 has been rehabilitated and are now well vegetated and have been classified as clean rather than disturbed. The sediment dams were initially constructed under DA 305-7-2003 for an 80%ile design rainfall event due to the temporary disturbance.

9.1.6 Maintenance

All ESC measures will be maintained in a functioning condition until individual areas have been deemed successfully rehabilitated. Where controls are observed to be not functioning correctly, the controls will be restored to meet the required standard. Where significant erosion is observed to be occurring on a regular basis, additional controls will be constructed.

9.1.6.1 Drains

Any signs of erosion along the length of either clean water or dirty water drains will be noted and remedial works undertaken as required. Where significant erosion is observed, additional erosion controls will be constructed, which may include the re-establishment of vegetative cover, installation of an erosion blanket or rock armouring.

9.1.6.2 Sediment Dams

Sediment dams require regular maintenance to retain their function as per design criteria (i.e. the Blue Book). The required maintenance is determined through the visual inspections undertaken of the sediment dams on a routine basis or following runoff generating rainfall (refer to ***Section 10.1***).

The sediment dams will be drawn down to a level which ensures that the full settling zone volume is available within the dam, within five days after the rainfall event occurred. This is typically undertaken by transferring water back into the mine water management system.

The sediment dams are also regularly de-silted when their storage capacity is reduced by the sediment storage zone volume (refer to design criteria in **Section 9.1.5.4**). The de-silting frequency is based on the amount of sediment being delivered into the sediment dam.

9.1.6.3 Temporary ESC Structures (Sediment Filter Fences)

Regular visual checks and repairs of temporary ESC structures, such as sediment filter fences, to maintain adequate function will be undertaken. Temporary structures will be removed and disposed of appropriately when no longer required (e.g. when permanent controls have been implemented or the area serviced has been adequately stabilised).

9.1.7 Decommissioning of Control Structures

The erosion and sediment control measures implemented during the course of the Project will be reviewed regularly to determine whether they are still required. Should specific control measures be identified as no longer needed (i.e. the area of disturbance has been rehabilitated and is stable), the measures that will be implemented include:

- filling and rehabilitating sediment dams;
- removal of drains and catchment bunds; and
- removal and appropriate disposal of temporary sediment fencing and other control measures.

All decommissioning works will be managed to minimise potential erosion risks during the undertaking of the works.

Some sediment dams will remain as farm dams (subject to harvestable rights entitlement and surface water licensing considerations) to enhance the value of the resultant land for agricultural purposes and biodiversity value. Depending on the chosen final land use, issues that will be addressed as part of post-mining water management system will likely include:

- removal of excess sediment from the surface dams for future use by the subsequent land owner or alternatively filling or removing the dams if they are no longer required;
- reshaping dams (where required) in accordance with their intended use. This may involve resizing, facilitating stock access or reshaping to enhance habitat functionality for specific fauna species; and
- where dams are to be retained, drainage structures will be designed to capture runoff from sufficient catchment area so that the dam can be utilised for its intended use and comply with harvestable rights and surface water licensing requirements.

9.1.8 Works within Watercourses

Works within 40 m of watercourses will be undertaken generally in accordance with the *DPI-Water Guidelines for Controlled Activities* (2012). For work within 40 m of a watercourse, the design, construction and maintenance will be undertaken generally in accordance with the *Guidelines for Controlled Activities on Waterfront Land, Policy and Guidelines for Fish Friendly Waterway Crossings* and *Why Do Fish Need To Cross The Road? Fish Passage Requirements for Waterway Crossings* or their latest versions.

The following key measures will be implemented:

- minimising the design and construction footprint and extent of disturbance as far as practicable;
- maintaining the existing or natural hydraulic, hydrologic, geomorphic and ecological functions of the watercourse;
- protecting against scour as necessary, such as using rock rip-rap and vegetation;
- stabilisation and rehabilitation of all disturbed areas as soon as practicable;
- schedule works during periods of low rainfall erosivity (refer to Table 4.3 of Volume 1 of the Blue Book) and forecast dry weather periods. Where scheduling of works on waterfront land during low rainfall erosivity is not possible or is impractical, erosion control measures should be implemented to ensure disturbed lands only have C-factors in excess of 0.1 (i.e. approximately 60% ground cover) when the three day forecast indicates that rain is unlikely. Management regimes should be established to ensure that the site can be stabilised (i.e. C-factor 0.1 or less) within 24 hours if the forecast is incorrect; and
- inspection and maintenance of the works until the site is stable.

9.2 Flooding Management

A flood levee will be constructed to provide flood protection for the open cut pit for the 0.1% AEP flood event (refer to ***Section 8.3***).

9.3 Training and Communication

General training on the aspects of the ESCP is provided to all employees and contractors through the GCAA ***Generic Surface Induction*** and the ***Site Familiarisation*** process.

