APPENDIX AD - EROSION AND SEDIMENT CONTROL PLAN

Isaac Downs Extension

Erosion and Sediment Control Plan

Stanmore ID Extension Pty Ltd

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For and on behalf of **Hydro**Balance
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1 Introduction

1.1 Background

Stanmore ID Extension Pty Ltd (ID Extension), a wholly owned subsidiary of Stanmore Resources Ltd (Stanmore) proposes to develop the Isaac Downs Extension (IDE) Project (the Project). The Project will extend the life of mining operations at Isaac Plains Complex (IPC). IPC comprises Isaac Downs Mine (IDM) and Isaac Plains Mine (IPM). Stanmore, through various subsidiary entities, operates IPC and other nearby mines, namely Poitrel Mine and Eagle Downs. Mining activities, including the workforce, will transition from IDM to the Project as operations ramp down at IDM.

The Project requires approvals from the:

- State under the *Environmental Protection Act 1994* (EP Act), for a new environmental authority (EA) and progressive rehabilitation and closure plan (PRCP) schedule.
- Commonwealth through referral under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The proponent has applied for four mining leases (MLs) for the Project (ML application [MLA] 700081, MLA 700082, MLA 700083 and MLA 700084), together forming the Project area. The proponent is preparing a voluntary environmental impact statement (EIS) under the EP Act which will support the EA, PRCP schedule and Referral for the Project.

The proposed Project layout, MLA areas and proposed disturbance area is shown in Figure 1.2. The proposed disturbance allows for working and construction areas within and around proposed Project activities and infrastructure. The area of the 4 MLAs is 2,707 ha and the proposed disturbance area is 2,080 ha. The disturbance area has been refined to minimise and / or avoid sensitive ecological features (e.g. habitat for listed threatened species and riparian areas). The disturbance area may be subject to further refinement for environmental or operational reasons. The disturbance area excludes approximately 2.5 ha of disturbance on IDM MLs for which an IDM EA and PRCP schedule amendment will be required, but which in included in the referral for the Project.

1.2 Purpose of this document

This Erosion and Sediment Control (ESC) Plan was developed to support the EIS submission for the Project, and sets out the principles and objectives for the management erosion and disturbed area runoff for the Project to meet the following conditions in the Model Mining Conditions (DETSI, 2024):

Condition F28 - An Erosion and Sediment Control Plan must be developed by an appropriately qualified person and implemented for all stages of the mining activities on the site to minimise erosion and the release of sediment to receiving waters and contamination of stormwater.

Condition F29 - Stormwater, other than mine affected water, is permitted to be released to waters from:

a. erosion and sediment control structures that are installed and operated in accordance with the Erosion and Sediment Control Plan required by condition F28.
b. water management infrastructure that is installed and operated, in accordance with a Water Management Plan that complies with condition F27, for the purpose of ensuring water does not become mine affected water (MAW).

Section 4 of the Project Surface Water Impact Assessment (SWIA) (HydroBalance, 2026) meets the intent of Condition F27 of the Model Mining Conditions (“*A Water Management Plan must be developed by an appropriately qualified person and implemented*”).

In the context of condition F28 and the Project, stormwater refers to both ‘diverted water’ and ‘sediment water’. Refer to Section 1.3 for further details.

1.3 Surface water types and application of ESC Plan

Surface water at the Project is categorised into six types, as described in Table 4.1 in the Project SWIA (HydroBalance, 2026), which are listed as follows:

- Mine affected water (MAW);
- Sediment water;
- Clean/diverted water;
- Raw/external water;
- Contaminated water; and
- Potable water.

The primary purpose of this document is to develop strategies to manage two types of surface water (**diverted** water and **sediment** water) at the Project. The management strategies for the remaining water types are described in the Project SWIA (HydroBalance, 2026). With respect to diverted and sediment water, this ESC Plan:

- examines and addresses all issues relevant to the generation, management, and mitigation of erosion and sediment transport at the Project;
- provides guidance in erosion and sediment related issues and management techniques applicable to the Project;
- determines the appropriate requirements for sediment and erosion control and management for all land uses at the Project; and
- complies with relevant environmental licences and other regulatory requirements.

The ESC Plan will contribute to effective environmental management of the Project through:

- minimising off-site impacts (by-products of erosion);
- delivering stable landforms that will not pollute downstream environments;
- providing clear, concise and standardised practices for operations;
- providing clarity for planners, supervisors and contractors; and
- improving auditability and conformance to standards.

This ESC Plan references the document prepared by the International Erosion Control Association (IECA) entitled Best Practice Erosion and Sediment Control (IECA, 2008).

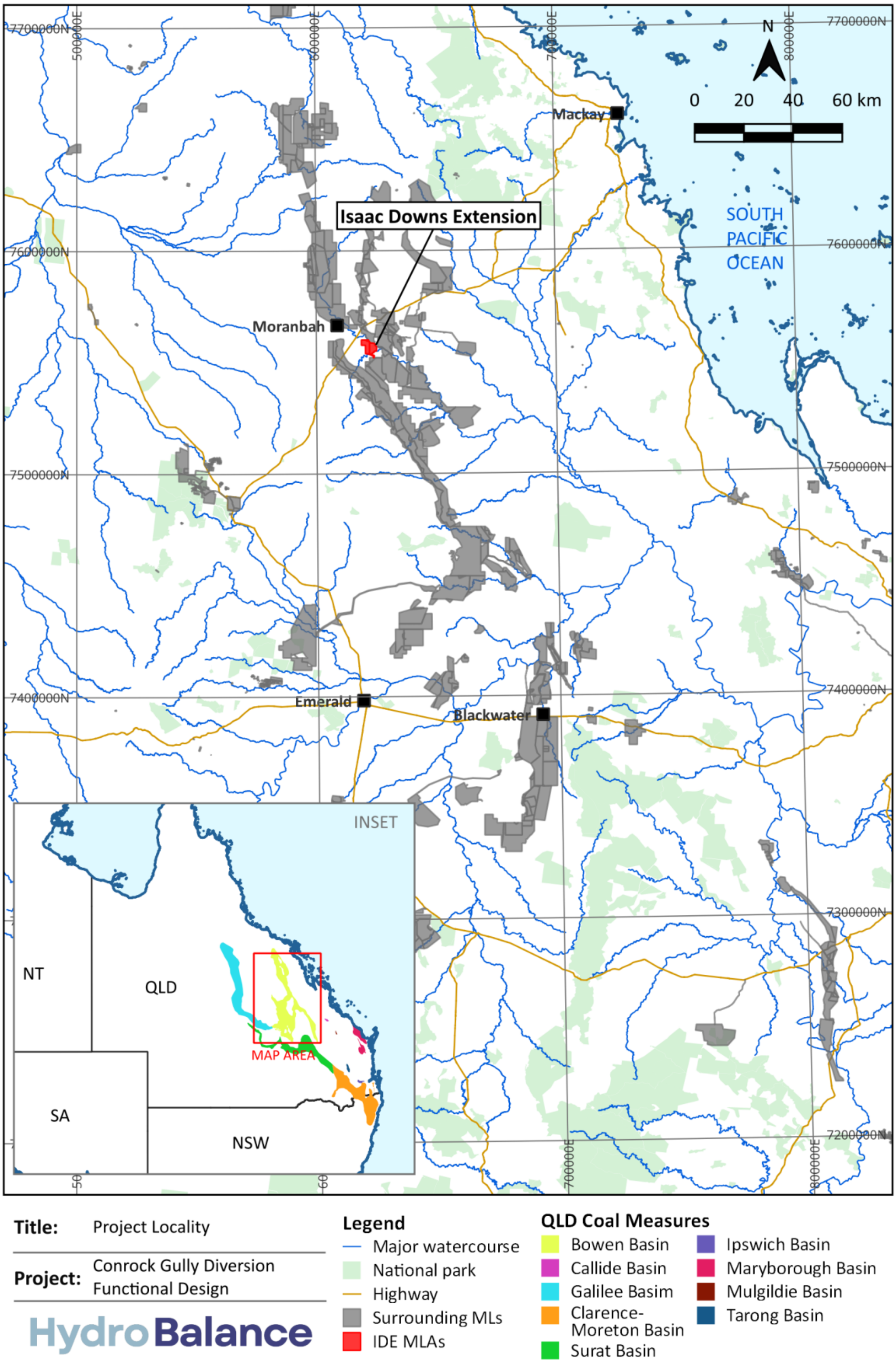


Figure 1.1 – Project locality

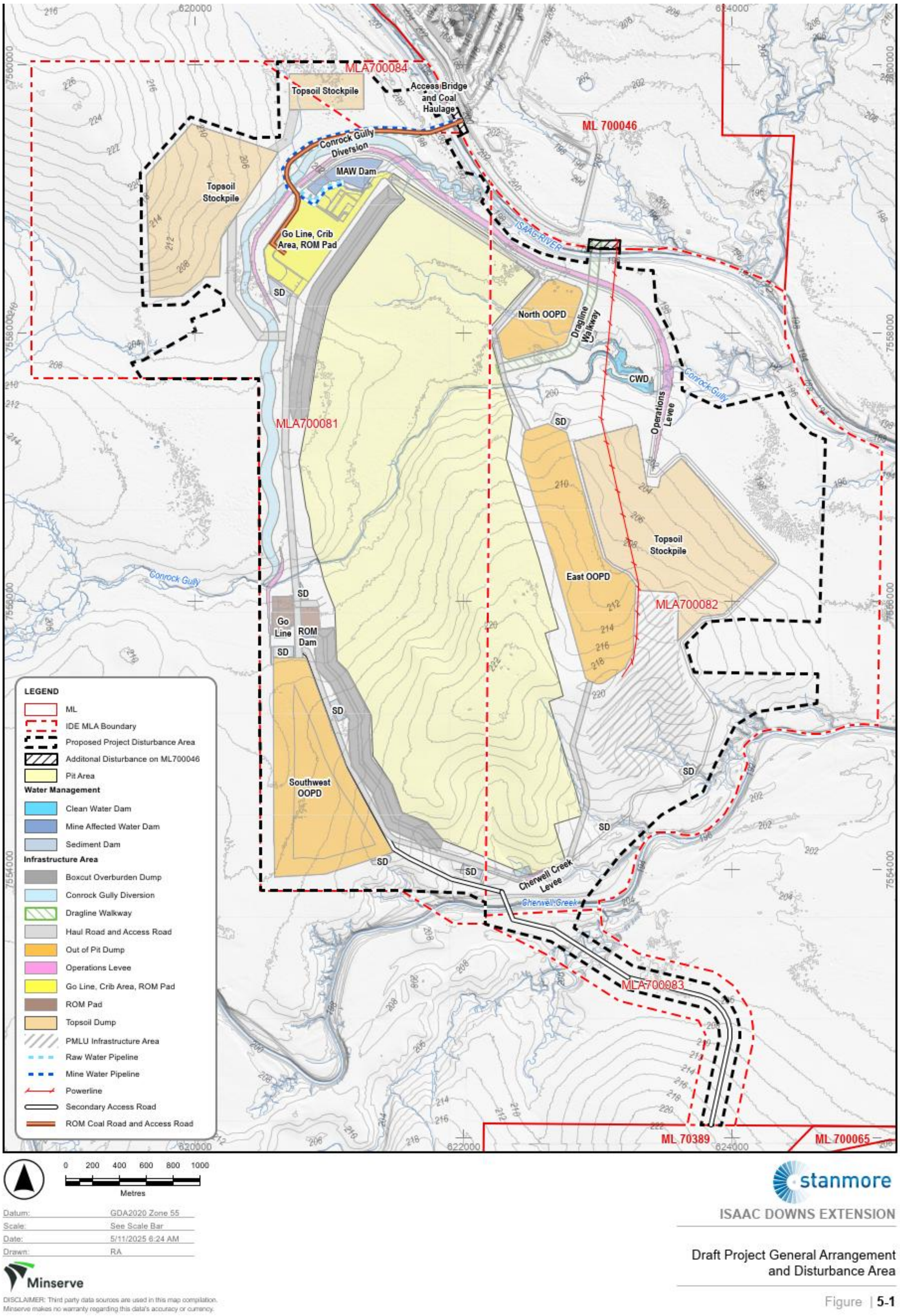


Figure 1.2 – Proposed Project layout

2 ESC framework

2.1 Regulatory framework and relevant guidelines

The following regulatory framework and relevant guidelines are applicable to the Project:

- Environmental Protection Act 1994 (EPA) and Environmental Protection (Water and Wetland Biodiversity) Policy 2019;
- Water Act 2000 and relevant Water Resources Plans (e.g. Water Resource (Fitzroy Basin) Plan 2011);
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018);
- Soil Conservation Act 1986 and Soil Conservation Regulation 1998;
- Stormwater guideline – Environmentally relevant activities (DEHP, 2014);
- Best Practice Erosion and Sediment Control (IECA, 2008);
- Australian Soils and Landscapes Handbook (CSIRO, 2004); and
- Model Mining Conditions guideline (DETSI, 2024).

