WHITEHAVEN COAL

ABN: 69 107 169 102

Werris Creek Coal Pty Limited

SURFACE WATER ASSESSMENT

for

Werris Creek Coal Mine Life of Mine Project

Prepared by

GSS Environmental

Specialist Consultant Studies Compendium
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December 2010

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Life of Mine Project

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EXECUTIVE SUMMARY

An application for project approval under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) is to be submitted and assessed to permit the northerly expansion of the Werris Creek Coal Mine to recover the remaining coal within the mining lease (the Life of Mine or LOM Project). R.W. Corkery and Co Pty Limited (RWC) have been engaged by Werris Creek Coal Pty Ltd (WCC) to prepare the *Environmental Assessment*. GSS Environmental (GSSE) was subsequently engaged to prepare a *Surface Water Assessment* to fulfil the requirements detailed in the Director-General's Requirements for the LOM Project.

The key aspects addressed within this *Surface Water Assessment* include the identification of potential surface water impacts as a result of the LOM Project and a description of the proposed mitigation and management measures to be implemented to address these potential impacts. This *Surface Water Assessment* also addresses licensing requirements, surface water monitoring and the development of a site water balance which includes a discussion on water sources, water security and predicted discharges from site.

A number of surface water management and mitigation measures are recommended by this *Surface Water Assessment* to ensure that the potential risk of any adverse off-site surface water impacts is minimised. This includes directing dirty water runoff into suitability sized sediment basins, preferential use of void water and dirty water from 'end-of-line' basins and the use of chemical flocculants to help increase settlement times. All on-site treatment of water, including any discharge off the Project Site, would be undertaken to ensure that the water quality criteria within the Environmental Protection Licence are met.

Available soil and water data for the Project Site suggests that total suspended solids (TSS) is likely to be the key water quality parameter requiring management to ensure the water quality in downstream watercourses is not impacted.

The results of the water balance indicate that during wet years the LOM Project may generate excess void water (except in Year 12 operations) which may not immediately be re-used at the Project Site as part of normal operations. This excess void water would be maintained on site within the void water storage system for reuse at a later date. The water balance shows that during all years there is likely to be an excess of dirty water which would require to be discharged following appropriate treatment.

If the surface water management and mitigation measures identified and discussed within this *Surface Water Assessment* are implemented and maintained, it is anticipated that there would be minimal impact on surface water downstream as a result of the proposed Werris Creek Coal Mine LOM Project.

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1. INTRODUCTION

1.1 PROJECT OVERVIEW

Werris Creek Coal Pty Limited ('the Proponent') currently operates the Werris Creek Coal Mine, located approximately 4 kilometres (km) south of the town of Werris Creek in the Liverpool Plains local government area. The Werris Creek Coal Mine is operated within Mining Lease (ML) 1563 on land owned by the Proponent. The location of the Werris Creek Coal Mine in relation to the town of Werris Creek is shown on **Figure 1**. Development Consent (DA-172-7-2004) for the existing open cut mining operation was granted in February 2005 and construction activities (as defined in the Development Consent) commenced in April 2005. The coal resource is currently mined using truck and excavator methods, producing up to 2.0 million tonnes per annum as raw coal for the export and domestic markets. The coal is transported directly by rail from the Werris Creek Coal Mine to the Port of Newcastle or via public roads to domestic markets.

On the 6th of October 2009, the Minister for Planning issued a modification (MOD 5) to DA 172-7-2004 to enable a small extension to the existing open cut operations to the north and allow for the dewatering of the underground workings associated with the former Werris Creek Colliery (Northern Extension). The proposed modification was made with the understanding that it would allow for a further extension of the mine to the north to fully recover the "life of mine" (LOM) resource.

Following an extensive exploration program to the north of the currently approved operations, a geological model of the coal seams has been developed and the extent of the LOM resource has been defined. The Proponent is proposing to extend the Werris Creek Coal Mine to the north to recover this LOM resource ('the LOM Project'). For the purposes of this document, the LOM Project would involve the following.

- Northerly extension of the approved open cut. The proposed extent of the open cut represents mining of the remaining Werris Creek outlier of the Greta coal measures, as defined by the sub-crop of the basal G Seam.
- An extension to the out-of-pit and in-pit overburden emplacements. The additional volume of overburden removed from the open cut would be placed over the current footprint of the Coal Processing Area and Site Administration and Facilities Area (out-of-pit emplacement) and extend north over the completed sections of the open cut (in-pit emplacement). In order to attenuate noise impacts and screen the operation visually from the town of Werris Creek, the overburden emplacement would extend around the eastern and north-eastern perimeter of the open cut. This extension of the overburden emplacement is referred to as the Acoustic and Visual Amenity Bund.
- Relocation of the Coal Processing Area and an increase in the size of the ROM stockpile to 200,000 t.
- Production of up to 2.5Mtpa of thermal and Pulverised Coal Injection (PCI) coal for the domestic and international markets. To improve operational flexibility, an increase in the approved hours of operation to 24 hours, 7 day per week is proposed.
- An increase in the road transport of coal to domestic markets to 100 000tpa (from 50 000tpa) to meet the needs of local customers for low ash coal.

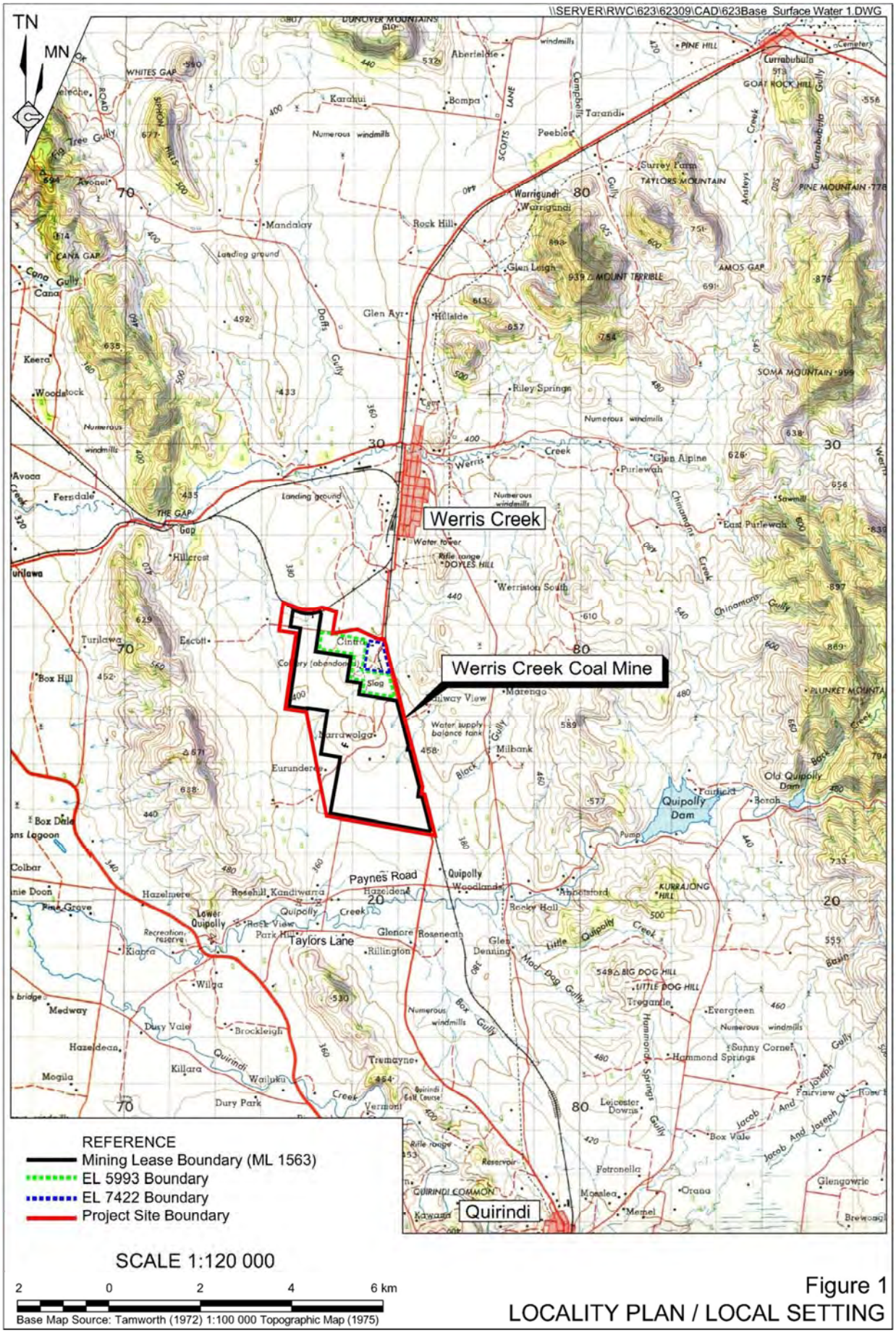


Figure 1
LOCALITY PLAN / LOCAL SETTING

- Relocation of the Site Facilities and Administration Area.
- Increase the size of the Product Coal Storage Area to 250,000 t by extending the pad to the east.
- Installation of a second feed point at the Rail Load-out Facility.
- Construction of a 'turn-around' rail loop off the Werris Creek Rail Siding to the immediate west of the Rail Load-out Facility.
- Construction of a new mine entrance off Escott Road (and closing the existing mine entrance off the Werris Creek Road).
- Continued dewatering of the old underground workings.
- Construction of a new Void Water Dam at the northern end of the Project Site.
- Possible construction of a conveyor to transport coal from the Coal Processing Area to the Product Coal Storage Area.

Figure 2 shows the current mining lease area and the proposed extension of the open cut operations. It also defines the Project Site boundaries utilised in this *Surface Water Assessment.*

R. W. Corkery & Co Pty Limited (RWC) has been engaged by Werris Creek Coal Pty Ltd (WCC) to undertake an *Environmental Assessment* (EA) of the proposed LOM Project for the Werris Creek Coal Mine. This EA will accompany an application for project approval to be submitted to the Department of Planning under Part 3A of the *Environmental Planning and Assessment Act 1979 (EP & A Act)*. The following *Surface Water Assessment* has been prepared as part of the requirements for the EA.

1.2 METHODOLOGY AND SCOPE OF THIS REPORT

The key aspects addressed within this *Surface Water Assessment* are as follows.

- The collation of relevant data, including meteorological (rainfall events), surface water flow regime (water quality and quantity), catchment characteristics, surface water features and surrounding land uses. Information has been collected from a literature review of the Werris Creek Coal Mine and NSW government records, and from site inspections undertaken on the 10th and 11th of May 2010 by Tara Pagnutti and Chad Stockham (GSSE).
- The identification of the key issues, relevant assessment criteria and constraints relating to surface water.
- The existing controls for management of surface water at the Werris Creek Coal Mine.
- The proposed surface water management measures to be implemented throughout the LOM Project.
- The recommended safeguards and mitigation measures to be implemented to ensure that potential surface water impacts are managed and appropriate criteria are met.
- An updated site water balance, based on a water balance previously completed for the site (GSSE, 2009b).
- Recommendations for ongoing surface water monitoring.

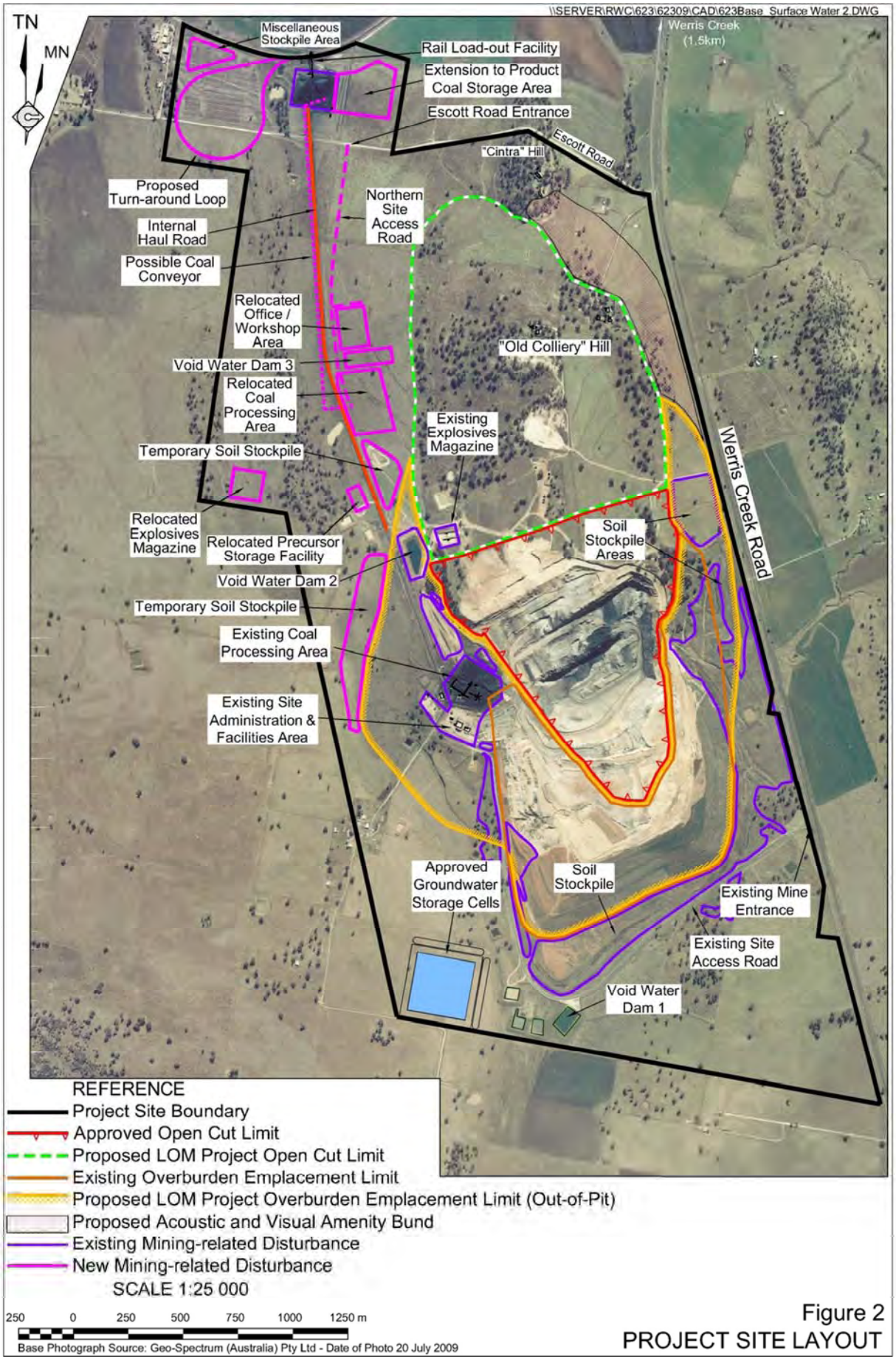


Figure 2
PROJECT SITE LAYOUT

This document fulfils the requirements detailed in the Director-General's Requirements (DGRs) relating to the preparation of a *Surface Water Assessment* for the LOM Project, as discussed in Section 2.

1.3 STUDY AREA

The Study Area for this Surface Water Assessment is shown on **Figure 2** and is the same as the Project Site. Hence, the Study Area for this assessment is referred to as the Project Site in this report. Notwithstanding this, the *Surface Water Assessment* has also taken into consideration the catchment areas that report to the Project Site from the neighbouring land. The existing mine site, as defined by DA-172-7-2004 and ML1563, is referred to as the Existing Mine Area in this report. This boundary is also shown in **Figure 1** for reference.

1.4 OBJECTIVES

The key objectives of surface water management for the Werris Creek Coal Mine LOM Project, as addressed in this assessment, are as follows.

- To prevent of the flow of sediment into watercourses and the flow-on impact of sedimentation on receiving waters, being Quipolly Creek and Werris Creek.
- To control of surface flows on rehabilitated areas to ensure minimal soil loss and to maintain adequate soil moisture for plant growth.
- To control of discharges from the Project Site and to ensure that all discharges are within the water quality criteria set out in the Environmental Protection Licence (EPL).
- To prevent of the inflow of water into the active work area wherever possible.
- To ensure site water usage requirements minimise the reliance on groundwater and clean water runoff.
- To ensure there is sufficient water available to meet LOM Project water requirements.

1.5 LITERATURE REVIEW

The following LOM Project specific documentation has been reviewed by GSSE as part of the *Surface Water Assessment*.

- Surface Water Assessment, Proposed Werris Creek Coal Mine prepared by Department of Lands - Soil Services (August 2004).
- Environmental Impact Statement for the Proposed Werris Creek Coal Mine prepared by R.W. Corkery & Co Pty Limited (August 2004)
- Werris Creek Coal Mine - Site Water Management Plan prepared by GSS Environmental, as updated by Werris Creek Coal (March 2009).
- Werris Creek Drainage Re-Design for the Southern Dump Area, Letter report prepared by GSS Environmental (9th March, 2009).
- Water Balance Review and Update 2009, Letter report prepared by GSS Environmental (29th, January 2009).

- Preliminary Environmental Assessment for the Werris Creek Coal Mine Life of Mine Project Prepared by R.W Corkery & Co. Pty. Limited (April 2010).
- Werris Creek Coal Pty Limited. Surface Water and Groundwater 2007/2008 Monitoring Annual Review Werris Creek, NSW prepared by GeoTerra Pty Ltd. (May 2008).
- Werris Creek Coal Pty Limited. Surface Water and Groundwater 2008/2009 Monitoring Annual Review Werris Creek, NSW prepared by GeoTerra Pty Ltd. (May 2009).
- Werris Creek Coal Pty Limited. Surface Water and Groundwater 2009/2010 Monitoring Annual Review Werris Creek, NSW prepared by GeoTerra Pty Ltd. (May 2010).
- Groundwater Assessment prepared by RCA Australia (August 2004).
- Numerous laboratory results for surface water quality samples taken during 2008, 2009 and 2010.
- Werris Creek Coal Life of Mine Project - Soils Assessment prepared by GSS Environmental (2010).

A full list of references used for the development of this *Surface Water Assessment* is contained in Section 11.

2. DIRECTOR-GENERAL'S REQUIREMENTS

The Director-General's Requirements (DGRs) for the LOM Project were provided in a letter from the Department of Planning (DoP) on 29th June 2010. **Table 1** provides a summary of the DGRs and the related Environmental Assessment Requirements (EARs) provided by other government agencies relating to surface water. Both tables indicate where specific issues have been addressed within this document.

Table 1
Summary of DGRs and EARs relevant to Surface Water Assessment

Page 1 of 6

Agency	Details of Requirements	Location in document where addressed
Department of Planning	**General**	
	The Environmental Assessment of the project must include: - a detailed description of the project, including for various stages of the mine - a detailed assessment of the key issues specified below, and any other significant issues identified in the risk assessment which	1

Table 1 (cont'd)
Summary of DGRs and EARs relevant to Surface Water Assessment

Agency	Details of Requirements	Location in document where addressed
Department of Planning (cont'd)	**General (cont'd)**	
	includes: - a description of the existing environment, using sufficient baseline data; - an assessment of the potential impacts of the project, including any cumulative impacts, taking into consideration any relevant guidelines, policies, plans and statutory provisions (see below); and - a description of the measures that would be implemented to avoid, minimise and if necessary, offset the potential impacts of the project, including detailed contingency plans for managing any significant risks to the environment;	3 6.2 6.4 to 6.9
	Soil and Water	
	• a detailed site water balance, including a description of site water demands, water supply and disposal methods; • detailed modelling and assessment of potential impacts on: - the quality and quantity of existing surface water and groundwater resources; - affected licensed water users and basic landholder rights; - the riparian, ecological, geomorphological hydrological values of watercourses: and - impacts to agricultural lands, • a detailed description of the proposed water management system (including all infrastructure and storages) and water monitoring program; • a detailed description of measures to minimise all water discharges, and • a detailed description of measures to mitigate surface water and groundwater impacts	7 6.11 6.11 6.11 6.11 6.4 6.4 6
Industry and Investment	Predicted potential and cumulative environmental and socio-economic impacts on agricultural activities. This should include: - Impacts on surface and ground waters, (flow regime, flow rates, quality and pressure) that might affect other water users (downstream and contiguous aquifer users) and the environment. - predicted and possible changes to water use requirements (surface and ground waters).	6.2.4 7.2.3

Table 1 (cont'd)
Summary of DGRs and EARs relevant to Surface Water Assessment

Agency	Details of Requirements	Location in document where addressed
NSW Office of Water	The EA must include a detailed Site Water Balance for the site including a detailed description of the proposed water management measures for the site, including all dams, sediment basins, diversion banks etc. A plan should be included showing the location of all structures.	7
	The EA must identify the location of all drainage lines and watercourses on and adjacent to the site and include options for the management of these areas.	5 & 6
	The NSW Farm Dams Policy must be addressed in the environmental assessment and the proposal needs to satisfy the Harvestable Right Order published in accordance with section 54 of the Water Management Act (WMA) 2400. Any current or additional dams, storages, detention basins constructed as part of the development will need to be in accordance with this policy.	6.8.1
	The EA must address erosion and sediment control measures on the site during operations.	6
	Riparian Zones	
	The assessment is required to consider the impact of the proposal on the watercourses an associated riparian vegetation within the site and provide the following: • Identify the sources of surface water. • Details of stream order (using the Strahler System). • Details of any proposed surface water extraction, including purpose, location of existing pumps, dams, diversions, cuttings and levees. • Detailed description of any proposed development or diversion works including all construction, clearing, draining, excavation and filling. • An evaluation of the proposed methods of excavation, construction and material placement. • A detailed description of all potential environmental impacts of any proposed development in terms of vegetation, sediment movement, water quality and hydraulic regime. • A description of the design features and measures to be incorporated into any proposed development to guard against long term actual and potential environmental disturbances, particularly in respect of maintaining the natural hydrological regime and sediment movement patterns and the identification of riparian buffers. • Details of the impact on water quality and remedial measures proposed to address any possible adverse effects.	7.2 3.6.2 7.3 6.4 6.6 6.4 & 6.11 6.4 & 6.11 3.8