Regular workforce communication days and toolbox talks allow for discussion of the objectives and requirements of this and any other relevant Plans.

Task Coordinators are required to undertake specific ***Ground Disturbance Permit Process*** training to understand the process and requirements of completing and implementing a GDP.

10. Measurement and Evaluation

10.1 Routine Inspections

The strategies outlined for the control of erosion and sedimentation will be inspected weekly during construction and monthly during operations. Monitoring and inspections of the site will include:

- inspections of water levels, silt build-up, scouring or erosion and the presence of hydrocarbons; and
- the revegetation progress of disturbed areas.

If the type and/or location of ESC strategies are identified during inspections as being ineffective, the control structures will be modified. Additional inspections will be carried out after high rainfall events (greater than 25 mm of rainfall in 24 hours) to ensure the effectiveness of the controls.

De-silting of ESC structures will be carried out as necessary to ensure the efficiency and capacity of the structure is maintained. This will be determined through visual assessment.

Inspection results are completed and recorded in CMO. In the event a non-conformance is identified during the inspection, corrective and/or preventative actions are identified and implemented. The completion and effectiveness of the corrective and/or preventative action is then assessed during subsequent inspections.

10.2 Flooding

Monitoring of rainfall and storm events will occur through weather forecast and warnings information for potential flooding. Regular inspections of floodways and structures will be conducted to prepare for severe weather.

Dam walls and other flood management structures will be inspected for damage, overtopping, structural damage, slips, slumps or movement that may compromise the integrity of the structure. Spillways will be inspected for damage or flow obstructions. If there is severe damage to the integrity of flood management structures, the damage will be mitigated or repaired and/or emergency services notified.

11. Review and Improvement

11.1 Reporting

A summary of the effectiveness and performance of ESC measures will be reported in the Annual Review. Where relevant, the Annual Review will include ESC related incidents and complaints and initiatives for implementation in the following year.

11.2 Plan Review

This ESCP will be reviewed and, if necessary, revised with any review of the ***United Wambo Water Management Plan***.

The ESCP will reflect any changes in environmental requirements, technology and operational procedures.

12. Document Information

12.1 Relevant Guidelines

Unless otherwise directed, all erosion and sediment controls will be designed, constructed and maintained in accordance with the following series of guidelines (generally referred to as the 'Blue Book') as a minimum standard:

- *Managing Urban Stormwater: Soils and Construction Volume 1* (Landcom 2004);
- *Managing Urban Stormwater: Soils and Construction Volume 2A: Installation of Services* (DECCW, 2008);
- *Managing Urban Stormwater: Soils and Construction Volume 2C: Unsealed Roads* (DECCW, 2008);
- *Managing Urban Stormwater: Soils and Construction Volume 2D: Main Road Construction* (DECCW, 2008);
- *Managing Urban Stormwater: Soils and Construction Volume 2E: Mines and Quarries* (DECCW, 2008); and
- *Best Practice Erosion and Sediment Control Guidelines*, IECA – Books 1-4.

12.2 Related Documents

Related documents, listed in Table 12-1 below, are internal documents directly related to, or referenced from, this document.

Table 12-1: Related Documents

Number	Title
GCAA-625378177-10320	GCAA 11.03 Water Management Protocol
GCAA-625378177-10596	GCAA 11.03 Water Accounting Framework Procedure
GCAA-625378177-10248	GCAA 11.02 Pipeline Management Protocol
UWOC-1689771511-365	United Wambo Water Management Plan
UWOC-1689771511-364	United Wambo Surface Water Management Plan
UWOC-1689771511-370	United Wambo Groundwater Management Plan
UWOC-1689771511-360	United Wambo Environmental Management Strategy
UWOC-1689771511-374	United Wambo Pollution Incident Response Management Plan
WA-ENV-MNP-509.7	United Wambo Open Cut and Wambo Water Management Strategy
WA-ENV-MNP-509.8	United Wambo Open Cut and Wambo Water Monitoring Program

Number	Title
WA-ENV-MNP-509.5	United Wambo Open Cut and Wambo Site Water and Salt Balance

12.3 Reference Information

Reference information, listed in ***Table 12-2*** below, is information that is directly related to the development of this document, or referenced from within this document.

Table 12-2: Reference Information

Reference	Title
Umwelt 2016a	*United Wambo Open Cut Coal Mine Project – Surface Water Assessment* (Umwelt, 2016a)
AGE 2016	*United Wambo Open Cut Coal Mine Project – Groundwater Impact Assessment* (AGE, 2016)
Umwelt 2016b	*United Wambo Open Cut Coal Mine Project – Environmental Impact Statement* (EIS) (Umwelt 2016b)
Umwelt 2017a	*United Wambo Open Cut Coal Mine Project – Response to Submissions* (RTS) (Umwelt, 2017a)
Umwelt 2017b	*United Wambo Open Cut Coal Mine Project – Response to Request for Further Information* (RtRfFI) (Umwelt, 2017b).