2.2 Strategic approach

This ESC needs to be evaluated and implemented for the following phases of work:

- Planning and design (non-operational); and
- Construction and operation.

This ESC Plan does not specifically include techniques for rehabilitation, although many of the given techniques are relevant.

All parties (both the Project workers and contractors) involved in earthworks and civil construction (including mechanical, electrical and pipeline contractors) engaged onsite will be given access to this ESC Plan. All works will be required to adhere to all aspects of the ESC Plan unless abnormal circumstances prohibit their use.

In addition, consideration should be given to the inclusion of this ESC Plan into tender documents and provision to prospective tenderers for related activities to enable efficient incorporation into daily operational procedures.

2.3 Responsibilities and accountabilities

The management and implementation of the ESC Plan is administered through the following key personnel:

- Site General Manager – accountable for the application of this ESC Plan.
- Site Environmental Superintendent - responsible for documentation and revisions of the ESC Plan.
- Contractors engaged to undertake work at the Project are responsible for implementation of this ESC Plan.

3 Existing site characterisation

3.1 Local drainage network

The following ephemeral drainage systems (shown in Figure 3.3) are located in the vicinity of the Project:

- Isaac River – 3,528 km^2 catchment to the Project (downstream of the confluence with Cherwell Creek).
- Cherwell Creek – 698 km^2 catchment to it confluence with the Isaac River.
- Conrock Gully– 71 km^2 catchment to its confluence with Cherwell Creek.
- JB Gully – 26 km^2 catchment to its confluence with the Isaac River.

3.1.1 Isaac River

The Isaac River channel in the vicinity of the Project has an average bed width of 45 m varying between 33 m and 60 m (90% confidence limits) and is approximately 10 m deep. The bed slope and hydraulic gradient from Moranbah township to the Cherwell Creek confluence is very uniform at 0.08%. Under the Strahler ordering system, the Isaac River is a fifth order stream upstream of the Grosvenor Creek confluence (which is located 7.3 km upstream of the Project) and a sixth order stream downstream of the Grosvenor Creek confluence (including the reach that drains past the Project).

The bed of the river channel is characterised by extensive sand sheet deposits indicating it is sediment choked. Sand point bars are evident on the inside of bends and vegetated benches are located on one or both sides of the river along the straight sections. A number of well vegetated sand islands are located in the river channel indicating that some of the old benches have eroded forming channels either side of the old river bank. SedNet modelling of the catchment undertaken by Dougall et al (2006) indicated hillslope erosion to be a dominant input over gully and river bank erosion. Total predicted sediment inputs range from 0.31 to 1.25 t/ha/annum.

The banks of the river consist of a sandy loam and have eroded to near vertical for a depth of 1 m to 2 m along much of its length and 1V:4H to 1V:5H batters above this depth. The bank batters are well vegetated with established and mature trees, mostly eucalypts and casuarinas, and buffel grass understorey. The active benches consist of scattered trees and buffel grass with the overbank areas cleared for grazing.

As part of the Project works, a bridge will be constructed across the Isaac River, connecting with Project with the neighbouring IDM. A temporary dragline crossing will also be constructed across the Isaac River. No diversion of the Isaac River is proposed.

3.1.2 Cherwell Creek and JB Gully

Cherwell Creek, a tributary of the Isaac River, runs west to east to the south of the Project area. The Cherwell Creek catchment begins in the Cherwell Range and Denham Ranges at an elevation of 380 m (west of the Project) and flows downstream to join the Isaac River at an elevation of 200 m (east of the Project). Cherwell Creek is approximately 65 km long to the Isaac River junction with a catchment area of approximately 698 km^2. Cherwell Creek and its tributaries have clearly defined channels.

The dominant land use within the Cherwell Creek catchment is beef cattle grazing, with substantial clearing of vegetation having occurred over time to improve pastures. The Peak Downs Mine is located in the middle reaches of Cherwell Creek, about 13 km upstream of the Project, and has approval for controlled releases to Cherwell Creek. The catchment is not in pristine condition and is susceptible to the impacts of these land use activities, such as increase runoff, scouring, erosion and unstable creek banks.

Cherwell Creek has previously been diverted (in 1991 and 1995) as part of the Peak Downs Mine progression. Both diversions replaced meandering sections of creek floodplain, terraces, benches, low flow channel, active channel, and high flow channel features with relatively straight alignment and trapezoidal channel. The designs were developed in accordance with best practice at the time, which preceded current best practice design guidelines (DNRM, 2019). Erosion of the Cherwell Creek diversions (channel widening and deepening) and reduced functioning of stream stabilisation structures has been observed in previous years.

Within and adjacent to the Project area, the natural low flow channel width varies between 15 m to 25 m wide and the high flow channel top width varies between approximately 100 m to 200 m. The channels are generally deeply incised to a depth of 6 m to 10 m. The channel banks slopes are typically 1(V) in 2(H) and vegetated with native long grass and scattered trees. A number of minor anabranches form along the length of Cherwell Creek, particularly within the Isaac River floodplain. The river bed consists mainly of silty sands.

Cherwell Creek also includes a second order tributary (JB Gully), that runs west to east to the south of the Project area. JB Gully is significantly smaller than Cherwell Creek, with a typical main channel bed width of 1 m to 2 m and a depth of 2 m. The high flow channel near the confluence with Cherwell Creek is relatively wide, around 200 m to 300 m, likely due to natural headcut from Cherwell Creek backwater flows.

The proposed secondary access route to the Project will cross Cherwell Creek (via a bridge) and JB Gully (low level crossing).

3.1.3 Conrock Gully

Conrock Gully has a catchment area of approximately 38 km^2 upstream of the proposed stream diversion, and approximately 71 km^2 to the confluence with the Isaac River.

The catchment extends west approximately 10 km from the western MLA boundary and east to the Isaac River confluence approximately 1.5 km upstream of the eastern MLA boundary.

The Conrock Gully channel banks appear well vegetated and relatively stable. Digital elevation models acquired in 2012 to 2018 shows no evidence of significant channel movement when compared to photographs taken in 2011.

A long section of the Conrock Gully channel bed in the vicinity of the Project area (approximately 6 km upstream from the confluence with the Isaac River, including the section that intersects the Project area) is shown in Figure 3.1. The channel bed slope in this area is a uniform 0.14% (1 in 690), aside from a steeper downstream section 0.48% (1 in 210) as Conrock Gully joins the Isaac River.

The Conrock Gully channel cross-section geometry can be typified by the generalised cross-section in Figure 3.2, which was created from a statistical analysis of cross-section data collected from the topography within and surrounding the Project area. The median channel can be described as having:

- A base width of approximately 4 m;
- A side slope of 1V in 6H for the channel;
- A side slope of 1V in 30H on the channel overbank;

The channel is typically approximately 1.5 m to 3.5 m deep. At a depth of 2 m, the channel top width is typically approximately 50 m.

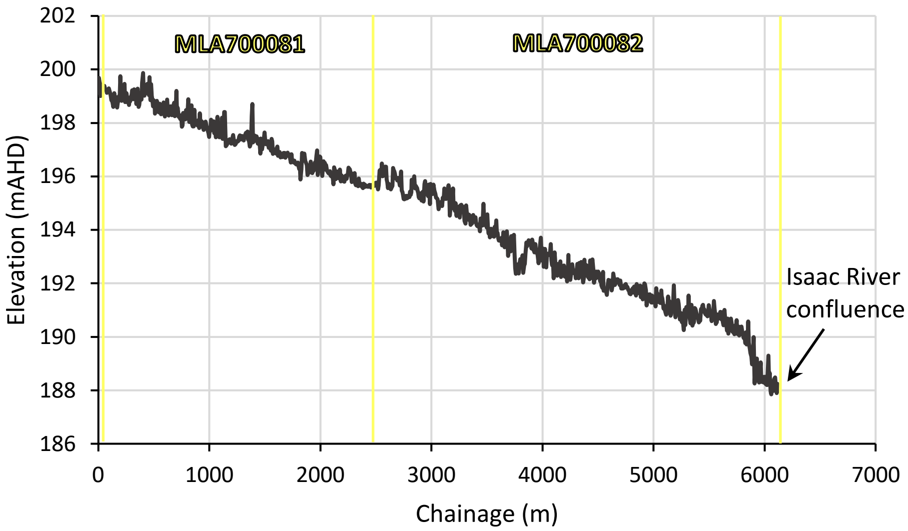


Figure 3.1 – Long-section of the Conrock Gully reach to be diverted

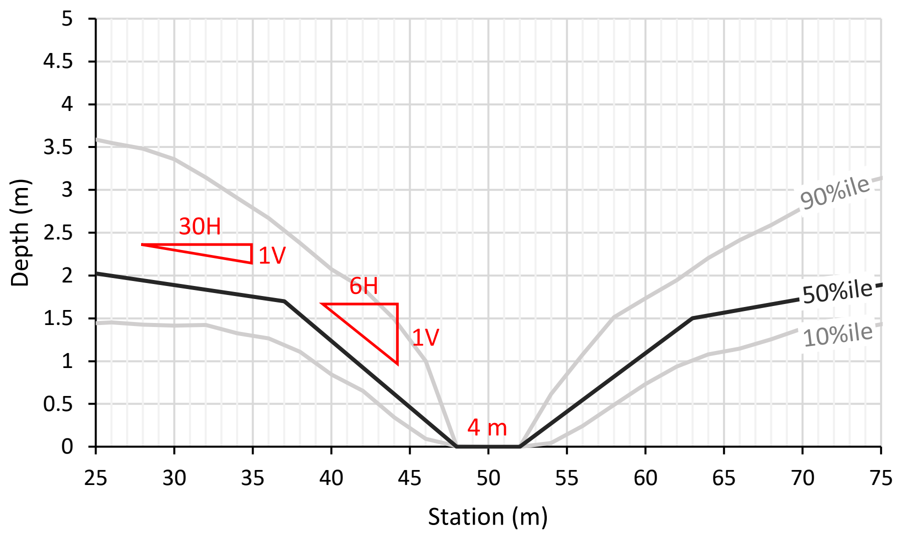
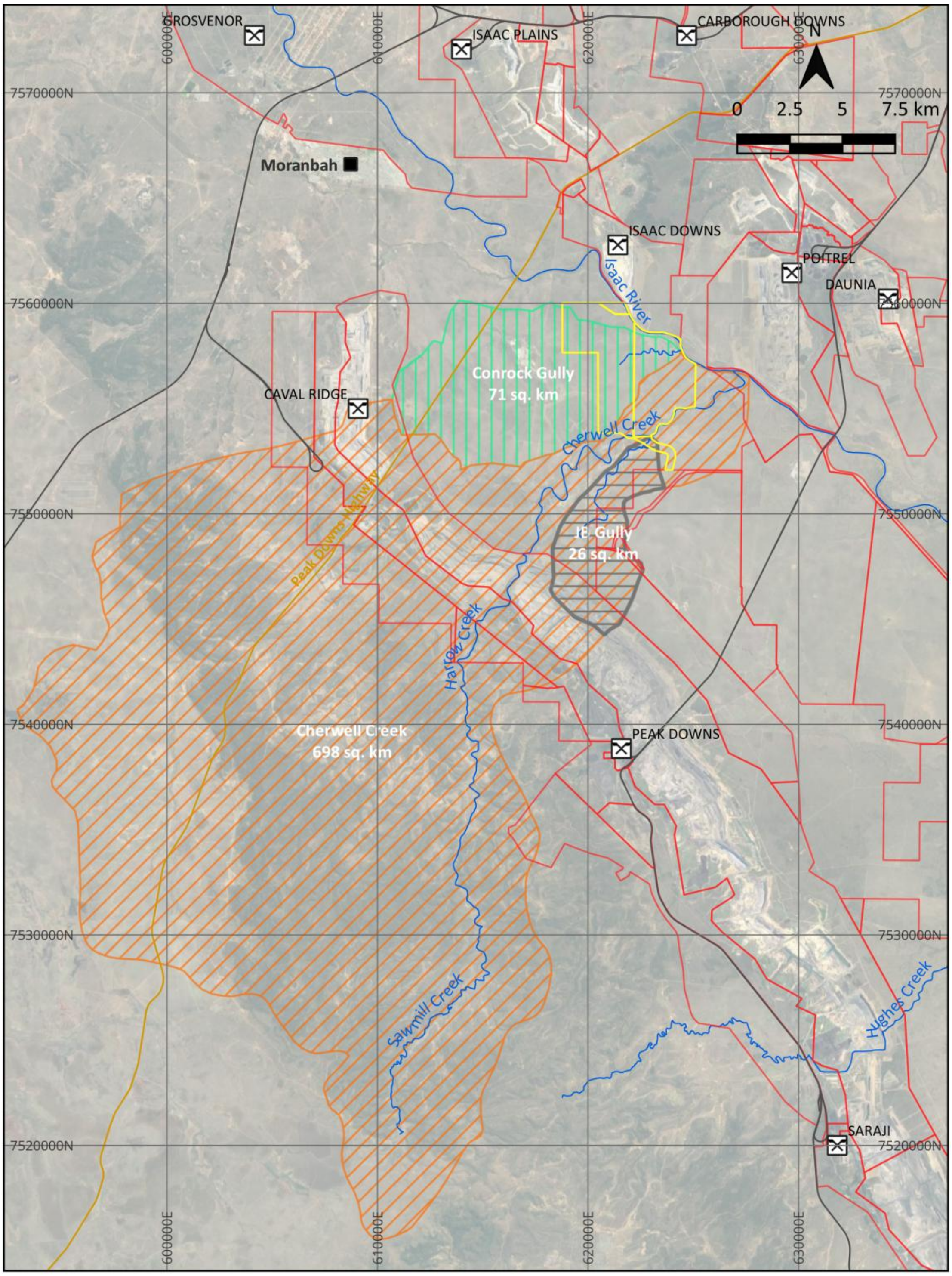


