



Ivanhoe Coal Pty Limited

***Lidsdale Siding
Water Management Plan***

January 2021

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	1	Independent Environmental Audit	24/01/2019	Consistency with Western Coalfields Regional Water Management Plan Clarification of dewatering procedure Update baseline monitoring data
	2	Consultation comments	27/09/2019	Clarification of erosion and sediment controls, PB02, monitoring of private bores, flood monitoring Consolidation with Flood Management Plan
	3	MOD 3 PA 08_0223	16/10/2020	Revision following modifications to PA 08_0223 conditions and upgrade to Triangle Pond

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Glossary

Alkalinity	A measure of the ability of an aqueous solution to neutralise acids. Alkalinity of natural waters is due primarily to the presence of hydroxides, bicarbonates and carbonates. It is expressed in units of calcium carbonate (CaCO_3).
Aquifer	An underground layer of permeable material from which groundwater can be usefully extracted.
Australian Height Datum	A common national surface level datum approximately corresponding to sea level
Average recurrence interval	A statistical estimate of the average period in years between the occurrence of a flood of a given size or larger, e.g. floods with a discharge equivalent to the 1 in 100 year average recurrence interval flood event will occur on average once every 100 years.
Baseline monitoring	Monitoring conducted over time to collect a body of information to define specific characteristics of an area (e.g. species occurrence or water quality) prior to the commencement of a specific activity.
Bore	Constructed connection between the surface and a groundwater source that enables groundwater to be transferred to the surface either naturally or through artificial means.
Catchment	The land area draining through the main stream, as well as tributary streams, to a particular location.
Clean water	Water that has not come into physical contact with coal or mined carbonaceous material.
Dewatering	The removal or pumping of water from an above or below ground storage, including the mine water within the water collection system of mine workings. Water removed from mine workings is regarded as dewatering unless the workings are flooded and at equilibrium with the surrounding strata (in which case the removal is considered groundwater extraction).
Dirty water	Water that has an elevated sediment load.
Discharge	The quantity of water per unit of time flowing in a stream, for example cubic metres per second or megalitres per day.
Electrical conductivity	A measure of the concentration of dissolved salts in water.
Flood	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or overland runoff before entering a watercourse and/or coastal inundation resulting from super elevated sea levels and/or waves overtopping coastline defences.
Floodplain	Area of land that is periodically inundated by floods up to the probable maximum flood event.
Groundwater	Water occurring naturally below ground level.

Groundwater extraction	For the purposes of this plan, groundwater extraction has been defined as the removal of groundwater from a groundwater source or aquifer, either via direct removal for use via a production bore or via incidental flow of groundwater from the aquifer into the mine workings during and after mining. Groundwater extraction includes the pumping of underground water from flooded mine workings in equilibrium with the surrounding strata as well as the removal of water from perched aquifers recharged directly from rainfall infiltration.
Guideline value	The concentration or load of physicochemical characteristics of an aquatic ecosystem, below which there exists a low risk that adverse ecological effects will occur. They indicate a risk of impact if exceeded and should 'trigger' action to conduct further investigations or to implement management or remedial processes.
Hardness	The concentration of multivalent cations present in water. Generally, hardness is a measure of the concentration of calcium and magnesium ions in water and is expressed in units of calcium carbonate (CaCO_3) equivalent. Hardness may influence the toxicity and bioavailability of substances in water.
Ion	Electrically charged atom.
Licensed discharge point	A location where the premises discharge water in accordance with conditions stipulated within the site Environmental Protection License.
Macroinvertebrate	An animal species that does not develop a vertebral column that is large enough to be seen without the use of a microscope. These animals generally include insects, crustaceans, molluscs, arachnids and annelids.
Median	The middle value, such that there is an equal number of higher and lower values. Also referred to as the 50th percentile.
Percentile	The value of a variable below which a certain percent of observations fall. For example, the 80th percentile is the value below which 80 percent of values are found.
pH	The value taken to represent the acidity or alkalinity of an aqueous solution. It is defined as the negative logarithm of the hydrogen ion concentration of the solution.
Potable water	Water of a quality suitable for drinking.
Riparian	Pertaining to, or situated on, the bank of a river or other water body.
Runoff	The amount of rainfall which actually ends up as streamflow, also known as rainfall excess.
Sediment	Soil or other particles that settle to the bottom of lakes, rivers, oceans and other waters.
Surface water	Water that is derived from precipitation or pumped from underground and may be stored in dams, rivers, creeks and drainage lines.
Topography	Representation of the features and configuration of land surfaces.

Total Kjeldahl nitrogen	The sum of the concentrations of organic nitrogen, ammonia (NH_3) and ammonium (NH_4^+) in water.
Total nitrogen	A measure of organic and inorganic nitrogen forms in water. The sum of concentrations of total kjeldahl nitrogen and nitrate + nitrite.
Total phosphorus	A measure of organic and inorganic phosphorus forms in particulate and soluble forms.
Total suspended solids	A measure of the filterable matter suspended in water.
Toxicity	The inherent potential or capacity of a substance to cause adverse effects in a living organism.
Tributary	A stream or river that flows into a main river or lake.
Turbidity	A measure of clarity (turbidity) of water. Turbidity in excess of 5 NTU is just noticeable to the average person.

Abbreviations

AEP	Annual exceedance probability
AHD	Australian Height Datum
ARI	Average recurrence interval
AUSRIVAS	Australian Rivers Assessment System
BOM	Bureau of Meteorology
DGV	Default guideline value
DPIE	Department of Planning, Industry and Environment
DPIEW	Department of Planning, Industry and Environment – Water
EC	Electrical conductivity
EIS	Environmental impact statement
EPA	Environment Protection Authority
EPL	Environment protection licence
ha	Hectare
km	Kilometre
L/s	Litre per second
LDP	Licensed discharge point
LOR	Limit of reporting
m	Metre
m ³ /s	Cubic metre per second
mg/L	Milligram per litre
ML	Megalitre
ML/day	Megalitre per day
ML/year	Megalitre per year
mm	Millimetre
mm/day	Millimetre per day
NTU	Nephelometric turbidity unit
PIRMP	Pollution Incident Response Management Plan
SILO	Scientific Information for Land Owners

SSGV	Site-specific guideline value
TARP	Trigger action response plan
TDS	Total dissolved solids
TKN	Total Kjeldahl nitrogen
TSS	Total suspended solids
WMP	Water management plan
µS/cm	Microsiemens per centimetre

1. Introduction

The Lidsdale Siding Rail Loading Facility (Lidsdale Siding) is a coal storage and rail loading facility owned and operated by Ivanhoe Coal Pty Ltd, a wholly owned subsidiary of Centennial Coal Company Limited (Centennial). Centennial is a wholly owned subsidiary of Banpu Public Company Limited. Lidsdale Siding is located near the village of Wallerawang, approximately 12 km north-west of Lithgow in the Western Coalfield, as shown in Figure 1-1.

This site-specific Water Management Plan (WMP) has been prepared for Lidsdale Siding and include the existing and approved operations and associated infrastructure within the site boundary. The WMP will be progressively developed and reviewed as water management requirements at the site change over time.

In accordance with the conditions of project approval 08_0223 for Lidsdale Siding, this WMP has been prepared by GHD Pty Ltd (GHD) in consultation with Centennial.

1.1 Overview of site operations

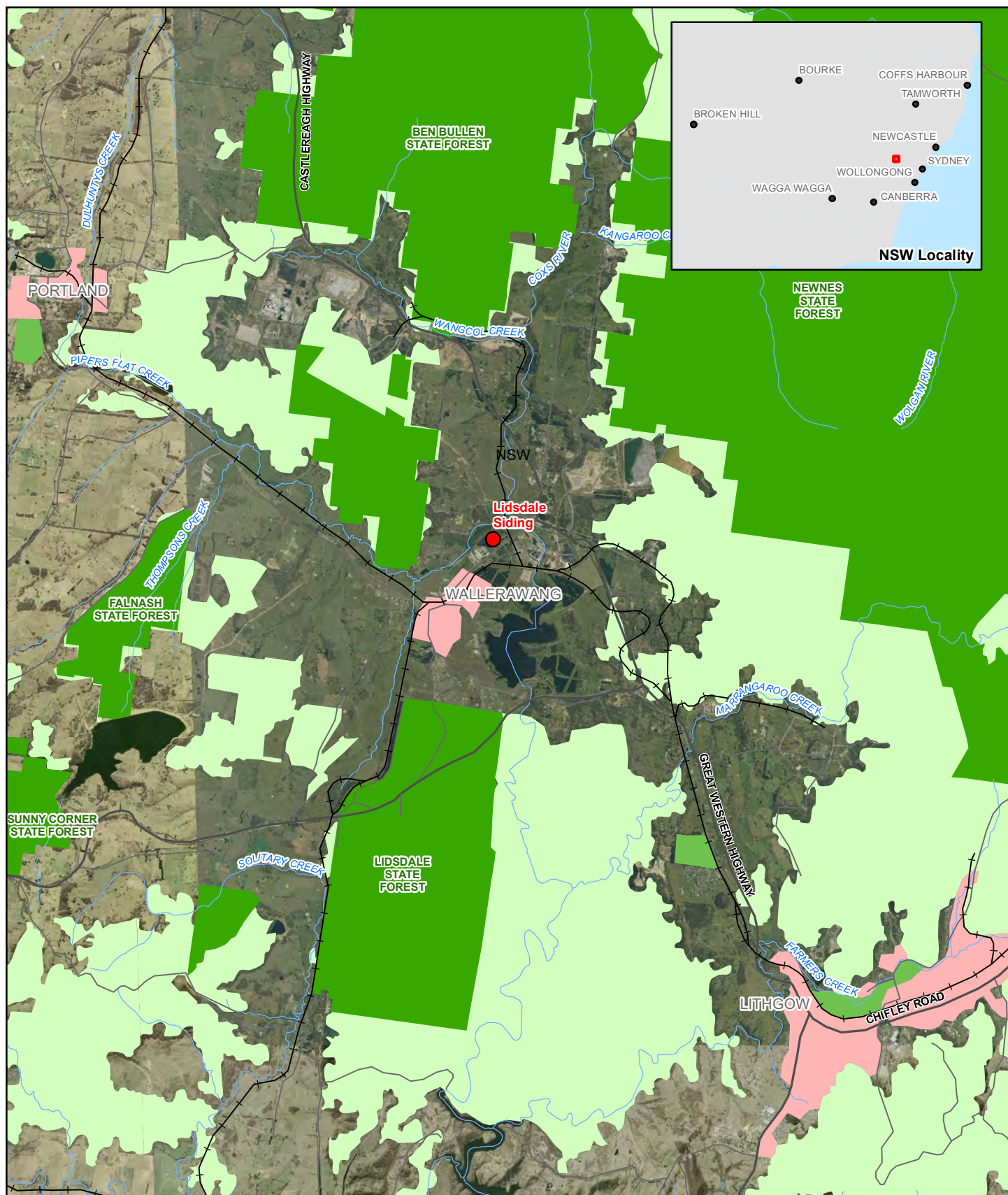
1.1.1 Site features

The surface site features at Lidsdale Siding are provided in Figure 1-2. The site features include:

- Administration building.
- Overland conveyor.
- Reclaim and tripper conveyors.
- Train load out facility (TLO).
- Coal unloader.
- Rail siding.
- Equipment store.
- Coal stockpile.
- Meteorological and air quality station.
- Water management facilities including Fire and Service Water Tank (formerly 'Transfer tank'), surface storages, water drainage diversions, and production bore.
- Licensed discharge point (LDP004).
- Groundwater monitoring bores.

1.1.2 Coal handling

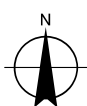
Coal is delivered by overland conveyor from Springvale Mine via Western Coal Services and transported for export. Lidsdale Siding was upgraded in 2014 to improve operational efficiency with an automated train loading process and increased throughput capacity to approximately 6.3 million tonnes per annum of product coal. In 2019, the approval for Lidsdale Siding was modified to allow the unloading of coal received from local mines to meet the demand of Mount Piper Power Station.



LEGEND

- | | | | |
|------------------|----------------|---------------|---------------------|
| Lidsdale Siding | Principal Road | Waterway | Recreation area |
| Existing Rail | Secondary Road | Waterbody | Nature Conservation |
| Dual Carriageway | Minor Road | Built Up Area | State Forest |
| | | | Forest Or Shrub |

Paper Size A4
 0 0.5 1 2 3
 Kilometers
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 56



CENTENNIAL

Lidsdale Siding
 Water Management Plan

Job Number 12510506
 Revision 1
 Date 04 June 2020

Locality plan

Figure 1-1

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E entlmail@ghd.com W www.ghd.com.au

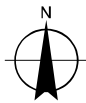
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Data source: Commonwealth of Australia (Geoscience Australia): 250K Topographic Data Series 3 2006; LPI : DTDB, 2012, Department of Finance & Innovation, Imagery, 2017. Created by: smacdonald



Paper Size A4
0 50 100 200
Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



LEGEND

- Licensed Discharge Point
- Fire and service water tank
- Production bore (PB02)
- Water Storage



Lidsdale Siding
Water Management Plan

Job Number | 12510506
Revision | 2
Date | 04 June 2020

Site features

Figure 1-2

1.2 Approvals and licensing requirements

1.2.1 Development consent

The WMP addresses specific water components of the conditions of Project approval 08_0223 (PA 08_0223), which was granted by the Planning Assessment Commission on 3 May 2013 for the Lidsdale Siding Upgrade Project. The project consent has been modified three times:

- A modification to enable Lidsdale Siding to receive and unload coal to supply Mount Piper Power Station was approved on 23 August 2019 (MOD 1).
- A modification to enable additional coal laden trains to arrive and leave site was approved on 24 October 2019 (MOD 2).
- A modification to enable unloading of coal from trains to be undertaken permanently was approved on 16 October 2020 (MOD 3).

No changes to water management are associated with MOD 1, MOD 2 and MOD 3. The relevant requirements of the WMP content from schedule 3 of PA 08_0223 are outlined in Table 1-1, along with the sections of the WMP where these have been addressed.