12.4 Change Information

Full details of the document history are recorded in the document control register, by version. A summary of the current change is provided in ***Table 12-3*** below.

Table 12-3: Change Information

Version	Date	Change Summary
1.0	September 2019	New document developed by Engeny and United
1.1	December 2019	Updated to address comments received from Department of Planning. Industry and Environment. Reviewed by Engeny.
1.2	May 2020	Glencore format change, updated template. Included RUSLE calculation for sediment dam design. Minor updates to sentence structure.
2.0	August 2020	Updated for Phase 2 operations. Reviewed by Umwelt.
2.1	June 2021	Reviewed and updated following reportable incident and submission of Independent Environmental Audit and Annual Review.

Version	Date	Change Summary
		Table of sediment dam design capacities included.

13. Accountabilities

Table 13-1 outlines the accountabilities associated with this ESCP.

Table 13-1: Accountabilities

Role	Accountabilities for this document
Operations Manager	Provide adequate resources for the implementation of this Plan.
Environment & Community Manager	Implement the ESCP. Responsible for ensuring that monitoring, periodic environmental inspections and visual assessments after high rainfall events are undertaken. Provide that the Training and Communication, Monitoring and Review and Improvement requirements of this Plan are met. Investigate and report all incidents involving the failure or damage to Water Management Structures.
Environment & Community Coordinator/Officer	Assist the E&C Manager as required in implementation of this Plan. Investigate and report all incidents involving the failure or damage to Water Management Structures.
Task Coordinators	Provide that the requirements of this Plan are met through compliance with United Wambo and GCAA procedures. Report all incidents involving the failure or damage to Water Management Structures.
All contractors	Undertake works in accordance with the objectives and principles of this Plan (where relevant). Report all incidents involving the failure or damage to Water Management Structures.
All personnel	Undertake works in accordance with the objectives and principles of this Plan (where relevant). Report all incidents involving the failure or damage to Water Management Structures.

Appendix A - Stakeholder Correspondence

Department	Comment	Response/Change
DPIE	Individual management plans need to make it clear what phases of the development and mining activities they apply (Phases 1A, 1B, 2 and 3 as defined in Development Consent SSD7142). Section 1.3 of the Water Management Plan indicates that the plan applies to "all operational activities at United Wambo", however, Section 1.4 indicates that the Wambo site Management Plan documents will continue to apply during Phase 1A and 1B. It is not clear if this is the intention for the other sub-water related management plans.	Further discussion and explanation on Phases of the development the management plan applies to have been provided in the Scope of each Management Plan.
DPIE	Provide evidence that the plans have been prepared by a suitably qualified and experienced person/s endorsed by the Planning Secretary (condition B52a).	Letter of endorsement has been added to the Appendix.
DPIE Erosion and Sediment Control Plan	Include measures that would be implemented to decommission redundant erosion and sediment control structures.	Added in Section 9.1.7 that discusses the Decommissioning process.

Appendix B - Design Standards for ESC Measures

B.1 Project Design Rainfall

The design rainfall that shall be used for the design of erosion and sediment control measures for the Project is outlined in ***Table 13-2.***

Table 13-2: Design Rainfall for the Project

Percentile	5-day Rainfall Depth Value	Source
85th	31.7mm	GCAA HSEC PCL 0025 Erosion and Sediment Control
90th	40.8mm	GCAA HSEC PCL 0025 Erosion and Sediment Control
95th	54.7mm	Derived from analysis of the South Wambo gauge for from 1959 – 2017 (from GCAA Water Infrastructure Manager)

B.2 Design Standards for ESC Measures

The applicable design standards are listed in ***Table 13-3*** below.

Table 13-3: GCAA Design Standards for Selected ESC Measures

ESC Measure	Design Standard	Reference Documents
Sediment Basins	Specific design requirements summarised in Table B-4 and based on the soils classification and the procedures set out in Managing Urban Stormwater Soils and Construction Dry freeboard of 300 mm above maximum basin water level during spill event, spillway capacity of 1 in 100 year ARI critical duration event	Managing Urban Stormwater – Soils and Construction Vol 1, 4th Ed (Landcom, March 2004) Managing Urban Stormwater – Mines and Quarries, Vol 2E (DECC, June 2008) Best Practice Erosion and Sediment Control Guidelines, IECA (November 2008) United Wambo Project EPL and Development Consent
Sediment Fences	Support post spacing max 2 m, sediment fence material keyed into ground to 200 mm or secured with 300mm of aggregate on the surface to the upstream	Best Practice Erosion and Sediment Control Guidelines, IECA – Books 1-4 Managing Urban Stormwater – Soils and Construction Vol 1, 4th Ed (Landcom, March 2004) and Vol 2E Mines and Quarries
Drainage Channels	Maintain channel velocity to < 1.5 m/s where possible, 500 mm dry freeboard above design event	