Figure 3.2 - Generalised Conrock Gully cross-section in the vicinity of the reach to be diverted



Title: Local Drainage

Project: Isaac Downs Extension Surface Water Assessment

HydroBalance

Legend

- Highway
- Railway
- Watercourse
- Surrounding MLs
- IDE MLAs
- Conrock Gully catchment
- Cherwell Creek catchment
- JB Gully catchment

Figure 3.3 – Local drainage characteristics

3.2 Geological setting

The Project is located in the northern part of the Permo-Triassic Bowen Basin. Structurally, the deposit lies on the western boundary of the deformed Nebo Synclinorium immediately west of the regional Isaac Thrust fault system. To the east and north of the thrust, seams are repeated.

The economic seams are contained in the Late Permian Rangal Coal Measures which are approximately 100 m thick. The Rangal Coal Measures are underlain by the Fort Cooper Coal Measures and overlain by the Late Permian to Early Triassic Rewan Group.

The Rangal Coal Measures comprise light grey, cross-bedded, fine to medium grained labile sandstones, grey siltstones, mudstones and coal seams. Cemented sections are common in the sandstones. The transition from the Rangal Coal Measures to the Rewan Formation is generally difficult to define and is often based on the change from the green-grey colour of the Rewan sandstones to the blue-grey colour of the Rangal sandstones. The transition between the formations is 15 to 60 m above the first major seam in the Rangal Coal Measures, being the Leichhardt Seam.

The Fort Cooper Coal Measures comprise typically tuffaceous sandstones, siltstones, mudstones and coal seams. The transition between the Rangal Coal Measures and the Fort Cooper Coal Measures is generally clearly marked by the Yarrabee Tuff - a basin-wide marker bed comprised of weak, brown tuffaceous claystone.

The deposit area contains Quaternary sediments range in thickness from 2 to 20 m (average 7.8m). Some thicker Quaternary sediments are present along the banks of the Isaac River in the north and a minor amount along Cherwell Creek to the south. In the north of the Project area the Leichhardt and the Vermont seams coalesce to form a thickened pod of coal. The Vermont coalesces with the Girrah seam in the south of the Project area. The Rangal Coal Measures dip to the east at 2 to 6 degrees.

Depth of weathering over the whole deposit ranges from 11 to 36 m averaging 20 m. Non-coal Permian sediments consist of moderately weak to strong sandstones, siltstones and minor mudstones. Sandstone and siltstone appear to be co-dominant. There are no significant Tertiary basalt flows in the Project area.

3.3 Overburden geochemistry

Terrenus (2026) summarised the overburden / spoil geochemistry for the proposed Project overburden emplacements as follows:

- *Spoil is expected to generate pH-alkaline to highly alkaline contact water (run-off and seepage), which is typical for mine spoil in the Bowen Basin.*
- *Based on the results of 266 samples, spoil – of which approximately 95% is non-carbonaceous spoil – has a very low potential to generate acid mine drainage (AMD) as either acid drainage (AD) and/or neutral mine drainage (NMD) and/or saline drainage (SD). Carbonaceous spoil, which is estimated to comprise approximately 5% of all spoil, has a slightly higher AMD source hazard compared to non-carbonaceous spoil, however when operational mixed throughout bulk non-carbonaceous spoil, general (bulk) spoil conservatively poses a low AMD source hazard.*
- *The test-work undertaken has demonstrated that the acid neutralizing capacity (ANC) for the spoil is generally expected to be about 37-67% available (median 48% available) under field conditions, with iron-dolomite being the main carbonate mineral likely to be contributing to the acid buffering potential of the spoil. Overall, spoil has excess acid neutralising capacity and is expected to be bulk acid consuming.*
- *Total metal and metalloid concentrations (assay) from 37 spoil samples tested are very low compared to average element abundance in un-mineralised soil/rock in the earth's crust, with no samples being significantly enriched with regard to any of the elements of potential environmental interest.*
- *Soluble multi-element results from 37 spoil samples indicate that leachate from spoil is expected to contain low concentrations of soluble metals and metalloids. For many spoil samples, particularly the weathered samples, the concentrations of most of the 17 environmentally important elements was below or marginally above to the laboratory limit of reporting (LOR).*

- *The assessment has demonstrated that spoil from the Project (based on 266 samples) has AMD characteristics that are comparable to spoil from nearby IDM (based on 153 samples). For the key aspects assessed, including acid based accounting (ABA) components (total S, Scr, ANC), total metals/metalloids and soluble metals/metalloids, the Project spoil samples had concentrations/values within the same range as spoil samples from IDM.*
- *Spoil has low median and low-moderate 95th percentile aged EC1:5 values of 406 and 821 µS/cm, respectively, and has very low total S concentrations. On this basis, contact water (run-off and seepage) is expected to be generally non-saline to slightly saline, as a result of dissolution of geogenic salts more so than from sulfide oxidation (sulfate salinity). Weathered spoil generally has higher aged EC1:5 values compared to fresh spoil.*
- *Spoil has generally low cation exchange capacity (CEC) values and generally high exchangeable sodium percentage (ESP) values, resulting in all spoil samples being classified as 'sodic' to 'strongly sodic' and, therefore, with potential for dispersion. Based on Emerson aggregate class testing to directly measure dispersion, very few spoil samples displayed dispersive characteristics, which was generally inconsistent with the dispersion predictions from the ESP results. Despite the inconsistencies between the ESP and Emerson Class results, the data suggests that spoil can be expected to be dispersive to varying degrees.*

3.4 Water quality objectives

A set of proposed receiving water contaminant triggers levels have been developed based on a combination of the Final Model Water Conditions for Coal Mines in the Fitzroy Basin (DERM, 2009), Isaac River Sub-basin Water Quality Objectives (QLD Government, 2011), and site-specific values. These are consistent with the currently approved EA conditions at IPM, IDM and generally consistent with other nearby operating coal mines.

These trigger levels are presented in Table 3.1 and are proposed to be measured at the upstream and downstream Isaac River monitoring stations. Monitoring at these locations will assist with controlled release operations, allow for an accurate evaluation of the impact of any releases from the Project, and allow for identification of any upstream influences that are not associated with the Project.

Table 3.1 – Proposed receiving water contaminant trigger levels

Quality characteristic	Units	Trigger level	Monitoring frequency
Electrical conductivity (EC)	µS/cm	1,000 (maximum)[1]	Daily during the release
pH	pH units	6.5 - 8.5 (range)[2]	
Total suspended solids (TSS)	mg/L	1,050 (maximum)[3]	
Sulphate (SO_4^{2-})	mg/L	250 (maximum)[1]	

Notes: 1/ Final Model Water Conditions for Coal Mines in the Fitzroy Basin (DERM, 2009)
2/ Isaac River Sub-basin Water Quality Objectives
3/ 80th percentile of local water quality

4 Erosion and sediment control

4.1 Overview

This ESC Plan is intended to assist in the management, reduction and mitigation of erosion and consequent sediment transport within and from the Project.

Preventing unacceptable levels of sediments from leaving the Project area and entering the receiving waters is one of the most important functions of ESC. The three cornerstones of ESC are as follows:

- **Erosion control** – prevention or minimisation of soil erosion (from dispersive, non-dispersive or competent material) caused by rain drop impact and exacerbated overland flow on disturbed surfaces.
- **Drainage control** – prevention or reduction of soil erosion caused by concentrated flows and appropriate management and separation of the movement of clean and dirty water through the area of concern.
- **Sediment control** – trapping or retention of sediment either moving along the land surface, contained within runoff (i.e. from up-slope erosion) or from windborne particles.

Catchments that drain internally to the mine water management system (i.e. into MAW dams or pits) do not require ESC management measures.

4.2 Principals of ESC

For ESC to be effective at the Project, the following fundamentals will be applied:

- ensure ESC measures are designed and constructed effectively;
- minimise the duration and extent of soil exposure;
- promptly stabilise disturbed areas;
- maximise sediment retention on the site;
- control water movement through the site;
- utilise existing topography and adopt construction practices that minimise soil erosion and sediment discharge from area;
- integrate erosion and sediment control issues / measures into the planning phases of operations;
- choose the ESC technique to account for site conditions such as soil, weather and construction conditions;
- maintain all ESC measures in proper working order at all times; and
- monitor the site and adjust ESC practices to maintain the required performance standard.

4.3 Potential sources of erosion

Operations at the Project may result in the alteration of existing surface water flow patterns by proposed activities and through diversion drains. Erosion may occur due to the following activities:

- ex-pit (out of pit) spoil dumps;
- externally draining spoil used in backfilling the pit (in-pit dumps), which is subsequently rehabilitated.
- topsoil and subsoil stockpiles;
- cleared land ahead of mining activities;
- installation of services and infrastructure;
- changes to drainage lines and/or catchments;

- runoff from construction and maintenance on haul roads;
- runoff from the construction of and maintenance of internal access roads;
- vehicle and equipment movements; and
- disturbed areas not yet rehabilitated.

Potential erosion and sediment sources as well as the potential contaminants, impacts and applicable period at the Project are presented in Table 4.1.