Table 1-1 Project approval 08_0223 conditions

	Condition	Where addressed
9 (c)	The proponent must install and operate equipment capable of applying water to the surface of coal loaded onto trains prior to leaving the site.	Section 3.4
15	The Proponent must ensure that it has sufficient water for all stages of the project, and if necessary, adjust the scale of its operations to match its available water supply, to the satisfaction of the Planning Secretary.	Section 3.6.2
16	The Proponent must preferentially use excess mine water from the Springvale Coal Mine for dust suppression at the site rather than potable town water supply.	Section 3.6.2
17	The Proponent shall ensure that all surface water discharges from the site comply with the discharge limits (both volume and quality) set for the project in any EPL.	Section 4.3
20	The Proponent must undertake a flood study for the site to the satisfaction of the Planning Secretary	Appendix E
21	The Proponent must prepare and implement a Water Management Plan for the project to the satisfaction of the Director-General. This plan must be prepared in consultation with the EPA, NRAR and WaterNSW by suitably qualified and experienced persons, and be submitted to the Director-General for approval within 6 months of the date of this approval.	This WMP Section 1 Appendix A
Site water balance		
21 (a)	Details of sources and security of water supply.	Section 3.6.2
	Details of water use on site.	Section 3.1
	Details of water management on site.	Section 3

	Condition	Where addressed
	Details of any water transfers to/from the site.	Section 3.5
Surface water management plan		
21 (b)	A description of the surface water management system for the project including clean water diversions, erosion and sediment controls and water storages.	Section 3.2
	Baseline data on surface water flows and quality of Pipers Flat Creek which receives the water from the licensed discharge point identified in the site's EPL.	Section 5.1
	Surface water quality and stream health assessment criteria, including trigger levels for investigating any potentially adverse surface water impacts.	Section 6.1 Section 6.2
	A surface water monitoring program for surface water discharges, surface water flows and quality, and stream health and channel stability of Pipers Flat Creek.	Section 4.2 Section 4.5
	Measures to reuse and recycle water, and to minimise potable water use from the town water supply.	Section 3.6.2
Groundwater monitoring plan		
21 (c)	Detailed baseline data of all groundwater levels, yield and quality in the area, and any privately-owned groundwater bores that may be affected by the project.	Section 5.3
	Groundwater assessment criteria based upon analysis of baseline data for groundwater, including trigger levels for investigating any potentially adverse groundwater impacts.	Section 6.1.3 Section 6.2.4
	A program to monitor and/or validate the impacts of the project on any privately-owned groundwater bores that may be affected by the project.	Section 4.4
Surface and groundwater response plan		
21 (d)	Describe the measures and/or procedures that would be implemented to respond to any exceedances of the surface water, stream health and groundwater assessment criteria.	Appendix I
	Describe the measures and/or procedures that would be implemented to mitigate and/or offset any adverse impacts on surface water and groundwater resources located within and adjacent to the site.	Appendix I

1.2.2 Lidsdale Siding Upgrade Project Statement of Commitments

In addition to the conditions of PA 08_0223 indicated in Table 1-1, Centennial also committed to the management strategies and monitoring activities outlined in Table 1-2 as part of the Lidsdale Siding Upgrade Project.

Table 1-2 Statement of commitments

Issue	Commitment	Where addressed
Surface water, soil and agriculture	During construction, contaminated water will be contained on site and moved towards the containment ponds.	Completed during construction.
	During construction, surface water sampling and analysis will be undertaken prior to discharge in accordance with the EPL.	Completed during construction.
	A site water management plan will be prepared prior to commissioning the new infrastructure.	Completed
Groundwater	Implement a groundwater management plan as part of the Construction Environmental Management Plan.	Completed
	Apply for a water extraction licence for the construction period and adhere to any specific conditions of the licence.	Section 1.2.4
Contamination	During construction, the production bore construction will be altered so groundwater is not allowed to migrate between aquifers.	Completed during construction, refer to Section 3.3.1.

1.2.3 Environment protection licence

Lidsdale Siding currently holds environment protection licence (EPL) 5129, with water licensed to be discharged through LDP004, from the outlet of the Triangle Pond into a stormwater discharge channel, which flows into Pipers Flat Creek. The location of LDP004 is indicated in Figure 1-2.

No volumetric limit monitoring requirements are specified by EPL 5129 for LDP004.

Water quality concentration limits for LDP004 specified by EPL 5129 are presented in Table 1-3.

In addition, water discharged through LDP004 is required to be monitored monthly during discharge for conductivity, oil and grease, pH and total suspended solids (TSS). Water quality concentration limits for LDP004 do not apply when the discharge occurs solely as a result of rainfall measured at the site which exceeds 56 mm over any consecutive five day period.

Table 1-3 Licensed discharge point water quality concentration limits

Parameter	Units	Concentration limit
Oil and grease	mg/L	10
pH	pH units	6.5–8.5
TSS	mg/L	30

1.2.4 Water access licences

Lidsdale Siding currently holds two water access licences (WALs) for the extraction of surface water and groundwater to supplement water supply to the site. The WALs include specific extraction, monitoring, recording and reporting requirements.

WAL 25774 licenses the extraction of up to 1 ML/year of surface water from Pipers Flat Creek, this water source is not currently used.

WAL 24362 licenses the extraction of up to 8.5 ML/year of groundwater from a production bore (referred to as PB02 and licenced by 10WA116403). This water source is also not currently used.

A number of licences are held by Lidsdale Siding under the *Water Act 1912* for groundwater monitoring bores. The details of these bores are provided in Section 4.4.

1.3 Water Management Plan objectives

The WMP has been developed to address the legislative, approvals and licensing requirements presented in Section 1.2. The objectives of the WMP are:

- Collate and review existing information and studies relating to the operation of the water management system at Lidsdale Siding.
- Establish an understanding of the water management system at the site.
- Categorise the existing conditions that are specific to water management requirements.
- Develop catchment plans for both the existing and the approved site layouts.
- Identify and maximise the separation of the clean and dirty water management systems.
- Undertake a review of the capacity of dirty and contaminate surface water storages in accordance with *Managing Urban Stormwater: Soils and Construction Volume 1* (Landcom 2004) and *Volume 2E* (DECC 2008).
- Determine the suitability of flooding management and waterway conditions.
- Undertake a surface water quality assessment and review existing water quality assessment criteria.
- Minimise water discharges from the site by maximising, where practicable, opportunities for the reuse and recycling of water on site.
- Manage discharges to natural waterways in accordance with relevant EPL conditions or as agreed with the EPA.
- Determine the future water management requirements.
- Review and develop water monitoring requirements.

1.4 Relationship to other plans

1.4.1 Upper Coxs River Action and Monitoring Plan

A number of water management performance measures are specified by Springvale Mine's development consent, including the requirement to eliminate toxicity and reduce the EC of mine water discharges via LDPs.

The Upper Coxs River Action and Monitoring Plan (UCRAMP) identifies actions and monitoring requirements undertaken by Centennial to meet long term mine water discharges criteria for the upper Coxs River catchment, which includes Lidsdale Siding. The UCRAMP includes details of increases to on-site dam volumes to reduce the frequency and volume of discharges through LDP004.

As no approval of the UCRAMP has been provided by the DPIE to date, none of the actions or requirements from the UCRAMP are binding.

2. Environment

2.1 Climate

2.1.1 Rainfall

Lidsdale Siding has a site-based meteorological station which was established in July 2010. The station provides historical and real-time data for wind speed and direction, rainfall, temperature, solar radiation, relative humidity and dust.

For assessments requiring a large historical set of rainfall data (i.e. greater than 50 years), patched point rainfall data is obtained from the Scientific Information for Land Owners (SILO) database operated by the Queensland Department of Science, Information Technology and Innovation. SILO patched point data is based on historical data from a particular Bureau of Meteorology (BOM) station with missing data 'patched in' with interpolations from nearby stations.

For this assessment SILO data was obtained for Lidsdale (Maddox Lane) Station (station number 63132) which is located approximately 3.5 km south-east of Lidsdale Siding. This station was chosen based on the length and quality of the data record and proximity to the site. Figure 2-1 presents the historical SILO patched point daily rainfall data from the Lidsdale (Maddox Lane) Station between 1889 and 2019 and site-based rainfall recorded between 2011 and 2019.

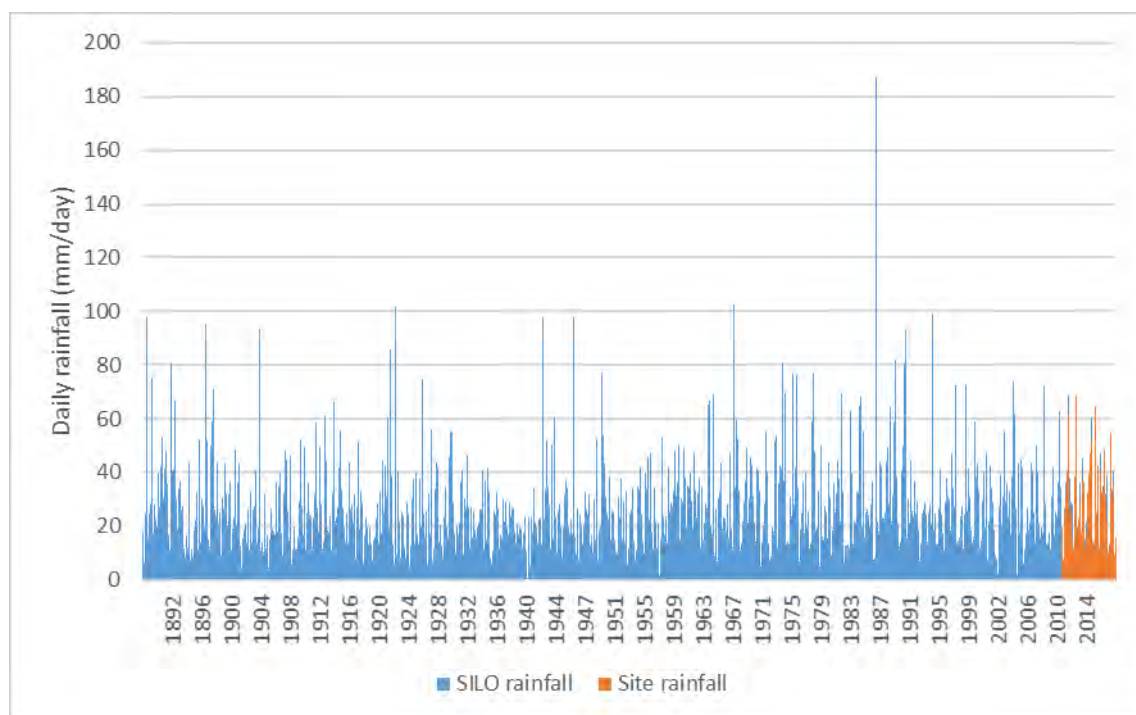


Figure 2-1 Historical daily rainfall at Lidsdale (Maddox Lane) Station and Lidsdale Siding

The annual statistics associated with the SILO patched point daily rainfall data from the Lidsdale (Maddox Lane) Station presented in Figure 2-1 are:

- Minimum annual rainfall – 330 mm in 2006.
- Average annual rainfall – 734 mm.
- Median annual rainfall – 720 mm.
- Maximum annual rainfall – 1,515 mm in 1950.

2.1.2 Evaporation

Evaporation estimates are not collected by the meteorological station at Lidsdale Siding. Information provided by SILO patched point daily evaporation data interpolated from surrounding BOM meteorological stations to a nearby GPS referenced location, was reviewed and average monthly evaporation rates were determined. The average daily evaporation rates are presented in Figure 2-2 based on 119 years of data from 1900 to 2019.

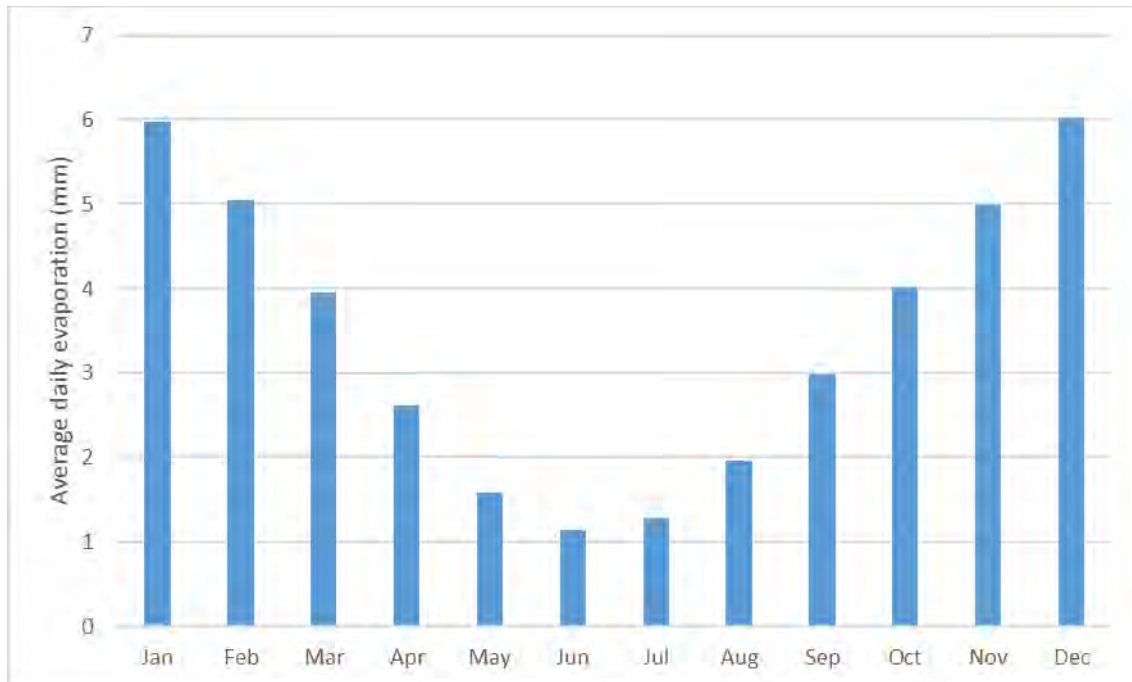


Figure 2-2 Average daily evaporation at Bathurst Agricultural Station

2.2 Topography

The terrain is predominantly open and flat to gently undulating, and lies in the natural valley floor of Pipers Flat Creek and the Coxs River. Included on the site are rises up to 885 m Australian Height Datum (AHD), with most of the site at approximately 880 m AHD. The lowest contour level on the site is approximately 875 m AHD located at the base of the Triangle Pond. Nearby mountain peaks reach approximately 1,050 m AHD and the base of the Coxs River close to Lake Wallace is approximately 870 m AHD.