Table 1 (cont'd)
Summary of DGRs and EARs relevant to Surface Water Assessment

Agency	Details of Requirements	Location in document where addressed
NSW Office of Water (cont'd)	Although Part 3A Major Projects are exempt from requiring a controlled activity approval (s91 of WMA'), the assessment is required to take into account the objectives and provisions of relevant legislation and guidelines.	4
	Dams	
	If the proposal includes existing or proposed water management structures/dams, the assessment is required to provide information on the following:	
	• Date of construction (for existing structure/s).	5
	• Details of the legal status/approval for existing structure/s.	6.9
	• Details of any proposal to change the purpose of existing structure/s.	6.4
	• Details if any remedial work is required to maintain the integrity of the existing structure/s.	6.5
	• Clarification if the structure/s is on a watercourse.	5 & 6.4
	• Details of the purpose, location and design specifications for the structure/s.	6
	• Size and storage capacity of the structure/s.	5 & 6.8
	• Calculation of the Maximum Harvestable Right Dam capacity (MHRDC).	6.9.1
	• Details if the structure/s is affected by flood flows.	3.6.2
	• Details of any proposal for shared use, rights and entitlement of the structure/s.	4.3
	• Details if the proposed development/subdivision has the potential to bisect the structure/s.	6.4
	Sustainable Water Supply	
	Many gazetted WSPs to-date have identified particular surface and groundwater systems that are currently over-allocated. In the case of over allocation the systems have subsequently been embargoed and no new water licences are to be issued within these catchments. Any new or expanded development within such catchments will therefore be unable to obtain any new water entitlements directly and will have to enter the water trading market to seek additional water.	4.2.1
	The assessment is required to address the issue of provision of a sustainable water supply for any project proposal. The assessment should include Water Management Plans detailing how a sustainable and efficient water supply can be sourced and implemented with minimal reliance on accessing valuable surface and groundwater resources.	6.4 & 7

Table 1 (cont'd)
Summary of DGRs and EARs relevant to Surface Water Assessment

Agency	Details of Requirements	Location in document where addressed
Liverpool Plains Shire Council	**Water Management**	
	The proposed mining shown in the PEA will have impacts on both surface and ground water catchments, and, given the sensitivity of this issue in the Namoi Valley it is Council's view that this issue be comprehensively addressed. Clearly, all stakeholders will be seeking assurances that no degradation of this precious resource will occur.	6 & 7
	The detail of the proposed water treatment facilities (including proposed sewage and sullage waste water which may require s68 Local Government Act approval) are of interest to Council.	6.10
Environment Climate Change & Water	ln summary the Department's key information requirements for the project are: the impact on air quality, noise amenity, ***water quality and quantity*** for all operations proposed for the mine and associated infrastructure;	6.2
	Impacts on Water Quality and Quantity	
	The Department recommends that a water balance be prepared to model water management through the life cycle of the mine.	7
	A detailed water management plan will be required for control of clean water, sediment laden water from disturbed areas and potentially saline/ contaminated water from mining operations and groundwater seepage into the mining void.	8
	Any modifications to existing discharge points will need to be identified with estimates of the frequency and volume of discharges and likely water quality discharges for key pollutants (but not limited to): - Total dissolved and suspended solids; - Heavy metals; - Grease and oil; - Nutrients; - pH - Total organic carbon; and - Conductivity (salts).	6.9.3 6.9.3
	The EA should consider any proposed discharge in terms of NSW Water quality and river flow objectives and utilising the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000).	4.3
	The Namoi Catchment Action Plan (CAP) objectives should be used to guide discharges including reference to the' NSW Salinity Strategy end of catchment salt concentration and load targets.	4.3.1

Table 1 (cont'd)
Summary of DGRs and EARs relevant to Surface Water Assessment

Agency	Details of Requirements	Location in document where addressed
Environment Climate Change & Water (cont'd)	Discharges of salt to the Namoi River, including potential lateral seepage and inputs to deep drainage, from land application, need to consider green offsets with an objective of no net impact from the development.	6.2 & 7.7
	An assessment of potential water quality impacts on groundwater resources must also be undertaken	6.2
	An assessment of likely water quality and frequency of discharges from the final mining void following rehabilitation must also be undertaken.	6.4.4
	The proponent must demonstrate that options for minimising the final mine void have been identified and that discharges from the mining void will meet ambient water quality targets and stored mine void water quality will meet requirements for proposed future land-use on the premises. An objective of no final mine void should also be fully evaluated.	6.4.4
Industry & Investment	The planned implementation of appropriate erosion control structures and practises.	6.4
	Key environmental management and rehabilitation strategies including; - the protection of alluvial areas and groundwater resources - wastewater and salinity management strategies	 8 8
NSW Office of Water	The EA will need to outline all water requirements for the project. The proponent must ensure they have an adequate water supply for the development.	7

3. SURFACE WATER ENVIRONMENT

3.1 RAINFALL / CLIMATE

The Project Site is located within the Liverpool Plains within the *Warm Summer / Cool Winter* climatic zone of northern NSW. The highest temperatures occur throughout December, January and February, with the coolest temperatures occurring in July. Autumn and spring are generally mild, while winters are cool to cold with overnight lows reaching close to zero on average during winter months.

Whilst rainfall is reasonably well distributed throughout the year, there is a slight peak in the summer months and marginally lower rainfall in autumn and winter. On average, December and January are the wettest months of the year, with April the driest.

The most relevant rainfall data used as input to the updated water balance has been obtained from an on-site meteorological station at the Werris Creek Coal Mine which has operated since April 2005, and from the climate statistics from the Australian Bureau of Meteorology (BOM) monitoring station at the Quirindi Post Office location (No. 055049) which has operated since 1882.

Table 2 contains the rainfall statistics for the 10th percentile (dry), 50th percentile (average) and 90th percentile (wet) rainfall years from the Quirindi Post Office BOM station.

Table 2
Annual Rainfall Statics (BOM Station No. 55049)

Year	Annual Rainfall (mm)
10th Percentile (dry year)	465.5
50th Percentile (median year)	683.7
90th Percentile (wet year)	916.8
Source: BOM Station No. 55049	

Where rainfall data collected at the Werris Creek Coal Mine weather monitoring station was complete, this data generally exhibited a reasonably high correlation with rainfall data from the Quirindi Post BOM station. A full comparison of rainfall data could not be undertaken as there is an incomplete data set for the Werris Creek Coal Mine weather monitoring station. Given the long term data available from Quirindi Post BOM station and the generally high correlation of this data to the Werris Creek Coal Mine station, the data from the Quirindi Post BOM station was considered suitable for undertaking the updated water balance for the LOM Project.

3.2 LANDFORM

The Project Site lies within the Namoi River Basin in an area characterised by the transition from the elevated ranges associated with the Liverpool Ranges to the south, Great Dividing Range to the east, Nandewar Range to the north, and open plains to the west. Locally, the Project Site is located within a valley created by two north-south trending ridgelines extending from Werris Creek in the north to Quipolly Creek in the south. Elevations within this area are effectively bounded by the north-south oriented ridgelines and Werris and Quipolly Creeks. Elevations in the local area range from approximately 340 m AHD on the banks of Werris Creek to 671 m AHD on Grenfell Hill, 3.5 km west of the Project Site (RWC, 2010).

3.3 VEGETATION

Detailed investigations of the flora within and adjacent to ML 1563 were undertaken by Geoff Cunningham Natural Resource Consultants Pty Ltd (GCNRC) as part of the studies undertaken during the preparation of the original Werris Creek Mine Environmental Impact Statement (EIS) in 2004 (GCNRC, 2004a).

Supplementary studies were undertaken by GCNRC (2009) and Eco Logical Australia Pty Ltd (ELA) in 2009 and 2010. These studies identified a total of six vegetation communities within the LOM Project Site.

No threatened flora species have been identified within the Project Site, although remnants of two State and Commonwealth Listed Threatened Ecological Communities were observed to be present, namely:

- White Box Grassy Woodland of the Nandewar and Brigalow Belt South;
- Derived Native Grasslands of the Brigalow Belt South and Nandewar Bioregions; and
- Brigalow – Belah Woodland of alluvial soil, mainly in the Brigalow Belt South.

Over the LOM Project, approximately 58 ha of White Box Yellow Box Blakely's Red Gum Woodland, 135ha of White Box Yellow Box Blakely's Red Gum Woodland – Derived Native Grassland and 0.35ha of Brigalow (*Acacia harpophylla*) woodland would be affected by the mining operations associated with the LOM Project.

3.4 SURROUNDING LAND USES

Land use in the area surrounding the LOM Project is best described as smaller scale mixed farming trending to larger more intensive agriculture further onto the Liverpool Plains. This mixed farming involves a combination of cropping (generally wheat, oats or lucerne) and cattle grazing and has been maintained on several of the properties owned by the Proponent, including "Narrawolga", "Escott", "Cintra", "Eurunderee", "Hill View" and "Railway View", through lease agreement with the former owners or current occupiers. To the south of the Project Site between Taylor's Lane and Paynes Road, a number of landholders are dependent on irrigation to sustain relatively high intensity lucerne cropping with cattle grazing. Within this general environment of mixed farming are several other current or previous land uses (RWC, 2010). These include:

- Tamworth Regional Council and Liverpool Plains Shire gravel extraction quarries;
- a zeolite processing plant, operated by Zeolite Australia Pty Ltd and servicing a zeolite mine west of the Project Site; and
- coal mining at the former Werris Creek Colliery was undertaken on and adjacent to the Project Site until the 1960's. Remnants of this underground mining and surface activity are present on the "Preston Park" and "Old Colliery" properties (RWC, 2010).

Sections of the "Eurunderee" and "Railway View" properties have recently been established as biodiversity offset areas. A Biodiversity Offset Strategy encompassing a corridor of land from "Railway View" in the east, the southern section of the Project Site and a portion of the "Eurunderee" property to the west has been established with sole function of this land being the conservation of native vegetation and the creation of a wildlife corridor between the large remnants of native vegetation which occur on the ridges to the east and west of the Project Site (RWC 2010). An updated Biodiversity Offset Strategy has been proposed as part of the LOM Project.

3.5 SOILS AND GEOLOGY

GSSE undertook a soils investigation in 2010 (GSSE 2010b) to characterise soils which would potentially be disturbed as part of the proposed LOM Project. The GSSE investigation targeted soils ahead of mining, to the north of the current extraction area. The investigation identified three soil units in the area ahead of mining as follows.

- Brown Chromosol.
- Stoney Brown Chromosol.
- Dark Brown Vertosol.

Key outcomes of the GSSE (2010) soils investigations are as follows.

- Soils are generally non sodic. Only one soil sample (a Dark Brown Vertosol) was considered to be sodic, however, the high organic content of this soil would likely protect it from dispersing.
- Soils are generally non saline.

3.6 SURFACE HYDROLOGY

3.6.1 Regional Hydrology

The Project Site is located within the Liverpool Plains catchment of the Namoi River Catchment in mid-northern NSW. The Namoi River Catchment covers an area of approximately 42 000 km^2 (NSW Government Namoi Catchment Management Authority, 2010) and is located within the Barwon-Darling River system in northwestern NSW. Major tributaries of the Namoi River include Coxs and Mooki Creeks, Peel, Cockburn, Manilla, and McDonald Rivers, all of which join the Namoi River upstream of Boggabri (RWC, 2010).

3.6.2 Local Hydrology

The Project Site is positioned between two creeks, namely Quipolly Creek in the south and Werris Creek to the north. Werris Creek flows into the Mooki River and then into the Namoi River. Quipolly Creek, while restricted by the Quipolly Dam located upstream from the Project Site, flows into Quirindi Creek, the Mooki River and then into the Namoi River (RWC, 2010).

Quipolly Creek (elevation 345m AHD) is approximately 2.9km south of the Project Site (elevation 360m AHD) and 15m lower than the southern-most point of the Project Site. Werris Creek is approximately 3.4km to the north of the Project Site and approximately 40m lower than the northernmost point of the Project Site. These factors would inhibit floodwaters from moving out of Quipolly and Werris Creeks and inundating the Project Site. Even in the event of a failure of the Quipolly Dam, the area of flooding would be restricted to the southern boundary of the Project Site (RWC, 2004). The slope of the southern section of the Project Site is approximately 1º and is considered a floodplain under Part 8 of the *Water Management Act 2000*. Water flowing in from the east of the Werris Creek Road onto the Project Site has been diverted to the south using clean water diversion bunds. This inflow would have the potential to result in isolated flooding of the southeastern part of the Project Site if it was not diverted around the Project Site.

Including the existing mine operations, approximately 210 ha of the Project Site lies within the Werris Creek Catchment and 698 ha lies within the Quipolly Catchment.

As part of the original *Surface Water Assessment* conducted in 2004 (Department of Lands-Soil Services, 2004), the existing mine area was divided into five separate catchments. The configuration of these catchments has altered as a result of the existing approved operations, with the updated catchments defined in **Table 3**. These catchment areas are also shown on **Figure 3.**

All dirty water generated at the Project Site currently reports to sediment basins prior to being discharged off the existing mine area (if required and in compliance with EPL conditions) via licensed discharge points (LDPs) at Sediment Basins SB2 (LDP10), SB9 (LDP12) and SB10 (LDP14). At present, catchments 3, 4 and 6 current report directly to these LDPs.

There is a large area of clean water catchment contained within the Project Site which is not captured within the existing water management system. This clean water catchment lies around the edges of the Project Site with runoff discharging offsite to adjacent drainage lines. The catchment has been delineated into Catchments 7, 8 and 9 as identified in **Table 3**.

Table 3

Existing Catchment Areas of the Project Site

Catchment	Description of Catchment
Catchment 1	This catchment generally falls in a west to southwesterly direction. The majority (~380 ha) of the catchment lies east of the Werris Creek Road. The rest of the catchment lies to the east of the 2005 approved limit of the Open Cut Mine and Overburden Emplacement. The runoff from this catchment is currently diverted around the existing operations and exits the Project Site in the south. The water then flows into Black Gully and in turn to Quipolly Creek some 2.7 km south of the Project Site.
Catchment 2	This catchment generally falls to the northwest. This area is a clean water catchment and does not include the area of the 2005 approved Product Coal Storage Area, Rail Load-out Facility or the northern extent of the Rail Load-Out Road which is incorporated in Catchment 6 as dirty water. The runoff water from Catchment 2 flows across the "Cintra" property into Werris Creek some 3.3 km north of the existing mine area boundary.
Catchment 3	This catchment generally falls to the south but has been altered by existing mining operations and associated water management structures. The catchment incorporates the 2005 Approved Coal Processing Area, Administration and Site Facilities Area, far southern end of the Rail Load-out Road, existing Mine Entry Road and Overburden Emplacement Area. The catchment is part of the existing dirty water management system. Controlled discharges from the catchment can occur through LDP 10 located on SB2 at the southern end of the Project Site which allows for water to be released off site into Black Gully and in turn to Quipolly Creek.
Catchment 4	This catchment falls generally in a southwesterly direction into Quipolly Creek. This area incorporates the centre of the Rail Load-Out Road, existing Magazine Area and Old Farm Water Management Structures. The catchment is part of the existing dirty water management system with controlled discharges able to occur through LDP 12 located on SB9. The released water flows into Black Gully and in turn to Quipolly Creek.
Catchment 5	This catchment is contained within the existing Mine Void. It includes seepage from the unshaped overburden to the south of the Active Mine Void. This catchment forms the Void Water Management System. All water within this catchment is contained on site.
Catchment 6	This catchment includes the 2005 approved Product Coal Storage Area and the Rail Load-out Facility. It forms part of the Dirty Water Management System. Controlled discharges of water can occur through LDP 14 located on SB10. The released water flows into Werris Creek. This area incorporates some small portions of clean water catchment which invariably flow into the dirty water system.
Catchment 7	This catchment flows from the northern part of the Project Site and off the properties to the northeast of the Project Site ("Hillview", "Greenslopes and Banool", "Werriston South") to the north towards Werris Creek. This catchment is bound by Catchment 2 to the west, Catchment 1 to the south, the Werris Creek Rail Siding to the north and the major north-south aligned ridge to the east.
Catchment 8	This catchment drains the southwestern part of the Project Site (west of Catchments 3, 4 and 6) following the general fall in topography to the south. The area of this large catchment is likely to incorporate several smaller sub-catchments and water flows towards Quipolly Creek.
Catchment 9	This catchment drains the northwestern part of the Project Site (west of Catchment 2) and follows the general fall in topography to the north. The area of this large catchment, which is partially bound to the south by the Werris Creek Rail Siding, is likely to incorporate several smaller sub-catchments as water flows towards Werris Creek.

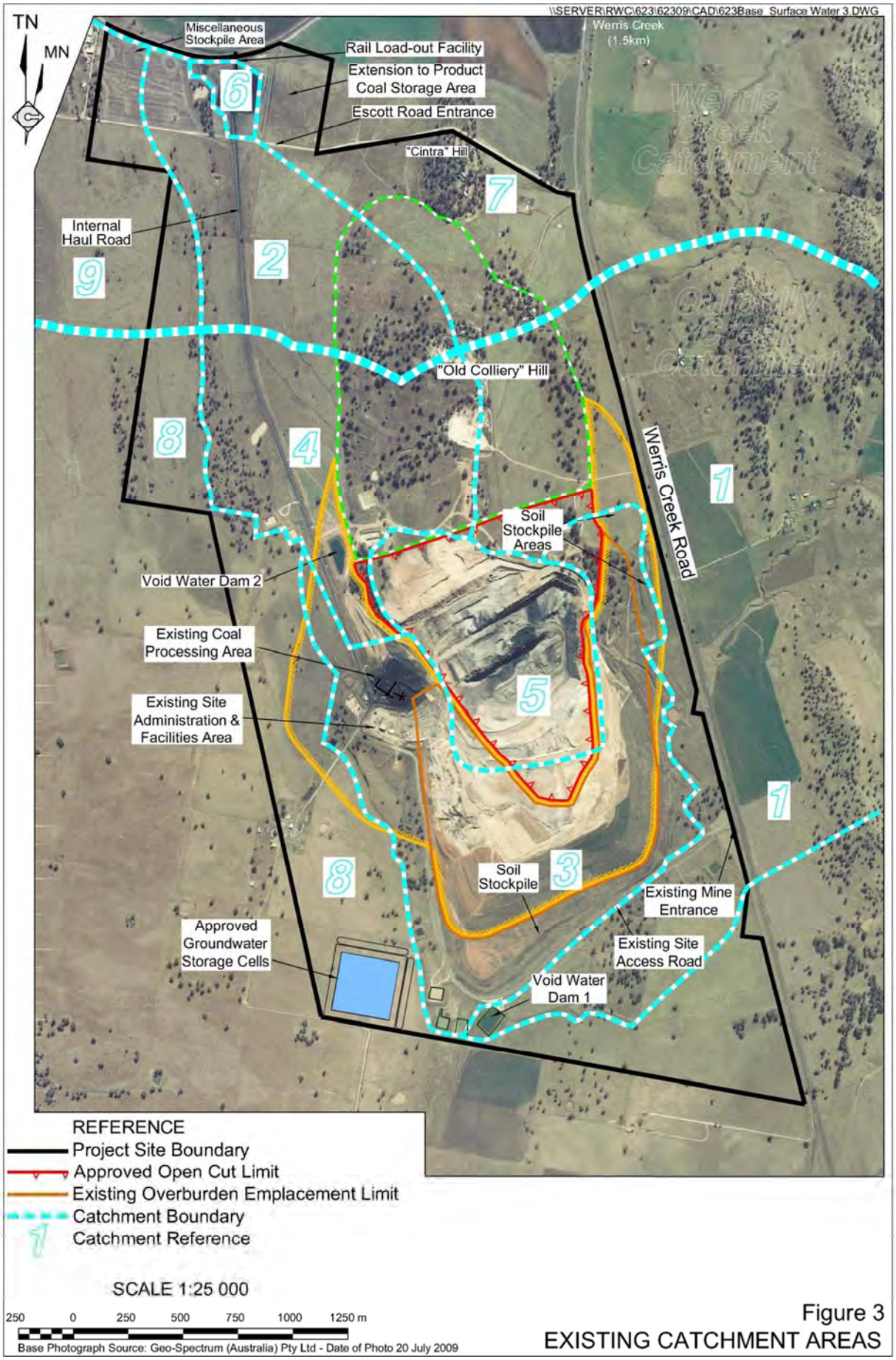


Figure 3
EXISTING CATCHMENT AREAS

Prior to the existing approved site operations commencing, there were two drainage lines (unnamed) that flowed into the Project Site from the east within Catchment 1. These drainage lines currently flow under the railway line (Main Northern Railway) and Werris Creek Road, located to the east of the Project Site. These drainage lines flow in a northeasterly to southwesterly direction and have been diverted to the south of the existing operations as part of the Werris Creek Coal Mine clean water management system. **Plate 1** shows a culvert under the railway line that conveys drainage from one of these unnamed drainage lines.