Table 4.1 – Potential erosion and sediment sources

Disturbance category	Substrate characterisation	Potential erosion mechanisms and impacts	Applicable period
Spoil / Overburden			
Unrehabilitated spoil	Unconsolidated material with varying quantities of low to moderate salinity and sediment pre-disposition.	Sheet and rill erosion of potentially alkaline / low to moderate salinity deposits leading to deposition of sediment volumes. Sediments affecting receiving waters through reduction in water quality and degradation of in-stream habitats.	During mine operations period
Topsoiled spoil (to be revegetated)	Unconsolidated materials. Runoff from these areas may contain sediments and elevated turbidity.	Sheet and rill erosion leading to sedimentation of waterways and loss of valuable rehabilitation material.	During rehabilitation period
Topsoiled spoil, ripped and seeded	Unconsolidated materials. Runoff from these areas may contain sediments and elevated turbidity.	Minimal once vegetation established.	During rehabilitation period
Topsoil			
Topsoil stripping area	Unconsolidated materials.	Sheet, tunnel, rill and gully erosion leading to movement and deposition of sediments, with runoff to receiving waters.	During construction and mine operations period
Topsoil stockpiles	Unconsolidated materials. Runoff from these areas may contain sediments and elevated turbidity.	Sheet, rill erosion leading to sedimentation of waterways and loss of valuable rehabilitation material.	During construction and mine operations period
Other land area			
Haul Roads	Disturbed materials from surface of the road.	Erosion of table drain material vulnerable to storm activity, leading to sediment runoff.	During construction and mine operations period
Sediment runoff from hardstand areas.	Runoff from these areas may contain sediments and elevated turbidity	Sediment runoff	During construction and mine operations period
Exploration / Drilling Activity	Disturbed materials. Runoff from these areas	Sediment runoff.	During mine operations period

Disturbance category	Substrate characterisation	Potential erosion mechanisms and impacts	Applicable period
	may contain sediments and elevated turbidity.		
Land clearing	Disturbed materials and exposed in-situ subsoils. Runoff from these areas may contain sediments and elevated turbidity.	Sediment runoff.	During construction and mine operations period
Drainage channels	Exposed in-situ subsoils. Runoff from these areas may contain sediments and elevated turbidity.	Sheet, tunnel, rill and gully erosion leading to movement and deposition of sediments, with runoff to receiving waters.	During construction and mine operations period

4.4 Erosion potential

Undertaking an assessment for risk of erosion is essential to determine the appropriate ESC technique to apply. There are five main categories that need to be taken into consideration, all of which influence the erosion potential and the type of control measure(s) applicable:

- soil/spoil classification;
- average slope of disturbance area;
- extent and duration of soil disturbance;
- location within the catchment (and whether run-off from upslope can be controlled); and
- proximity to waterways.

4.4.1 Soils/spoil

Soils/spoil are classified into three categories:

- dispersive soil;
- non dispersive soil; and
- blocky / competent material.

The following is provided as background to identifying soil / material types.

Dispersive soils are structurally unstable in water and tend to break down into their constituent particles which consequently cloud the water. Dispersive soils are highly susceptible to erosion on slopes and drains when exposed.

Non-dispersive soils are characterised by large, water-stable aggregates separated by large pore spaces that absorb water rapidly. These soils are typically high in clay content although some clays are highly dispersive and break down when wet making them highly erodible (i.e. dispersive). Sandy soils are generally non-dispersive on gently sloping land, however are dispersive on steep slopes.

Blocky / competent soil material is structurally sound and typically does not contribute a large portion of erosion problems or sediment runoff. These materials may be used to construct various erosion and sediment control techniques.

Based on the soils assessment for the Project (Landloch, 2025) and the landform erosion modelling for the Project (Landloch, 2026), soils are described as follows

- Good quality topsoil and marginal topsoil are demonstrated to have sufficient volumes for use in rehabilitation, and are non-sodic to moderately sodic, with few limitations for plant growth.
- Across all soil types, ESP is less than 6% (i.e. non-sodic) in the good quality and marginal topsoil proposed for use in rehabilitation.
- Subsoils are generally sodic and dispersive.

Spoil / overburden sodicity is described in Section 3.3.

Based on the available historical spoil and soil classification information, it expected that:

- The overburden dumps material will contain mostly dispersive material; and
- The surface disturbance areas will include a mix of non-dispersive (topsoil layers) and dispersive (subsoil layers) material, with non-dispersive material targered for use in rehabilitation.

Soil types are described in Landloch, 2025 for any area of activity where this ESC Plan needs to be referenced. Should there be any uncertainty on soils types the Project environmental personnel will be contacted and appropriate steps undertaken to determine soil type. This may include undertaking additional soil assessments as per published documentation (e.g. IECA, 2008).

4.4.2 Slope

The steepness of the slope and slope length are important determinants in the erosion risk of a site. The externally draining side slopes of the dump will be at 15% or less. The top surface of the dump will be relatively flat.

Drainage and sediment control measures will be installed during the formation and rehabilitation of dumps, including plateau drains to intercept flow from the top of the dump, contour drains to direct water from the slopes to the chutes, chutes to convey this water down the sides of the dump, and collection drains to direct the runoff to sediment dams. Surface run-off and seepage from overburden dumps will be directed to sediment dams.

4.4.3 Area and duration

A principle of ESC is to minimise the extent and duration of soil disturbance. Therefore, mining schedules should aim to minimise the duration for which open soils are exposed to the erosive elements (wind, rain and flowing water). Reducing the period where soils are exposed to erosive elements during the construction phase lessens opportunity for displaced sediment to enter into the surrounding environment.

Strategies to minimise increased risk of erosion during the operational phase of the mine site include:

- minimise the extent of the disturbance;
- prompt revegetation of non-operational disturbed area;
- ensure both temporary earthworks and permanent land-shaping provide a landform that minimises erosion; and
- design temporary runoff collection, conveyance and disposal systems to minimise erosion prior to commencement.

4.4.4 Location within the localised catchments

One of the major principles in achieving effective erosion and sediment control across any site is the necessity to separate run-off from undisturbed catchments and disturbed catchments. Disturbed sites positioned low in a localised catchment with the potential to receive overland or flood flows represent an increased erosion risk. It is therefore necessary to establish site drainage works to convey overland flows safely through or around a site during the disturbance period. For the Project, the diversion of Conrock Gully is the key drainage control to separate run-off from undisturbed catchments and disturbed catchments. A clean water dam (CWD) captures runoff to the west of mining activity and within the Isaac River levee area. Water from the CWD will be pumped to the Isaac River.

4.4.5 Waterways

The proximity to watercourses may trigger an increased level of planning. Disturbances to existing waterways should be avoided wherever practical. The Project involves construction of crossings of the Isaac River and Cherwell Creek, with ESC measures to be implemented during construction.

During operational phases the proximity of ESC measures to watercourses should be undertaken where practicable and reasonable. Design should take into account floodplain extent, soil conditions and flood immunity of the selected ESC measure.

Within this process any mitigation works required to minimise erosion and sediment transport will be detailed.

5 Erosion control measures

5.1 Overview

Soil erosion is the process through which the effects of wind, water or physical action displace soil particles, causing them to be transported. This section discusses the potential measures to mitigate or reduce erosion caused by water. The most common forms of water erosion are:

- **Splash erosion** is the spattering of soil particles cause by the impact of raindrops on soil;
- **Sheet erosion** is the uniform removal of soil in thin layers from sloping land;
- **Rill erosion** is the removal of soil by water concentrated in small but well-defined channels; and
- **Gully erosion** produces channels deeper and larger than rills (generally greater than 300 mm deep).

5.2 Erosion control techniques

5.2.1 Soil stabilisation and protection

A list of general erosion control techniques is provided in Table 5.1.

Table 5.1 – Summary of erosion control techniques

Technique	Typical use
Gravelling[1]	Protection of non-vegetated soils from raindrop impact erosion.
	Stabilisation of office area, parking areas and access roads.
Heavy mulching[2]	Stabilisation of soil surfaces that are expected to remain non-vegetated for medium to long periods.
	Suppression of weed growth on non-grassed areas.
Light mulching[2]	Control of raindrop impact erosion on flat and mild slopes. May be placed on steeper slopes with appropriate anchoring.
	Control water loss and assist seed germination on newly seeded soil.
Revegetation[3]	Temporary and permanent stabilisation of soil.
	Stabilisation of long term stockpiles.
Rock mulching[4]	Stabilisation of long term, non-vegetated banks and minor drainage channels.
Soil binders[5]	Dust control.
	Stabilisation of unsealed roads.

[1] https://www.austieca.com.au/documents/item/98
[2] https://www.austieca.com.au/documents/item/100
[3] https://www.austieca.com.au/documents/item/101
[4] https://www.austieca.com.au/documents/item/102
[5] https://www.austieca.com.au/documents/item/227

During the pit backfilling and rehabilitation phase, erosion control will primarily be achieved through revegetation of the dump and pit footprints across a stable landform that is similar to the pre-mine landform.

5.2.2 Control of erosion on slopes

A list of appropriate erosion control measures to be used on flat, mild and steep slopes is given in Table 5.2.

Table 5.2 – Erosion control measures on slopes

Flat land (flatter than 1 in 10)	Mid slopes (1 in 10 to 1 in 4)	Steep slopes (steeper than 1 in 4)
Gravelling[1]	Mulching[2]	Cellular confinement systems[5]
Mulching[2]	Revegetation[3]	Revegetation[3]
Revegetation[3]	Rock mulching[4]	Rock armouring

[1] https://www.austieca.com.au/documents/item/98
[2] https://www.austieca.com.au/documents/item/100
[3] https://www.austieca.com.au/documents/item/101
[4] https://www.austieca.com.au/documents/item/102
[5] https://www.catchmentsandcreeks.com.au/docs/E-CCS-1.pdf

Given the slopes of the sides of the overburden dump (≤15%), erosion control measures will be applied to direct and control runoff through these areas.

5.2.3 Dispersive soil management

The following actions in dispersive soil should be avoided wherever possible:

- Expose dispersive subsoils to rain;
- Allow water to pond on dispersive soils;
- Stockpile or spread untreated dispersive soils; and
- Concentrate stormwater in drainage lines containing dispersive soils.

Exposed dispersive soils are highly erodible even at low flow velocities and therefore must be managed using a combination of the following:

- Identification and avoidance where possible by using alternative drainage techniques such as drainage bunds rather than cutting channels;
- Minimise the amount of time land is exposed;
- Discharge stormwater and runoff into relatively erosion resistant areas;
- Treatment with gypsum if required (note that the application of chemical treatments including gypsum should avoid harmful changes to pH levels, particularly within 20 m from the top of bank of a waterway. The mechanical application of chemical amelioration should also be avoided in areas intended for tree/vegetation retention); and
- Cover exposed dispersive soils with stable topsoil (at least 200 mm deep) and/or use geotextile barriers followed by revegetation.

6 Drainage control measures

6.1 Overview

This section outlines the measures to be taken when constructing drainage channels at the Project to minimise erosion and downstream sedimentation. Control measures for two different drainage channels are discussed as follows:

- temporary drainage in low gradient areas such as catch drains, diversion channels or flow diversion banks that either collect concentrated flow or overland flow.
- temporary drainage down slopes such as chute drains.

6.2 Operational drainage controls

Operational drainage is considered temporary and only used during the operational period. All operational drainage shall be decommissioned and rehabilitated.

The key drainage controls at the Project are as follows:

- Upslope catchment diversion drain, which diverts the natural catchment around the site;
- Plateau drains, which convey runoff from the top of the dump towards the chutes and runoff collection drains;
- Overburden dump rock chutes, which collect runoff from the top and sides of the dump and convey the flow to the collection drains.
- Collection drains, which convey flow from the dump and infrastructure areas to the sediment dams.

The conceptual arrangement and location of the proposed sediment drains for an early stage of the Project is shown in Figure 6.1. Final design and sizing of the proposed sediment drains will be undertaken by the mining contractor. This will include details of ESC controls during the construction phase of the Project.