2.3 Geology

Lidsdale Siding is located within the southern part of the Western Coalfield of NSW, on the western edge of the Sydney Basin. The area is underlain by Triassic sandstone of the Narrabeen Group, which is underlain by the Illawarra Coal Measures.

2.4 Hydrogeology

2.4.1 Overview

The majority of the site is covered in a layer of unconsolidated alluvium/colluvium that is generally around 2 m to 6 m thick. The deposits are underlain by shale which is weathered in the top section (approximately 7 m) and fresh below this depth.

The primary water bearing zones are associated with the weathered shale and shallow alluvium. The fresh shale is known to be of low permeability and is not classified as an aquifer. The shallow groundwater table follows a general conformance with surface topography and is disconnected from deeper hydrogeological units. Locally within the site area the shallow groundwater flow is from the south to north and north-east towards the Pipers Flat Creek. The low permeability of the underlying shales provides a disconnection between the shallow aquifer and any deeper groundwater systems. No groundwater dependent ecosystems have been identified at the Lidsdale Siding site or the broader study area.

2.4.2 Registered groundwater bores

A search of the database of registered groundwater bores managed by WaterNSW was undertaken to identify registered bores within a 1 km radius of Lidsdale Siding. The search identified three bores, with details of the bores outlined in Table 2-1.

Table 2-1 Identified groundwater bores

Detail	Bore GW053071	Bore GW110520	Bore GW110437
Bore depth (m)	15.2	38.0	90.0
Easting	227433.0	227995.0	227895.0
Northing	6300764.0	6300665.0	6300507.0
Status	Lapsed	Cancelled	Cancelled
Authorised purpose	Stock, irrigation, domestic	Test bore	Test bore
Water bearing zone (m)	9.1–9.1 10.7–10.7 12.2–12.2	5.0–8.0	3.0–4.0
Standing water level (m)	–	1.2	–
Yield (L/s)	4.55 4.55 9.09	0.51	0.06
Strata	Shale	Shale	Shale

2.5 Hydrology

Lidsdale Siding is located within the upper Cocks River catchment. The Cocks River rises within the Ben Bullen State Forest to the north of Lidsdale Siding and flows generally in a south-east direction into Lake Burragorang, which is impounded by Warragamba Dam and is the primary reservoir for drinking water supply to Sydney. The flow in Cocks River is regulated by three reservoirs, Lake Wallace, Thompsons Creek Reservoir and Lake Lyell, which are used to supply water for power generation activities at Mount Piper Power Station.

Pipers Flat Creek is located adjacent to the north-west boundary of the site, as shown in Figure 2-3, and flows into the Cocks River to the north of the site. Pipers Flat Creek is naturally an ephemeral creek; however, the creek receives artificial recharge from the Wallerawang sewage treatment plant (STP) that is located upstream of Lidsdale Siding. The lower reaches of Pipers Flat Creek downstream of the Wallerawang STP flow for the majority of the year. The creek was diverted into an engineered channel located north of the rail line, south-west of the main operational section of the site, in the 1950s.

Natural local drainage is still (in part) draining through the site from Main Street, a rural residential property and the local church/easement in the south and industrial area in the south-west.

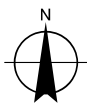
A flood assessment of Pipers Flat Creek was completed by Aurecon (2014) with a Flood Management Plan for Lidsdale Siding completed by GHD (2016b) and is included in Appendix E. Further detail on flooding at the site is provided in Section 3.7.