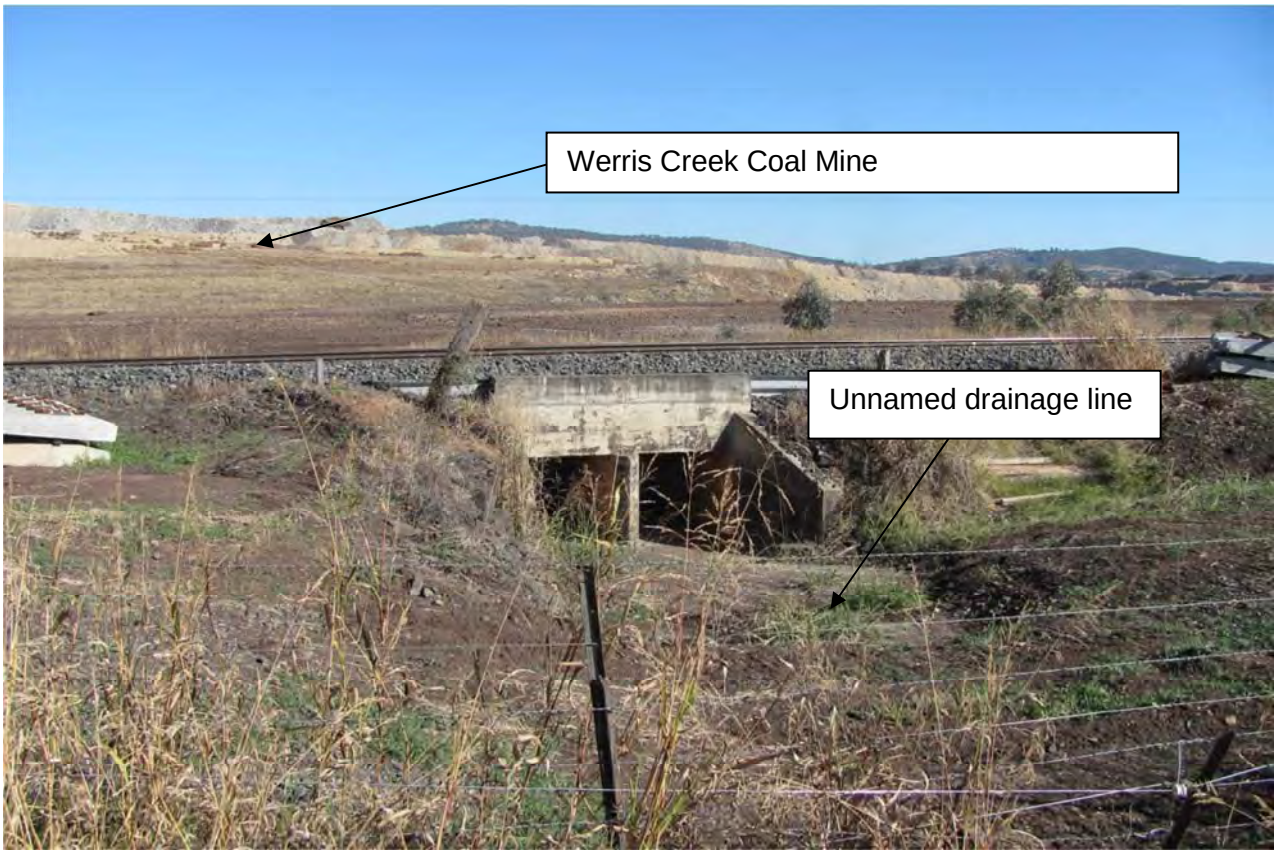


Plate 1 Un-named Drainage Line East of the Project Site

(View facing west towards the Project Site from the east side of Werris Creek road and the Main Northern Railway)

Other drainage lines altered as a result of the existing approved operation include short lengths of first order creeks which had been heavily altered by past agricultural practices including numerous farm dams along the drainage lines and associated contour banks.

All the drainage lines within the Project Site are poorly defined with no channels containing significant riparian vegetation, channel banks or bed. The existing natural drainage channels are rather broad, low gradient, pasture covered depressions that accommodate overland flow paths, rather than concise, concentrated flow paths. This is attributed to the small catchment areas and reasonably flat slopes of the existing environment within the Project Site.

Surface water released from the Project Site via LDPs is presently conveyed to Quipolly and Werris Creeks via small poorly defined drainage paths with no incised channel or clearly defined banks.

3.7 LICENSED DISCHARGE POINTS

Werris Creek Coal Mine currently has three Department of Environment, Climate Change and Water (DECCW) LDPs covered under EPL 12290 allowing for the discharge of waters from the existing mine area under certain conditions. The locations of the LDPs are shown on **Figure 4**. LDP 14 is located at SB10, adjacent to the Rail Load-out Facility (north area of the site). This LDP services Catchment 2 and drains to Werris Creek via overland flow. LDP 12 is located at SB9 and is situated in the western central portion of the Werris Creek Coal Mine, servicing Catchment 3. The third LDP (LDP 10) is located in the south end of the Project Site at SB2 and services Catchment 4. Both LDP 10 and 12 discharge through overland flow paths into Quipolly Creek. The LDPs have concentration limit conditions placed on them to ensure the water discharge is of a suitable quality (see Section 3.8).

3.8 SURFACE WATER QUALITY AND ASSESSMENT CRITERIA

3.8.1 Regulatory Assessment Criteria

Impact assessment criteria for surface water are only relevant to water actually discharging from the Werris Creek Coal Mine. DECCW have included criteria in EPL 12290 for the LDPs. The concentration limits set in the current licence for both discharge locations are presented in **Table 4**.

Table 4
EPL12290 Discharge Limits

Parameter	50 Percentile Concentration Limit	90 Percentile Concentration Limit	100 Percentile Concentration Limit
Oil and Grease	-	-	10 mg/L
pH	-	-	6.5 – 8.5
Total Suspended Solids[1]	20 mg/L	35 mg/L	50 mg/L
Note 1 - The total suspended solids concentration limits specified for Points 10, 12 and 14 (wet weather discharge points) may be exceeded for water discharge from the sediment basins provided that: - The discharge occurs solely as a result of rainfall measured at the premises that exceeds 39.2 mm over any consecutive 5 day period immediately prior to the discharge occurring; and - All practical measures have been implemented to dewater all sediment dams within 5 days of rainfall such that they have sufficient capacity to store run off from a 39.2 mm, 5 day rainfall event.			
Source – EPL 12290			

Whilst there are no concentration limits for electrical conductivity, nitrate, total nitrogen, total phosphorous and reactive phosphorus, these parameters are required to be monitored during discharges. There are currently no volumetric limits placed on the LDPs.

EPL12290 also includes requirements for ambient water quality monitoring for the abovementioned pollutants in various water bodies within and surrounding the Werris Creek Coal Mine.

Further details of surface water monitoring currently required for the Werris Creek Coal Mine are presented in Section 9.

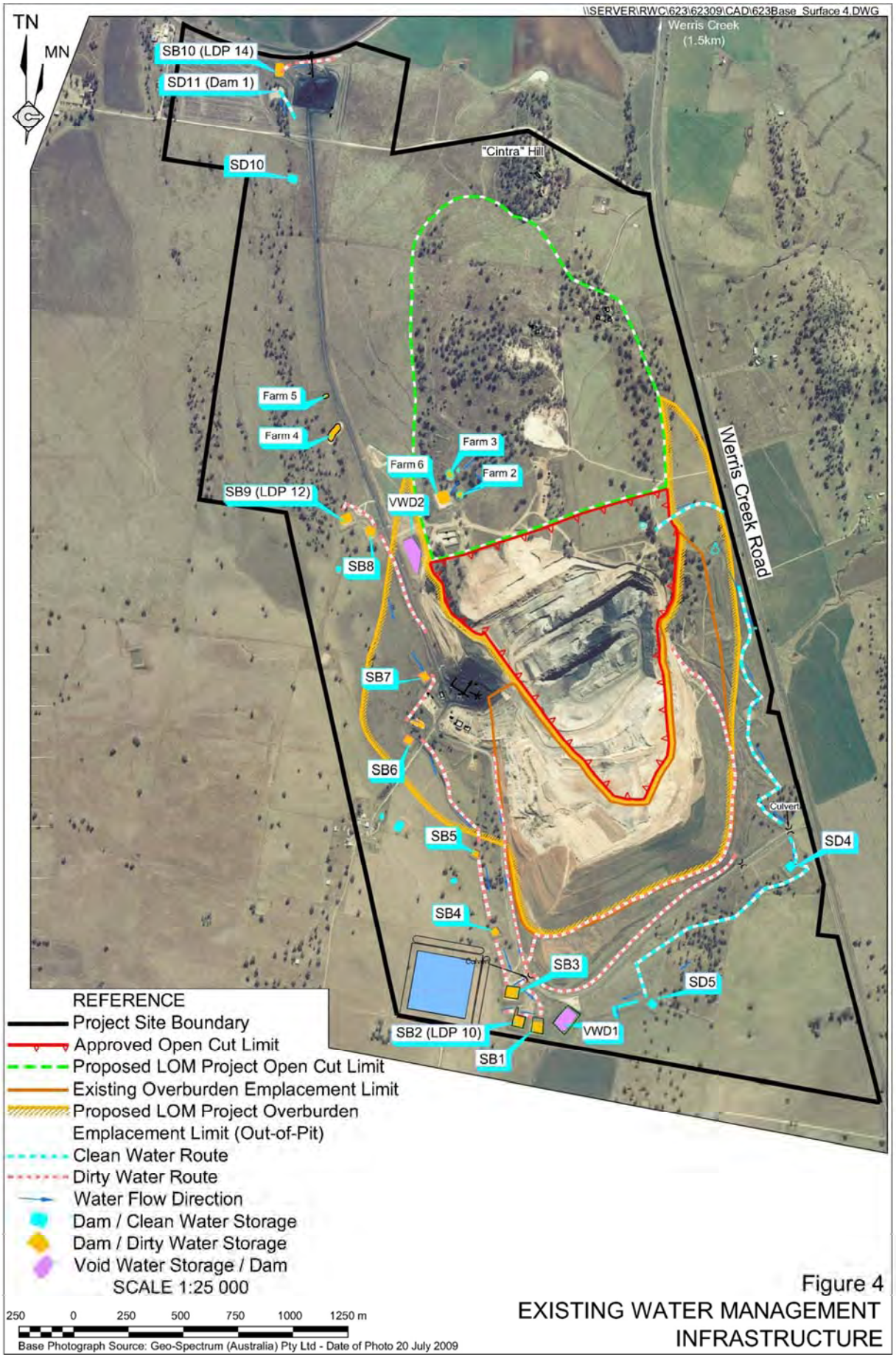


Figure 4
EXISTING WATER MANAGEMENT INFRASTRUCTURE

3.8.2 Existing Surface Water Quality

The Proponent currently undertakes water quality monitoring of numerous surface water features within and surrounding the Project Site in accordance with the approved water monitoring program contained in the *Site Water Management Plan* (SWMP) (GSSE & WCC, 2009). The following section summarises the results of this monitoring over previous years, along with baseline data collected prior to mining activities commencing in 2005.

Baseline Water Quality Data (prior to mining)

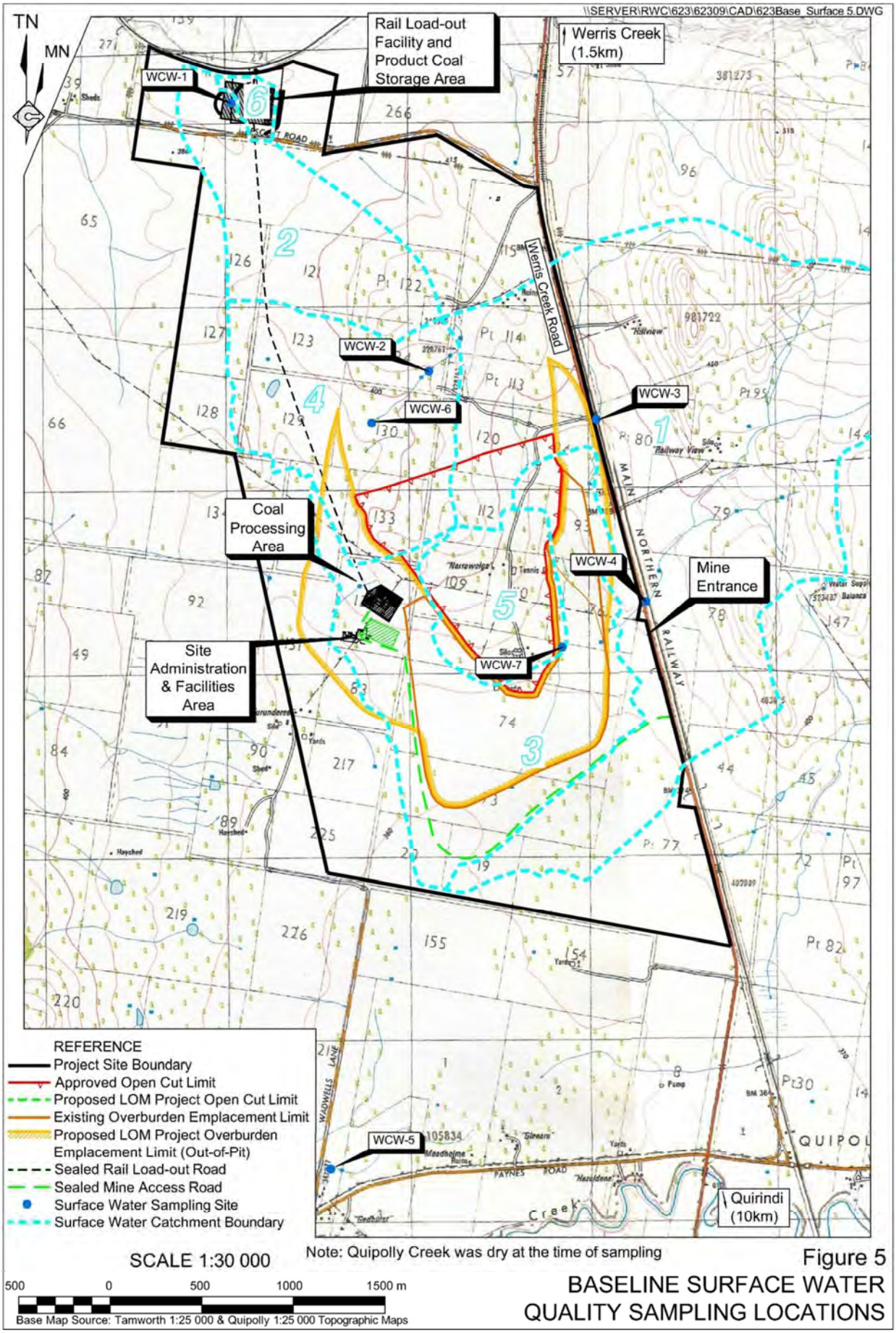
Baseline water quality data was collected as part of the original EIS (RWC, 2004) for the Werris Creek Coal Mine. Samples were collected from seven sites on and surrounding the existing mine area, (**Figure 5**), on the 25th and 26th of February 2004, following rainfall yielding 78mm (78mm was recorded at the Quirindi weather station approximately 11km southeast of the Project Site between 23rd and 26th of February 2004). With the exception of monitoring locations WCW1 and WCW7 (agricultural dams), the samples were taken from flowing water.

The samples taken from these sites provided an indication of the existing/natural chemistry and suspended sediment load of runoff from the area prior to disturbance activities associated with the mine. **Table 5** presents a description of each sampling location and a summary of the analytical results.

Table 5
Baseline Water Quality Data

Catchment	Sampling Site	Description	pH	EC (µS/cm)	TSS (mg/L)	Fe (mg/L)	Na (mg/L)
ANZECC Guidelines[1]	-	-	6.5-8.0	30-350	-	-	-
Werris Creek	WCW1	Farm dam	7.16	138	1070	7.95	5
Quipolly Creek	WCW2	Drainage line	7.42	132	45	0.48	8
Quipolly Creek	WCW3	Culvert under road	7.58	327	29	0.26	22
Quipolly Creek	WCW4	Culvert between road and railway	7.83	277	25	0.26	16
Quipolly Creek	WCW5	Sheet flow drainage	6.74	100	39	0.70	11
Quipolly Creek	WCW6	Drainage line (lower down from WCW2)	7.19	155	170	2.18	7
Quipolly Creek	WCW7	Farm dam	7.70	206	26	0.08	14
Note 1 - Default trigger values for slightly disturbed upland river aquatic ecosystems presented in ANZECC, 2000)							
Source: R.W. Corkery & Co. Pty Limited (RWC, 2004)							

All water samples tested were within the trigger values for slightly disturbed upland river ecosystems presented in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC) (2000) for both pH and electrical conductivity (EC). There was a very high TSS reading of 1070mg/L for the sample collected from the farm dam (this is now referred to as SD11). There were also high readings of TSS in the unnamed drainage line below WCW2. All other baseline TSS readings were below the current 100 percentile concentration limit of 50mg/L for the existing LDPs under EPL 12290.


\\SERVER\RWC\623\62309\CAD\623Base_Surface 5.DWG
TN
MN
Rail Load-out Facility and Product Coal Storage Area
Werris Creek (1.5km)
WCW-1
WCW-2
WCW-3
WCW-4
WCW-5
WCW-6
WCW-7
Werris Creek Road
Coal Processing Area
Site Administration & Facilities Area
Mine Entrance
MAIN NORTHERN RAILWAY
PAYNES ROAD
Quirindi (10km)
Creek
1
2
3
4
5
6
REFERENCE
Project Site Boundary
Approved Open Cut Limit
Proposed LOM Project Open Cut Limit
Existing Overburden Emplacement Limit
Proposed LOM Project Overburden Emplacement Limit (Out-of-Pit)
Sealed Rail Load-out Road
Sealed Mine Access Road
Surface Water Sampling Site
Surface Water Catchment Boundary
SCALE 1:30 000
500 0 500 1000 1500 m
Base Map Source: Tamworth 1:25 000 & Quipolly 1:25 000 Topographic Maps
Note: Quipolly Creek was dry at the time of sampling
Figure 5
BASELINE SURFACE WATER QUALITY SAMPLING LOCATIONS

Iron levels were fairly low within all samples except sample WCW1 (Farm Dam) and WCW6 (Lower Drainage Line). Both of these samples had TSS levels somewhat higher than all other samples and it is considered likely that the elevated iron levels can be attributed to high iron content of the total suspended sediment.

Wet Weather Discharge Data

Current surface water monitoring locations are shown in **Figure 12**. EPL 12290 specifies that surface water monitoring must be undertaken at nominated sampling locations during or immediately following events where surface waters discharge off site. Since alterations to the water management system in 2008, there have been a total of six discharges from the existing operations. Discharge data collected prior to this date is not representative of the current environment, so is not presented in this report.

Water samples are taken and tested for a range of water quality parameters at both the relevant LDP and the receiving waters during discharge events. Samples are taken from the receiving waters upstream and downstream of where discharged water from the site enters the creek. All six discharge events have been to Quipolly Creek via either SB2 or SB9. No discharges have occurred from SB10 which reports to Werris Creek. The water quality results of the wet weather discharges since 2008 are summarised in **Table 6**.

As specified under condition L3.4 of EPL12290, the TSS concentration limits specified for LDP 10, 12 and 14 may be exceeded for water discharged from the sediment basins provided that:

a) the discharge occurs solely as a result of rainfall measured at the premises that exceeds 39.2 mm over a consecutive 5 day period immediately prior to the discharge event; and

b) all practical measures have been implemented to dewater all sediment dams within 5 days of rainfall such that they have sufficient capacity to store runoff from a 39.2 mm, 5 day rainfall event.

While there have been three discharge events with elevated TSS levels (refer to **Table 6**), five day rainfall levels prior to each discharge were greater than 39.2mm and therefore were in accordance with EPL 12290. Where the TSS criteria was exceeded, the TSS concentrations at the downstream monitoring location within Quipolly Creek were determined to be low, not exceeding 15mg/L.

Although no site water has been discharged to Werris Creek under the existing water management system, when discharges occur into Quipolly Creek, water samples from Werris Creek have also been taken and are presented in **Table 7**.

The results of the water samples taken in Werris Creek at times when water has been discharged to Quipolly Creek only indicate that there are sometimes very high natural readings of EC and TSS in Werris Creek. Very high TSS readings of between 375mg/L to 8040mg/L were recorded on the 7 October, 28 November and 13 December 2008. Six of the nine samples taken also had conductivity levels above the ANZECC 2000 trigger values for slightly disturbed upland river ecosystems.

Table 6
Water Quality of Wet Weather Discharge into Quipolly Creek

Sample Location	EC (µS/cm)	Nitrate Nitrogen (mg/L)	Oil and Grease (mg/L)	pH	Reactive P (mg/L)	Total N (mg/L)	Total P (mg/L)	TSS (mg/L)
EPL 12290 CRITERIA			10	6.5-8.5				50
Discharge - 7 October 2008								
SB2 (Reports to QC[1])	375	-	<2	7.5	-	-	-	22
QC-UP	400	-	<2	7.9	-	-	-	21
QC-Down	380	-	<2	7.5	-	-	-	41
Discharge – 28 November 2008								
SB9 (reports to QC)	50	<0.1	<5	7.0	0.74	1.3	0.85	**69**
SB2 (Reports to QC)	360	<0.1	<5	8.5	0.02	0.38	0.05	8
QC-UP	60	0.8	<5	7.4	0.26	2	0.64	2740
QC-Down	890	<0.1	<5	7.8	0.1	0.11	0.14	10
Discharge - 13 December 2008								
SB9 (reports to QC)	50	<0.1	10	6.9	0.53	0.85	0.69	**68**
SB2 (Reports to QC)	280	0.5	7	7.5	0.29	1.9	0.47	**154**
QC-UP	220	0.4	7	7.1	0.23	0.6	0.61	466
QC-Down	790	<0.1	6	7.8	0.18	0.38	0.22	13
Discharge – 4 & 6 January 2010								
SB9 (Reports to QC)	122		<5	7.41				30
QC-UP	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
QC-Down	687	-	<5	7.71	-	-	-	10
Discharge – 15 February 2010								
SB9 (reports to QC)	129	0.1	<5	7.9	<0.01	1.5	0.18	**138**
QC-UP	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
QC-Down	861	0.02	<5	7.8	0.1	0.3	0.1	10
Discharge – 5 May 2010								
SB9 (reports to QC)	173	<0.01	<5	7.98	0.04	1.6	0.35	46
QC-UP	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
QC-Down	1010	0.3	<5	7.99	0.02	0.3	0.15	8

Bold – data exceeds EPL12290 100 percentile criteria
Note 1 - QC - Quipolly Creek
Source: Geoterra (2010) and Geoterra (2009)

Table 7
Water Quality of Werris Creek

Sample Location	EC (µS/cm)	Nitrate Nitrogen (mg/L)	Oil and Grease (mg/L)	pH	Reactive P (mg/L)	Total N (mg/L)	Total P (mg/L)	TSS (mg/L)
7 October 2008								
WC-UP	905	-	<2	7.7	-	-	-	905
WC-DOWN	375	-	<2	7.8	-	-	-	375
28 November 2008								
WC-UP	250	0.3	<5	7.7	1.27	3.9	1.99	780
WC-DOWN	230	0.5	<5	7.9	0.88	5.0	3.57	8040
13 December 2008								
WC-UP	370	2.5	6	7.8	0.56	4.5	1.29	2350
WC-DOWN	1140	<0.1	7	8.1	0.25	0.45	0.31	40
6 January 2010								
WC-UP	1270	-	<5	7.87	-	-	-	13
WC-DOWN	668	-	<5	7.71	-	-	-	4
15 February 2010								
WC-UP	-	-	-	-	-	-	-	-
WC-DOWN	118	3.87	<5	7.82	0.05	5.8	0.11	62

Source: Werris Creek Coal - Water Quality Database (2010)

Dry Weather / Operational Water Quality Monitoring Data

In addition to the wet weather discharge monitoring undertaken, further monitoring has been undertaken to meet the requirements of the EPL 12290 and the existing SWMP (GSSE & WCC, 2009). A summary of the latest results since April 2008, including median values where applicable, is presented in **Table 8.** The results since April 2008 have only been presented as they are considered the most representative of the current water management system.