6.2.1 Design standards

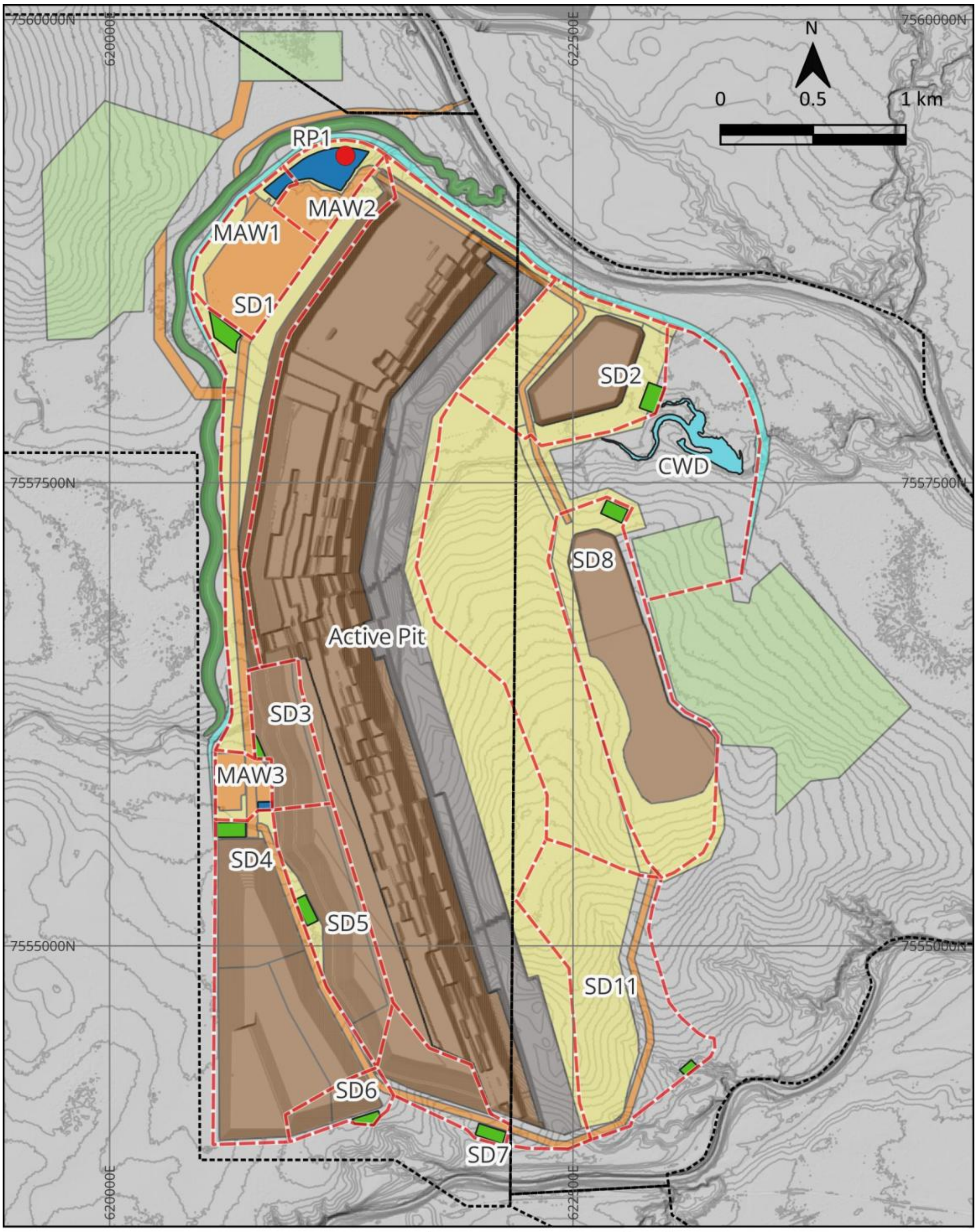
Table 6.1 shows the proposed design standard of operational drainage structures at the Project. Operational drainage controls that are anticipated to last longer than 24 months would be designed to cater for a 20-year Average Recurrence Interval (ARI) design storm to provide effective separation of diverted and sediment water. This may involve a combination of channels and compacted embankments.

Table 6.1 – Drainage design standards for temporary drainage works

Anticipated design life (months)	Design standard (years ARI)
< 12	2
12 to 24	5
> 24	20

6.2.2 Drainage design technique

In accordance with IECA (2008), drainage channels, whether permanent or temporary, should be designed and constructed at a gradient that limits the maximum flow velocity for the adopted design event standard (refer Table 6.1) to a value not exceeding the maximum allowable flow velocity for the given surface material. The principal factor in the selection of drainage control measures is the design discharge peak velocity. In accordance with IECA (2008), drainage channels, whether permanent or temporary, should be designed and constructed at a gradient that limits the maximum flow velocity to a value not exceeding the maximum allowable flow velocity for the given surface material.



Title:	Catchment and Land Use Plan - Phase 4 (Year 6-10)
Project:	Isaac Downs Extension Mine Stage Plans

Legend
- MLA boundary
- Catchment boundary
- Contours (1m interval)
- ReleasePoint

Dam type
- Clean
- MAW
- Sediment

Land use type
- Spoil Dump
- Levee
- ROM / MIA / Access /Haul Roads
- Active Pit
- Drain
- Topsoil Dump
- Cleared/Prestrip

HydroBalance

Figure 6.1 – Conceptual arrangement of the Project sediment drains

The velocity limit for a drain depends on its gradient and the channel material. Channel material needs to be taken into consideration for erosion/scour resistance and Manning's 'n' roughness, which has an impact on velocity. Table 6.2 shows the typical velocity limits for different drainage material.

Table 6.2 – Velocity limits for drain material types (IECA, 2008)

Material types	Velocity limit (m/s)
Sandy/dispersive soil/spoil	0.3
Non-dispersive soil/spoil	0.7
70% grass cover	1.3
100% Grass cover	1.7
Erosion control blankets	1.5
Erosion control mesh/rock check dams	1.7
Rock armour (D50 = 200 mm)	2.0
Rock armour (D50 = 300 mm)	2.5
Rock armour (D50 = 400 mm)	3.5

Excessive flow velocities can cause channel erosion, usually along the invert of the drain, which can then lead to bank slumping and widening of the channel. The flow velocity can be reduced by either:

- reducing the depth of flow (increasing the width of the channel);
- reducing the bed slope;
- reducing the peak discharge (reducing catchment area); and/or
- increasing channel roughness.

If the channel width, depth or gradient cannot be altered, then there are two options for controlling erosion as follows:

- reduce the flow velocity through the placement of rock check dams; and/or
- increase the effective scour resistance in the channel through the placement of an effective channel liner (e.g. rock amour).

6.2.3 Drain velocity control structure

A list of appropriate check dam velocity control structures is given in Table 6.3. Figure 6.2 shows a typical rock check dam configuration.

Table 6.3 – Velocity control structures for channels and drains

Technique	Typical use
Fibre roll[1,2,4]	• Biodegradable logs. • Used in wide shallow drains where logs can be successfully anchored down. • Used in locations where it is desirable to integrate into the vegetation, such as vegetated channels. • Minor sediment trap.
Rock check dams[3,4]	• Used in drains with a depth exceeding 0.5 m and a gradient less than 10%. • Minor sediment trap.

Technique	Typical use
Recessed rock check dams[4]	• Used in wide, high velocity, shallow channels where sandbag check dams would likely wash away. • Recessed into the soil to maintain hydraulic capacity in the channel. • Minor sediment trap.
Sandbag check dams[4]	• Used in shallow drains with a depth less than 50 mm and gradient less than 10%. • These check dams are small and less likely to divert water out of the drain. • Minor sediment trap.
Triangular ditch check[4]	• Commercially available, reusable product. • Commonly used to stabilise newly formed table drains. • Used in drains with less than 10% gradient. • Minor sediment trap.

[1] https://www.austieca.com.au/documents/item/124
[2] https://www.austieca.com.au/documents/item/196
[3] https://www.austieca.com.au/documents/item/82
[4] https://www.catchmentsandcreeks.com.au/docs/CDT-1.pdf

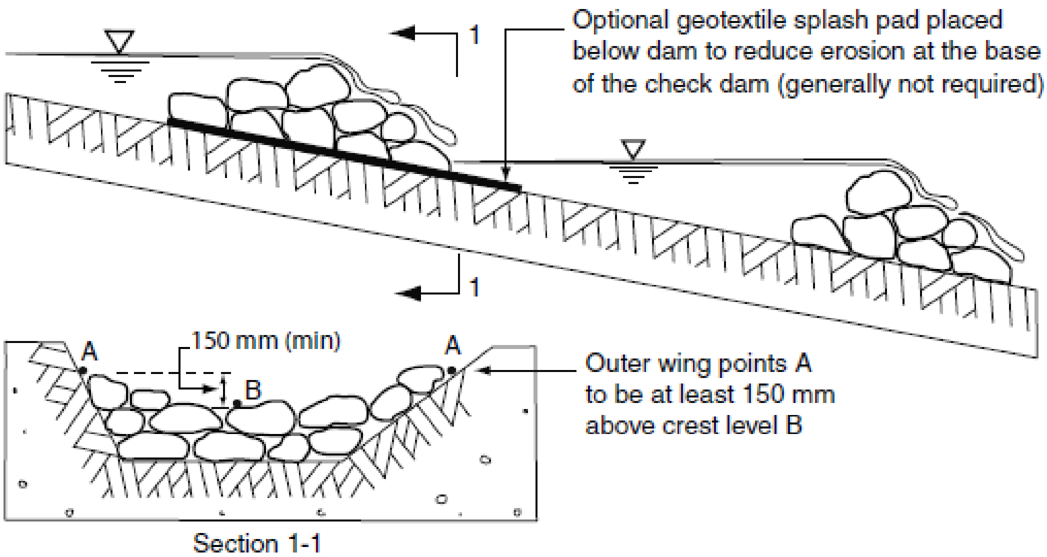


Figure 6.2 – Typical rock check dam configuration (IECA, 2008)

6.2.4 Chute and channel linings

Chutes are typically short in length and steep (greater than 5% slope) and therefore additional erosion protection may be required. A list of appropriate channel and chute linings to provide effective scour protection is given in Table 6.4. Figure 6.3 and Figure 6.4 shows a typical chute configuration.

Table 6.4 – Scour protection and lining types for chutes and channels

Technique	Typical use
Cellular confinement system[1]	• Typically used to stabilise chutes when the only local supply of rock consists of rock smaller than 200 mm. • May be filled with small rocks and grassed to form a permanent reinforced grassed chute.

Technique	Typical use
	• Also used to form a temporary construction access across dry sandy bed streams.
Grass lining[2]	• Permanent protection of low to medium velocity chutes and channels. • Requires suitable growing medium and time to establish.
Hard armouring[3]	• Hard armouring systems include corrugated sheet metal, reinforced concrete and shotcrete.
Rock mattresses[4]	• Suitable high velocity chutes and spillways.
Rock lining[5]	• High velocity drainage channels. • Drainage chutes. • Sediment basin spillways

[1] https://www.catchmentsandcreeks.com.au/docs/E-CCS-1.pdf
[2] https://www.austieca.com.au/documents/item/309
[3] https://www.austieca.com.au/documents/item/311
[4] https://www.austieca.com.au/documents/item/299
[5] https://www.austieca.com.au/documents/item/300

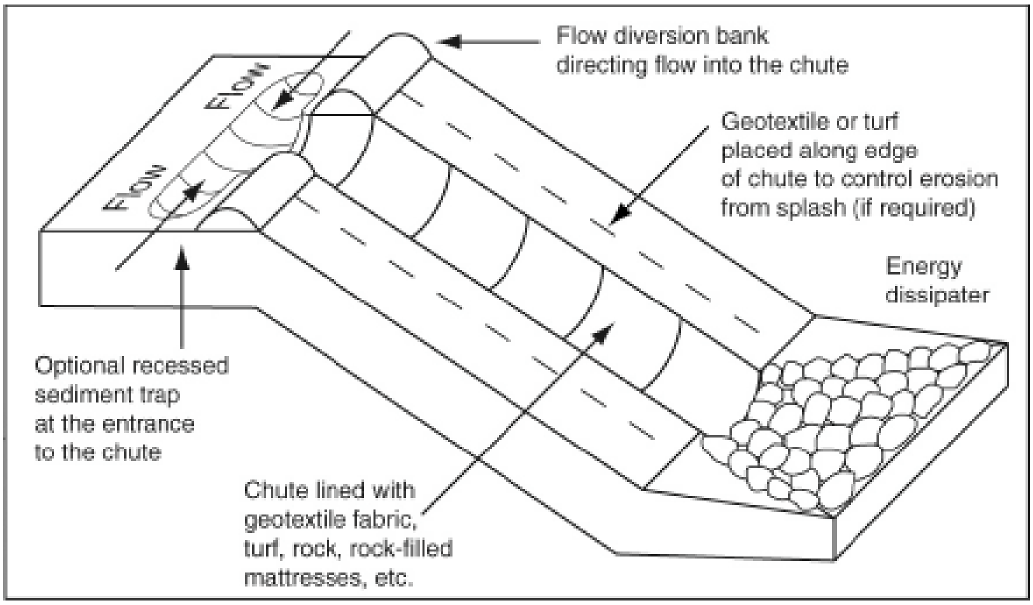


Figure 6.3 – Typical chute configuration (IECA, 2008)