LEGEND

- ~ ~ ~ Watercourse - Non Perennial
- ~~~~~ Watercourse - Perennial

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0 45 90 180 270 360
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



Lidsdale Siding
Water Management Plan

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Date 04 June 2020

Watercourses in the vicinity
of Lidsdale Siding

Figure 2-3

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\\ghdnet\ghd\AU\Newcastle\Projects\22\0105001\GIS\Maps\Deliverables\Western\Lidsdale Siding\12510506\WMP\12510506_WMP003_Watercourses_2.mxd

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3. Water management

3.1 Water management overview and objectives

The water management system at Lidsdale Siding is comprised of surface, potable, waste and groundwater elements. Sources of water at the site include potable water supply, rainfall, runoff, and groundwater extracted from the production bore. The primary water demands are for dust suppression, equipment and vehicle wash-down, fire-fighting storage, service water, and staff amenities.

Surface water runoff from areas where there is no coal storage, transportation, handling or any disturbance is considered to be clean water. Clean water runoff is diverted around dirty water and coal-contact catchments to avoid mixing.

Clean water runoff is typically from natural and impervious catchments such as areas of vegetation, sealed roads and sealed car parks, and adjoining industrial businesses.

Dirty water is runoff from disturbed areas and areas potentially contains suspended sediment, oils, grease and hydrocarbons. This typically includes workshop and fuel storage areas. Dirty water includes coal contact water. Coal-contact water is runoff from catchments where coal storage, transportation and handling occurs and is managed within the dirty water management system.

A schematic of the overall water management system at Lidsdale Siding is provided in Figure 3-1.

Lidsdale Siding has site-specific water objectives that include:

- Maximise the separation of clean and dirty surface water systems.
- Minimise water discharges from the premises by maximising, where practicable, opportunities for the reuse and recycling of water on site.
- Minimise discharges of dirty water from the premises.
- Maintaining capacity within site water storage structures.
- Manage discharge to natural waterways in accordance with the relevant EPL conditions or as agreed with the EPA.

3.2 Surface water management

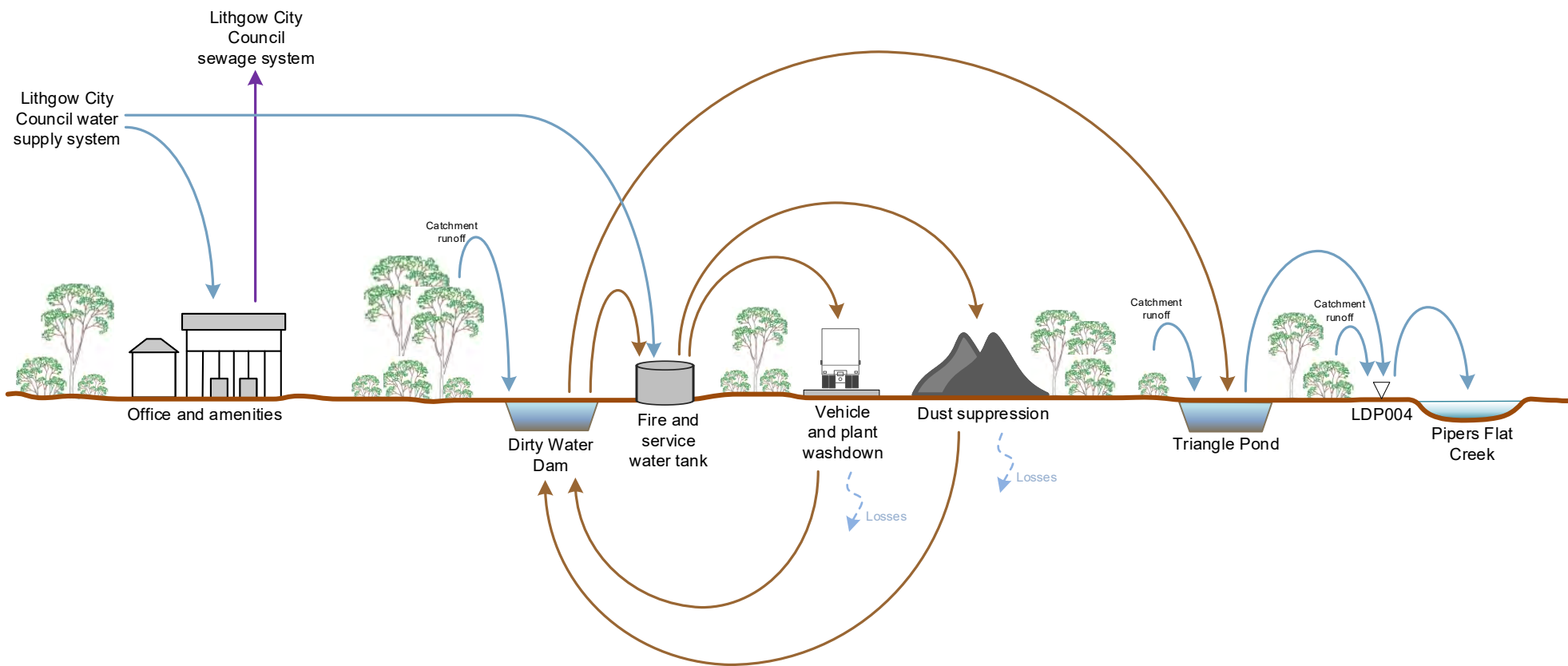
Water management at Lidsdale Siding focuses on the capture of dirty surface water runoff across the site and the minimisation of discharges from LDP004 by the transfer and reuse of water across the site.

The surface water management features and site catchments of Lidsdale Siding are presented in Figure 3-2.

3.2.1 Clean water management

Clean water diversions exist at Lidsdale Siding to enable the redirection of clean catchment runoff away from dirty water catchment areas. Open surfaces, drains and areas adjacent to bunds are maintained to minimise ponding of water across open surfaces within the operational area. All culverts and drains are regularly maintained.

Clean water diversions on site are typically stabilised with grass and regularly maintained to provide drainage capacity. Due to the shallow grade of these diversion systems, they are susceptible to flooding within Pipers Flat Creek and Coxs River. Diversion CW1 is the most influenced by flooding within Pipers Flat Creek.



Legend

- Clean Water
- Wastewater
- Underground Water
- Dirty Water



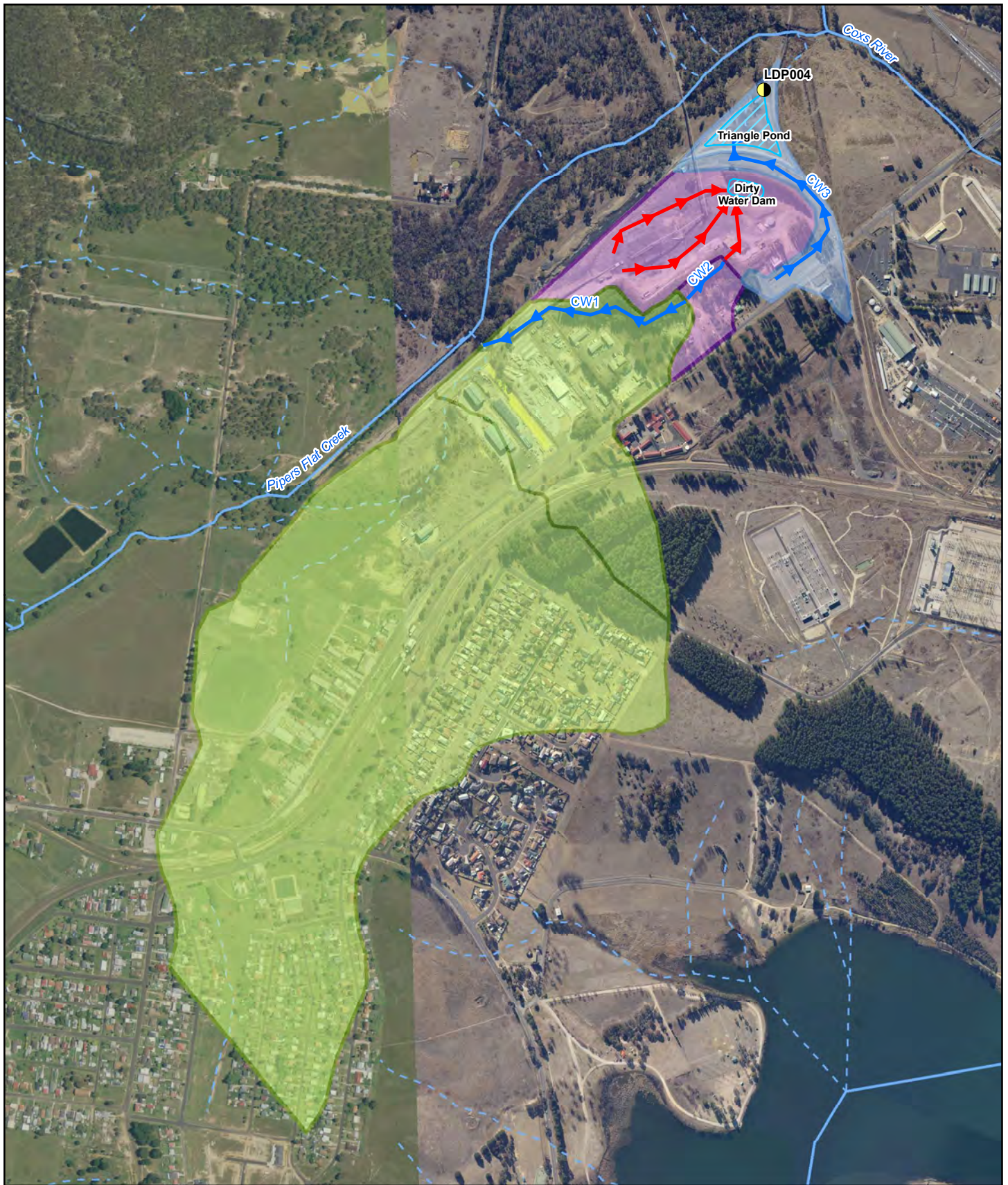
Ivanhoe Coal Pty Ltd
Lidsdale Siding
Water Management Plan

Overall water management schematic

Project No. 12510506
Revision No. 0
Date 29/01/2021

FIGURE 3-1

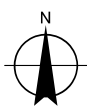
Created by: Tyler Tinkler



LEGEND

- | | | |
|--------------------------|---|-------------------------|
| Licensed Discharge Point | External Catchment to Pipers Flat Creek | Watercourse - Perennial |
| Water Storage | Triangle Pond | Clean water |
| Dirty Water Dam | Watercourse - Non Perennial | Dirty water |

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Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



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Lidsdale Siding
Water Management Plan

Surface water management
features and site catchments

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Revision 2
Date 04 June 2020

Figure 3-2

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\\ghdnet\ghd\AU\Newcastle\Projects\22\0105001\GIS\Maps\Deliverables\Western\Lidsdale Siding\12529457\WMP\12516545_WMP004_Flowpaths_2.mxd

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Data source: Department of Finance, Services & Innovation, Imagery, 2017; LPI: DCDB, 2012; Centennial: LDP, 2013. Created by: tinkler

Table 3-1 outlines each of the clean water diversion structures at Lidsdale Siding.

Table 3-1 Clean water diversions

Location	Type	Catchment diverted (ha)	Top width (m)	Depth/height (m)	Discharge to	Design compliance
CW1	Open channel	17.62	4.5	1.0	Pipers Flat Creek	20 year ARI*
CW2	Bund	1.99	20	2.0	Facilities area	20 year ARI
CW3	Open channel	3.03	6.5	1.0	Triangle Pond	20 year ARI

* ARI – average recurrence interval.

3.2.2 Dirty water management

The permanent dirty water management structures at Lidsdale Siding provide sediment control at the site. In the event of construction at Lidsdale Siding, disturbance activities are to be managed in accordance with the Land Disturbance Management Plan (SCSO 2020). Where disturbance activities are significant, a construction environmental management plan will be prepared.

Dirty water runoff (coal-contact and sediment-laden water) is managed by two dirty water storages which enable suspended solids to settle out of the water column and allow for dirty water to be reused in site processes minimising the potential for dirty water discharges into the surrounding environment.

The dirty water management structures are periodically de-silted to maximise available storage capacity.

Table 3-2 provides a summary of the dirty water storages present at Lidsdale Siding.

Table 3-2 Dirty water storages

Storage	Maximum capacity at outlet (ML)	Function	Treatment	Design compliance	Overflow type	Discharge to
Dirty Water Dam	6.1	Capture dirty water and coarse material	Sediment settling	95th percentile, 5 day rainfall event	Culvert	Triangle Pond
Triangle Pond	5.1 ^A	Sediment control	Sediment settling	95th percentile, 5 day rainfall event	Weir	Pipers Flat Creek via LDP004

^A – Works are planned for 2021 to increase Triangle Pond's capacity to up to 8.1 ML.

Dirty Water Dam

The Dirty Water Dam receives surface water runoff from coal stockpiles and coal loading areas; and return flow from the vehicle and equipment wash-down, and dust suppression. Water is supplied to the Fire and Service Water Tank from the dam.

The Dirty Water Dam provides a primary settling and treatment function and has a weir structure leading to a culvert below the railway line draining to the Triangle Pond.

Triangle Pond

The Triangle Pond captures surface water runoff from the northern part of the site and overflows from the Dirty Water Dam. The Triangle Pond acts as a final sediment settling storage. Overflows from the pond occur via a spillway through LDP004 to Pipers Flat Creek during discharge events. Works are planned for 2021 to increase Triangle Pond's capacity to up to 8.1 ML.

Following rainfall events, the volume and quality of water in the Triangle Pond is measured and compared to the discharge management performance criteria (refer to Table 1-3). To maintain storage capacity for future rainfall events, the water in Triangle Pond is treated by settling, before being dewatered by pump and discharged via LDP004. This process is summarised in Figure 3-3.

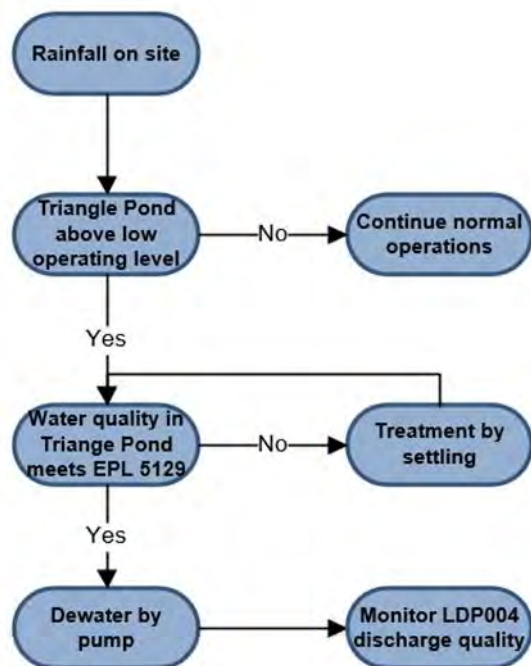


Figure 3-3 Dewatering and discharge procedure

Fire and Service Water Tank

The Fire and Service Water Tank is supplied by transfers from the Dirty Water Dam as well as extractions from the production bore and make-up water sourced from the Lithgow City Council (LCC) potable water supply system (non-preferentially as required). Water used for wash-down and dust suppression is supplied from this tank.

3.2.3 Erosion and sediment control

As part of surface water management, erosion and sediment control is critical to minimise excessive soil loss as a result of activities that require disturbance of existing groundcover. Erosion and sediment controls are implemented for all phases of operation including construction/maintenance activities, operational activities and during rehabilitation to mitigate the impacts of the operations on watercourses and the surrounding environment.

While the permanent dirty water management system (refer to Section 3.2.2) aims to mitigate the potential erosion and sediment loss hazard during normal operations, in the event of construction activities that require ground disturbance, erosion and sediment control plans (ESCPs) will be developed that:

- Identify activities with the potential to cause erosion and generate sediment.
- Plan activities to minimise the area of disturbance.
- Install erosion and sediment controls prior to commencement of disturbance activities.
- Maintain erosion and sediment control structures.
- Design erosion and sediment control structures to be stable for the 5% AEP design peak flow.

Design parameters and detail typical for erosion and sediment controls for Lidsdale Siding are included in Appendix J.

3.3 Groundwater management

3.3.1 Groundwater extraction

Lidsdale Siding was granted approval for groundwater extraction through a production bore (PB01) in 2011. During redrilling of PB01 in 2014, it was discovered that PB01 and the Dirty Water Dam were connected through water migration between aquifers. PB01 was decommissioned following the discovery of contaminated water entering the bore. PB01 was grouted from the surface to hard rock at approximately 5.5 m below ground level to prevent the mobilisation of the contamination.

A production bore (referred to as PB02 and licenced by 10WA116403) was installed for water use on site in 2016. A total of 8.5 ML/year is licensed to be extracted from the production bore under WAL 24362. Extraction of groundwater from the production bore was originally planned to be used to supplement water harvested by the surface water system for use in operational activities, however water from PB02 has not been required to date and PB02 is tagged permanently out of service.

3.3.2 Hydrocarbon contamination

A diesel spill of approximately 20,000 L occurred at a former above ground storage tank (AST) at Lidsdale Siding in the 1970s. Basic remedial works were undertaken at the time of the spill, however residual petroleum hydrocarbon contamination remains present in soils at the spill site and in groundwater underlying the site. A number of site assessments have been undertaken to determine the extent of the hydrocarbon contamination.

An assessment of the spill area has estimated an area of environmental concern, which is shown in Figure 3-4, based on soil sampling and analysis of petroleum hydrocarbon contaminants.

Contamination is identified to extend across an area of at least 2,800 m² and at depths of up to 5.1 m below ground level (Arcadis 2018).

A Phase 2 Environmental Site Assessment (ESA) (Environmental Strategies, 2017) was conducted in 2016 and completed in 2017 which formally investigated and identified the extent of hydrocarbon contamination at Lidsdale Siding.

This assessment identified impacts sourced from the AST and dispensing infrastructure with comparison of the results to the latest and most relevant regulatory guidance. The purpose of the assessment was to address data gaps in previous site assessments to the extent practicable to satisfy project approval conditions.

The assessment identified that hydrocarbon impacts in the vicinity of the AST:

- Are not considered to pose a risk to human health in any of the matrices investigated;
- Exceed ecological screening and site management limits in soil;
- Are not currently migrating beyond the site boundary; and

Overall, the assessment did not consider that remediation of the site is required to meet the NSW DPI conditions of consent for the site.

Based on the above, an Environmental Management Plan (Arcadis 2018) has been implemented for the site specific to management of identified impacts and is included as Appendix F.

3.4 Dust suppression

All dust suppression water at Lidsdale Siding is sourced from on-site water storages. No potable town water is used for dust suppression.

Water application to coal loaded train wagons is done through automated sprays that are installed and triggered to activate at the TLO as loaded trains pass the TLO building. The automated process was implemented as part the Lidsdale Siding Upgrade Project in 2014.

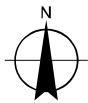
Irrigation systems to moisten coal and reduce surface dust generation are installed at Lidsdale Siding stockpiles and conveyor coal transfer points.