Although the EPL 12290 concentration limits criteria are not directly relevant to this data, they do provide a guide to assess the effectiveness of the existing water management system. All median pH values are within the current EPL concentration limits apart from the clean water dams located on the eastern and southern area of the mine. The vast majority of all pH readings from dams within the dirty and void water management system have pH readings within the range set in the current EPL. There are median values of TSS concentrations above the current EPL criteria for dams located within the dirty water management system. These include SB5, SB9 and SB10. Potential TSS mitigation options for dirty water dams are discussed in Section 6.5.

Operational water quality data indicates that electrical conductivity within the LDP dams (SB2, SB9 and SB10) ranged from 134 µS/cm to 575 µS/cm. Wet weather discharge data indicates that conductivity within the LDP dams is somewhat lower than that for operational water quality sampling with conductivity ranging from 50 µS/cm to 360 µS/cm suggesting that during discharge events the additional rainfall/runoff captured within the LDP dams provides a diluting effect.

Background water quality within adjacent drainage lines varied considerably during these wet weather discharge events with readings ranging from 118 to 1,270 µS/cm in Werris Creek and 60 to 1,010 µS/cm in Quipolly Creek. There are no notable trends for conductivity readings within the adjacent drainage lines with the exception that conductivity readings are generally quite high in relation to the ANZECC guidelines for conductivity (30 to 350 µS/cm).

3.9 SURFACE WATER FEATURES OF CONSERVATION SIGNIFICANCE

Based on existing documentation and the site visit conducted in May 2010, there are no surface water features of conservation significance within the Project Site.

4. RELEVANT LEGISLATION, POLICY AND GUIDELINES

4.1 INTRODUCTION

A number of legislative requirements, government policies and guidelines relating to surface water management are applicable to the LOM Project and have been considered in this *Surface Water Assessment*. The relevant policies, guidelines and legislative requirements are summarised below.

Table 8
Operational Water Quality Data from Internal Dams on Site

Sample Location	Date of Samples	pH	TSS (mg/L)	Oil & Grease (mg/L)	EC (µS/cm)	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)
Clean Water Dams							
SD1	9 Apr 08 8 Jul 08	7.9 (7.7-8.1)	32 (28-36)	ND	190 (160-220)	0.55 (0.21-0.88)	1.65 (1.4-1.9)
SD2	9 Apr 08 8 Jul 08 10 Nov 09	8.5 (8.1-8.9)	14 (7-21)	ND	243 (225-260)	0.13 (0.07-0.22)	1.4 (1.1-1.5)
SD3	3 Apr 08 8 Jul 08	8.6 (8.5-8.7)	16 (8-24)	ND	385 (370-400)	0.31 (0.07-0.54)	1.1 (1.0-1.2)
SD4	9 Apr 08 8 Jul 08 15 Jan 09 6 May 09 26 Aug 09 10 Nov 09 23 Feb 10	8.86 (8.1-9.16)	16 (10-48)	ND	252 (238-335)	0.1 (0.05-0.58)	1.2 (0.93-1.4)
SD5	9 Apr 08 8 Jul 08 20 Oct 08 15 Jan 09 6 May 09 26 Aug 09 10 Nov 09 23 Feb 10	8.9 (7.5-9.2)	44 (15-312)	ND	366 (255-458)	0.25 (0.08-0.78)	2.1 (1.3-3.6)
SD11	8 Apr 08 10 Jul 08	7.75 (7.7-7.8)	49.5 (32-67)	ND	150 (150-150)	0.89 (0.58-1.2)	2.4 (2-2.8)
Dirty Water (controlled discharged through LDP 10 at the south of the site as required)							
SB2	10 Jul 08 7 Oct 08 27 Oct 08 15 Jan 09 6 May 09 26 Aug 09 23 Feb 10	8.16 (7.4-8.58)	22 (5-68)	ND	376 (335-470)	0.07 (0.01-0.19)	0.6 (0.4-1.4)
SB5	27 Oct 08 15 Jan 09	7.7 (7.6-7.8)	93.5 (67-120)	ND	350 (320-380)	0.44 (0.21-0.67)	1.5 (1.1-1.9)
SB6	15 Jan 09 6 May 09 28 Jun 09 10 Nov 09 23 Feb 09	7.63 (7.61- 8.24)	50 (11-92)	ND	493 (350-1980)	0.58 (<0.01-1.12)	9.8 (7.2-23.2)
Dirty Water (controlled discharged through LDP 14 at the north of the site as required)							
SB10	15 Jan 09 6 May 09 26 Aug 09 23 Feb 10	7.68 (7.1- 8.12)	60 (47-360)	ND	243 (189-282)	2.4 (0.7-3.5)	1.3 (0.6-3.5)
Dirty Water (controlled discharged through LDP 12 at the east of the site as required)							
SB9	10 Jul 08 14 Jan 09 27 Oct 09 6May 09 28 Aug 09 10 Nov 09 23 Feb 10	7.92 (7.5-8.14)	100 (8-128)	ND	177 (134-575)	1.8 (0.9-3.3)	1.5 (0.3-3.1)
Void Water							
VWD 1	15 Jan 09 6 May 09 26 Aug 09 10 Nov 09 23 Feb 09	8.29 (8.03-8.4)	8.5 (5-14)	ND	1010 (845-1080)	0.025 (<0.01-0.04)	3.2 (0.58-4.9)
VWD 2	23 Jan 09 6 May 09 26 Aug 09 23 Feb 10	8.03 (7.9-8.48)	16.5 (3-257)	ND	1009 (932-1220)	0.03 (<0.01-0.04)	2.45 (0.6-9.1)

ND – Not detected
Figures in brackets show the range of values for the period. Figures not in brackets are the median values for the period.
Source: Werris Creek Coal - Water Quality Database (2010)

4.2 LEGISLATION

4.2.1 Water Act 1912 and Water Management Act 2000

The *Water Act 1912* and *Water Management Act 2000* (WM Act) contain provisions for the licensing of water capture and use. If any dams are proposed as part of the water management system, consideration must be given to whether the dams need to be licensed. There are currently no new 'clean' water dams proposed for the LOM Project. There are new 'dirty' water dams (or pollution control dams) proposed for the purpose of erosion and sediment control, however these are exempt from licensing requirements as they are not a water harvesting feature. It must be noted that the existing dams within the Project Site currently collecting 'clean' water are within the harvestable right of the property.

A licence would be required under the *Water Management Act 2000* for the extraction of groundwater (including incidental mine in-flows resulting from interception of the regional groundwater table) as a consequence of mining related activities and is addressed in the *Groundwater Assessment* developed for the LOM Project (RCA, 2010).

4.2.2 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) is relevant to the Project as it contains requirements relating to the prevention of the pollution of waters. In this regard, the discharge of water from the Project Site would need to be controlled to an agreed standard to reduce the potential for pollution of the receiving waters. As outlined above, the Proponent has an existing EPL under the POEO Act for the discharge of 'dirty' water from the existing mine area. The proposed water management system for the LOM Project would maintain the use of existing LDPs under EPL 12290 with no additional LDPs being required for the LOM Project.

A modification to EPL 12290 may be required under Section 47 of the *Protection of the Environment Operations Act 1997* to reflect the expanded footprint and likely additional water quality monitoring points within proposed future dams.

4.3 POLICIES AND GUIDELINES

4.3.1 Namoi Catchment Action Plan

The Project Site is situated within the Namoi River Catchment and is covered by the Namoi Catchment Management Authority (CMA). In January 2007, the Namoi CMA published the *Namoi Catchment Action Plan* (CAP). The CAP identifies catchment issues and sets measurable management targets with respect to land practices and water quality. The management targets address issues identified as having the most significant impact on the four catchment resources, those being the landscape, people and their communities, native plants and animals, and surface and groundwater systems. For surface and groundwater systems, the overriding catchment target is as follows.

> *From 2006, there is an improvement in the condition of surface and ground water ecosystems.*

There are a total of four management targets which underpin this catchment target including one with regards to surface and groundwater (MTW2). This target specifies the following.

> *From 2006, maintain or improve surface and ground water quality suitable for irrigation, raw drinking water and aquatic ecosystem protection at Gunnedah, Narrabri and Goangra. Target values are as determined by:*
>
> *a) Australian & New Zealand Environmental Conservation Council Guidelines 2000, for Irrigation Water - Electrical conductivity range of 650 –1300µS/cm; and Aquatic Ecosystem Protection - mean values of Total Endosulphan < 0.03 µS/Litre and Atrazine < 0.7 µS/Litre.*
>
> *b) MDBC; River Salinity of 550 µS/cm 50% of the time and < 1000 µS/cm 80% of the time at Goangra (at time of writing the CAP).*

The CAP states that the underlying principle to achieving many of these targets is through the use of Best Management Practices (BMPs). In the context of management of surface waters, BMPs refer to the management procedures and practices which are generally considered industry standard and for the purposes of this SWA, refers to those management procedures outlined within the Blue Book (DECC, 2008). The application of these procedures and practices to water management for the LOM Project is discussed in Section 6.

4.3.2 NSW Water Quality and River Flow Objectives

The *NSW Water Quality and River Flow Objectives w*ere established by the NSW Government in September 1999 for the majority of NSW catchments. Eleven water quality objectives (WQOs) were developed for NSW rivers and estuaries and these provide guideline levels to assist water quality planning and management. According to the *Namoi River Objectives,* the streams associated with the Project Site are classified as "Uncontrolled Streams" for Werris Creek and "Controlled Rivers with Reduced Flows" for Quipolly Creek.

There are numerous WQOs for "Uncontrolled Streams" and "Controlled Rivers with Reduced Flows" within the Namoi catchment depending upon the environmental values within the area. The most relevant of these objectives for the Project Site are:

- aquatic ecosystems (maintaining or improving the ecological condition of waterbodies and their riparian zones over the long term); and
- livestock water supply (protecting water quality to maximise the protection of healthy livestock).

The aquatic ecosystem objective for both "Uncontrolled Streams" and for "Controlled Rivers with Reduced Flows" is directly in-line with the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC 2000) default trigger values for slightly disturbed ecosystems in southeast Australia as discussed in Section 4.3.3.

The livestock water supply objectives for both "Uncontrolled Streams" and for "Controlled Rivers with Reduced Flows" are based on four key indicators. These indicators and their numerical trigger values are summarised in **Table 9**.

A discussion of the relevant management procedures and practices which would be implemented at the Werris Creek Coal Mine as part of the LOM Project to help achieve these water quality and river flow objectives are contained within Section 6.

Table 9
Livestock Water Supply Guidelines for Uncontrolled Streams and Controlled Rivers with Reduced Flows in the Namoi Catchment

Indicator	Numerical Criteria (trigger values)
Algae and Blue-Green Algae	Increased risk when Microcystins >11 500cells/mL and/or >2.3µg/L expressed as microcystin-LR toxicity equivalents
Salinity (electrical conductivity)	For no adverse effect – Poultry at 0 - 2985 µS/cm Dairy Cattle 0 - 3731 µS/cm Beef Cattle, Pigs, Horses at 0 - 5970 µS/cm Sheep 0 - 7462 µS/cm
Thermotolerant coliforms (faecal coliforms)	<100 thermotolerant coliforms per 100 mL (median value)
Chemical contaminants	See Table 4.3.2 of ANZECC Guidelines
Source – Namoi Catchment Management Authority (2007)	

4.3.3 ANZECC Guidelines

Water quality impacts have been assessed for aquatic ecosystems in accordance with the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000). The watercourses within the Project Site are considered to be 'slightly *disturbed ecosystems*' as described in the ANZECC Guidelines and the elevation of the Project Site places it in the '*upland river ecosystem'* category. Key default trigger values presented in ANZECC 2000 for slightly disturbed upland rivers in NSW are shown in **Table 10**.

Table 10
Key Default Trigger Values for Slightly Disturbed Upland NSW Rivers

Indicator	Trigger Value
pH	6.5 – 8.0
Conductivity (µS/cm)	30 - 350
Turbidity (NTU)	2 - 25
Total Phosphorus (µg/L)	20
Total Nitrogen (µg/L)	250
Dissolved Oxygen (% saturation)	90 -100%
Aluminium (mg/L)	0.055
Cadmium (mg/L)	0.0005[1]
Copper (mg/L)	0.004[1]
Lead (mg/L)	0.014[1]
Nickel (mg/L)	0.028[1]
Zinc (mg/L)	0.020[1]
Note 1 - Range based on lower 85% saturation limit and typical water temperature range 13 to 20^{o}C	
Source: ANZECC (2000)	

The existing Werris Creek Coal Mine operation currently adopts the EPL concentration limits as assessment criteria for pH and TSS as opposed to the ANZECC Guidelines.

4.3.4 Managing Urban Stormwater

In NSW, the most relevant and comprehensive guidelines for the design of stormwater controls relating to mines is contained in *Managing Urban Stormwater: Soils and Construction Vol 2E – Mines and Quarries* (DECC, 2008) in conjunction with the references to Volume 1 (Landcom, 2004). Both of these references are referred to in this report as the "Blue Book". The principles of surface water control, including the design of erosion and sediment control structures, have been adopted where applicable in this *Surface Water Assessment.*

4.3.5 NSW State Rivers and Estuaries Policy

The *NSW State Rivers and Estuaries Policy* contains state-wide objectives for the protection and enhancement of watercourses. The proposed surface water management for the LOM Project should be consistent with the Policy objectives. The key aspect of this would be to demonstrate that there is no degradation of Werris Creek or Quipolly Creek as a result of mining activities.

4.3.6 NSW Farm Dams Policy

The *NSW Farm Dams Policy* was introduced in 1999. Under this policy it is not necessary to obtain a licence or other consent from the NSW Office of Water (NOW) for a farm dam provided:

- they are not collecting flow from a major stream; and
- the combined capacity does not exceed the Maximum Harvestable Rights Dams Capacity (MHRDC) for the property.

There are a number of new dams proposed as part of the LOM Project which would require consideration under the *NSW Farm Dams Policy* including existing dams proposed to be modified as part of the LOM Project. The application of the *NSW Farm Dams Policy,* to these dams is discussed in Section 6.9.

5. EXISTING SURFACE WATER MANAGEMENT

5.1 INTRODUCTION

The existing SWMP for the Werris Creek Coal Mine was prepared by GSSE in April 2008 and was updated in March 2009 by WCC to reflect additional changes to the water management system (GSSE & WCC, 2009). In summary, the principal objectives of the existing SWMP incorporate the following.

- Ensure all legislative requirements with respect to water management at Werris Creek Coal Mine are met; including the Development Consent and EPL.
- Ensure that adequate quantities of water are obtained to meet the requirements of water usage onsite such as dust suppression.
- Ensure the separation of water on site into the following three 'streams' of water:
    a. 'Void' water – groundwater infiltration or rainfall runoff captured within the mine void and/or specific void water storage dams, which is potentially saline;

b. 'Dirty' water – rainfall/runoff captured from the disturbed catchments, which is potentially sediment laden; and

c. 'Clean' water – rainfall/runoff captured from the undisturbed catchments.

- Preferentially use water on site in the following order, 'Void' water, 'Dirty' water and 'Clean' water.
- Ensure nil discharge of 'Void' water and minimise the necessity to harvest 'Clean' water.
- Install and maintain appropriate sediment control structures to ensure any discharges from the 'Dirty' water catchments are kept to a minimum and comply with water quality criteria.
- Implement best practice water management procedures across the site to ensure that any environmental impacts related to surface water management are minimised.
- Minimise erosion and sedimentation from all active mining and rehabilitated areas of the site.

A description of the approved existing water management infrastructure for the currently approved mine operation is summarised below with their locations shown on **Figure 4**. The majority of the existing approved water management infrastructure was constructed as part of the original mine development. However, a number of modifications to the system have been undertaken over subsequent years. There are also a number of farm dams within the Project Site which were originally part of the agricultural water system for the "Eurunderee" and "Narrawolga" properties. The construction date of these dams is unknown.

For water management purposes, the categories of water currently managed within the existing Werris Creek Coal Mine footprint are listed below.

1. 'Void' water. The 'Void' water catchment area comprises of the active mine void area and some areas of undisturbed land and overburden emplacement areas that drain back into the open cut void and include incidental groundwater make.
2. 'Dirty' water. The 'Dirty' water catchment area currently comprises of the following areas within the Project Site.
   - The location of the existing Office and Site Facilities Area.
   - The location of the existing Coal Processing Area.
   - The Rail Load-out Facility.
   - The initial proposed location of the approved Explosives Precursor Storage Facility.
   - The location of the existing Explosives Magazine.
   - The Product Coal Storage Area.
   - Various soil stockpiles.
   - Haul roads.
   - The active overburden emplacement area.
   - Rehabilitated areas of the overburden emplacement.
3. 'Clean' water. The 'Clean' water catchment area comprises of a large area to the east of the existing mine operation.

Existing water management at the Werris Creek Coal Mine is centred on the separation of the three separate water categories to enable appropriate management of each category depending on the specific characteristics of the water.

All attempts are made to capture and divert clean water runoff around the existing mine area so as to avoid contamination. The volume of 'Dirty' and 'Void' water that is managed is minimised by both preventing mixing with 'Clean' water and through maximising the re-use of 'Dirty' and 'Void' water on-site for dust suppression and other process water requirements. The water is used on site based on the following preferential order:

'Void' water (1st) ⇨ 'Dirty' water (2nd) ⇨ 'Clean' water (3rd)

The following sections describe the existing systems in place at Werris Creek Coal Mine to manage the abovementioned categories of water.

5.2 EXISTING CLEAN WATER MANAGEMENT

Clean water runoff from catchments to the north and west of the existing mine area is prevented from entering disturbed areas primarily through the use of a series of dams and diversion banks constructed around the northern, western and southern boundaries of the active mining area.

The existing clean water dams are labelled as Storage Dams (SD's) in **Figure 4**. The SD's in use and their estimated capacities are shown in **Table 11**.

Table 11
Existing Clean Water Storage Dams

Label	Function	Capacity (ML)	Source of Capacity
SD4	Clean water capture and use Diversion of Clean water around mine	5.05	Surveyed
SD5	Clean water capture and use Diversion of Clean water around mine	4	Surveyed
SD10	Clean water capture and use	1.9	Surveyed
SD11 (dam 1)	Clean water capture and use	3	Estimated
Total Capacity of All Existing Clean Water Dams		**13.95 (ML)**	
Only existing dams at the time of this assessment are shown. Dams that were previously in place but have been removed for various reasons are not shown as they are no longer relevant to the existing operation.			
Source: GSSE & WCC (2009)			

The total combined capacity and the amount of 'Clean' water used for the existing operations is limited to the volume defined as the Maximum Harvestable Right defined in the original EIS as 47.5 ML per year. The Maximum Harvestable Right for the LOM Project is discussed in Section 6.9.1.

5.3 EXISTING DIRTY WATER MANAGEMENT

Dirty water is generated by rainfall runoff from a number of disturbed areas around the existing mine area. Dirty water is captured and treated in accordance with the *Managing Urban Stormwater: Soils and Construction, 4th Edition (Landcom, 2004)* prior to being used on site or discharged off-site under licensed conditions. The locations of existing dirty water management infrastructure are shown in **Figure 4** with the existing dirty water catchments shown in **Figure 3.**

Southern Area (offices, workshops, coal processing operations, overburden emplacements and areas undergoing rehabilitation – Catchment 3)

The Southern Area drains (via a series of dams and catch drains) to Sediment Basins (SB1, SB2, SB3, SB4, SB5, SB6 and SB7) which store and treat dirty water prior to re-use or discharge off-site at LDP 10 (SB2). Water levels in SB1, SB3, SB4, SB5, SB6 and SB7 are kept below 50% capacity to provide capacity to store dirty water during rainfall events. Where possible sediment dam SB2 is maintained in a dry condition to provide maximum capacity to store water during rainfall events.

Middle Area (Rail Load-out Road and Magazine Area - Catchment 4)

The Middle Area drains (via a series of dams and catch drains) to Sediment Basins SB8 and SB9 which store and treat dirty water prior to re-use or discharge at LDP 12 (SB9). Where possible sediment dam SB2 is maintained in a dry condition to provide maximum capacity to store water during rainfall events. As SB9 is the licensed discharge point, it is maintained in a dry condition to provide full capacity to store dirty water during rainfall events. Additionally, Farm Dams 2, 3, 4, 5 and 6 are located within the Middle Area catchment and account for 16.15 ML of storage. These Farm Dams store and treat dirty water originating from upstream in the catchment and along the table drains of the haul road before linking up with SB8 and SB9. The storage level within Farm Dam 6 is maintained below 50% to provide additional capacity during rainfall events.

Northern Area (Rail Load-out Facility –Catchment 6)

The Northern Area is surrounded by catch drains which direct all run-off to a Sediment Basin (SB10) which stores and treats dirty water prior to re-use or discharge at LDP 14 (SB10). Where possible sediment dam SB10 is maintained in a dry condition to provide maximum capacity to store water during rainfall events.