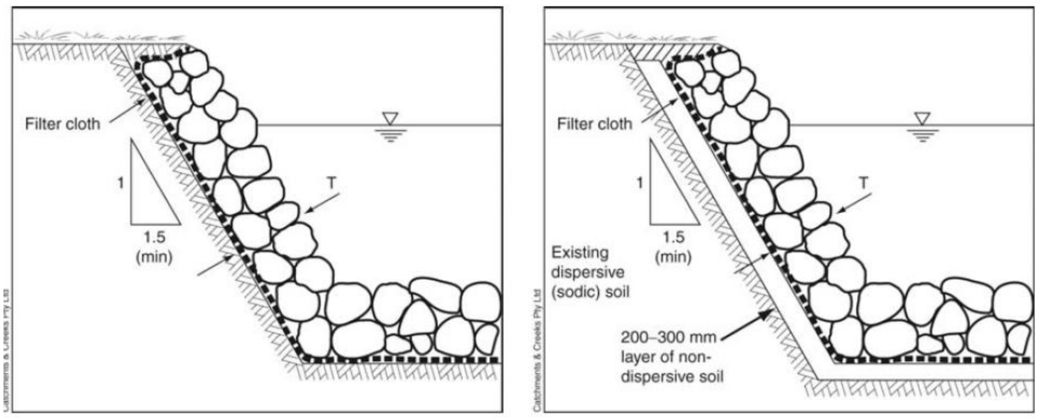


Figure 6.4 – Typical rock placement in a chute (IECA, 2008)

6.2.5 Outlet structures

All drains require an outlet structure, unless they flow directly into a sediment basin. A list of appropriate outlet structures to be used at the end of chutes to provide effective scour protection is given in Table 6.5. Figure 6.5 and Figure 6.6 show a typical level spreader and energy dissipator configuration.

Table 6.5 – Outlet structures for scour protection

Technique	Typical use
Level Spreader[1]	• Conversion of minor concentrated flows back to sheet flow. • Catchments less than 1 hectare or maximum design discharge of 0.85 m3/s. • Level and very gently Inclined slopes.
Energy dissipator (rock protection)[2]	• Used at the end of chute drains to dissipate energy and control scour. • Used as a permanent energy dissipater on pipe and culvert outlets.

[1] https://www.austieca.com.au/documents/item/309
[2] https://www.austieca.com.au/documents/item/307

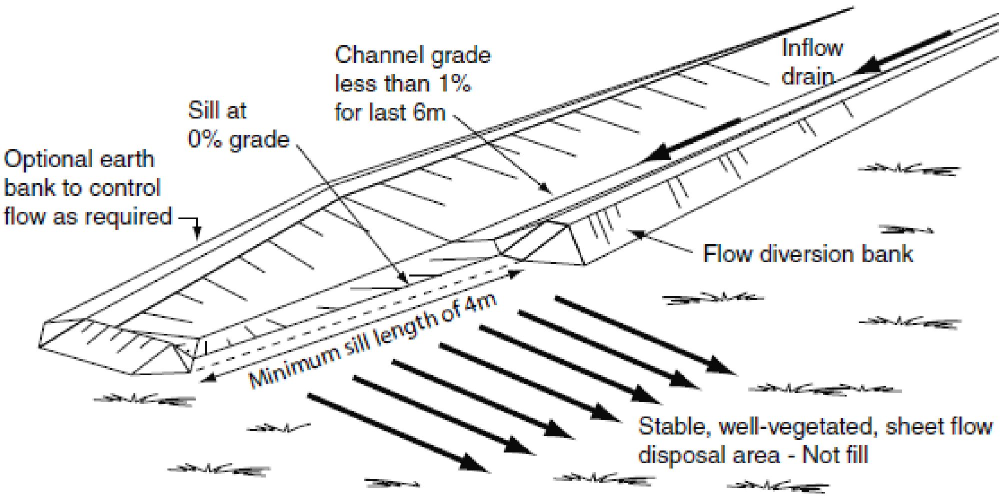


Figure 6.5 – Typical level spreader configuration (IECA, 2008)

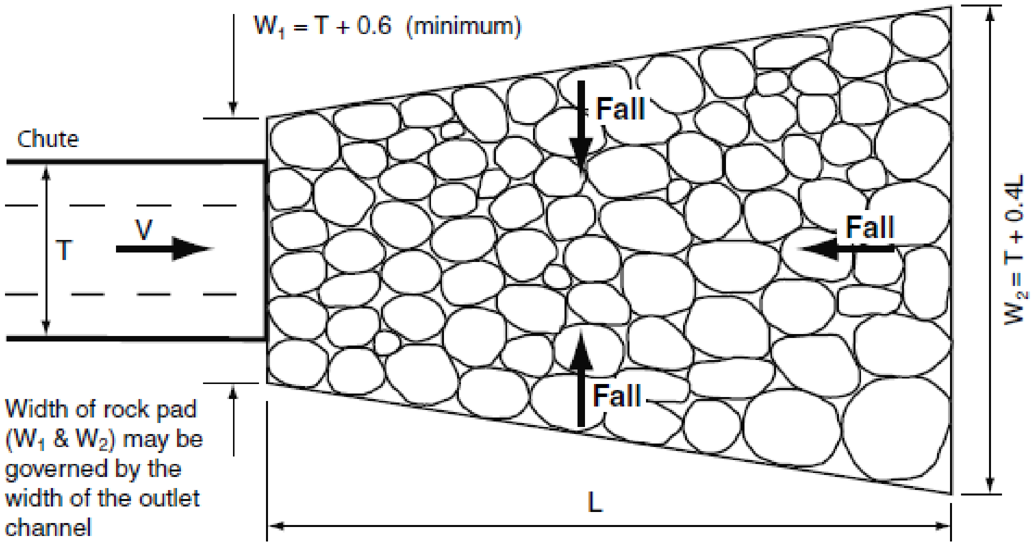


Figure 6.6 – Typical energy dissipater configuration (IECA, 2008)

6.2.6 Drainage control on unsealed roads

The following general principles will be followed in the design of drainage controls for unsealed roads:

- Stormwater runoff from unsealed roads should be allowed to shed at regular intervals. The runoff should be discharged into a sediment trap or released as sheet flow via a level spreader into adjacent grassland.
- Where stormwater runoff from unsealed roads collects within table drains adjacent to the roadway, this water should ideally be discharged from the table drain at regular intervals.
- Where table drains are steep and water cannot shed, such as through a cutting or into a river channel, the controls given in Table 6.3, Table 6.4 and Table 6.5 should be considered.
- When access is required across a slope, the road should be sited as close as possible to the contour of the land. This allows upslope water runoff to pass evenly across the track, thus avoiding concentrated flow.
- When an access road diagonally traverses a slope, the road will likely collect and concentrate upslope stormwater runoff. The collected runoff will need to shed at regular intervals using a level spreader or drainage channels constructed.
- Wherever practical, table drains should form wide U-shaped drains to minimise potential invert erosion. Deep V-shaped drains should be avoided where roads are constructed on steep slopes along a cutting.

6.2.7 Waterway crossings (culvert and bed level crossings)

The following general principles will be followed in the design of drainage controls for culvert and bed level crossings of waterways:

- Culvert designs should always consider the effects of debris blockages and potential erosive forces caused by overtopping flows. Ideally, culverts should have a flow capacity at least equal to the normal channel capacity of the watercourse when the water level is just below the crest of the culvert deck.
- Where possible, crossings of streams should be constructed at right angles to the flow and in locations where the channel is straight and has well defined banks.

- Crossings should be covered with a non-erodible material such as rock or gravel and the upstream and downstream batters should be armoured with rock to control erosion caused by overtopping flows.

Figure 6.7 shows a typical waterway crossing configuration.

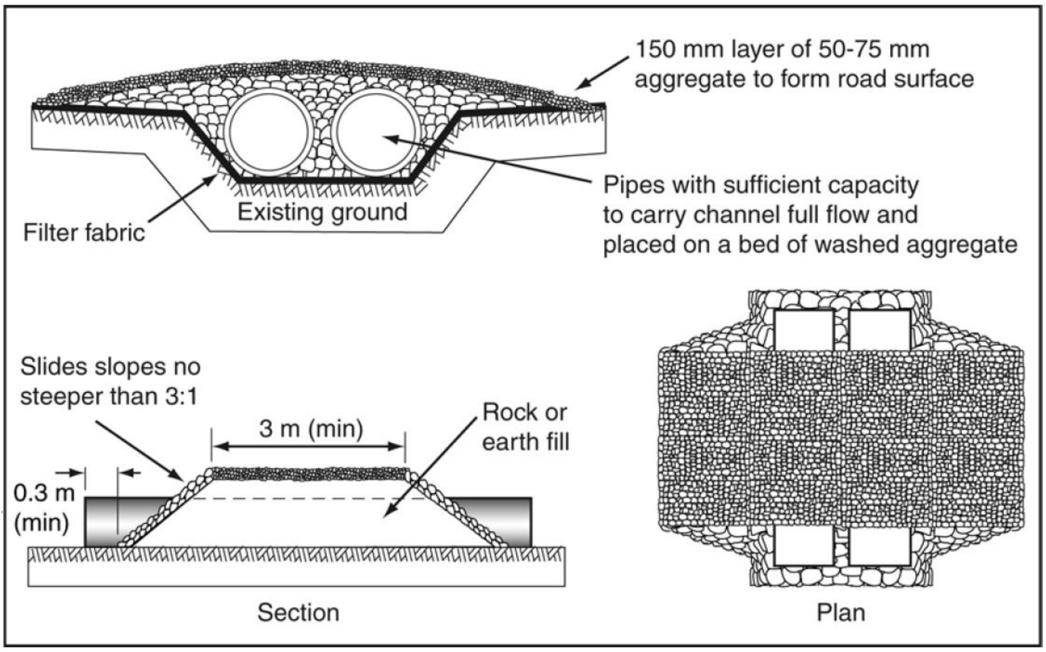


Figure 6.7 – Typical waterway crossing configuration - culverts (IECA, 2008)

6.2.8 Typical drain configurations – channel

The configuration (dimensions) of the upslope catchment drain will be dependent on the upslope catchment area and slope. Drain design can be broken into two categories of low flows and high flows based on the upslope catchment and slope of the drain. The drain should typically contain the following features identified below and shown in Figure 6.8:

- Trapezoidal channel;
- Bank batters of between 1:2 (V:H) and 1:7 (V:H);
- Channel batters at least 1(V):2(H), but preferably 1:4 (V:H);
- Where necessary rock check dams will be used to maintain specified channel grades;
- Channel grades should not exceed 5%;
- Bank bottom widths will vary depending on the adopted bank batters;
- Diversion banks will be constructed to appropriate engineering standards.
- The channel outlet (level spreader) will be flared out to a minimum width of 1.5 x channel base width. Ground slopes below the channel outlet shall be less than or equal to the channel grade; and
- Stable grass cover to be maintained in the bed and banks of the channel and below the channel outlets (as much as possible).