3.5 Potable and wastewater systems

Potable water is provided by LCC municipal potable water supply system to the administration building and equipment storage area. External make-up water supplied to the Fire and Service Water Tank can also be sourced from the LCC system, however is preferentially taken from the Dirty Water Dam and the production bore (PB02). Grey water and sewage from the site is directed to the LCC sewerage system.



Paper Size A4
0 25 50 100 150 200 250
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



LEGEND

- Licensed Discharge Point
- Groundwater monitoring bore
- Watercourse - Non Perennial
- Watercourse - Perennial
- Water Storage
- Contamination area (ES 2017)



Lidsdale Siding
Water Management Plan

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Date | 04 June 2020

Area of known
hydrocarbon contamination

Figure 3-4

3.6 Site water balance

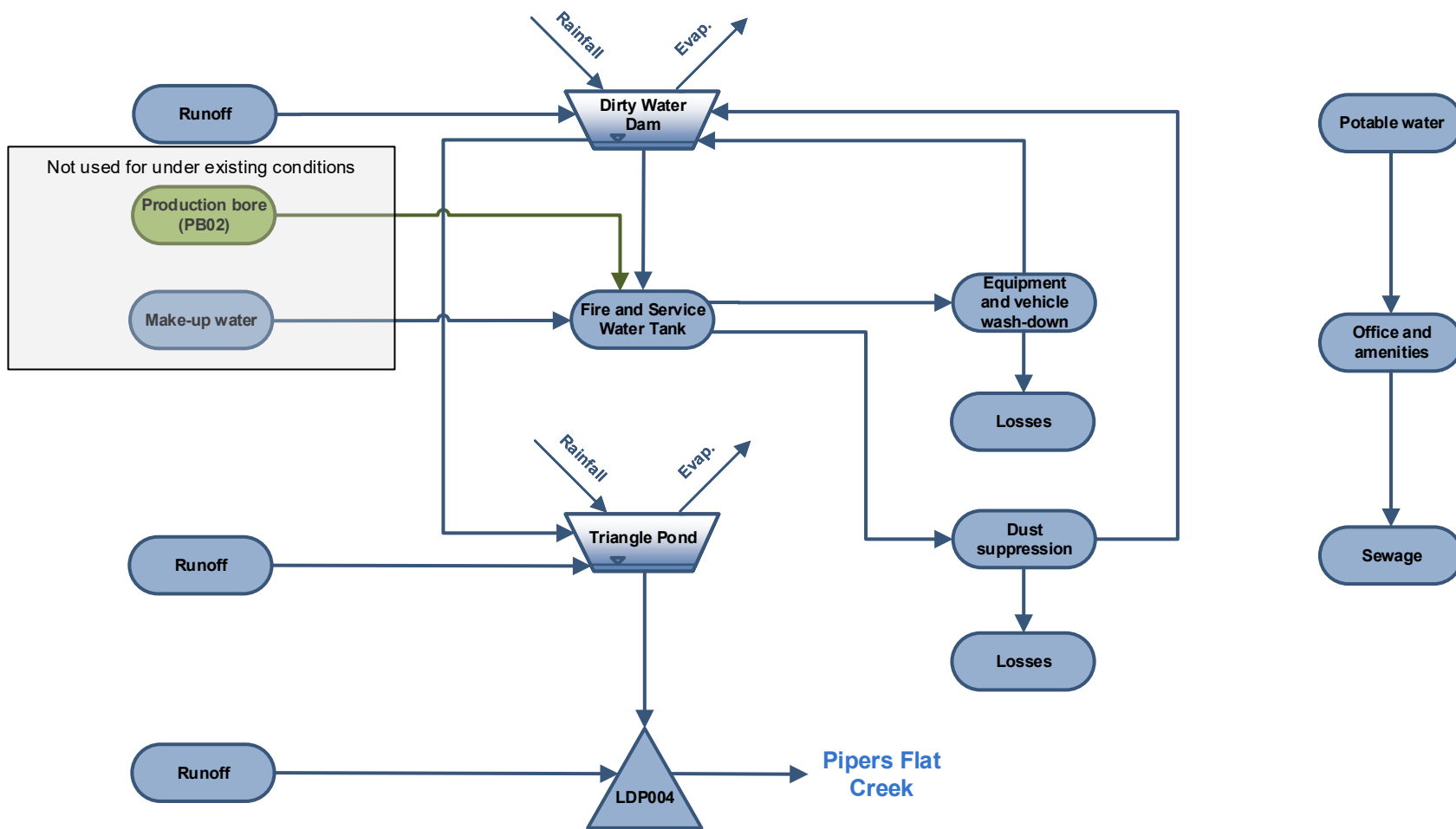
3.6.1 Summary

A site water balance model has been developed for the water management system at Lidsdale Siding (GHD 2017) to quantify water transfers within the site under various rainfall conditions. The site water balance assumes that Lidsdale Siding operates at its full approved throughput. In reality, actual throughput is lower than the approved limit and therefore site water demands are supplied without external make-up water supply. No changes to water management or the site water balance are associated with MOD 1, MOD 2 or MOD 3. The proposed upgrade to Triangle Pond is expected to result in only slight changes to the site water balance.

A schematic of the water management system is presented in Figure 3-5. A summary of the average annual inputs and outputs for the water management system is presented in Table 3-3.

Table 3-3 Summary of annual water balance at approved limits

Water management element	Water (ML/year)
INPUTS	
Direct rainfall onto storages and catchment runoff	29
External potable water supply	1
Extraction from production bore (PB02)	8
External make-up water supply (Springvale Mine)	3
TOTAL INPUTS (rounded)	41
OUTPUTS	
Evaporation from storages	2
Dust suppression	20
Equipment and vehicle wash-down	6
Discharge through LDP004	12
Sewage to LCC system	1
TOTAL OUTPUTS (rounded)	41
CHANGE IN STORAGE	
Dirty Water Dam	0
Triangle Pond	0
Fire and Service Water Tank	0
TOTAL CHANGE IN STORAGE (rounded)	0
BALANCE	
Inputs – outputs – change in storage	0



Legend



Underground storage



Surface process



Surface water flow



Underground process



Licensed discharge point



Groundwater flow



Surface storage



Entrained moisture



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Lidsdale Siding
Water Management Plan

Water cycle schematic

Project No. 12510506
Revision No. 0
Date 29/01/2021

FIGURE 3-5

Created by: Tyler Tinkler

3.6.2 Water supply security

Water supply to meet site demand is sourced using the hierarchy below:

1. Surface water from the Dirty Water Dam and Triangle Pond.
2. Groundwater from the production bore (PB02) (maximum 8.5 ML/year).
3. Excess mine water from Springvale Coal Mine where practical.
4. Potable water from the town water supply.
5. Surface water extracted in accordance with WAL 25774 (extraction via this licence has not been utilised since the upgrade project in 2014 and is not currently utilised as part of the site water supply nor currently proposed in the future with all pumping infrastructure decommissioned).

Given the security of potable water from LCC, there are no significant water supply risks associated with achieving appropriate environmental management requirements.

3.6.3 Discharge frequency

Discharges through LDP004 occur via overflow of the Triangle Pond into a stormwater channel which flows into Pipers Flat Creek. The average annual discharge was predicted by the site water balance to be 12 ML/year (GHD 2017).

Figure 3-6 presents the percentiles of the range of daily flow rates predicted to pass through LDP004. Discharges were modelled to occur for less than 10% of days in the year. The maximum daily discharge through LDP004 was estimated to be 21 ML/day, with a frequency of less than 0.002% of days modelled (GHD 2017).

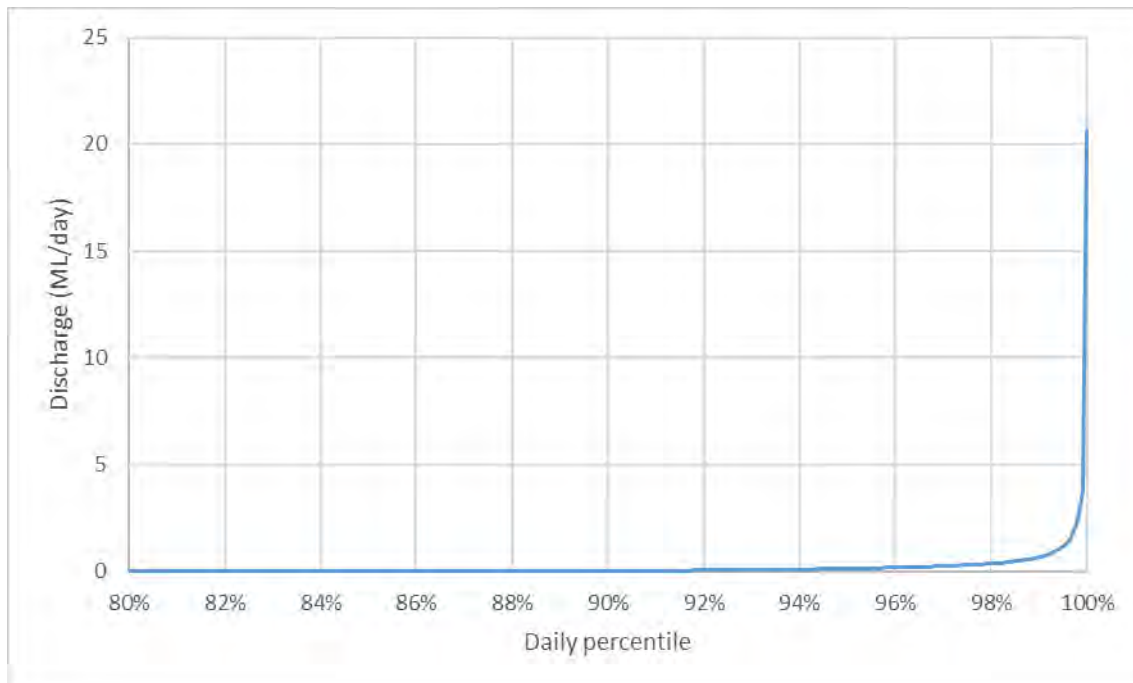


Figure 3-6 Predicted LDP004 daily flow percentiles

3.7 Flooding

A flood assessment of Pipers Flat Creek was completed by Aurecon (2014) with a Flood Management Plan for Lidsdale Siding completed by GHD (2016b) and included in Appendix E. These reports considered the potential for inundation of the site and sources of potential impact to water quality if inundation were to occur. The identified sources of impact to water quality were stockpiled coal, unsealed surface and an historic diesel spill.

For the 1 year ARI event:

- Flooding dominated by local site runoff to minor drainage lines.
- No flooding within the rail triangle.
- Velocity highest within channelised areas.

For the 2 year ARI event:

- Flooding cross the railway south of the Lidsdale Siding facilities area.
- Velocities within channelised areas increase slightly.

For the 5 year ARI event:

- Flooding within rail triangle occurs.
- Extended flooding south of the Lidsdale Siding facilities area.
- Backwater effects from Pipers Flat begin to influence the southern portions of the facilities area but not impede on operational areas.
- Velocities in flood flow paths fringing the site occur between 1 to 2 m/s.

For the 10 year ARI event:

- Slightly increased flood depth and extent to 5 year ARI predictions.
- Backwater effects from Pipers Flat influence the southern portions of the facilities area but not impede on operational areas.

For the 20 year ARI event:

- Flooding impedes on stockpile and coal handling area from the south at a shallow depth. Stockpile and coal handling pad elevation has been since raised to be outside of the inundation area. Works undertaken following completion of Aurecon Flood Assessment.
- No flooding of reclaim tunnel occurs.

For the 100 year ARI event:

- Railway extensively overtopped along the western boundary of the operations area.
- Operational pad area inundated but below the invert of the reclaim tunnel. Pad elevation has been since raised to be outside of the inundation area. Works undertaken following completion of Aurecon Flood Assessment.
- Velocity over operational area is less than 0.5 m/s, however small flows paths up to 1.5 m/s velocity were predicted.

The Flood Management Plan (Appendix E) was provided to the NSW Department of Planning, Industry and Environment (DPIE) on 14 October 2016 with no formal response received. Following the completion of flood related works at Lidsdale Siding, the potential flooding impacts are not expected to change at Lidsdale Siding. The Flood Management Plan will be reviewed on an as needed basis following major flooding events or changes to hydraulic conditions in the extent of the flood modelling.

4. Monitoring requirements

4.1 Inspections

Site inspections are completed by Centennial staff and occur at a minimum:

- Weekly during operations and following rainfall events/process changes.
- Monthly when non-operational.
- Within 24 hours following rainfall events that exceed 20 mm in 24 hours.

Inspections include the following activities:

- Walking around the site systematically and inspecting water management and sediment control structures for capacity, structural integrity and effectiveness.
- Recording and reporting on the condition of water management and sediment control structures, including the water level in Triangle Pond.

Maintenance of the water management structures is implemented when maintenance requirements are observed and identified through the inspection process. An example of an operational checklist is included in Appendix H.

4.2 Surface water monitoring

Surface water quality is monitored at the following locations:

- Triangle Pond and Dirty Water Dam.
- MP1 – Pipers Flat Creek downstream of Wallerawang STP and upstream of Lidsdale Siding.
- Pipers Flat Creek U/S – Pipers Flat Creek upstream of LDP004 discharges, approximately 650 m upstream of the confluence with the Coxs River.
- Pipers Flat Creek D/S – Pipers Flat Creek immediately downstream of LDP004 discharges, approximately 90 m upstream of the confluence with the Coxs River.

During times of high flow in Coxs River there is potential for water from Coxs River to flow back up Pipers Flat Creek and may result in non-representative samples from the Pipers Flat Creek D/S sampling location. The state of flow (flow/no flow) in both Pipers Flat Creek and Coxs River is noted at the time of sampling at Pipers Flat Creek U/S and Pipers Flat Creek D/S, and is taken into consideration when assessing monitoring results.

Figure 4-1 presents the locations of monitoring points for Lidsdale Siding and Table 4-1 summarises the frequency and monitored parameters.

Table 4-1 Surface water quality monitoring program

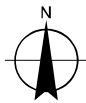
Location	Frequency	Parameters
Pipers Flat Creek U/S Pipers Flat Creek D/S	Quarterly During discharge from LDP004*	Physicochemical: EC, pH, TSS, turbidity. Nutrients: nitrate, nitrite, nitrate + nitrite, total phosphorus. Major ions: alkalinity (bicarbonate, carbonate, hydroxide, total), calcium, chloride, magnesium, potassium, sodium, sulphate.
Triangle Pond Dirty Water Dam MP1	Quarterly	Dissolved metals: aluminium, cadmium, copper, iron, manganese, nickel. Other: Benzene, toluene, ethylbenzene, xylene (BTEX), oil and grease, total recoverable hydrocarbons (TRHs).

* as soon as safe and practical



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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



LEGEND

- Surface Water Monitoring
- ✕ Groundwater Monitoring
- ✕ Aquatic ecology monitoring

- Water Storage
- Watercourse - Non Perennial
- Watercourse - Perennial



Lidsdale Siding
Water Management Plan

Job Number	12510506
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Date	04 June 2020

Monitoring locations

Figure 4-1

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Data source: LPI : DCDB, 2012; Centennial: LDP, 2013, Site features, 2016; Department of Finance, Services & Innovation, Imagery, 2017. Created by: smacdonald

4.3 Discharge water monitoring

Monitoring of the volume and quality of LDP004 discharge is undertaken in accordance with the requirements of EPL 5129.

Discharge volume at LDP004 is recorded automatically via an installed weir and automated water level monitor installed in the Triangle Pond.

Table 4-2 presents the frequency and monitored parameters of LDP004 discharges.

Table 4-2 Discharge water quality monitoring program

Location	Frequency	Parameters
LDP004	Monthly during discharge	Physicochemical: EC, pH, TSS, turbidity. Other: oil and grease.

4.4 Groundwater monitoring

The groundwater monitoring network includes nine monitoring bores (MW1, MW3, MW4, MW5, MW6, MW7, MW8, MW9, and MW10). Figure 4-1 presents the locations of monitoring points for groundwater and Table 4-3 summarises the frequency and monitored parameters.

The volume of groundwater extracted from the production bore (PB02) is monitored continuously via a flow meter at the Fire and Service Water tank.

Table 4-3 Groundwater monitoring program

Location	Frequency	Parameters
MW1	Quarterly	Water level.
MW3		Physicochemical: DO, EC, pH, TSS, turbidity, temperature.
MW4		Nutrients: nitrate, nitrite, nitrate + nitrite.
MW5		Major ions: alkalinity (bicarbonate, carbonate, hydroxide, total), calcium, chloride, magnesium, potassium, sodium, sulphate.
MW6		Dissolved metals: cadmium, copper, iron, manganese, nickel.
MW7		Other: BTEX, oil and grease, TRHs.
MW8		
MW9 (ESMW01)		
MW10 (ESMW02)		

There is no monitoring of private bores around Lidsdale Siding. There are no operational private bores in the vicinity of Lidsdale Siding (refer to Section 2.4.2). In the event that Lidsdale Siding were aware of a nearby operational private bore and groundwater was required to be extracted from PB02, Centennial would investigate monitoring nearby operational private bores.

4.5 Stream health monitoring

4.5.1 Watercourse stability

Visual monitoring of Pipers Flat Creek is carried out periodically by site personnel to identify any instabilities that may form as a result of operations at Lidsdale Siding. This includes inspection following rainfall events triggering discharge from LDP004 and any potential future riparian works along Pipers Flat Creek.

Due to the low frequency and volume of discharge from LDP004, it is unlikely that watercourse stability downstream of the site is affected by site discharges.

The distance between the LDP004 discharge point on Pipers Flat Creek and the confluence to the Cocks River is minimal, therefore impacts on watercourse stability on Pipers Flat Creek is likely negligible.

Inspections will identify any changes in stream bed, stream bank and stream vegetation conditions in the vicinity of where discharge from LDP004 enters Pipers Flat Creek.

4.5.2 Aquatic ecology

Aquatic ecology monitoring occurs biannually in spring and autumn at the following monitoring locations, as shown in Figure 4-1.

- PFup – Pipers Flat Creek approximately 550 m upstream of LDP004 discharges.