'Dirty' water is used for dust suppression, coal processing or watering of vegetation, (where there is insufficient 'Void' water). Excess 'Dirty' water is contained in sediment basins which allow for the settling of suspended sediment.

The existing Sediment Basins (SB's) are shown in **Figure 4**. The existing sediment basins in use and their estimated capacities are shown in **Table 12**.

5.4 EXISTING VOID WATER MANAGEMENT

Void water is generated by rainfall-runoff from within the open cut void (Catchment 5 as presented on **Figure 3**) and adjacent areas and from a small amount of groundwater inflow. Any water collected within the void is drained to sumps. Some of this water may naturally seep underground, however, the majority of water is pumped out to prevent the accumulation of water within the void. Groundwater pumped from the former underground workings is also classified as void water and is treated within the void water management system.

Table 12
Existing Sediment Basins

Label	Function	Capacity (ML)	Source of Capacity
SB10	Northern Area - Dirty water capture, treatment and use EPL Discharge Point (No. 14)	2.85	Surveyed
	Sub-Total (Northern Area)	**2.85 (ML)**	
SB8	Middle Area - Dirty water capture, treatment and use	3	Estimated
SB9	Middle Area - Dirty water capture, treatment and use EPL Discharge Point (No. 12)	4	Estimated
Farm 2	Middle Area - Ancillary to Dirty water system	0.4	Estimated
Farm 3	Middle Area - Ancillary to Dirty water system	0.4	Estimated
Farm 4	Middle Area - Ancillary to Dirty water system	4.2	Estimated
Farm 5	Middle Area - Ancillary to Dirty water system	0.45	Estimated
Farm 6	Middle Area - Ancillary to Dirty water system	10.7	Surveyed
	Sub-Total (Middle Area)	**23.15 (ML)**	
SB1	Southern Area - Dirty water capture, treatment and use	8.5	Surveyed
SB2	Southern Area - Dirty water capture, treatment and use (EPL Discharge Point No. 10)	7.0	Estimated
SB3	Southern Area - Dirty water capture, treatment and use	6.5	Surveyed
SB4	Southern Area - Dirty water capture, treatment and use	2.45	Surveyed
SB5	Southern Area - Dirty water capture, treatment and use	1.4	Surveyed
SB6	Southern Area - Dirty water capture, treatment and use	4.5	Surveyed
SB7	Southern Area - Dirty water capture, treatment and use	2.55	Surveyed
	Sub-Total (Southern Area)	**32.90 (ML)**	
	Total Capacity of All Existing Dirty Water Dams	**58.90 (ML)**	
Source: GSSE & WCC (2009)			

The void water can be pumped either directly into a water truck for dust suppression, or to dam's outside the void for storage or re-use within the existing mine area. The existing clean water dams and diversions act to prevent the majority of overland flows from surrounding lands entering the void water catchment, thereby minimising the quantity of void water to be managed.

The existing void water treatment system includes Void Water Dam 1 and 2 (VWD1 and VWD2) and Groundwater Storage Cell 1 (GWC1) as shown on **Figure 4**.

VWD1 has an approximate capacity of 20ML. VWD1 is located in the southern area of the Project Site. VWD2 is located in the western central area of the Project Site and has a reported capacity of 35 ML. GWC1 has a reported capacity of 200 ML. Void water is pumped to either of VWD1, VWD2 or GWC1 via an overland pipe network.

Where void water accumulates beyond the capacity of the mine to use or store the water, this water accumulates in the void and may prevent normal operation of the mine for a short period of time.

RWC (2009) noted that approximately 318ML of brackish and of almost neutral pH water remained within the underground workings of the Werris Creek Colliery. This estimate has subsequently been revised downward to approximately 200ML based on more recent monitoring of water levels within the underground workings and updated estimates of void space. Water from the underground workings is dewatered ahead of open cut mining and pumped to the void water management system. This water is used preferentially for dust suppression. In operations to date, pumping from the former underground void spaces has not been required, with water levels dropping as a consequence of seepage from the void spaces into the open cut pit. This water has been pumped from the void sumps to the existing void water management system.

6. SURFACE WATER IMPACTS AND PROPOSED MANAGEMENT MEASURES

6.1 INTRODUCTION

The following sections outline the anticipated surface water impacts, and the proposed surface water management measures to be implemented for the LOM Project. The proposed Werris Creek Coal Mine LOM Project would progressively mine the coal resources towards the north of the Project Site. As a result, progressive changes in water management would be implemented to ensure the effective control of potentially dirty water, as well as, ensuring the water demands for the Project Site are met at various stages of the mine life. Water management measures are described for three key operational scenarios for the LOM Project, as well as a brief overview of drainage controls to be implemented on the final landform of the Project Site. These measures are described in Section 6.3.4.

6.2 POTENTIAL IMPACTS OF THE PROJECT

6.2.1 Introduction

There are a number of activities commonly associated with open cut coal mining which can potentially impact upon the quality and quantity of surface water flow within the surrounding environment. The following aspects of the LOM Project have been identified as having potential to impact upon surface water quality and quantity within and surrounding the Project Site. The activities associated with the operational scenarios are presented in Section 6.2.2, with the decommissioning and rehabilitation phase being presented in Section 6.2.3.

6.2.2 Construction and Operation

The activities identified during the operational phases of the Project with the potential to impact on surface waters would be:

- construction of the visual amenity bund;
- relocation of the various infrastructure areas;
- coal extraction activities;
- overburden extraction and emplacement;
- ongoing activity associated with infrastructure areas;
- stockpiling and crushing activities;
- product transportation and vehicular access; and
- machinery maintenance activities.

The manner in which these activities may impact upon surface water quality and quantity may include (but not be limited to) the following.

- Elevated turbidity within surface water runoff.
- Entrainment of coal fines within surface water runoff.
- The potential for elevated mineral and nutrient content in surface water runoff.
- The potential for increased salinity within surface water runoff.
- The potential for elevated levels of hydrocarbons associated with maintenance activities.
- Changes in clean water flows reporting to surrounding watercourses.
- Potential for further alteration to the existing hydrologic regime.

Where the appropriate water management measures (discussed below) are put in place, the potential to impact on surrounding water quality and quantity would be substantially reduced.

6.2.3 Decommissioning and Rehabilitation

The likely impacts of the LOM Project and the contaminants of concern during decommissioning and rehabilitation are likely to be similar to those identified in Section 6.2.2 (with the exception that the quantity of these contaminants would decrease as rehabilitation work progresses and revegetation is successfully established). The appropriate design of the final landform and the temporary erosion and sediment control measures required prior to establishment of successful revegetation is essential in controlling both the quantity and quality of runoff from the final landform during the rehabilitation phase.

6.3 WATER MANAGEMENT OBJECTIVES

The principle objective of surface water management at the Project Site would be to segregate clean and dirty water flows and to minimise surface flows across disturbed areas. The key water management strategies proposed to be adopted across the Project Site are summarised as follows.

- Dirty water generated from disturbed areas, such as Soil Stockpile Areas and Overburden Emplacement Areas, would be captured and diverted using contour banks and drop structures in a manner that minimises the potential for concentrated overland flow and subsequent erosion. This water would be channelled through a series of sediment basins to reduce sediment loads prior to discharge under licence conditions.
- Water generated within the open cut, primarily as a result of rainfall/runoff and possible groundwater seepage, would be contained within the open cut via in-pit sumps. This water would be directed to and contained within these in-pit sumps until it is necessary to pump the water to Void Water Dams.
- Clean water diversions would be constructed wherever possible upstream of disturbance areas, such as the Open Cut and Overburden Emplacement Areas, to minimise the amount of dirty water to be contained and treated within the dirty water management system. The primary function of these clean water diversions would be to redirect clean water flowing onto the Project Site from adjacent lands (including agricultural land) into existing drainage lines.

- Progressive rehabilitation of all formed surfaces, such as shaped overburden emplacement areas, long-term soil stockpiles and drainage lines, would occur to help reduce the concentration of TSS (and possible high pH and salinity) in runoff from disturbed areas. This would also reduce the dependence on the sediment controls and help improve water quality.
- Re-use of as much water as possible collected in the open cut, (Void Water Dams), groundwater storage cells and/or dirty water dams for dust suppression purposes to minimise the need to undertake discharges in accordance with the Environmental Protection Licence. Where required, discharge would be undertaken to minimise the potential for pollution of downstream waterways.
- Sediment control structures would be maintained to design capacities to ensure optimum settling rates. This would be most critical for those 'end-of-line' sediment basins which discharge from the Project Site.
- Implementation of an effective revegetation, maintenance and monitoring program for all water management infrastructure associated with the Project.

6.4 PROPOSED WATER MANAGEMENT SYSTEM

A number of surface water management mitigation measures are recommended for implementation for the LOM Project to ensure the effective management of surface water and minimise the risk of any impacts on surface water resources beyond the Project Site. An overview of the proposed water management system, which incorporates these measures at three key stages of the life of the mine, is provided below. The following sections also describe how these measures would specifically be applied to the various areas of the Project Site as the LOM Project is developed.

It is proposed to maintain the majority of existing water management infrastructure at the Werris Creek Coal Mine with additional water management measures implemented at key stages during the LOM Project to accommodate an enlarged disturbance area. Presently, the main catchment divide runs approximately east to west through the area known as the "Old Colliery" Hill. The majority of dirty water management measures are located to the south of this catchment divide and report to LDP 10 and 12 (refer to **Figures 3** and **4**).

The proposed dirty water management system aims to direct all dirty water through existing LDPs, thereby eliminating the need for an additional LDP. All dirty water runoff from within the Project Site would report to one of three LDPs (LDPs 10, 12 and 14). As such, the design of the proposed dirty water system is discussed in terms of the respective catchment areas which would report to these LDPs. Water treatment and discharge would be undertaken in accordance with the methods outlined in Section 6.8.

The changes proposed to the water management system as part of the LOM Project have been designed to direct the majority of additional dirty water flow to LDP 10 and LDP 12. This strategy has been adopted as the preferred water management option in order to best utilise the existing available water management infrastructure. The proposed water management measures described below have been designed so that these measures would remain functional throughout the LOM Project and would not require to be disturbed throughout the remainder of the mining operation.

For the purposes of this *Surface Water Assessment*, the proposed dirty water management for the LOM Project is discussed in terms of the three key catchment areas of the Project Site (being the catchment areas which report to the various LDPs) (**Figure 6**). These catchment areas would change throughout LOM Project as the open cut advances to the north. The catchment areas detailed in **Figure 6** are for the water management system presented for Year 12 of the LOM Project (when they at their largest size) and are as follows:

- Northern Catchment draining to LDP 14 - includes the Rail Load-out Facility, Turn-around Loop, Product Coal Storage Area, parts of the Internal Haul Road, Northern Site Access Road, a soil stockpile and a small clean water catchment.
- Middle catchment draining to LDP 12 – includes the Office and Site Facilities Area, Coal Processing Area, Explosives Magazine, Precursor Storage Facility, soil stockpiles, northern portion of the Acoustic and Visual Amenity Bund and some clean water catchment.
- Southern catchment draining to LDP 10 – includes the overburden emplacement, soil stockpiles, southern portion of the Acoustic and Visual Amenity Bund and clean water catchment.

The proposed water management infrastructure for Years 3, 7 and 12 of the LOM Project are illustrated on **Figures 7, 8** and **9** respectively, with the final landform shown on **Figure 10**. The location and purpose of proposed future dams is discussed in Section 6.6.

6.4.1 Scenario 1 - Year 3 of the LOM Project

By Year 3 of the LOM Project the active open cut would have advanced to the north but would still be to the south of the southern/middle catchment divide. The overburden emplacement area would have expanded substantially to the north and would begin to encroach upon the area where the existing facilities and amenities are currently situated. The water management measures proposed to be implemented during Year 3 of the LOM Project are shown in **Figure 7**.

Clean Water Management

Clean water run-on from the east would continue to be routed to the south of the Project Site using existing clean water diversion bunds and sediment dams SD4 and SD5. An additional clean water diversion bund would be constructed in the northern area of the Project Site to divert clean water runoff, from the clean water catchment (to the west of “Cintra” Hill), around the Rail Load-out Facility and Product Coal Storage Area. This clean water diversion bund would be routed to existing drainage lines to the north. The positioning of this diversion bund and the catchment area it services would depend upon the final layout of site facilities areas.

Dirty Water Management

The majority of existing dirty water management measures would be retained throughout the LOM Project. The dirty water management structures that would be implemented in approximately Year 3 of the Project are summarised for each catchment below.

Southern Catchment

Dirty water runoff from the overburden emplacement area would continue to be collected by dirty water diversion bunds running around the toe of the dump and reporting to existing Storage Dams to the south. The diversion bund along the eastern side of the overburden emplacement area may need to be extended to the north to accommodate the expanding overburden emplacement area.

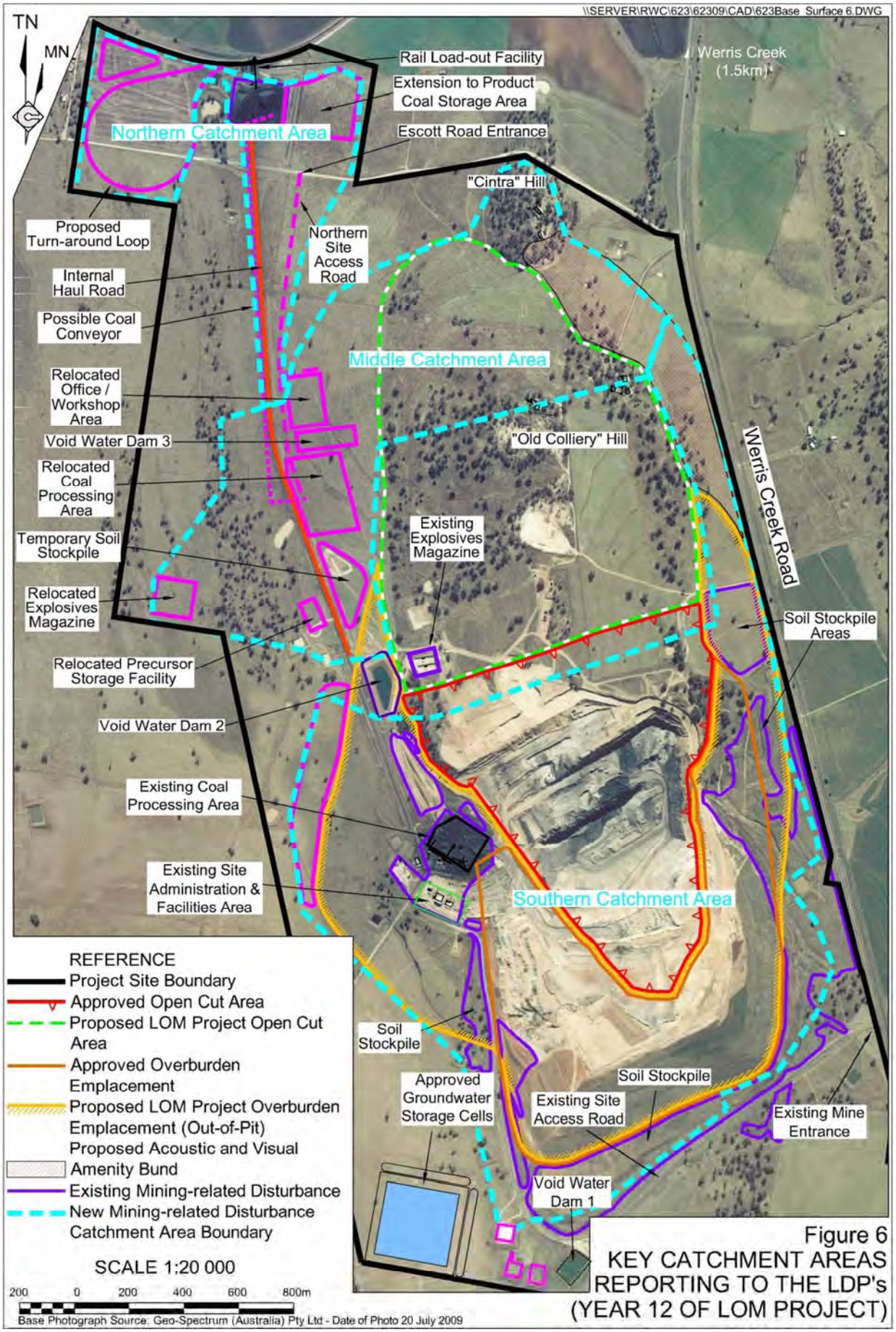


Figure 6
KEY CATCHMENT AREAS REPORTING TO THE LDP's (YEAR 12 OF LOM PROJECT)