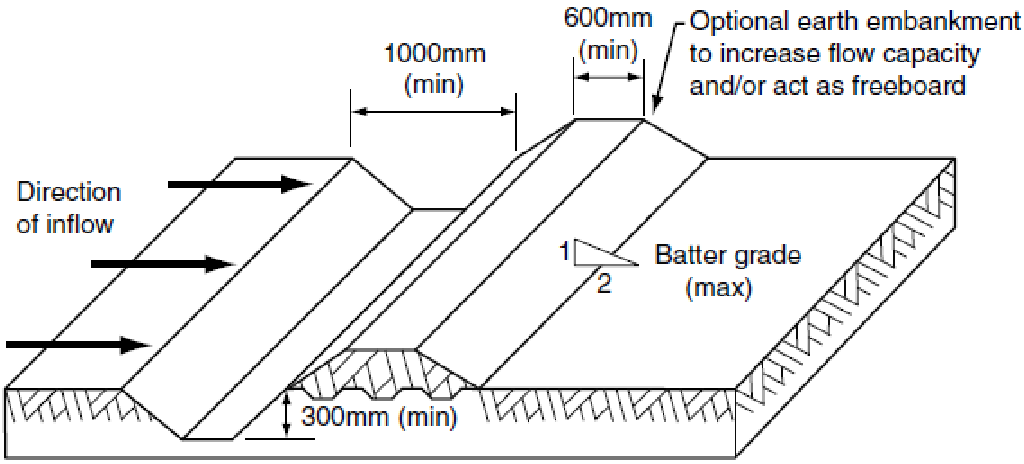


Figure 6.8 – Typical drainage configuration – channel (IECA, 2008)

7 Sediment control measures

7.1 Overview

The primary function of sediment control measures is to trap the coarser sediment fraction. Sediment basins and some filtration systems used during dewatering operations are possibly the only sediment control techniques that have any significant ability to trap finer sediment particles such as silts or clays. Due to the difficulty of trapping these finer sediments, priority should be given to the use of effective erosion control measures wherever practical.

Due to the design of the mine and natural topography, only a limited proportion of the total mine disturbance area drains towards the receiving environment. The majority of the catchments drain internally to the Project WMS. Notwithstanding this, internally draining spoil dumps and other ESC catchments will be managed under the ESC Plan.

There are eleven sediment dams proposed over the Project life-of-mine (LoM):

- SD1 (active from Year 1) – captures runoff from the out-of-pit dump (OOPD) and haul road west of the open cut pit.
- SD2 (active from Year 6) – captures runoff from the North OOPD.
- SD3 (active from Year 1) – captures runoff from the OOPD west of the open cut pit.
- SD4 (active from Year 1) – captures runoff from the Southwest OOPD.
- SD5 (active from Year 1) – captures runoff from the OOPD west of the open cut pit.
- SD6 (active from Year 1) – captures runoff from the Southwest OOPD.
- SD7 (active from Year 1) – captures runoff from the OOPD and haul road at the southern extent of the mining area.
- SD8 (active from Year 6) – captures runoff from the East OOPD.
- SD9 (active from Year 16) – captures runoff from disturbed catchment in the vicinity of the proposed Pumped Hydro Dam..
- SD10 (active from Year 2) – captures cleared/prestrip areas ahead of mining.
- SD11 (active from Year 2) – captures cleared/prestrip areas ahead of mining.

The location of the proposed sediment dams is shown in Figure 7.1. Additional minor sediment control structures will be constructed as part of the out of pit dump development.

Final design and sizing of the proposed sediment dams will be undertaken by the mining contractor. This will include details of ESC controls during the construction phase of the Project.

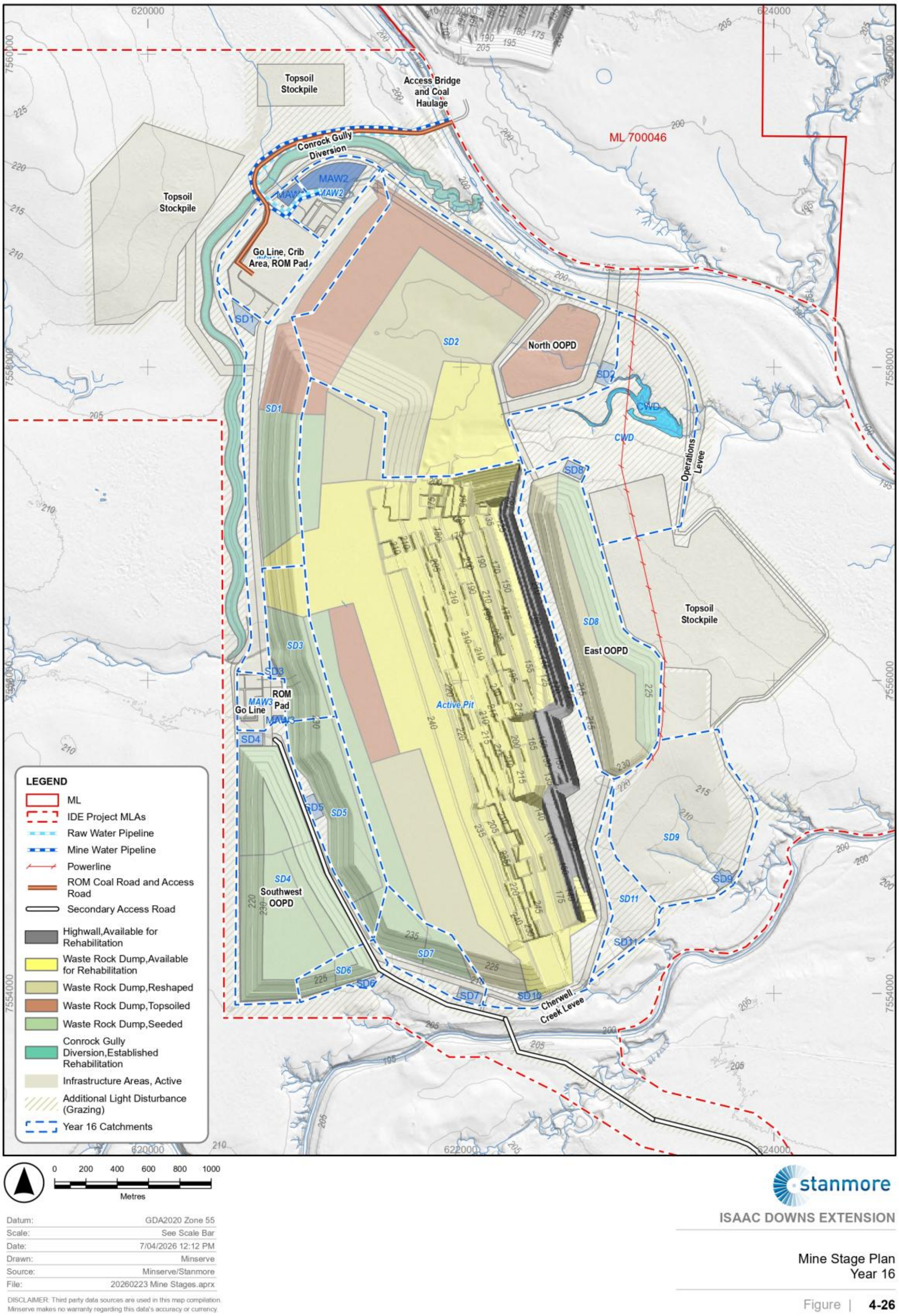


Figure 7.1 – Proposed Project sediment dams

7.2 Sediment control techniques

7.2.1 Primary controls – sediment dams

7.2.1.1 Proposed sediment dams

The proposed sediment dams have been sized in accordance with the IECA method (IECA, 2018), and have been based on the following design standards and methodology:

- "Type D" sediment dams;
- Total sediment dam volume = settling zone volume + sediment storage volume (shown in Figure 7.2). The sediment storage volume is the portion of the dam storage volume that progressively fills with sediment until the dam is de-silted. The settling zone is the minimum required free storage capacity that must be restored within 5 days after a runoff event.
- sediment dam settling volume based on 95th percentile 5-day duration rainfall (77.0 mm) with an adopted volumetric event runoff coefficient for disturbed catchments of 0.69 (Group C soils – loamy clay); and
- solids storage volume = 50% of settling zone volume.

Sediment dams are not intended to be full containment storages, and the adopted design standard does not provide 100% containment for runoff from disturbed areas. It is likely overflows will occur from sediment dams if rainfall exceeds the design standard. Further, the water collected by the sediment dams could be captured and retained for reuse on-site where possible (e.g. dust suppression) if water quality is suitable for the intended use, or pumped back to IDM via pipeline.

It should be noted that six of the eleven sediment dams overflow internally to the Project WMS, rather than the receiving environment, as follows:

- SD1 – overflows to MAW1.
- SD2 – overflows to CWD.
- SD3 – overflows to the remnant Conrock Gully channel. If this occurs, mobile pumps would be used to dewater the channel back to MAW2.
- SD4 - overflows to the remnant Conrock Gully channel. If this occurs, mobile pumps would be used to dewater the channel back to MAW2.
- SD5 – overflows to SD6.
- SD8 – overflows to CWD.

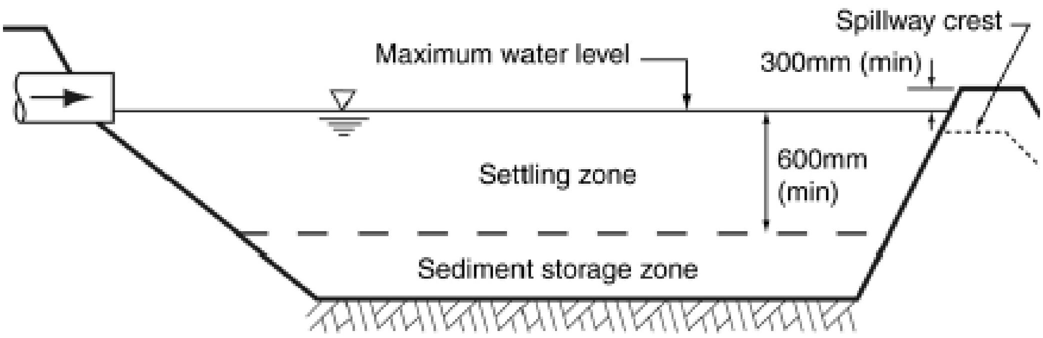


Figure 7.2 – Typical Type D sediment dam cross section (IECA, 2008)

A summary of the proposed sediment dam capacities and surface areas is provided in Table 7.1.

Table 7.1 – Proposed sediment dam capacities and surface areas

Dam name	Maximum catchment area (ha)	Settling volume (ML)	Solids storage volume (ML)	Total capacity (ML)
SD1	94.9	16.8	8.4	25.2
SD2	238.8	42.2	21.1	63.3
SD3	30.0	5.3	2.7	8.0
SD4	95.7	16.9	8.5	25.4
SD5	42.7	7.6	3.8	11.3
SD6	11.9	2.1	1.1	3.2
SD7	25.1	4.4	2.2	6.7
SD8	100.9	17.8	8.9	26.8
SD9	96.8	17.1	8.6	25.7
SD10	78.7	13.9	7.0	20.9
SD11	84.7	15.0	7.5	22.5

7.2.2 Supplementary sediment control techniques

Supplementary sediment controls are used in areas where the sediment producing catchment is small or the potential for producing sediment laden runoff is low. A list of appropriate primary and secondary supplementary sediment control techniques is given in Table 7.2.

These supplementary sediment control techniques may be applied to the overburden dump, however they are more likely to by suitable to be implemented to assist with sediment control from the haul roads and topsoil stockpiles.

Table 7.2 – Summary of supplementary sediment control techniques

Technique	Typical use
Rock filter dam[1]	• Locations where there is sufficient room to construct a relatively large rock embankment. • The incorporation of a filter cloth is the preferred construction technique if the removal of fine-grained sediment is critical (high maintenance).
Check dam sediment trap[2]	• Supplementary sediment trap in minor concentrated flow areas. • Trapping sediments in table drains and minor drainage lines. • Check dams may be constructed of rock, sand bags or compost filled socks.
Buffer zones/ grass filter strips[3]	• Mostly suited to sandy soils. • Can provide some degree of turbidity control while the buffer zone remains unsaturated.
Sediment fence[4]	• Supplementary device for sheet flow from minor catchment areas. • Suitable for all soil types. • Require maintenance after every runoff event.

1 https://www.austieca.com.au/documents/item/270
2 https://www.austieca.com.au/documents/item/247
3 https://www.austieca.com.au/documents/item/246
4 https://www.austieca.com.au/documents/item/277

7.3 Technical notes

The following technical notes are adopted from IECA (2008) to provide general guidelines that should be followed for correct implementation of sediment controls:

- Every opportunity should be taken to trap sediment within the site, and as close as practicable to its source.
- The potential safety risk of a proposed sediment trap to site workers and the public must be given appropriate consideration, especially those devices located within publicly accessible areas – Hazardous Structure assessments must be completed where necessary in accordance with the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures* (DES, 2016).
- All reasonable and practicable measures must be taken to prevent, or at least minimise, the release of sediment from the site.
- Suitable all-weather maintenance access must be provided to all sediment control devices.
- Materials, whether liquid or solid, removed from sediment control devices during maintenance or decommissioning, must be disposed of in a manner that does not cause ongoing soil erosion or environmental harm.
- Settled sediment must be removed from sediment basins when the volume of the sediment exceeds the designated sediment storage volume, or the design maximum sediment storage elevation.