- PFdn – Pipers Flat Creek immediately downstream of LDP004 discharges.

The monitoring sites are located on Pipers Flat Creek upstream and downstream of the point where LDP004 discharges enter the creek.

The aquatic ecology monitoring methodology includes:

- Sampling, sorting and identification of macroinvertebrates associated with pool edge habitat in accordance with the Australian Rivers Assessment System (AUSRIVAS) protocols (Turak et al. 2004).
- Assessment of the condition of the aquatic habitat using modified NSW AUSRIVAS field sheets.
- Measurement of dissolved oxygen (DO), EC, pH, temperature and turbidity just below the surface of the water column and at depth where sufficient water is available.
- Collection of surface water and sediment grab samples for water and sediment quality analysis.

Further detail of the aquatic ecology monitoring methodology and regional sampling extent is provided in the Upper Cocks River Catchment Biological Monitoring Program (GHD, 2016).

4.6 Hydrocarbon contamination monitoring

The Lidsdale Siding Environmental Management Plan (Arcadis 2018) requires the sampling of groundwater bores to monitor hydrocarbon contamination on site. A summary of the monitoring program is presented in Appendix F.

4.6.1 Groundwater monitoring

The hydrocarbon contamination groundwater monitoring network includes nine monitoring bores (MW1, MW3, MW4, MW5, MW6, MW7, MW8, MW9 (ESMW01) and MW10 (ESMW02)). Figure 4-1 presents the locations of monitoring points for groundwater and Table 4-4 summarises the frequency and monitored parameters.

Table 4-4 Hydrocarbon groundwater monitoring program

Location	Frequency	Parameters
MW1	Every two months for the first year (2018/2019)	Depth to water and base of well
MW3		Physiochemical: DO, EC, pH, redox and temperature
MW4	Quarterly for the period of 2 – 4 years (2019 – 2023)	Dissolved Metals: Calcium, Copper, Lead, Manganese, Mercury, Nickel and Zinc
MW5		BTEX: Benzene and Xylene (o)
MW6	Biannual for the period of 5 – 10 years (2023 – 2028)	PAH: Napthalene
MW7		TPH/TRH: Petroleum hydrocarbons
MW8	Annually after 10 years	
MW9 (ESMW01)		
MW10 (ESMW02)		

5. Baseline data

5.1 Surface water monitoring

5.1.1 Surface water flow

Pipers Flat Creek is a naturally ephemeral watercourse, but receives discharges from Wallerawang Sewage Treatment Plant (WSTP), located upstream of Lidsdale Siding. Therefore the hydrological regime in Pipers Flat Creek at Lidsdale Siding is dominated by the discharges from WSTP. LCC monitor discharges from WSTP to Pipers Flat Creek on a daily basis and publish the information on a monthly basis. This publically available record provides a suitable proxy record of flows in Pipers Flat Creek.

Discharge flow monitoring has been undertaken daily during discharge from the WSTP to Pipers Flat Creek by Lithgow City Council since March 2014. The maximum, minimum and mean daily discharges by month from the WSTP are summarised in Figure 5-1.

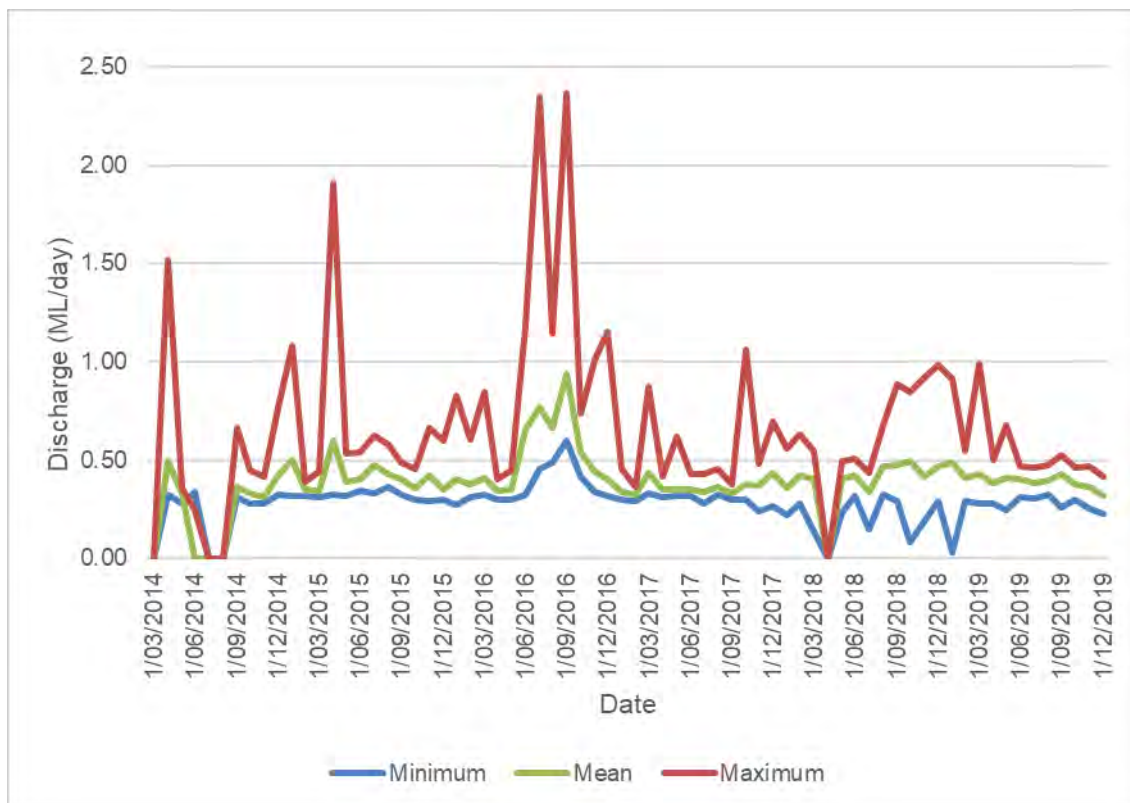


Figure 5-1 WSTP discharge to Pipers Flat Creek

5.1.2 Surface water quality

Appendix C presents the baseline surface water quality data for parameters monitored in Pipers Flat Creek. Table 5-1 presents the extent of baseline data considered. Surface water monitoring of Triangle Pond, Dirty Water Dam and Pipers Flat Creek D/S has only commenced recently, so no baseline data is currently available.

Where the analytical result was below the limit of reporting (LOR) for a particular parameter, then the detection limit was included in the calculation.

Table 5-1 Details of baseline surface water quality data

Location	Period from	Period to	Number of points
MP1	17/09/2009	18/11/2019	36-62
Pipers Flat Creek U/S	17/09/2009	18/11/2019	36-62

5.2 Discharge water monitoring

5.2.1 Discharge volume

LDP004 discharge from the Triangle Pond to Pipers Flat Creek is measured continuously during discharge events. Historical discharge data from October 2012 to January 2020 is presented in Figure 5-2 along with rainfall recorded on site.

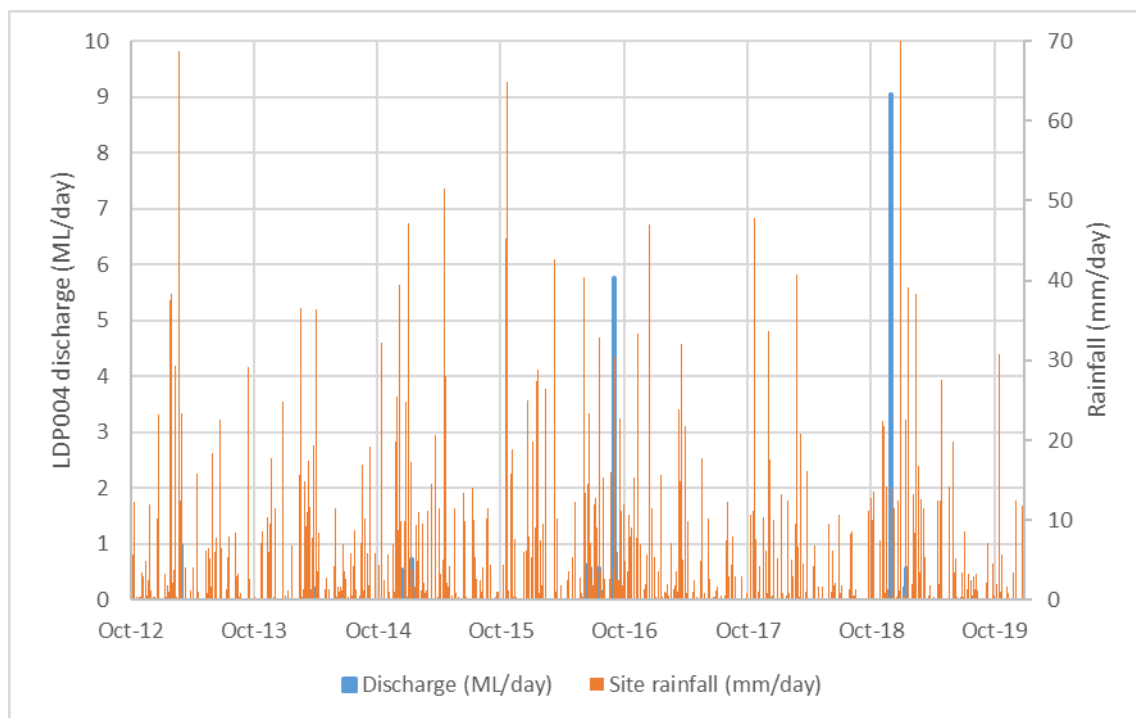


Figure 5-2 Recorded LDP004 discharge volume

5.2.2 Discharge water quality

Water quality results for LDP004 discharges are presented in Appendix C.

Table 5-2 presents the extent of baseline data considered. Where the analytical result was below the LOR for a particular parameter, then the detection limit was included in the calculation.

Table 5-2 Details of baseline LDP004 water quality data

Location	Period from	Period to	Number of points
LDP004	17/09/2009	18/11/2019	26–39

5.3 Groundwater monitoring

Appendix C presents the baseline groundwater level and quality data for monitoring bores at Lidsdale Siding. Table 5-3 presents the extent of baseline data for groundwater level and quality data considered.

Table 5-3 Details of baseline groundwater level and quality data

Location	Period from	Period to	Number of points
MW1	17/09/2009	29/08/2019	3-41
MW3	17/09/2009	29/08/2019	2-33
MW4	17/09/2009	18/11/2019	36-51
MW5	17/09/2009	18/11/2019	28-43
MW6	17/09/2009	18/11/2019	35-51
MW7	26/02/2016	18/11/2019	11-14
MW8	26/02/2016	18/11/2019	10-14
MW9	10/05/2017	18/11/2019	10-14
MW10	31/08/2017	18/11/2019	8-9

5.4 Stream health monitoring

5.4.1 Watercourse stability

No watercourse stability monitoring of Pipers Flat Creek has occurred to date due to the low frequency and volume of discharge from LDP004. It is unlikely that watercourse stability downstream of the site is affected by site discharges.

The distance between the LDP004 discharge point on Pipers Flat Creek and the confluence to the Coffs River is minimal, therefore impacts on watercourse stability on Pipers Flat Creek is likely negligible.

5.4.2 Aquatic ecology

Aquatic ecology monitoring at Lidsdale Siding has been undertaken within Pipers Flat Creek biannually (spring and autumn) since 2011.

Monitoring undertaken by GHD (2019) indicated the following:

- Normal water levels were observed at both sites during autumn and spring sampling.
- There were no major changes in the condition of site riparian banks or channel areas observed. Clearing and regeneration of riparian vegetation was evident along the banks upstream in autumn 2018. The site contained *Typha* sp., *Cyperaceae* sp. and woody debris, with the riparian zone dominated by blackberry.
- Aquatic habitat availability in 2018 was similar to previous monitoring rounds, consisting of woody debris, undercut banks and macrophytes during both sampling events. Filamentous algae was also observed in autumn 2018.

- Sediments at both sites on Pipers Flat Creek contained low concentrations of all metals, with concentrations below the SQGVs in both autumn and spring 2018.
- There were 27 macroinvertebrate taxa recorded at the PFup site, with 25 taxa recorded at the PFdn site in spring 2018. Taxa richness was above the long-term PFup median in all Pipers Flat Creek samples except one replicate collected from PFup in autumn.

6. Response plans

6.1 Triggers

6.1.1 Surface water quality triggers

Water quality monitored downstream of Lidsdale Siding is assessed against site-specific guideline values (SSGVs) derived for the catchment, as shown in Table 6-1. SSGVs are based on a review of ANZECC (2000) default guideline values (DGVs) and water quality observed at Pipers Flat Creek U/S (upstream reference site). Appendix D provides further detail on the methodology used to derive SSGVs.

Table 6-1 Site-specific guideline values for assessment of surface water quality

Parameter	Units	Trigger value
Physicochemical		
EC	µS/cm	1,000
pH	pH units	6.5–9.0
TSS	mg/L	25
Turbidity	NTU	25
Nutrients		
Ammonia	mg/L	0.9
Nitrate	mg/L	0.7
Total nitrogen	mg/L	0.2
Total phosphorus	mg/L	0.02
Dissolved metals		
Aluminium	mg/L	0.055
Arsenic	mg/L	0.024
Boron	mg/L	0.37
Cadmium	mg/L	0.0002
Chromium	mg/L	0.001
Cobalt	mg/L	0.0025
Copper	mg/L	0.0014
Iron	mg/L	0.3
Lead	mg/L	0.0034

Parameter	Units	Trigger value
Manganese	mg/L	1.9
Mercury	mg/L	0.0006
Nickel	mg/L	0.011
Selenium	mg/L	0.011
Silver	mg/L	0.00005
Zinc	mg/L	0.008

6.1.2 Discharge water triggers

Water quality limits are specified by EPL 5129 for LDP004, which are provided in Table 1-3.

Note that the water quality concentration limits for LDP004 do not apply when the discharge occurs solely as a result of rainfall measured at the site which exceeds 56 mm over any consecutive five day period.

No volumetric discharge limits apply to LDP004.

6.1.3 Groundwater triggers

Groundwater level and quality trigger values have been developed with reference to baseline monitoring data.

Groundwater level trigger values are based on the historical minimum observed groundwater level.

Groundwater quality trigger values are based on the 80th percentile historical concentrations as shown in Table 6-2. For pH, a range of trigger values are used, based on the 20th percentile and 80th percentile historical values.

Note that trigger values for bores MW7, MW8, MW9 and MW10 will be derived when an appropriate number of observations have been made.

Table 6-2 Groundwater trigger values

Parameter	Units	MW1	MW3	MW4	MW5	MW6
Water level	m AHD	876.5	880.4	873.9	875.6	875.8
Physicochemical						
EC	µS/cm	609	310	633	362	577
pH	pH units	6.6–6.8	5.6–6.0	4.3–4.5	5.5–5.9	6.3–6.5
TSS	mg/L	2,185	2,480	2,600	2,570	1,660
Turbidity	NTU	897	2,865	1,029	1,730	1,730
Dissolved metals						
Cadmium	mg/L	0.0001	0.0001	0.0002	0.0001	0.0001
Copper	mg/L	0.002	0.004	0.003	0.003	0.002
Iron	mg/L	35.3	0.12	0.38	0.07	0.05
Manganese	mg/L	1.21	0.036	0.536	0.039	0.025
Nickel	mg/L	0.001	0.002	0.041	0.024	0.002
Other						
BTEX	mg/L	5	1	1	1	1
Oil and grease	mg/L	8	5	5	5	5
TRHs	mg/L	21,600	100	100	100	100

6.2 Performance criteria

Performance criteria have been developed from baseline information and the approach presented within the Regional Water Management Plan (GHD 2016a). These criteria form the basis of the trigger action response plans (TARPs) provided in Appendix I.

6.2.1 Surface site operations

The performance criteria for surface water management is outlined in Table 6-3.

Table 6-3 Site surface operations criteria

Aspect	Criteria
Site storages	Storages sized in accordance with Landcom (2004) and DECC (2008) and maintained within the capacity of each storage.
Water quality management	Clean and dirty water separation.
Erosion and sediment control	Minimise disturbance area. Surface disturbance and other construction activities are to be managed in accordance with the approach and guidelines outlined in the Regional Water Management Plan (GHD 2016a). Where construction works are significant, an erosion and sediment control plan and construction environmental management plan will be prepared.
Hydrocarbon management	Chemical and hydrocarbon storage to be undertaken in accordance with Australian Standard AS1940:2004.

6.2.2 Watercourses

The performance criteria developed for watercourses are provided in Table 6-4.

Table 6-4 Watercourse criteria

Aspect	Criteria
Water quality	Within or below SSGVs provided in Table 6-1.

6.2.3 Discharge management

The discharge management performance criteria are outlined in Table 6-5.

Table 6-5 Discharge management criteria

Aspect	Criteria
Discharge quality	Within or below water quality limits provided in Table 1-3.

6.2.4 Groundwater environment

The performance criteria for the groundwater environment is provided in Table 6-6.

Table 6-6 Groundwater environment criteria

Aspect	Criteria
Groundwater level	Above trigger values provided in Table 6-2. No complaints regarding groundwater access.
Groundwater quality	Within or below trigger values provided in Table 6-2. No complaints regarding groundwater quality.

6.2.5 Stream health

The performance criteria developed for stream health is provided in Table 6-7.

Table 6-7 Stream health criteria

Aspect	Criteria
Watercourse stability	
Incisional processes and instabilities	Occurrence of erosional processes does not occur as a result of discharge.
Aquatic ecology	
Instream/riparian vegetation	Vegetation type and density within the range observed during previous monitoring rounds.
Macroinvertebrate community condition	Metrics at downstream sites are within the range observed at reference/background sites.

6.3 Trigger action response plans

TARPs are provided in Appendix I for:

- Site surface operations.
- Watercourses.
- Flooding.
- Discharge management.
- Groundwater environment.
- Stream health.

7. Site-specific reviews and reports

7.1 Site water balance

The site water balance will be reviewed and revised every three years as a minimum or as necessary when there are changes to operations.

8. References

- ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, Australia and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand.
- Arcadis (2018) *Lidsdale Siding Environmental Management Plan*, prepared for Centennial Coal Company Limited.
- Auercon (2014) *Lidsdale Siding Upgrade: Lidsdale Siding Flooding Assessment Report*, prepared for Centennial Coal Company Limited.
- DECC (2008) *Managing Urban Stormwater: Soils and construction Volume 2E*. NSW Department of Environment and Climate Change.
- Environmental Strategies Pty Ltd (2017) *Limited Phase 2 Environmental Site Assessment*, prepared for Ivanhoe Coal Pty Limited.