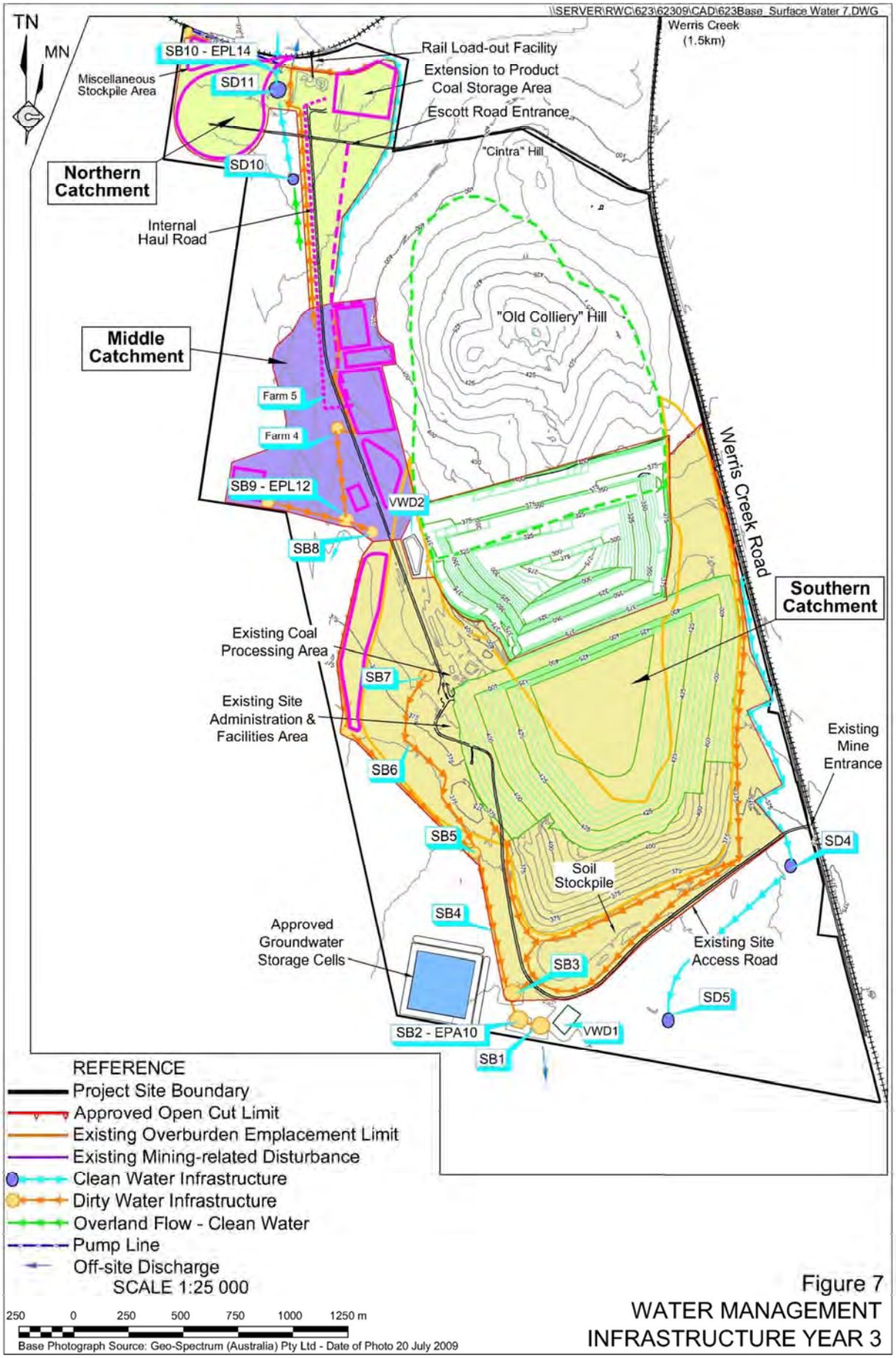


Figure 7
WATER MANAGEMENT
INFRASTRUCTURE YEAR 3

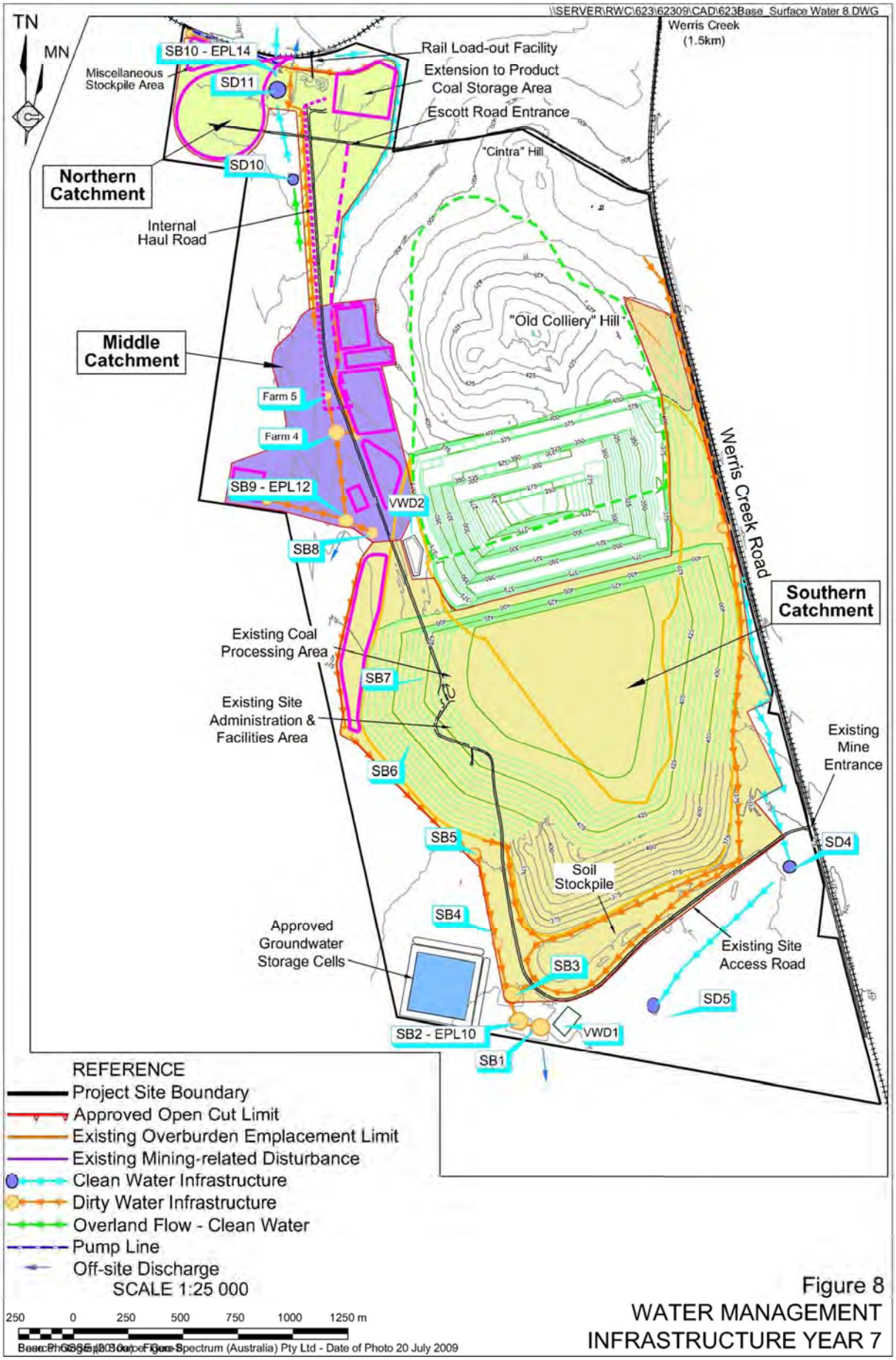


Figure 8
WATER MANAGEMENT
INFRASTRUCTURE YEAR 7

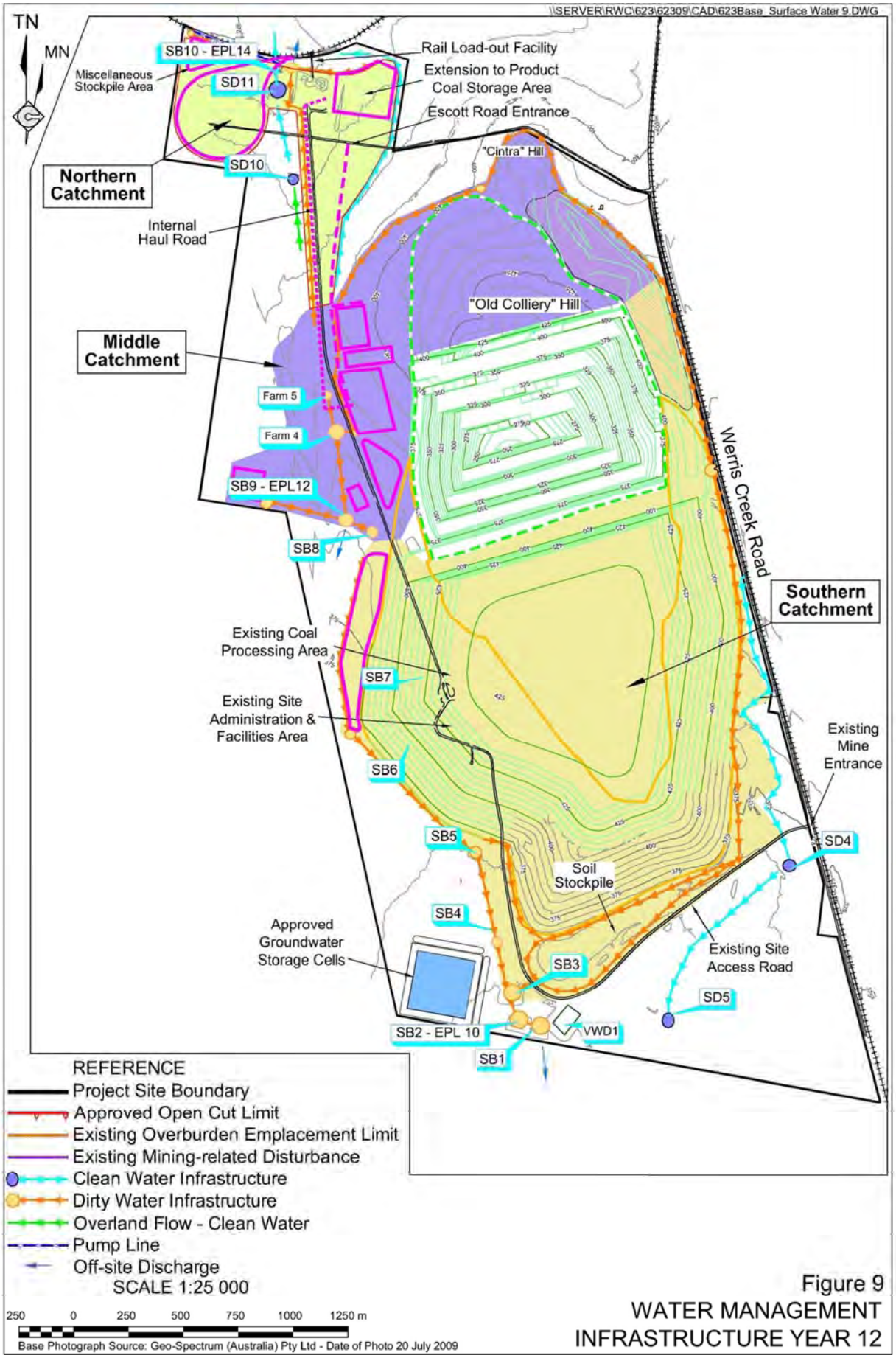


Figure 9
WATER MANAGEMENT INFRASTRUCTURE YEAR 12

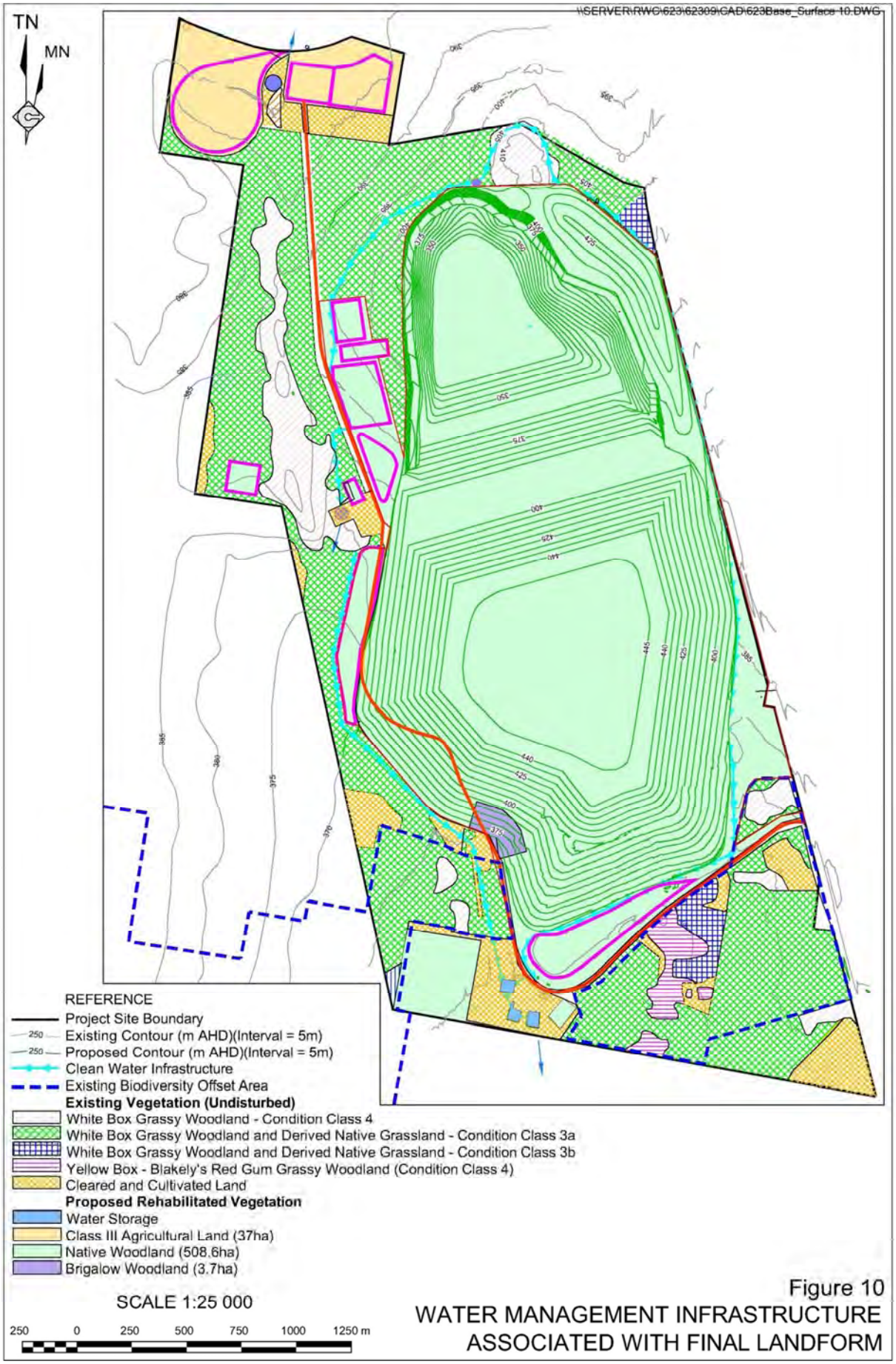


Figure 10
WATER MANAGEMENT INFRASTRUCTURE ASSOCIATED WITH FINAL LANDFORM

An additional dirty water diversion bund would be constructed around the southwest boundary to collect dirty water generated from the proposed temporary soil stockpile immediately to the south of SB8 and direct this flow to SB2. As the overburden emplacement area expands, this diversion bund would also act to capture dirty water runoff generated from the overburden emplacement area. The additional dirty water generated from the expanded overburden emplacement area would require additional sediment basin capacity which could be achieved through augmenting existing sediment basins or the construction of new sediment basins (see Section 6.6).

Middle Catchment

The existing dirty water drain and associated dirty water dams along the western boundary of the Project Site reporting to SB9 (LDP 12) would continue to receive dirty water generated from the relocated Office and Site Facilities Area and Coal Processing Areas. Runoff from the relocated Precursor Storage Facility and additional temporary soil stockpiles would also be captured within this system.

The relocation of the Coal Processing Area and Office and Site Facilities Area may require additional dirty water diversions to be constructed to capture and treat rainfall/runoff from these areas and help direct flow to SB9. Existing Farm Dams 4 and 5, currently ancillary to the dirty water system would be converted to dirty water dams to provide additional sediment basin capacity. Farm Dam 2 and Farm Dam 3 would be removed by Year 3 of the LOM Project. While the remaining capacity of sediment basins within the middle catchment area (reporting to LDP12) would be adequate, it is recommended that small sediment traps be constructed adjacent to the disturbance areas to capture coarse sediment within runoff.

A small sediment trap and dirty water diversion bund may also be required to direct dirty water runoff from the relocated Explosives Magazine to SB9.

Northern Catchment

The proposed temporary soil stockpile in the north of the Project Site would require temporary erosion controls to be implemented. If this soil stockpile is proposed to be regularly disturbed it may require the construction of a small diversion bund and sediment trap to contain any dirty water generated from this area. Dirty water may also be required to be pumped to the SB10 for offsite discharge. As discussed in Section 6.6, the increased disturbance area would require for the capacity of SB10 to be augmented or a new dam constructed for additional capacity.

Void Water Management

Void water including seepage from groundwater from the former Werris Creek Colliery underground workings would continue to be managed in accordance with existing void water management procedures, utilising VWD1 and VWD2 and the groundwater storage cell (GWC1). Approval has been granted for the construction of an additional groundwater storage cell (GWC2), however this storage cell has not yet been built. If required, GWC2 would be constructed to supplement the existing groundwater storage capacity. An additional Void Water Dam (VWD3) would be constructed by Year 3 of the LOM Project to supplement the existing void water storage capacity. It is proposed that this dam would be constructed in the north of the Project Site adjacent the relocated Office and Site Facilities Area, however, the positioning of this dam would be dependent upon the final layout of site infrastructure in this area of the Project Site.

6.4.2 Scenario 2 - Year 7 of the LOM Project

By Year 7 of the LOM Project the active mining area would be encroaching upon the "Old Colliery" Hill with work having commenced on the construction of the Acoustic and Visual Amenity Bund to the northeast of the proposed limit of the open cut.

The overburden emplacement area would have expanded substantially into the area of the existing amenities and Coal Processing and Office and Site Facilities Areas requiring the removal of sediment basins SB6 and SB7 and the dirty water diversion bund joining these dams. The water management measures proposed to be implemented during Year 7 of the LOM Project are shown in **Figure 8.**

Clean Water Management

Clean water would continue to be managed in accordance with the management measures in use as at Year 3 of the LOM Project, including the clean water diversions in the north and east of the Project Site and associated clean water dams.

Dirty Water Management

Southern Catchment

The dirty water diversion on the eastern side of the overburden emplacement area would be extended to the north to capture dirty flow generated from the Acoustic and Visual Amenity Bund. A small sediment basin may also be constructed in the east of the Project Site to treat dirty water runoff from the Acoustic and Visual Amenity Bund, however, it would also be possible to allow this water to be treated in sediment basins further down in the dirty water system.

With SB6 and SB7 covered by the overburden emplacement area by Year 7, dirty water runoff generated from the overburden emplacement would report to the dirty water diversion constructed to accommodate the temporary soil stockpile on the western side of the Project Site. Additional sediment basin capacity would need to be sourced in order to offset the loss of SB6 and SB7 and allow appropriate treatment of dirty water runoff. This would be achieved by augmenting existing sediment basins in the south of the Project Site or by constructing additional sediment dams (see Section 6.6).

Middle Catchment

Dirty water management measures in the middle catchment of the Project Site would remain unchanged from those described as part of dirty water management for Year 3 of the LOM Project. The area of the middle catchment would be reduced due to the expanding mining operations.

Northern Catchment

Dirty water management measures in the northern catchment of the Project Site would remain relatively unchanged from those described as part of dirty water management for Year 3 of the LOM Project.

Void Water Management

Void water would continue to be managed in accordance with existing void water management procedures, utilising VWD1 and VWD2 and the groundwater storage cell in the south of the Project Site.

6.4.3 Scenario 3 - Year 12 of the LOM Project

By Year 12 of operations the active open cut would have progressed through the "Old Colliery" Hill and the Acoustic and Visual Amenity Bund would be fully constructed to the northeast of the limit of the open cut. The overburden emplacement would be expanding substantially into the area of the existing amenities and Coal Processing and Office and Site Facilities Areas.

The proposed water management system for Year 12 of the LOM Project would be in use through to the end of mining and it is not anticipated that any additional water management measures (with the exception of temporary erosion control measures) would be implemented following Year 12 of the LOM Project. The water management measures proposed to be implemented during Year 12 of the LOM Project are shown on **Figure 9.**

Clean Water Management

Once the active open cut advances beyond the "Old Colliery" Hill a new dirty water diversion would be constructed in this area with a portion of the clean water catchment flowing to the north intercepted by the new dirty water diversion. This would reduce the catchment area flowing to the clean water diversion bund to be constructed as part of Year 3 of the LOM Project.

Clean water run on from the east of the Project Site would continue to be managed as described above in Section 6.3.1.

Dirty Water Management

Southern Catchment

Dirty water management measures in the southern catchment of the Project Site for Year 12 would remain relatively unchanged from those described as part of dirty water management for Year 7 of the LOM Project.

Middle Catchment

The expansion of the Acoustic and Visual Amenity Bund to the north would require the construction of an additional dirty water diversion bund to capture dirty water runoff which would otherwise flow to the north. This diversion bund would run around the north of "Cintra" Hill and would run back to the southwest to direct flow to SB9 via the dirty water diversion proposed to capture runoff from the relocated coal processing, amenities and workshop areas.

The existing sediment basins within the middle catchment area would have enough capacity to accommodate the additional catchment, however, an additional sediment basin may be constructed within the small gully to the southwest of Cintra Hill to treat dirty water runoff from the northern portion of the proposed Acoustic and Visual Amenity Bund.

The diversion bund would be positioned just beyond the edge of the proposed extent of the open cut such that it would remain functional until the end of mine life. This diversion bund would need to be constructed prior to the construction of the northern portion of the visual amenity bund.

Northern Catchment

Dirty water management measures for Year 12 in the northern catchment of the Project Site would remain relatively unchanged from those described as part of dirty water management for Year 7 of the LOM Project.

Void Water Management

Prior to Year 12 of mining, the overburden emplacement area would encroach upon VWD2, which would be removed. Void water would continue to be managed in accordance with existing void water management procedures, utilising VWD1 and VWD3 and the groundwater storage cell.

6.4.4 Final Landform

The water management measures described as part of Year 12 of operations would continue to be utilised through to the end of mine life with various aspects of the water management system incorporated into the final landform where appropriate. Shaping of the final landform would include shaping of the open cut void to grades nominated in the Rehabilitation and Environmental Management Plan (REMP). It is anticipated that backfilling would be undertaken to a level above the depth of the extracted coal seam in order to minimise groundwater seepage into the final void. Water management infrastructure associated with the final landform is shown in **Figure 10.**

Clean water diversions utilised throughout the LOM Project would likely be maintained following the cessation of mining. However, these structures may be removed at this time following appropriate consultation with government agencies. Similarly, dirty water management measures in use at the end of mining would be maintained throughout the rehabilitation phase of the Project or until appropriate rehabilitation works have been completed. These structures would then be either retained and incorporated into the final landform or would be decommissioned and made stable following appropriate discussions with DECCW.

Active pumping of mine void water would effectively cease following the end of mining. The Void Water Dams (VWD1 & VWD3) and groundwater storage cells would be drained, with the banks pushed in, covered with topsoil and rehabilitated.

Rehabilitation and shaping of the final landform would be undertaken in accordance with the REMP and would include the construction of contour banks and potentially drop structures on steep slopes within the Project Site.

6.5 CLEAN WATER MANAGEMENT INFRASTRUCTURE

Where clean water diversions are implemented, the diversion banks would be constructed generally in accordance with *Blue Book Standard Drawing SD 5-6.* A summary of the general minimum design specifications is as follows.

- Gradient of the diversion banks should be approximately 1%.
- Height of the bank should have at least 400 mm freeboard.
- Channel width should be at least 3 m.
- A level spreader (or sill) should be constructed at the bank discharge point to reduce the risk of erosion at this point, as per *SD 5-6*.
- Within ten days of construction, pasture should be sown to prevent erosion of the bank and drain.

The clean water diversion channels should be designed to convey the 20 year Annual Recurrence Interval (ARI) storm event, as recommended by the Volume 2E of the *Blue Book* for temporary drainage controls, where the duration of disturbance is greater than 3 years.

Additional temporary clean water diversions may be implemented above the moving highwall in order to divert clean water rainfall/runoff (from the catchment up-slope) away from the active extraction area.

6.6 DIRTY WATER MANAGEMENT INFRASTRUCTURE

6.6.1 Dirty Water Diversions

Where dirty water diversions are required, these would be constructed prior to any disturbance occurring. Where practical, the diversion banks would be constructed generally in accordance with *Blue Book Standard Drawing SD 5-6* and the general design specification listed in Section 6.5. In practice, it may not be practical or necessary to achieve these design specifications given that these diversions are within the dirty water management system and need to work in with challenging site conditions. The keys aspects of the design of the dirty water diversions is to ensure that they convey dirty water to the nominated sediment basin and that they are stabilised (e.g. grass cover, jute mesh, rock or otherwise) to prevent erosion of the channel.

6.6.2 Sediment Basin Design

As part of this assessment, an analysis of the required sediment basin volumes was undertaken, considering the available capacity of existing dams (presented in Section 5.2) and proposed dams required to achieve appropriate management of dirty water associated with future disturbance areas. Calculations and analysis were undertaken following the guidelines and procedures presented in *Volume 1 and 2E (Mines and Quarries)* of the *Blue Book* for the minimum criteria for Type D/F sediment dams.

The general parameters that remained constant for the analysis of existing dams and designs of proposed future dams are presented below.

- Design Storm of 5 Days, 90th percentile - based on the minimum design criteria presented in Table 6.1 of *Volume 2E (Mines and Quarries)* of the *Blue Book* and the existing EPL, which recommends adopting a 90th percentile design storm event when designing a Type D/F basin where the duration of disturbance will be greater than 3 years. For the Gunnedah region which incorporates the Project Site, the 5 day, 90th percentile rainfall depth is 38.4mm.
- Volumetric Runoff Coefficient of 0.64 – this reflects the *Blue Book* soil hydrologic group D which has a very high runoff potential. Group D soils are fine-textured (clay) and are surface sealed. The coefficient is also in line with the default runoff characteristic presented in *Volume 2E (Mines and Quarries)*, which recommends using soil hydraulic group D in the absence of site-specific data.
- Soil Classification of Type D (dispersive) – the Soils Assessment for the LOM Project (GSSE, 2010) identified soils within the Project Site to be predominantly of Type D hydrologic group. This is in agreement with the findings of the original *Surface Water Assessment* (Department of Lands – Soils Service, 2004) for the Werris Creek Coal Mine. This soil hydrologic group is in line with the conservative design classification recommended by the *Blue Book*.