8 Construction

8.1 Overview

Disturbance activities will be conducted in accordance with Stanmore's administrative processes that will guide the implementation of ESC, including:

- Permit to Disturb;
- Internal projects standards;
- Project-specific approvals; and
- Inspections.

ESC measures should be put in place prior to disturbance to reduce sediment laden stormwater discharging to the receiving environment. The scheduling and timing of works is an important element of any construction activity. ESC measures shall be designed and constructed by suitably qualified and experienced persons.

8.2 Construction timing

Table 8.1 shows the risk rating and the required action for the construction timing based on the median monthly rainfall.

Table 8.1 – Risk rating based on median monthly rainfall during construction period

Risk rating	Median monthly rainfall (mm)	Months	Action
Low	< 25mm	April, May, June, July, August, September, October	Catchments with low erosion risk don't need sediment controls if disturbance is less than 3 months
Medium	25 <> 70 mm	March, November	Normal ESC Planning
High	> 70 mm	January, February, December	Reschedule work where possible
			No work within a watercourse
			Sediment basins required if disturbance is greater than 1 ha

8.3 Construction records and management of change

- Management of change process is to be followed for the construction of ESC infrastructure.
- Each sediment basin and drain shall be registered in the Project's planning records with a functional location as part of management of change.
- Construction designs, records, testing, operational rules, as-built survey, basis of design and other engineering documentation are to be saved against the functional as a minimum.
- Inspection regimes are to be setup as part of Project close out and prior to handover to operations.

9 ESC planning

The key area of ESC planning for the Project is associated with the overburden dumps. Other areas include the haul roads and topsoil stockpiles. While this document covers proposed ESC measures for the Project, it is possible that any changes to the proposed layout during the detailed design and construction phase may require a review of the ESC controls.

The following section outlines the typical planning process for ESC, from the initial decision process through to implementation and decommissioning of works.

9.1 ESC decision process

The following outlines the steps required to determine the applicable ESC techniques for a catchment:

1. Identify the ESC catchment boundary and outlet;
2. Define the land disturbance associated with where the control measure will be implemented (catchment area, area of disturbance, soil type, slope, duration of disturbance etc.)
3. Determine if the catchment will be able to implement erosion controls during operations:
   a. spoil emplacement will consider erosion controls; and
   b. peripheral areas such as laydown areas can be stabilised through gravel pads etc.
4. Determine if a diversion drain is required and if any drainage controls are required:
   a. short term sediment controls shall be installed until the diversion drain is stabilised;
5. Conceptually align and size drainage:
   a. the drain material type, length, catchment area and bed slope are required to conceptually size the drain; and
   b. the conceptual sizing is used to determine the drain peak velocity and depth which determines if additional drainage controls (or an alternate material type) is needed.
6. Determine what type of sediment control is required:
   a. the catchment area and design rainfall depth are required to conceptually size the sediment basin;
   b. an assumed dam depth of at least 3 m should be used to conceptually size the basin footprint;
   c. the 5-day pump rate is calculated which is applicable to dewater Type D sediment basins; and
   d. the outlet should be located where it will not cause erosion or impacts to operational areas.
7. Prepare a plan of the area identifying the adopted techniques and document the measures within GIS that shows the following information:
   a. significant landmark/project boundary;
   b. general soil description;
   c. existing and final contours - including location of spoil dump or topsoil stockpiles;
   d. existing and final drainage paths;
   e. limits of clearing where applicable;
   f. location of vegetated buffer strips;
   g. haul roads and light vehicle tracks;
   h. location of all proposed temporary drainage control measures;
   i. location of all proposed erosion and sediment control measures; and
   j. details on installation sequence/
8. Implement maintenance requirements and inspection regime using an ESC Inspection Proforma.

9.2 Installation sequence

The sequence for installation of ESC measures should occur as follows:

1. Establish the entry and exit points;
2. Divert upslope catchment around the planned disturbance and appropriately stabilise any drainage channels (and supplementary sediment control structure/s if required);

3. Install sediment control structure/s;
4. Construct drainage controls to the sediment control structure/s;
5. Clear only areas approved under the site disturbance permit;
6. Stockpile soil within the sediment-controlled area;
7. Stabilise exposed earth with erosion control structures where possible;
8. Commence works;
9. Maintain all control structures in good working order; and
10. Revegetate or otherwise stabilise the site (not applicable to overburden dump during operations period).

9.3 Decommissioning sequence

Decommissioning of ESC measures is part of returning the site to a natural landform which is safe, stable and non-polluting. The objective of decommissioning is to remove the operational structures and establish revegetation. The sequence for decommissioning of ESC measures should occur as follows:

1. The catchment shall have achieved at least 80% ground cover (IECA, 2008) as determined by annual rehabilitation monitoring;
2. Decommission all up-slope drainage controls (contour banks and drop structures) and revegetate;
3. Once vegetation is established on the decommissioned up-slope drainage, decommission the catchment boundary drains (toe drains);
4. De-water the sediment basins and remove any sediment from the sediment storage zone;
5. Decommission the sediment basin, by removing walls, filling any voids and revegetating the disturbance area. The sediment basin shall not be able to contain water; and
6. Continue rehabilitation monitoring of the decommissioned ESC measures and conduct maintenance of the rehabilitation as required.

9.4 ESC criteria

The decision as to which combination of ESC measures will be adopted lies with the site general manager with input from the Environmental representative onsite and the contractors. The decision will be based on several factors as follows:

- site topography;
- material / soil / surface / strata type – where the control measure will be implemented and downstream of the control measure;
- current disturbance category;
- site specific constraints e.g. proximity of local watercourse;
- length of time that area will remain at this disturbance category;
- overall purpose of implementing ESC at a particular location; and
- applicability of ESC measure as per ESC Matrix.

The selection criteria that should be applied when choosing the most appropriate ESC measure(s) are (refer IECA, 2008):

- applicability to the full range of site conditions considered reasonable (construction phase and operational phase of ESC measure);
- availability of materials from onsite operations;
- cost-effectiveness based upon overall life of the work involved;
- durability in relation to hydraulic and structural design during the life of the control measure performance in relation to purpose and control standard requirements; and
- performance in relation to purpose and control standard requirements.

9.5 ESC matrix

Table 9.2 shows a matrix of land uses and ESC measures developed to assist in determining which ESC measure may be applicable. Not all ESC measures will be applicable to the relevant land use type.

This tool for selecting appropriate ESC measures is based on:

- the phase of the site (operational, non-operational or construction);
- land use type, adjacent land usage / classification and proximity to watercourses; and
- level of priority in providing ESC measures.

Where multiple ESC measures can be applied to the same situation, the Environment representative shall be consulted. Once an ESC measure has been selected from the matrix, reference can be made to the IECA (2008) guidelines, which summarise design aspects for each of the ESC measures.

9.6 ESC implementation

The site should maintain a GIS layer showing the area within each ESC Catchment Plan to demonstrate that all surface and diverted water within the Project area is covered. The ESC Catchment Plan should be given a unique number which is listed on both the Plan and the electronic file holding each Plan. The ESC Catchment Plan will be prepared listing all ESC structures within the area. These assets will be located in a GIS map and a unique identification number (asset number) will be given to them.

9.7 ESC inventory register

An asset register database will be prepared for all ESC structures at the site. These assets will be located in a GIS map and a unique identification number (asset number) will be given to them.

9.8 Performance indicators

To assess and determine the effectiveness of ESC management on site, the performance indicators defined in Table 9.1 should be adopted.

Table 9.1 – Performance indicators

Parameter	Performance indicator
Compliance is maintained with EA conditions	ESC Plan developed and implemented in accordance with the EA. Records of monitoring and inspections are maintained.
Community complaints	No Complaints received regarding ESC impacts. Any complaints received related to erosion and sediment impacts will be recorded and investigated in accordance with the EA and Stanmore event reporting and investigation requirements.
Visual Inspections	Sediment basins must not contain water that has visual or odour evidence of slick, hydrocarbons and/or coal.

Table 9.2 – ESC matrix

ID	Phase (O = Operational; N = Non-operational;	Landuse type	ESC Priority (L= low, M = Medium, H = High, HH = top	Drainage control									Erosion control							Sediment control				
				Catch Drains	Check Dams (incl. fibre rolls)	Grass	Cellular Confinement systems	Hard Armouring	Rock Mattress	Rock Lining	Level Spreader	Rock Protection	Cellular Confinement systems	Compost Blanket	Gravelling	Mulching	Revegetation	Rock Mulch	Soil Binders	Rock Filter Dam	Check Dam Sed. Trap	Sediment Basin	Buffer Zone	Sediment Fence
1	O	Spoil - Draining Externally	HH	✓									✓	✓	✓	✓	✓	✓	✓			✓		
2	O	Spoil - Draining Internally	M	✓	✓											✓						✓		
3	O	Spoil Topsoiled (to be revegetated)	H	✓	✓											✓	✓		✓	✓	✓	✓	✓	✓
4	O	Spoil Topsoiled, ripped and seeded	L	✓	✓	✓														✓	✓	✓	✓	✓
5	O	Topsoil stripping area	M	✓	✓											✓				✓	✓	✓	✓	✓
6	O	Topsoil Stockpiles	M	✓	✓	✓								✓	✓	✓	✓			✓	✓	✓	✓	✓
7	O	Exploratory and access tracks	M	✓	✓	✓	✓				✓		✓		✓	✓	✓	✓	✓	✓	✓		✓	✓
8	O	Haul Roads	H	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓					✓	✓	✓	✓	✓
9	O	Infrastructure Areas	L	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓	✓	✓	✓	✓	✓
10	N	Exploration Activity	M	✓	✓	✓	✓				✓			✓	✓	✓	✓		✓	✓		✓	✓	✓
11	C	Land clearing (woody vegetation)	M	✓	✓						✓					✓				✓		✓	✓	✓
12	O	Drainage channels	HH	✓	✓	✓	✓	✓	✓	✓	✓	✓								✓				
13	N	Licenced stream diversions / Levees	H			✓	✓	✓	✓	✓		✓					✓	✓						
14	C	Construction / excavation work	M	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓

10 Monitoring and emergency reporting

10.1 Monitoring and maintenance inspections

An effective monitoring program is recommended to assess the effectiveness of the ESC measures. The monitoring methodology for all onsite activities is detailed in the license or conditions of the approval to operate and the internal processes at the Project.

Maintenance and routine inspection options are:

- Prior to 1 November each year (prior to onset of wet season);
- After each significant rainfall event that may have impacted the functionality of the ESC measure; and
- A routine inspection mid-way through the wet season (e.g. February).
- For sediment control structures (e.g. sediment dams), check for sediment deposition and the requirement for its removal.

The ESC Inspection sheet should state the maintenance and inspection frequency. The inspection and monitoring regime should collect and record the following key information:

- The previous condition of the infrastructure and any recommendations or works actioned since the last inspection;
- The current condition of the ESC infrastructure;
- The ESC controls currently in place, and their condition; and
- Recommendations on remedial measures or additional ESC controls.

Any failure of effectiveness of a structure will be reported to the Senior Environmental Advisor. The implementation plan should include the recommendations for the incident report.

10.2 Incident reporting procedures

Incident reporting procedures will be managed in accordance with the site environmental management system.

10.3 Revisions and updates

This ESC Plan is to be reviewed by an appropriately qualified person each calendar year and regularly updated to ensure it remains current in relation to applicable reference documents, ESC techniques and application.

11 References

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QLD Government, 2011	*Environmental Protection (Water) Policy 2009: Isaac River Sub-basin Environmental Values and Water Quality Objectives – Basin No. 130 (part), including all waters of the Isaac River Sub-basin (including Connors River).* September 2011. Department of Environment and Resource Management, Queensland Government.
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