- GHD (2016) *Upper Cocks River Catchment Biological Monitoring Program*, prepared for Centennial Coal Company Limited.
- GHD (2016a) *Western Operations: Regional Water Management Plan*, prepared for Centennial Coal Company Limited.
- GHD (2016b) *Lidsdale Siding: Flood Management Plan*, prepared for Centennial Coal Company Limited.
- GHD (2017) *Lidsdale Siding: Water and Salt Balance Assessment*, prepared for Centennial Coal Company Limited.
- GHD (2019) *Upper Cocks River Aquatic Ecology Monitoring: Annual Report 2018*; prepared for Centennial Coal Company Limited.
- Landcom (2004) *Managing Urban Stormwater: Soils and construction Volume 1*.
- Marine Pollution Research (2016) *Aquatic ecology monitoring: Wangcol and Pipers Flat Creeks Autumn 2016*, prepared for Centennial Coal Pty Ltd.
- Marine Pollution Research (2017) *Aquatic ecology monitoring: Wangcol and Pipers Flat Creeks Final data report spring 2016*, prepared for Centennial Coal Pty Ltd.
- SCSO (2020) *SCSO - Land Disturbance Management Plan*, Centennial Coal - Springvale Coal Services Operation.
- SLR (2014) *Supplementary Contamination Delineation Assessment and Remedial Action Plan: Historical Diesel AST Spill*, prepared for Centennial Ivanhoe Pty Limited.
- Turak, E., Waddell, N. and Johnstone, G. (2004) *New South Wales (NSW) Australian River Assessment System (AUSRIVAS) Sampling and Processing Manual*, Environment Protection Authority.

APPENDIX A – Correspondence with regulators

SUBMISSION FOR APPROVAL DETAILS	Revision	Circulation date	Feedback date	Approval date
	0	26 September 2013	31 October 2013	14 November 2013
	1	18 March 2019	20 May 2019	NA
	2	27 September 2019	21 November 2019	NA
	3	TBC		
CONSULTATION DETAILS	Department		Circulation date	Feedback date
Water management plan	Department of Industry – Crown Lands and Water		18 March 2019	None received to date
	Natural Resources Access Regulator		18 March 2019	None received to date
	Environment Protection Authority		18 March 2019	None received to date
	Water NSW		18 March 2019	11 April 2019
	Department of Planning and Environment		6 May 2019	20 May 2019
	Department of Planning, Industry and Environment		30 September 2019	21 November 2019
Flood management plan (refer to Appendix E for correspondence)	Department of Planning and Environment		1 May 2014	9 May 2014
	Environment Protection Authority		1 May 2014	9 May 2014
	Sydney Catchment Authority		1 May 2014	1 July 2014



18 March 2019

Email: water.enquiries@industry.nsw.gov.au

Department of Industry – Crown Lands & Water
GPO Box 5477
Sydney NSW 2001

To Whom It May Concern:

Centennial Coal – Lidsdale Siding Water Management Plan

Ivanhoe Coal has recently revised the Lidsdale Siding Water Management Plan. The revised Water Management Plan has been updated to align with Centennial's regional management plan framework and reflect current operational requirements. In accordance with the Lidsdale Coal Loader development consent, a copy of the revised Water Management Plan has been enclosed for your review and comment.

Any feedback on the Water Management Plan should be provided in writing by 5pm on Friday 12 April 2019 to:

James Wearne
Group Approvals Manager
Centennial Coal
PO Box 1000
TORONTO NSW 2283
james.wearne@centennialcoal.com.au

Yours sincerely

James Wearne
Group Approvals Manager

Enclosed

- Lidsdale Siding Water Management Plan



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Fassifern

100 Miller Road
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Toronto NSW 2283 Australia

T: 61 2 4935 8960
F: 61 2 4959 5299
E: info@centennialcoal.com.au
W: www.centennialcoal.com.au

18 March 2019

Email: water.referrals@nrar.nsw.gov.au.

Natural Resources Access Regulator
GPO Box 5477
Sydney NSW 2001

To Whom It May Concern:

Centennial Coal – Lidsdale Siding Water Management Plan

Ivanhoe Coal has recently revised the Lidsdale Siding Water Management Plan. The revised Water Management Plan has been updated to align with Centennial's regional management plan framework and reflect current operational requirements. In accordance with the Lidsdale Coal Loader development consent, a copy of the revised Water Management Plan has been enclosed for your review and comment.

Any feedback on the Water Management Plan should be provided in writing by 5pm on Friday 12 April 2019 to:

James Wearne
Group Approvals Manager
Centennial Coal
PO Box 1000
TORONTO NSW 2283
james.wearne@centennialcoal.com.au

Yours sincerely

James Wearne
Group Approvals Manager

Enclosed

- Lidsdale Siding Water Management Plan



18 March 2019

Mr Darryl Clift
Head Central West Unit
Environment Protection Authority
PO Box 1388
Bathurst NSW 2795

Dear Mr Clift

Centennial Coal – Lidsdale Siding Water Management Plan

Ivanhoe Coal has recently revised the Lidsdale Siding Water Management Plan. The revised Water Management Plan has been updated to align with Centennial's regional management plan framework and reflect current operational requirements. In accordance with the Lidsdale Coal Loader development consent, a copy of the revised Water Management Plan has been enclosed for your review and comment.

Any feedback on the Water Management Plan should be provided in writing by 5pm on Friday 12 April 2019 to:

James Wearne
Group Approvals Manager
Centennial Coal
PO Box 1000
TORONTO NSW 2283
james.wearne@centennialcoal.com.au

Yours sincerely

James Wearne
Group Approvals Manager

Enclosed

- Lidsdale Siding Water Management Plan



18 March 2019

Mr Peter Dupen
Mining Manager
WaterNSW
PO box 398
Parramatta NSW 2124

Dear Mr Dupen

Centennial Coal – Lidsdale Siding Water Management Plan

Ivanhoe Coal has recently revised the Lidsdale Siding Water Management Plan. The revised Water Management Plan has been updated to align with Centennial's regional management plan framework and reflect current operational requirements. In accordance with the Lidsdale Coal Loader development consent, a copy of the revised Water Management Plan has been enclosed for your review and comment.

Any feedback on the Water Management Plan should be provided in writing by 5pm on Friday 12 April 2019 to:

James Wearne
Group Approvals Manager
Centennial Coal
PO Box 1000
TORONTO NSW 2283
james.wearne@centennialcoal.com.au

Yours sincerely

James Wearne
Group Approvals Manager

Enclosed

- Lidsdale Siding Water Management Plan



6 May 2019

Mr Paul Freeman
Team Leader
Resource Assessments
Department of Planning and Environment
GPO Box 39
Sydney NSW 2001

Dear Mr Freeman

Re: Lidsdale Siding Water Management Plan

Please find enclosed a copy of a revised Water Management Plan for the Lidsdale Siding operations for your review and approval. The Water Management Plan has been updated to be consistent with Centennial's regional management plan framework. The Water Management Plan has been designed to satisfy the conditions of development consent 08_0223 and has been developed in consultation with WaterNSW, EPA, the Department of Industry and the Natural Resource Access Regulator.

If you have any questions or require any further information in regards to the enclosed Water Management Plan, please contact me on my mobile 0407207530 or email james.wearne@centennialcoal.com.au.

Yours sincerely

A handwritten signature in blue ink, appearing to read 'James Wearne'.

James Wearne
Group Approvals Manager
Centennial Coal

Enclosed:

- Lidsdale Siding Water Management Plan

Lidsdale Siding – WMP Feb 2019

Reviewer: Wayne Jones wayne.jones@planning.nsw.gov.au

Date: 20 May 2019

PA 08_0223				
Condition 9c of Schedule 3	Satisfactory (Yes/No/Partial)	Comment	Action Required	Company Response
The Proponent shall: (c) install and operate equipment capable of applying water to the surface of coal loaded onto trains prior to leaving the site;	No	No details of water application provided in WMP	Include details of water application to coal trains	
SOIL AND WATER	Satisfactory (Yes/No/Partial)	Comment	Action Required	
SOIL AND WATER Note: Under the Water Act 1912 and/or the Water Management Act 2000, the Proponent is required to obtain all necessary water licences for the project	Yes	Section 1.2.4	-	
Water Supply Condition 15 Schedule 3	Satisfactory (Yes/No/Partial)	Comment	Action Required	
Water Supply The Proponent shall ensure that it has sufficient water for all stages of the project, and if necessary, adjust the scale of its operations to match its available water supply, to the satisfaction of the Director-General	Yes	Section 3.5.2	-	
Condition 16 of Schedule 3	Satisfactory (Yes/No/Partial)	Comment	Action Required	
The Proponent shall preferentially use excess mine water from the Springvale Coal Mine for dust suppression at the site rather than potable town water supply	No	No details of using water from Springvale Coal Mine	Include details on water supply from Springvale Coal Mine	
Surface Water Discharges Condition 17 of Schedule 3	Satisfactory (Yes/No/Partial)	Comment	Action Required	
The Proponent shall ensure that all surface water discharges from the site comply with the discharge	Yes	Section 1.2.3	-	

Lidsdale Siding – WMP Feb 2019

Reviewer: Wayne Jones wayne.jones@planning.nsw.gov.au

Date: 20 May 2019

limits (both volume and quality) set for the project in any EPL.				
Condition 21 of Schedule 3	Satisfactory (Yes/No/Partial)	Comment	Action Required	
The Proponent shall prepare and implement a Water Management Plan for the project to the satisfaction of the Director-General. This plan must be prepared in consultation with the EPA, NOW and SCA by suitably qualified and experienced persons, and be submitted to the Director-General for approval within 6 months of the date of this approval. The plan must include	Yes	Initial WMP reviewed by relevant agencies	-	
Condition 21a of Schedule 3	Satisfactory (Yes/No/Partial)	Comment	Action Required	
a Site Water Balance that includes details of:	Yes	Section 3.5	-	
• sources and security of water supply;	Yes	Sources - Section 3.1, Security 3.5.2	-	
• water use on site;	Yes	Section 3.1	-	
• water management on site; and	Yes	Section 3	-	
• any water transfers to/from the site	Partial	No details of Springvale water	Include details on water supply from Springvale Coal Mine	
Condition 21b of Schedule 3	Satisfactory (Yes/No/Partial)	Comment	Action Required	
Surface Water Management Plan that includes:	Yes	Section 3.2.	-	
• A description of the surface water management system for the project including clean water diversions, erosion and sediment controls, and water storages;	Partial	Section 3.2 includes details of surface water management, however only refers to ERSED controls in the regional WMP.	Needs to include details of ERSED	
• baseline data on surface water flows and quality of Pipers Flat Creek which receives the water from the licensed discharge point identified in the site's EPL;	Partial	Section 5.1 and Appendix C contains baseline data on Piper Flat Creek however no flow details	Include flow details for Piper Flat Creek.	

Lidsdale Siding – WMP Feb 2019

Reviewer: Wayne Jones wayne.jones@planning.nsw.gov.au

Date: 20 May 2019

surface water quality and stream health assessment criteria, including trigger levels for investigating any potentially adverse surface water impacts	Partial	Section 6.1 are triggers Section 6.2 are Criteria. See general notes below	Ensure trigger levels are used, not criteria.	
a surface water monitoring program for surface water discharges, surface water flows and quality, and stream health and channel stability of Pipers Flat Creek; and	Yes	Section 4	-	
measures to reuse and recycle water, and to minimise potable water use from the town water supply;	Yes	Section 3.2, 3.2.2, 3.5.2	-	
Condition 21c of Schedule 3	Satisfactory (Yes/No/Partial)	Comment	Action Required	
a Groundwater Monitoring Program that includes:	Yes	Section 4.4	-	
detailed baseline data of all groundwater levels yield and quality in the area, and any privately owned groundwater bores that may be affected by the project	Partial	Baseline data - Section 5.1 and Appendix C. No monitoring of private bores	Include monitoring or agreement to monitor private bores in WMP	
groundwater assessment criteria based upon analysis of baseline data for groundwater, including trigger levels for investigating any potentially adverse groundwater impacts; and	Partial	Section 6.1.3 and Table 6-6 mix criteria and triggers	Ensure criteria and triggers are well defined	
a program to monitor and/or validate the impacts of the project on any privately-owned groundwater bores that may be affected by the project;	No	No monitoring of private bores included in WMP	Include monitoring or agreement to monitor private bores in WMP	
Condition 21d of Schedule 3	Satisfactory (Yes/No/Partial)	Comment	Action Required	
a Surface and Ground Water Response Plan that describes the measures and/or procedures that would be implemented to:	Yes	Appendix E	-	
respond to any exceedances of the surface water, stream health, and groundwater assessment criteria; and	Yes	Appendix E	-	

Lidsdale Siding – WMP Feb 2019

Reviewer: Wayne Jones wayne.jones@planning.nsw.gov.au

Date: 20 May 2019

mitigate and/or offset any adverse impacts on surface water and groundwater resources located within and adjacent to the site.	Partial	Appendix E addressed onsite but not adjacent groundwater impacts	Include monitoring or agreement to monitor private bores in WMP	