- Soil Erodibility Factor (K factor) of 0.02 – based on site specific soil data presented in the Werris Creek Coal Mine's *Soils and Land Capability Assessment* (GCNRC, 2004).
- Rainfall Erosivity Factor of 1500 – based on Project Site's location on the rainfall erosivity maps presented in *Appendix B of Volume 1* of the *Blue Book*.

Conservative ground cover management factors (C-factor) were adopted for the calculation of the anticipated sediment storage zones for the basins (based on anticipated percentage ground cover). Where the basins receive runoff from within the disturbed areas of the site it was assumed that ground cover varied from 0% to 50% depending on the year of mining and the progression of rehabilitation.

6.6.3 Summary of Proposed and Existing Dams

A summary of the required sediment basin capacities for each respective catchment area (draining to the LDPs) is presented in **Table 13** with a detailed breakdown of the required sediment basin capacities for various structures and features contained within the Project Site (for various operational phases) presented in **Table 14**.

Table 13
Required Sediment Basin Capacities for Respective Catchment Areas

Sediment Basin Capacities (ML)				
Catchment Area	Existing	Future Total Required Capacity		
		Year 3	Year 7	Year 12
Northern (LDP 14)	2.85	4	4	4
Middle (LDP 12)	23.15[1]	7.25	7.25	15
Southern (LDP 10)	32.90	36[2]	35[3]	34[4]

Note 1: The available capacity in the Middle catchment would be reduced to 22.3 ML in the first few years of operations as Farm Dam 2 and Farm Dam 3 would be removed by the expanding operations)

Note 2: Includes overburden emplacement and southwest soil stockpile

Note 3: Includes overburden emplacement, southern section of the Acoustic and Visual Amenity Bund and the southwest temporary soil stockpile

Note 4: Includes the overburden emplacement, southern section of the Acoustic and Visual Amenity Bund and the southwest temporary soil stockpile

Based on the proposed future development for the Project Site, the existing sediment basin capacities within the northern and southern catchments was determined to be inadequate. Additional sediment basins would need to be constructed or existing sediment basins upgraded to accommodate the additional disturbance areas (see **Figures 7** to **9**). Existing available sediment basin capacity within the middle catchment area was determined to be adequate throughout the LOM Project.

The calculated sediment basin capacities detailed in **Tables 13** and **14** consider various areas which would not be disturbed by mining related activity (clean catchment) but which would be incorporated within the dirty water management system. The required capacities would constantly change throughout the life of the LOM Project as the active extraction and dumping areas progress and as rehabilitation becomes established.

Table 14
Required Sediment Basin Capacity for Various Areas/Features

Project Feature/Structure	Within Catchment Area	Required Sediment Basin Capacity (ML)
Overburden Emplacement Year 3	Southern	34
Overburden Emplacement Year 7	Southern	27
Overburden Emplacement Year 12	Southern	26
Acoustic and Visual Amenity Bund (South Area)	Southern	5.7
Southwest Temporary Soil Stockpile	Southern	1.9
Coal Processing Area	Middle	1.4
Office and Workshop Area	Middle	0.6
Central Soil Stockpile	Middle	0.7
Precursor Storage Facility	Middle	0.15
Explosives Magazine	Middle	0.5
Acoustic and Visual Amenity Bund (north area)	Middle	4.8
Product Coal Storage Area	Northern	4
Miscellaneous Soil Stockpile (north)	Northern	0.5
Note: When added together for each catchment area, the various capacities detailed above exceed the total areas detailed in **Table 14** as these consider each disturbance area individually, while those in **Table 14** consider rehabilitation of disturbance areas as the mine progresses.		

While it would be feasible to allow runoff from all future disturbance areas to report to sediment basins lower down in the dirty water management system, it is recommended that small sediment traps be constructed immediately downstream from all proposed future disturbance areas such that coarse sediment contained within dirty water runoff would be contained within these sediment traps and be prevented from accumulating within the respective dirty water diversion bunds.

The required sediment basin capacity for the various infrastructure and facilities areas is likely to remain constant throughout the life of the Project. The capacity of sediment basins calculated for the overburden emplacement area considers that runoff would progressively decline from rehabilitated areas as vegetation becomes established and that this would take approximately 3 to 5 years. This runoff would continue to be captured by the existing dirty water system and be directed to existing sediment dams in the south. In calculating the required sediment basin capacity for the overburden emplacement area, it has been assumed that approximately 90 ha of the overburden emplacement could be considered rehabilitated as at Year 3 of the LOM Project.

In estimating the rehabilitated area of the overburden emplacement for Year 7 and Year 12, it has been assumed that areas of the overburden emplacement could be considered rehabilitated after three years if there was no additional disturbance to that area. Based on the progressive mine development, it has been assumed that the majority of the overburden emplacement would be rehabilitated as it became available. As such, the rehabilitated areas of the overburden emplacement for Year 7 and Year 12 have been assumed as 202 ha and 224 ha (approximately 90%) of the total overburden emplacement respectively.

The dirty water diversion bund proposed to service the north area of the Acoustic and Visual Amenity Bund would intercept an approximate clean water catchment area of 67 ha which would have previously been reporting to the north clean water diversion bund. This would require an approximate additional sediment basin volume of 5.2 ML within the middle catchment area. This additional required capacity would progressively reduce as the extraction area advances to the north and encroaches upon this clean water catchment.

The methodology described above is based on a conservative approach which allows for a slight excess in dirty water storage capacity when compared to the minimum *Blue Book* requirements. In addition, where site conditions allow, the actual constructed capacity of new sediment basins should exceed the required sediment basin capacities detailed in **Table 14** which would provide some additional storage above Blue Book requirements.

6.7 WATER SOURCES

The majority of water required on the Project Site would be utilised for dust suppression activities. A nominal amount of potable water for drinking purposes would be required and would continue to be sourced from rainwater collected from the Project Site buildings and stored in rainwater tanks and supplemented by water trucked in to the Project Site.

Water sources for operational activities would continue to be used in the following order of preference.

- Void water (via Void Water Dams and groundwater storage cells).
- Dirty water from the sediment basins, preferentially sourced from the basins with higher electrical conductivity readings and end of line basins.
- Licensed bores. Clean water within the mining lease (via storage dams).
- Water occasionally trucked in from off-site if required.

A schematic of the proposed water management system and the various water sources available for the site is presented in **Figure 11**.

6.8 WATER TREATMENT AND DISCHARGE

Where water generated within the Project Site requires discharge from the Project Site, the following treatment and disposal methods would be employed.

Controlled Discharge

Controlled discharge of treated (e.g. settled and/or flocculated) dirty water would be undertaken in accordance with EPL12290 from the respective LDP discharge dams (SB2, SB9 and SB10). This discharge should be undertaken within the 5 day management period following rainfall events such that sediment dams would be maintained in a drawn down state. In doing so, this would provide the capacity to contain the design rainfall events and reduce wet weather discharges. Controlled discharge (of treated dirty water) during dry weather would significantly reduce the potential for discharge of sediment laden water during wet weather events. Discharge of dirty water in a controlled manner allows adequate settlement of sediment to be achieved prior to discharge.

Wet Weather Discharge

Where discharge is undertaken during wet weather it would be undertaken in accordance with the discharge procedures for controlled discharge and the conditions in the EPL.

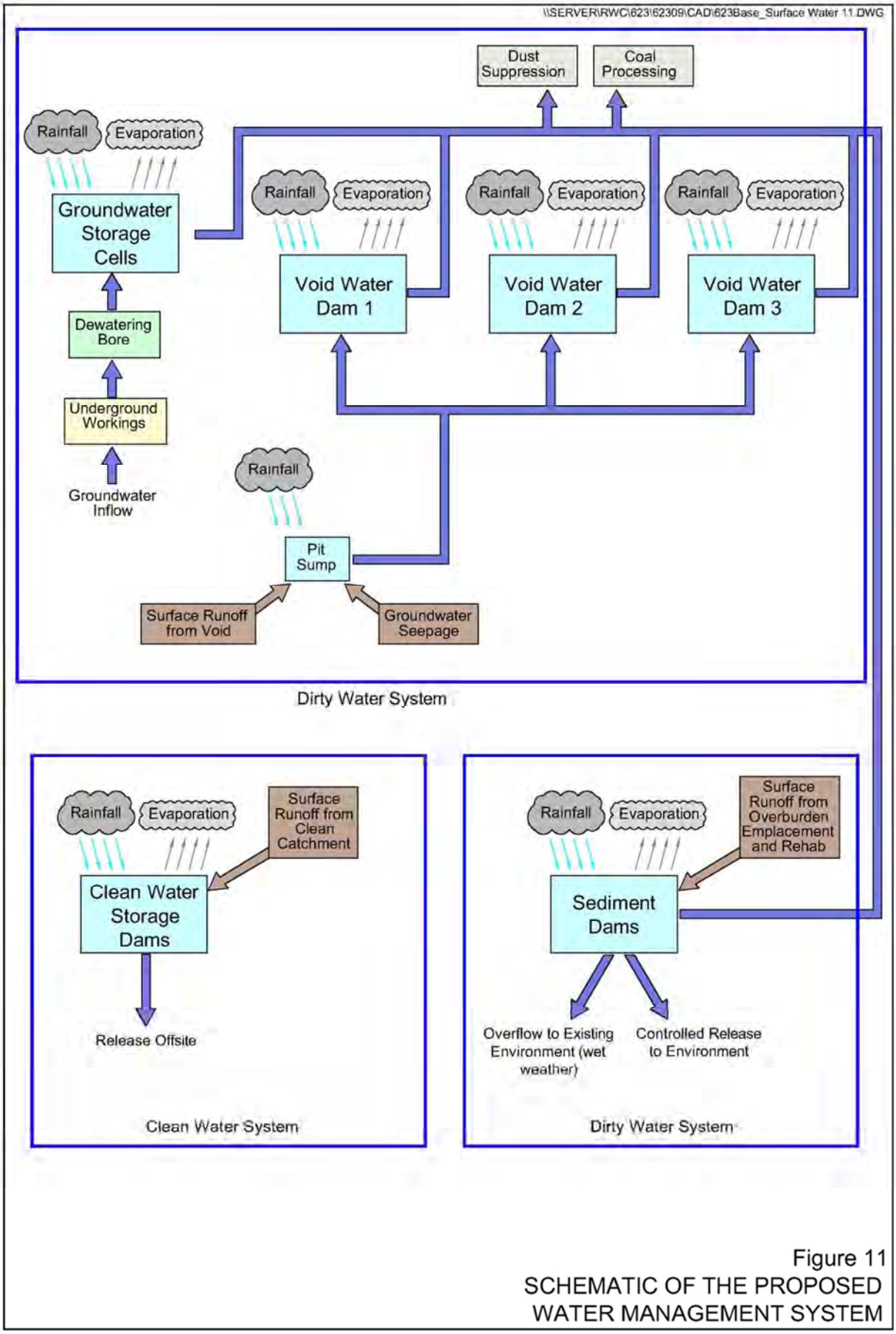


Figure 11
SCHEMATIC OF THE PROPOSED WATER MANAGEMENT SYSTEM

As specified under condition L3.4 of EPL12290, the TSS concentration limits specified for LDP 10, 12 and 14 may be exceeded for water discharged from the sediment basins provided that:

a) the discharge occurs solely as a result of rainfall measured at the premises that exceeds 39.2 mm over a consecutive 5 day period immediately prior to the discharge event; and

b) all practical measures have been implemented to dewater all sediment dams within 5 days of rainfall such that they have sufficient capacity to store runoff from a 39.2 mm, 5 day rainfall event.

Treatment of Saline Water

Void water produced within the active extraction area and groundwater extracted from within the former Werris Creek Colliery underground workings may potentially have elevated electrical conductivity. It is proposed to temporarily store this water within storage dams on the Project Site for re-use within operational activities.

The site water balance indicates that there would be excess void water generated during wet years at times throughout the LOM Project. This excess void water would be retained within the void water storage system for reuse at a later date.

Treatment of Dirty Waters

Dirty water that is to be discharged is required to meet a TSS concentration limit of 50 mg/L in accordance with the current EPL. Where elevated TSS is identified within end of line sediment basins (i.e. discharge locations) and discharge is anticipated, chemical flocculation may be used to help decrease the settling times of the sediment in the water column. Previous testing using Floc Blocs indicate that TSS concentrations can be effectively reduced via chemical flocculation.

There are various other methods and techniques available to remove solids from sediment-laden water and the most appropriate would be determined for use on a case by case basis in conjunction with specialists and relevant government agencies. Flocculants that may be used include alum, gypsum or synthetic flocculants such as polyacrylamide. All have particular environmental constraints, but all are well recognised as useful chemicals for the task of clarifying water prior to discharge to a natural waterway.

Due to the low frequency of application and practical needs for operating on a mine site, the task of flocculating water prior to discharge would likely be conducted by an external contractor or by site environmental personnel.

6.9 LICENSING REQUIREMENTS

6.9.1 Maximum Harvestable Right Dam Capacity

The maximum harvestable right dam capacity (MHRDC) of the Project Site is determined by the following calculation:

MHRDC = Project Site Area (ha) x Multiplier Value (0.07)

The MHRDC has been calculated to be approximately 63 ML based on the Project Site area of 908ha.

All existing clean water storage dams that would be used for water supply are within the MHRDC of 63 ML. Hence no licences are required for these existing dams.

6.9.2 Dirty Water Dams

All the existing and proposed dirty water dams (sediment basins) are exempt from harvestable right calculations under the *NSW Farm Dams Policy 1999*. This is because the purpose of the dams is to prevent the contamination of downstream waterways from pollutants such as TSS.

The Void Water Dams and the groundwater containment cells would continue to be used as 'turkeys nest' dams to contain water pumped from the open cut void and the licensed groundwater bores connected to the former Werris Creek Colliery underground workings. These dams do not capture water from the natural catchment and are therefore also exempt from licensing under the *NSW Farm Dams Policy 1999*.

6.9.3 Licensed Discharge Points

The current LDPs (LDPs 10, 12 and 14) would continue to be used as the only discharge points for controlled and wet weather discharge. LDPs 10 and 12 would continue to discharge to Quipolly Creek in the south while LDP 14 would discharge to Werris Creek in the north. The only significant change to the current discharge regime would be an increased discharge volume from LDP 12 (SB9) as a result of an increase in catchment area following construction of the Acoustic and Visual Amenity Bund and associated dirty water diversion.

As discussed in Section 3.8.2.3, elevated levels of TSS have previously been detected within sediment basins SB9 (LDP12) and SB10 (LDP10). To reduce the potential for discharge of water with elevated levels of TSS, a number of mitigation measures may be adopted including chemical flocculation and coagulation and installation of additional temporary erosion control measures (refer to Section 6.8). The requirement for additional pollution control measures would be based on requirements at the time and the outcome of additional water quality monitoring within these dams.

6.9.4 Groundwater Licences

Groundwater which currently seeps into the open cut void would continue to be captured within sumps and pumped to the surface for management within the two Void Water Dams and used for dust suppression, stockpile wetting or coal processing purposes (RWC, 2010). Extraction of groundwater from within the former Werris Creek Colliery ahead of open cut mining may also be conducted if seepage of this water to the open cut does not keep up with the progression of mining. This water would be transferred to the purpose built groundwater storage cell GWC1.

A groundwater licence would be required under Part 5 of the *Water Act 1912*/*Water Management Act 2000* for any activities relating to the following:

- Open cut mining (where groundwater is extracted and utilised for mining related activity).
- The installation of groundwater monitoring piezometers.
- Extraction of water from underground workings (where groundwater is extracted and utilised for mining related activity).
- The installation of production bores (where groundwater would be extracted and utilised for mining related activity).

The Groundwater Assessment (RCA 2010) notes that a licence would be required for the interception of the groundwater table during operations. The predicted maximum groundwater make during operations is 50ML/year which is termed incidental water make and requires an aquifer interference licence.

Groundwater licensing is discussed further in the Groundwater Assessment section of the EA.

6.10 CONTAMINATED WATER AND SEWAGE DISPOSAL

Contaminated water and sewage would continue to be managed in accordance with existing management procedures for the Werris Creek Coal Mine.

Potentially contaminated runoff from workshop areas and wash down bays would pass through an oil/water separating unit to reduce concentrations of oil and grease. The clarified water would then be incorporated into the dirty water management system and eventually report to SB9.

Sewage would be treated by a biocycle sewage treatment system approved by Liverpool Plains Shire Council. This facility would be serviced by a licensed waste collection and disposal contractor as required.

The only significant change which would occur as part of the LOM Project would be the relocation of the existing contaminated water and sewage water management facilities to within the relocated Office and Workshop Area. Alternatively, new facilities may be constructed to service these areas. If required, temporary or portable management measures may be utilised during relocation works.

6.11 FLOW REGIMES, SURFACE WATER QUALITY AND QUANTITY

As described above in Section 6.3, all clean water flowing onto the Project Site would be diverted around the disturbance areas and into existing drainage lines. The clean water runoff from the eastern catchment would be diverted south into Quipolly Creek. This would result in a large area of clean catchment being diverted around the Project Site and into the natural drainage system rather than being retained for on-site water re-use.

As a result of the diversions, only runoff that lands within the disturbed areas of the Project Site would be retained on the Project Site. This equates to an area of approximately 600 ha at the full extent of mining operations of which approximately 350 ha relates to the proposed extension to the approved operations for the LOM Project.

The use of clean water diversions would assist in maintaining ephemeral flows and sediment movement patterns in the watercourses downstream of the Project Site. It must also be noted that through the provisions of the EPL, water of suitable quality contained within the water management system may also be discharged when required via DECCW registered LDPs.

The Werris Creek catchment comprises an area of approximately 404 km^2, while the Quipolly Creek catchment comprises approximately 190 km^2. The disturbance area of the LOM Project equates to approximately 1.5% and 3% of the Werris Creek and Quipolly Creek catchments respectively, which is very minor in relation to the total catchment area for these watercourses.

The proposed LOM Project would constitute an extension to existing mining operations to the north of the current open cut area following the ridgeline of the “Old Colliery” Hill. As such, no existing drainage lines would be impacted by the proposed expansion.

The proposed water management infrastructure for the LOM Project would be designed in accordance with the standard design criteria presented in the *Blue Book* and Best Management Practice (BMP). Where discharge is required, it would be designed to comply with the existing EPL discharge conditions. Ongoing monitoring of receiving waters upstream and downstream would continue in accordance with the existing EPL to confirm that potential off-site impacts are minimised. Based on the above information, it is anticipated that there would be no impacts to surface water quality or quantity on the receiving waters and that there would be no impact upon the riparian, ecological or hydrological value of the receiving watercourses resulting from the LOM Project.

6.12 MODELLING OF POTENTIAL IMPACTS

The DGRs for the Werris Creek Coal Mine LOM Project require modelling to assess the potential impact upon surface water and groundwater resources. Based on the likely minimal impact upon water quality and quantity, ecological, riparian, geomorphological and hydrological values of watercourses, modelling of these impacts is not justified and has not been undertaken as part of this SWA.

Groundwater modelling undertaken by RCA Australia (2010) has predicted a drawdown of up to 1.0m within the Project Site and a drawdown of less than 0.1m in the vicinity of the LOM Project Site. Reductions in saturated thickness are not predicted to occur above the trigger criteria at any monitoring bores.

RCA (2010) also determined that groundwater inflows into the void were predicted to reach a maximum of approximately 50ML/year (not including inflows from the underground workings). The predicted rate of groundwater inflow is below the average evaporative rate for the area. Variations in climatic conditions are likely to result in water make within the open cut from time to time.

RCA (2010) also determined from their groundwater modelling that there is no predicted impact to either Quipolly Creek or Werris Creek. The likelihood of occurrence of Groundwater Dependent Ecosystems (GDE's) would be very low and, in combination with the absence of predicted impacts, there are no impacts to GDEs likely to occur as a result of the LOM Project.

7. SITE WATER BALANCE

7.1 INTRODUCTION

This section examines the site water requirements and available water storage against water availability to present a water balance for the LOM Project. Site water balance calculations were undertaken for the scenarios referred to as Years 3, 7 and 12 of the LOM Project and include an assessment of median, dry and wet years.

This water balance is based on the same methodology used for the water balance within the 2005 Site Water Management Plan (RWC) and represents water management at Werris Creek Coal Mine on an annual basis, which is reasonable given the relatively low site water usage and limited disturbance in relation to general coal mining projects within NSW.

This water balance covers the requirement to address a description of site water demands, water supply and disposal methods and has been based on the proposed water management system described within Section 6.

As site water management is considered in terms of three separate water streams, the results of the water balance are presented below as three separate water balances for clean, dirty and void water management. Whilst each water stream is managed separately there is potential for the streams to be mixed (see Section 6.8) and for water to be taken from each stream in accordance with the preferential usage nominated (see Section 6). The selection of water source is based on the preferential use of water as described in Section 6.5.

The supply of water used for drinking and bathhouse facilities is not sourced or disposed of through any of the water streams within this water balance. Subsequently, the management of this water is not addressed within the water balance.

7.2 WATER INPUTS

7.2.1 Rainfall Runoff

Rainfall runoff from the void area has been determined using the following BOM statistical annual rainfall measured at the Quirindi post office station (1882 to 2010).

- Annual 10th percentile (dry year): 465.5 mm.
- Annual 50th percentile (average year): 683.7 mm.
- Annual 90th percentile (wet year): 916.8 mm.

The runoff coefficients referred to below are annual volumetric runoff coefficients, which have been assumed by GSSE based on:

- the previous Surface Water Assessment;
- site characteristics and anecdotal observations by site personnel;
- GSSE experience;
- *Australian Journal of Soil Research publications*; and
- consideration of other publications (including *Blue Book, ARR, DLWC Guidelines*).

The rainfall runoff from catchments from each of the three water streams is addressed separately below.

Clean Water Catchment

The area making up the clean water catchment is the large area to the east of the open cut. This area (480 ha) is assumed to have fairly natural characteristics.

Additional undisturbed catchment areas are located within the Project Site boundary, however, the majority of these catchments are incorporated into the dirty water management system or drain off the Project Site. There is a small portion of undisturbed catchment in the north of the Project Site draining to SD11 which is also included in the water balance.