ESC Measure	Design Standard	Reference Documents
Rock check dams	Toe of check dam to be level with crest of next downstream check dam, centre of crest to be minimum 15 0mm lower than edges, check dam to be keyed into drain 150 mm minimum, maximum 2H:1V for faces of check dams.	
Chutes	Chutes to be lined with appropriate material to accommodate predicted velocities and discharge structure to limit exit velocity to < 1.5 m/s or less if discharging onto steep slopes.	
Temporary Watercourse Crossings	Design to acceptable ARI with upstream and downstream erosion protection.	Managing Urban Stormwater – Soils and Construction Vol 1, 4th Ed (Landcom, March 2004) and Vol 2E Mines and Quarries

B.3 Construction and Design matrix for Erosion and Sediment Control Structures

The following matrix provides design details for the construction of erosion and sediment control structures outlined in the ESCP.

Table 13-4: Drainage Channel Design Criteria (for permanent drains that are to be in place for greater than three months)

Drain Type	Location	AEP Storm Event	Storm Duration	Free-board	Typical Grade	Side Batters	Comments
Clean[2]	Entire site	5%	Time of concentration [1]	Minimum of 0.5 m	0.5% to 1.0%	No steeper than 1:2 (v:h)	Where velocity >1.5 m/s in 20 year ARI storm event place rock bars every 100 metres to reduce scour potential. All drains to be vegetated and/or rock lined. Level spreaders to be located at ends of all drains.
Dirty[2]	Entire site	5%	Time of concentration [1]	Minimum of 0.5 m	0.5% to 1.0%	No steeper than 1:2 (v:h)	Where velocity >1.5 m/s place rock bars every 100 metres

Drain Type	Location	AEP Storm Event	Storm Duration	Free-board	Typical Grade	Side Batters	Comments
							to reduce scour potential. Level spreaders to be located at ends of all drains.

Table 13-5: Sediment Dam Design Criteria

Parameter	Requirement	Source
Sediment Basing Type	Type D/F	Based on typical soil properties at United
Settling Zone	Refer to ***Table B-1*** for design rainfall and use runoff coefficient (Cv) = 0.9 (hardstand)/runoff coefficient (other areas) = 0.79	Blue Book Vol. 1
Sediment Storage Zone	50% Settling Zone Volume OR 12 months soil loss as calculated using the RUSLE method	Based on assessment of potential erosion hazard being 'Low' for slopes <13% (Blue Book Vol. 1, Figure 4.6)
Dam Length: Width Ratio	3:1 minimum (unless site constraints prevent otherwise)	Standard Drawing SD6-4 Blue Book Vol.1
Minimum Freeboard	750 mm between spillway and crest of dam	Standard Drawing SD6-4 Blue Book Vol.1
Batter Slopes	1v:2h (internal) 1h:3h (external)	Standard Drawing SD6-4 Blue Book Vol.1
Minimum water depth	1.5m from toe of dam wall to crest of spillway (0.6 m for Settling Zone)	Standard Drawing SD6-4 Blue Book Vol.1
Entry/Exit Points	To be stabilised to prevent excessive erosion	Standard Drawing SD6-14 Blue Book Vol.1

DPIE Letter of Endorsement

Planning, Industry & Environment

Planning and Assessment
Resource Assessments
Contact Melanie Hollis
Phone 9274 2043
Email melanie.hollis@planning.nsw.gov.au

Aislinn Farnon
Approvals Manager
United Wambo Joint Venture Project
134 Jerrys Plains Road
WARKWARTH NSW

Dear Ms Farnon

United Wambo Open Cut Coal Mine (SSD 7142)
Water Management Plan

I refer to your letter dated 10 December 2019, requesting the Planning Secretary's endorsement of suitably qualified and experienced persons to prepare the Water Management Plan (WMP) in accordance with condition B52(a) of SSD 7142.

The Department has reviewed the credentials of Ms Susan Sheld and Ms Liz Webb and considers that they are suitably qualified and experienced to prepare the WMP.

The Planning Secretary therefore endorses the following personnel to prepare the WMP:

- Ms Liz Webb (EMM Consulting) - Groundwater Management Plan component; and
- Ms Susan Sheld (Engeny Water Management) -- Water Management Plan including Site Water Balance, Salt Balance, Surface Water Management Plan and Erosion and Sediment Control Plan

Should you have any enquiries in relation to this matter, please contact Melanie Hollis.

Yours sincerely,

11/12/2019

Matthew Spratt
Director
Resource Assessments
as nominee of the Secretary