Dirty Water Catchment

The areas making up the dirty water catchment include the following.

- Northern Catchment Area incorporating:
  - the Rail Load-out Facility (8.6 ha);

  - the proposed temporary northern soil stockpile located adjacent to the proposed rail loop (1.8 ha);
  - the undisturbed catchment upslope from the Coal Processing Area (18 ha); and
  - those parts of the Haul Road and Northern Site Access Road which drain to the northern catchment.
- Middle Catchment Area incorporating:
  - the Coal Processing Area (5.5 ha);
  - the Precursor Storage Facility (0.6 ha);
  - the Explosives Magazine (2 ha);
  - the Workshop and Office Area (2.3 ha);
  - the temporary central soil stockpile (2.7 ha);
  - the undisturbed catchment (area varies according to expanding operations); and
  - the Acoustic and Visual Amenity Bund north area (12.0 ha).
- Southern Catchment Area incorporating:
  - the southwest temporary soil stockpile (7.5 ha);
  - the Acoustic and Visual Amenity Bund south area (20.9 ha);
  - the southern existing soil stockpile (10.0 ha);
  - the undisturbed catchment to the east and west of the overburden emplacement (area varies as the overburden emplacement area expands);
  - the rehabilitated areas of the overburden emplacement (area varies as rehabilitation becomes established - assumed as 68%, 91% and 91% of the total overburden emplacement for Years 3, 7 and 12 respectively and
  - the active overburden emplacement (area varies as the overburden emplacement expands - assumed as 42%, 9% and 9% of the overburden emplacement for Years 3, 7 and 12 respectively).

Void Water Catchment

The areas making up the void water catchment include the following.

- The active open cut area, including areas of active mining and the various haul roads that report to the active open cut area. This area varies as mining progresses but would remain somewhat constant throughout the life of the Project.
- The area of the active overburden emplacement which drains to the open cut void. This area would vary throughout the mine life but would remain fairly constant throughout the life of the Project.
- The undisturbed area (above the highwall). This area would progressively decline as mining progresses.

7.2.2 Runoff Coefficients

The various catchment areas have been considered separate within the water balance to reflect the different runoff potential for each area. Runoff coefficients assigned to each area are as follows.

- Active infrastructure areas - such as the Coal Processing and Office and Site Facilities Areas are assumed to be a mixture of bare/hard compacted areas with high runoff potential (runoff coefficient of 0.6).
- Undisturbed catchment areas - assumed to have a fairly low runoff potential (runoff coefficient of 0.2).
- Soil stockpiles - assumed to comprise of slightly compacted soils with a moderate runoff potential (runoff coefficient of 0.35).
- Active overburden emplacement - incorporating:
    - shaped overburden areas – assumed to be 60% of active overburden emplacement with a moderate runoff potential (runoff coefficient 0.35); and
    - unshaped overburden areas-assumed to be 40% of active overburden emplacement comprising of loose material with a low runoff potential (runoff coefficient of 0.1).
- Rehabilitated overburden emplacement area - assumed to have a low runoff potential (runoff coefficient of 0.2).
- Active open cut area – assumed to comprise a mixture of bare compacted areas and some loose materials with a high runoff potential (runoff coefficient of 0.5).

7.2.3 Groundwater inflow

The *Groundwater Assessment* (RCA, 2010) has predicted the following inflows into the void.

- Year 3 - 13 ML/year.
- Year 7 - 50 ML/year.
- Year 12 - 47 ML/year.

7.2.4 Groundwater Extraction from Bores

Werris Creek Coal Mine has access to licensed groundwater extraction bores to enable groundwater to be supplied for various mine purposes as required. The amount of groundwater available is, however, limited by extraction limits set in the relevant license agreement. For this reason, water would not generally be sourced from groundwater extraction bores unless the other water sources on the Project Site were unavailable, and groundwater extraction from bores has been assumed to be negligible for the water balance. Any use of groundwater from the licensed bores would be monitored to validate usage against extraction limits.

Extraction of water via licensed groundwater extraction bores from the underground workings is currently not required as the amount of seepage into the active void from the underground workings is currently sufficiently managed. However, based on the Statement of Environmental Effects (SoEE) for – the Northern Extension (RWC 2009), it is assumed that all of the anticipated 200ML of water in the underground workings will be required to be dewatered by approximately Year 3 of the LOM Project. This would be achieved using the existing licensed groundwater extraction bore and pumped to the Void Water Dams. Additional groundwater extraction bores would be licensed and initiated if and where required. For the purposes of the water balance, it has been assumed that this groundwater would be dewatered at an approximate rate of 67 ML per annum and has been considered within the water balance for Year 3 of expanded operations.

RCA (2010) predicts that groundwater inflow from sources other than water from the underground workings would be at a level where essentially evaporation exceeds the inflow and therefore not requiring extraction via the licensed groundwater extraction bores unless there are heavy rainfall events.

7.3 WATER OUTPUTS

7.3.1 Evaporation

There would be evaporation losses from the Clean, Dirty and Void Water Dams and the groundwater storage cells. The assumptions used in calculating evaporative losses are as follows.

- Annual evaporation is estimated to be 1971mm/yr. This has been derived from data obtained by the Bureau of Meteorology Tamworth airport station.
- The average annual evaporation loss has been multiplied by a factor of 0.7 to account for the fact that the dams are not always full and that BOM data is pan evaporation.
- The estimated surface area of various water holding bodies throughout LOM Project would be as presented in **Table 15**.

Table 15
Estimated Surface Area of Water Holding Bodies

Water holding bodies	Estimated Surface Area of Water Holding Bodies (ha)		
	Clean water	Dirty water	Void water
Existing[1]	2.4	3.7	2.4
Year 3	1.9	4.25	9.7[2]
Year 7	1.9	5.1	9.7
Year 12	1.9	5.4	9.1[3]

Note 1: Existing data from RWC water balance

Note 2: Includes existing VWD1 and VWD2, new proposed VWD3 and GW storage cells.

Note 3: VWD2 will be removed between Year 7 and Year 12 and replaced by VWD3

The surface areas presented in **Table 15** are based on existing surface areas presented in the original RWC (2005) water balance with future estimations being an extrapolation of this data.

7.3.2 Dust Suppression and Crushing/Screening Operations

The AEMR for 2008/2009 (anniversary date of 1st April) states that approximately 130 ML of water was used for mine site operational and processing facility dust suppression purposes during the 12 month period to April 2009. The 2009/2010 AEMR reports 154.6 ML of water was used for the 12 month period to April 2010. The Quirindi Post Office rainfall gauging station (BOM station number 055049) reported 746 mm of rainfall for the 12 month period to April 2009 while 588 mm of rainfall was reported for the 12 month period to April 2010, which was not an unusually dry period. It is anticipated that water use requirements would increase marginally as a result of the increasing production rate associated with the LOM Project.

Based on this data and for the purposes of this water balance it has been assumed that LOM Project water use requirements would be approximately 192 ML per annum for a median rainfall year with a variation of ±10% to account for assumed increases and decreases in water use for dry and wet years (i.e. 211 ML dry year and 173 ML wet year). The above volumes may vary from the estimated dust suppression requirements listed in the Air Quality Assessment. GSSE considers that the volumes detailed in the Air Quality Assessment overestimate the required dust suppression volumes and have utilised dust suppression volumes based on historical water use and the proposed mine development.

For the purpose of the water balance, water would be sourced from either the 'Void' water, 'Dirty' water and/or 'Clean' water sources in accordance with preferential use of water as described in Section 6.

7.4 VOID WATER BALANCE

The void water balance is provided for dry, average and wet years (10th, 50th and 90th percentile rainfall years) and is presented in the **Table 16**.

Table 16
Void Water Balance

		Year 3			Year 7			Year 12		
		Average	**Dry**	**Wet**	**Average**	**Dry**	**Wet**	**Average**	**Dry**	**Wet**
Inputs	Rainfall/runoff	191	129	256	207	140	277	178	121	239
	GW Inflow	13	13	13	50	50	50	47	47	47
	Input from Underground	**67**	**67**	**67**	**0**	**0**	**0**	**0**	**0**	**0**
	Total	**271**	**209**	**336**	**256**	**190**	**327**	**225**	**168**	**286**
Outputs	Evaporation	134	134	134	134	134	134	134	134	134
	Water use	137	75	173	122	56	173	92	34	152
	Total	**271**	**209**	**307**	**256**	**190**	**307**	**226**	**168**	**286**
Balance		**0**	**0**	**29**	**0**	**0**	**20**	**0**	**0**	**0**

7.5 DIRTY WATER BALANCE

The dirty water balance is provided for dry, average and wet years (10th, 50th and 90th percentile rainfall years) and is presented in the **Table 17**.

Table 17
Dirty Water Balance

		Year 3			Year 7			Year 12		
		Average	**Dry**	**Wet**	**Average**	**Dry**	**Wet**	**Average**	**Dry**	**Wet**
Inputs	Rainfall/runoff	528	345	733	584	386	805	643	426	881
	Total	**528**	**345**	**733**	**584**	**386**	**805**	**642**	**426**	**881**
Outputs	Evaporation	59	59	59	70	70	70	75	75	75
	Water use	55	136	0	70	155	0	100	177	21
	Total	**114**	**195**	**59**	**140**	**225**	**70**	**175**	**252**	**96**
Balance		**414**	**150**	**674**	**444**	**161**	**734**	**467**	**174**	**785**

7.6 SUMMARY

A summary of the overall results for the water balance for all years for wet average and dry years is presented in **Table 18**.

The results of the site water balance suggest that during wet years the Werris Creek Coal Mine may generate excess void water (apart from Year 12) which would not be immediately re-used as part of normal operations. This excess void water would be retained within the void water storage system within VWD1, VWD2, GWC1, GWC2 (yet to be constructed) and proposed VWD3 for use at a later date. The results show that during all years it is likely that there will be excess dirty water which would be discharged as per the procedure proposed in Section 6.8.

Table 18
Total Mine Site Water Balance

	Year 3			Year 7			Year 12		
	Average	**Dry**	**Wet**	**Average**	**Dry**	**Wet**	**Average**	**Dry**	**Wet**
Void Water Balance	**0**	**0**	**29**	**0**	**0**	**20**	**0**	**0**	**0**
Dirty Water balance	**414**	**150**	**674**	**444**	**161**	**734**	**467**	**174**	**785**
Total Mine Water Balance	**414**	**150**	**703**	**444**	**161**	**754**	**467**	**174**	**785**

8. SITE WATER MANAGEMENT PLAN

The existing SWMP would be updated following Project approval in accordance with regulatory requirements and conditions of consent. The SWMP would be developed in accordance with the *Blue Book* (Volume 1 and Volume 2E), and would address the impacts and mitigation measures discussed in Section 6 of this *Surface Water Assessment*. It is recommended that the SWMP incorporate the following.

- On-site soil and water management principles and objectives, including the following.
  - Containment of void water runoff from open cut areas by directing this water into in-pit sumps.

  - Pumping excess void water from the in-pit sumps into the Void Water Dams.
  - Directing sediment-laden runoff from disturbance areas and rehabilitated areas into designated sediment control dams.
  - Installing temporary erosion and sediment control devices as required (i.e. sediment fences, sand bag weirs) to minimise the discharge of sediment laden water from newly disturbed areas.
  - Diverting clean water runoff unaffected by the operations away from disturbed areas and off-site, where possible.
  - Maintaining sediment control structures to ensure that the designed capacities are maintained for optimum settling of sediments.
  - Implementing an effective revegetation and maintenance program for the site.
- Identification of sources of sedimentation and erosion.
- Soil BMPs to be implemented on-site, including:
  - mine planning considerations (such as minimising disturbance);
  - topsoil/subsoil handling and stockpiling procedures; and
  - topsoil/subsoil respreading procedures.
- Water BMPs to be implemented on-site, including;
  - clean water diversions;
  - dirty water capture and treatment;
  - capture and reuse of void water;
  - additional sediment protection measures to be employed during the life of the Project; and
  - maintenance of sediment control structures.
- Water treatment and discharge procedures.
- Water monitoring procedures.
- Documentation and reporting procedures.

9. SURFACE WATER MONITORING PROGRAM

9.1 INTRODUCTION

The original *Surface Water Monitoring Program* was prepared by GSSE in April 2008. The document was prepared in accordance with the development approval issued by the Department of Planning (DA 172-4-2004) and included:

- provision of baseline data on surface water flows and quality in adjoining creeks and water bodies that could be affected by the mine;
- surface water impact assessment criteria;
- a program to monitor the impact of the mine on surface water flows and quality; and
- procedures for reporting the results of this monitoring.

As the majority of existing water management infrastructure would be retained throughout the LOM Project it is proposed to maintain the existing surface water monitoring program.

9.2 BASELINE DATA

The baseline water quality data available for the Project Site is presented in Section 3.8.2. The baseline data includes samples from water bodies surrounding the Project Site including Werris Creek and Quipolly Creek.

9.3 SURFACE WATER IMPACT ASSESSMENT CRITERIA

The impact assessment criteria for surface water are only relevant to water actually discharged from the mine site. The existing EPL 12290 for the Werris Creek Coal Mine contains concentration limits for water discharged through SB2 (LDP10), SB9 (LDP12) and SB10 (LDP14). These are presented in **Table 4.** It is recommended that these criteria be retained as the on-going water quality criteria for the LOM Project.

9.4 MONITORING LOCATIONS

9.4.1 Regulatory Compliance

The Werris Creek Coal Mine currently undertakes water quality monitoring in line with the current *Surface Water Management Plan* prepared by GSSE and WCC (2009). The existing monitoring program addresses the surface water impact assessment criteria and a program to monitor surface water flows and quality upstream and downstream of the confluence of the north catchment into Werris Creek and the southern catchment into Quipolly Creek.

It is proposed to maintain the existing LDPs registered under EPL 12290 throughout the LOM Project and accordingly, maintain the existing surface water monitoring program for the LOM Project. The existing and proposed water monitoring program, including the monitoring parameters, monitoring locations and frequency of monitoring are detailed in **Table 19**. The unit of measure and the sampling methods for each parameter are detailed in **Table 20**. The proposed sampling locations are shown on **Figure 12**.

As detailed in Section 6.7.2, a number of additional dams and sediment basins would be constructed as part of the LOM Project to service additional disturbance areas. Where the proposed dams are of a permanent nature, monitoring would be undertaken for these dams similar to that detailed in **Table 20** for all Clean, Dirty and Void Water Dams.

9.4.2 Additional Operational Monitoring

In addition to the proposed monitoring outlined in **Table 19**, opportunistic sampling within water bodies within or adjacent to the Project Site may also be undertaken. This sampling would assist in assessing the performance of the surface water management system and would help to direct the implementation of additional water management controls if deemed necessary.

9.5 REPORTING OF MONITORING DATA

It is recommended that Werris Creek Coal Mine collate surface water analysis data and maintain an up to date record of analysis both in hard copy (laboratory reports) and electronic (results) format. These results should be interpreted as they are received in order to ensure appropriate operational guidance on maintaining water quality within desired parameters.

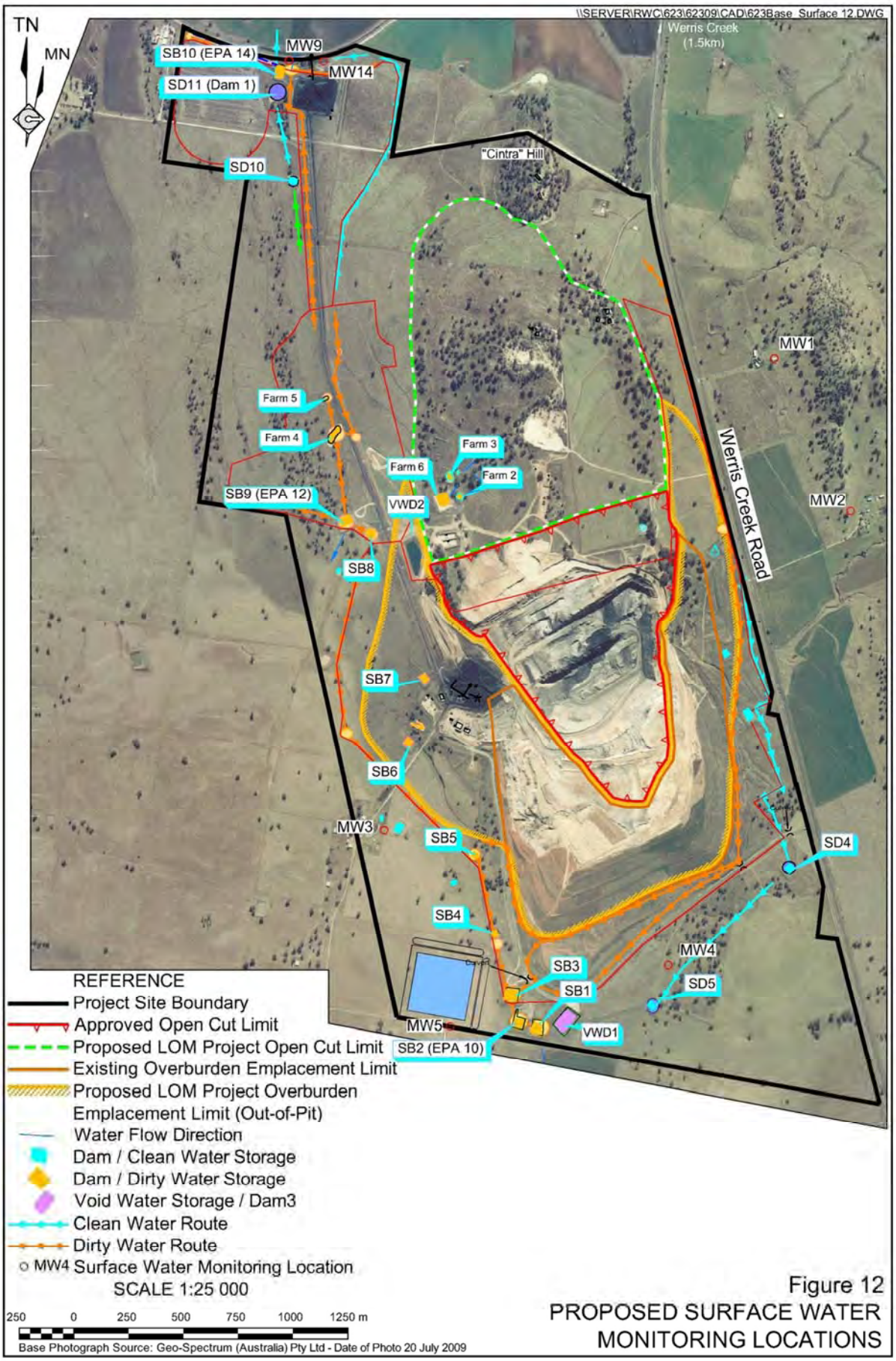


Figure 12
PROPOSED SURFACE WATER MONITORING LOCATIONS

Table 19
Surface Water Monitoring Locations, Frequency & Parameters

Monitoring Site	Monitoring Frequency	Parameters
Licensed Wet Weather Discharge Points - SB2 (EPA 10) - SB9 (EPA 12) - SB10 (EPA 14)	• Quarterly • As soon as practicable after any overflow off-site commences and in any case not more than 12 hours after any overflow off-site commencing	*Water quality including, but not limited to:* - Total Suspended Solids - Oil & Grease - pH - Electrical Conductivity,
Receiving Waters (u/s & d/s) - WC-U (Werris Creek) - WC-D (Werris Creek) - QC-U (Quipolly Creek) - QC-D (Quipolly Creek)	• Quarterly • Within 12 hours after any overflow off-site from a sediment dam(s) on the premises occurring.	
Clean, Dirty and Void Water Dams including: VWD1, VWD2[1], VWD3[2] GWC1, GWC2[2]	Quarterly	
Other dams / storages to be removed / constructed as part of the LOM Project	As Required	
Note 1: Dam would be removed during the LOM Project. Note 2: Yet to be constructed.		
Source: GSSE & WCC (2009)		

Table 20
Surface Water Parameters

Pollutant	Unit of Measure	Sampling Method
Total Suspended Solids	mg/L	Grab sample
Oil & Grease	mg/L	Grab sample
pH	-	Grab sample
Electrical Conductivity	µS/cm	Grab sample
Sampling will be undertaken in accordance with the Department of Environment and Conservation, Approved Methods for the Sampling and Analysis of Water Pollutants in NSW, March 2004		
Source: GSSE & WCC (2009)		

The results of water quality analysis should be reported in the relevant Annual Environmental Monitoring Report and be made available to Community Consultative Committee (CCC) members on a regular basis. In the event that an exceedance in surface water quality criteria is identified, the exceedance should be investigated and reported to the relevant agencies in accordance with the requirements of the EPL with appropriate mitigation measures adopted to prevent a recurrence.

10. CONCLUSION

Based on the proposed mitigation measures to maintain flow regimes including diverting water around the Project Site from upstream catchments via clean water diversions, along with treated dirty water being allowed to discharge from LDPs under EPL conditions, it is anticipated that there would be minimal impact on flow regimes downstream of the Project Site due to the LOM Project.

Available soil and water data for the Project Site suggests that TSS is likely to be the key water quality parameter requiring management throughout the life of the LOM Project to ensure the water quality in downstream watercourses is not impacted. A number of surface water management and mitigation measures are recommended in this *Surface Water Assessment* to ensure that the potential risk of any adverse off-site surface water impacts is minimised. This includes directing dirty water runoff into suitability sized sediment basins, preferential use of water from 'end-of-line' basins and the use of chemical flocculants to help increase settlement times.

The results of the water balance indicate that during wet years the Werris Creek Coal Mine LOM Project may generate excess void water which would be retained within the void water storage system for re-use at a later date. The results show that during all years it is likely that there will be excess dirty water which would be required to be discharged as per the procedure proposed in Section 6.8.

If the surface water management and mitigation measures identified and discussed within this *Surface Water Assessment* are implemented and maintained, it is anticipated that there would be minimal impact on surface water downstream of the Project Site as a result of the proposed Werris Creek Coal Mine LOM Project.

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