Statement of Commitments Air Quality	Satisfactory (Yes/No/Partial)	Comment	Action Required	
Water sprays will be located on the main stockpile to reduce particulate emissions due to wind erosion.	Yes	Figure 3.1 illustrates dust suppression on stockpiles	-	
Water sprays will be located at the coal transfer point.	No	No details of water application provided in WMP	Include details of water application to coal trains	
Statement of Commitments Surface Water, Soils and Agriculture	Satisfactory (Yes/No/Partial)	Comment	Action Required	
Erosion and sediment controls will be implemented as per Managing Urban Stormwater: soils and construction (Landcom, 2004) during construction	Partial	ERSED included in Regional WMP not WMP. Site storages in WMP developed from Landcom 2004	Include ERSED Plan	
Contaminated water will be contained on site and moved towards the containment ponds	Partial	Section 3.3.2 describes the contamination and its monitoring but no details on contamination ponds	Include contaminated water containment details	
Surface water sampling and analysis will be undertaken prior to discharge in accordance with the EPL	Yes	Section 4 and 1.2.3	-	
A site water management plan will be prepared prior to commissioning the new infrastructure.	Yes	This WMP	-	
Statement of Commitments Ground Water	Satisfactory (Yes/No/Partial)	Comment	Action Required	
Implement a groundwater management plan as part of the Construction Environmental Management Plan	Yes	Completed	-	
Apply for a water extraction licence for the construction period and adhere to any specific conditions of the licence.	Yes	Section 1.2.4 WAL 24362 obtained	-	

Lidsdale Siding – WMP Feb 2019

Reviewer: Wayne Jones wayne.jones@planning.nsw.gov.au

Date: 20 May 2019

Statement of Commitments	Satisfactory (Yes/No/Partial)	Comment	Action Required	
Contamination				
The production bore construction will be altered so groundwater is not allowed to migrate between aquifers.	No	No details provided	Include details of alterations performed to production bore	
General comments:				
• Table 1-1 Include Conditions 9c, 15, 16 and 17				•
• Statement of Commitments – Include the Contamination Commitment				•
• Section 1 – Include another section on Relationship to Other Plans, as per Angus Place and WCS WMP				•
• Section 1 – Explain why Lidsdale Siding continue to discharge to the Cox's River, if Angus Place discharge was stopped as part of the Upper Cox's River Action and Monitoring Plan.				•
• Section 1 – Where are the sites ERSED commitments documented?				•
• Table 2.1 – Who owns the adjacent registered groundwater bores and what is the groundwater used for?				•
• After Section 2.5 – include details of Groundwater baseline information – See Angus Place and WCS WMPs. E.g. which way does groundwater flow across the site?				•
• Section 3.1. Definition of coal contact water included. Why is this term not used in the rest of the WMP, only dirty water?				•
• Figure 3.1 – Include the load out point dust suppression				•
• Table 3.1 – Lowest point of CW2 appears to terminate near the centre of the site, how does it discharge offsite?				•
• Table 3.2 – Include calculations as an appendix for the volume of Dirty Water Dam and the Triangle pond.				•
• Table 3.2 - How have these dam volumes been confirmed?				•
• Figure 3.3 – Include a similar figure to illustrate the procedure when heavy rainfall occurs				•
• Section 3.3.2 - Include details of the alterations made to production bore in relation to the contamination				•
• Section 3.5.3 – How can the site discharge 21ML/day if water balance predicts 12ML/day				•
• Section 3.6 – Include more detail on the frequency of flooding				•
• Section 4.1 – Include a standard inspection form utilised on site as appendix. Who are these inspection reports provided to?				•
• Section 4.5.1 - Include the frequency of monitoring watercourse stability?				•
• Section 5.1 – Still confusing in this format. Highlight reference to Appendix C. Appendix C only includes median result. Consider including median, minimum and maximum in Appendix C to provide the reader with an idea of the range for all analytes in Appendix C. Table 6.1 provides an illustration of the presentation expected for baseline information for each point. Table C.2.1 also provides a good summary of results using 20 th and 80 percentiles.				•
• Table 5.2 – if LD004 is monitored monthly for 9 years why are there only 26-37 records?				•
• Section 5.2.1 – Include description of why no monitoring undertaken for six years after approval.				•

Lidsdale Siding – WMP Feb 2019

Reviewer: Wayne Jones wayne.jones@planning.nsw.gov.au

Date: 20 May 2019

• Section 5.2.2 – Why is 2017 diversity indices if document was prepared in 2019?	•
• Section 6.1.1 – Document upstream reference site	•
• Table 6.1 EPA to review	•
• Section 6.1.2 – EPL limits are criteria, not triggers. Triggers should prompt action before criteria is reached.	•
• Table 6.3 – ERSED in Regional WMP – condition require in in WMP.	•
• Table 6-4 – Criteria are not triggers. Triggers should prompt action before criteria is reached.	•
• Table 6-7 – Criteria for Instream riparian vegetation do not allow for natural change – e.g. impacts of drought	•
• Table 6-7 – Include statistical value to define significant change	•
• Table D-5 – EPA to review	•
• TARPS refer to exceedance of criteria which could well be non-compliances. Purpose of TARPs is to manage issues well before reaching criteria. If criteria is met or exceeded the TARP has failed. Review all TARPS to ensure trigger is well below criteria.	•
• Appendix F – How does the criteria in Table 2 interact with the groundwater table in Table 6-2? Realise Table 6.2 is trigger however table 6-6 refers to this table.	•
• Surface and Groundwater trigger levels are very different to triggers proposed in 2014 WMP. Propose EPA to review these triggers.	•

Tyler Tinkler

Subject: FW: D2019/34212 : Lidsdale Siding - Water Management Plan_January 2019 (part of Centennial Coal Western Coalfields Regional Water Management Plan)

CompleteRepository: 12510506
Description: Centennial - Lidsdale Siding WMP update - 2019
JobNo: 12510506
OperatingCentre: 222
RepoEmail: 12510506@ghd.com
RepoType: Project

From: "Peter Dupen" <Peter.Dupen@waternsw.com.au>
Date: 11 April 2019 at 3:16:51 pm AEST
To: "james.wearne@centennialcoal.com.au" <james.wearne@centennialcoal.com.au>
Cc: "Ravi Sundaram" <ravi.sundaram@waternsw.com.au>, "Girja Sharma" <Girja.Sharma@waternsw.com.au>
Subject: D2019/34212 : Lidsdale Siding - Water Management Plan_January 2019 (part of Centennial Coal Western Coalfields Regional Water Management Plan)

Hi James

WaterNSW has reviewed the Lidsdale Siding Water Management Plan, which is part of Centennial Coal's Western Coal Operations Regional Water Management Plan.

The site is within the Upper Coxs River catchment and there is a licensed discharge point into Pipers Flat Creek from the site. We consider the proposed management of clean and dirty water proposed as set out in the WMP appears sound and that adequate monitoring is proposed to assess their effectiveness.

It is noted that there are discharges into Pipers Flat Creek upstream of the site from the Wallerawang STP.

We have no other comments at this time, but are happy to discuss the above if requested.

Kind regards and thanks for the opportunity to comment,

Pete

Pete Dupen
Mining Manager

Level 14, 169 Macquarie Street
Parramatta NSW 2150
P: 9865 2509 M: 0438 729 164
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-----Original Message-----

From: Ravi Sundaram
Sent: Monday, 1 April 2019 2:50 PM
To: Peter Dupen <Peter.Dupen@waternsw.com.au>
Subject: HPE Records Manager Document : D2019/34212 : Lidsdale Siding - Water Management Plan_January 2019 (part of Centennial Coal Western Coalfields Regional Water Management Plan)

Hi Peter

I have reviewed this report and find it to be satisfactory. My comments are noted in the Notes section. The WMP will be useful to assess the site's environmental operations that is reported in the aemr for the Lidsdale Siding Project.

Regards

Ravi

-----< HPE Records Manager record Information >-----

Record Number : D2019/34212

Title : Lidsdale Siding - Water Management Plan_January 2019 (part of Centennial Coal Western Coalfields Regional Water Management Plan)

This e-mail has been scanned for viruses

Lidsdale Siding – WMP Sep 2019

Reviewer: Andrew Rode andrew.ode@planning.nsw.gov.au

Date: 21 November 2019

PA 08_0223				
Condition 9c of Schedule 3	Satisfactory (Yes/No/Partial)	Comment	Action Required	Review of Sep 2019 WMP
The Proponent shall: (c) install and operate equipment capable of applying water to the surface of coal loaded onto trains prior to leaving the site;	No	No details of water application provided in WMP	Include details of water application to coal trains	Completed – Section 3.4
SOIL AND WATER	Satisfactory (Yes/No/Partial)	Comment	Action Required	
SOIL AND WATER Note: Under the Water Act 1912 and/or the Water Management Act 2000, the Proponent is required to obtain all necessary water licences for the project	Yes	Section 1.2.4	-	
Water Supply Condition 15 Schedule 3	Satisfactory (Yes/No/Partial)	Comment	Action Required	
Water Supply The Proponent shall ensure that it has sufficient water for all stages of the project, and if necessary, adjust the scale of its operations to match its available water supply, to the satisfaction of the Director-General	Yes	Section 3.5.2	-	
Condition 16 of Schedule 3	Satisfactory (Yes/No/Partial)	Comment	Action Required	
The Proponent shall preferentially use excess mine water from the Springvale Coal Mine for dust suppression at the site rather than potable town water supply	No	No details of using water from Springvale Coal Mine	Include details on water supply from Springvale Coal Mine	Completed - Lidsdale Siding does not accept or use water from Springvale Mine.
Surface Water Discharges Condition 17 of Schedule 3	Satisfactory	Comment	Action Required	

Lidsdale Siding – WMP Sep 2019

Reviewer: Andrew Rode andrew.ode@planning.nsw.gov.au

Date: 21 November 2019

	(Yes/No/Partial)			
The Proponent shall ensure that all surface water discharges from the site comply with the discharge limits (both volume and quality) set for the project in any EPL.	Yes	Section 1.2.3	-	
Condition 21 of Schedule 3	Satisfactory (Yes/No/Partial)	Comment	Action Required	
The Proponent shall prepare and implement a Water Management Plan for the project to the satisfaction of the Director-General. This plan must be prepared in consultation with the EPA, NOW and SCA by suitably qualified and experienced persons, and be submitted to the Director-General for approval within 6 months of the date of this approval. The plan must include	Yes	Initial WMP reviewed by relevant agencies	-	
Condition 21a of Schedule 3	Satisfactory (Yes/No/Partial)	Comment	Action Required	
a Site Water Balance that includes details of:	Yes	Section 3.5	-	
• sources and security of water supply;	Yes	Sources - Section 3.1, Security 3.5.2	-	
• water use on site;	Yes	Section 3.1	-	
• water management on site; and	Yes	Section 3	-	
• any water transfers to/from the site	Partial	No details of Springvale water	Include details on water supply from Springvale Coal Mine	Completed - Lidsdale Siding does not accept or use water from Springvale Mine.
Condition 21b of Schedule 3	Satisfactory (Yes/No/Partial)	Comment	Action Required	
Surface Water Management Plan that includes:	Yes	Section 3.2.	-	
• A description of the surface water management system for the project including clean water diversions, erosion and sediment controls, and water storages;	Partial	Section 3.2 includes details of surface water management, however only refers to ERSED controls in the regional WMP.	Needs to include details of ERSED	Completed - Section 3.2.2.

Lidsdale Siding – WMP Sep 2019

Reviewer: Andrew Rode andrew.ode@planning.nsw.gov.au

Date: 21 November 2019

baseline data on surface water flows and quality of Pipers Flat Creek which receives the water from the licensed discharge point identified in the site's EPL;	Partial	Section 5.1 and Appendix C contains baseline data on Piper Flat Creek however no flow details	Include flow details for Piper Flat Creek.	Section 5.1.1 – qualitative baseline data of surface water flow in Pipers Flat Creek is insufficient. The Department recommends that Centennial attempt to source flow data from the Wallerawang Sewage Treatment Plant to use and justify as a substitute for the lack of baseline flow monitoring data.
surface water quality and stream health assessment criteria, including trigger levels for investigating any potentially adverse surface water impacts	Partial	Section 6.1 are triggers Section 6.2 are Criteria. See general notes below	Ensure trigger levels are used, not criteria.	Satisfactory response - "criteria ... including triggers levels" are required.
a surface water monitoring program for surface water discharges, surface water flows and quality, and stream health and channel stability of Pipers Flat Creek; and	Yes	Section 4	-	
measures to reuse and recycle water, and to minimise potable water use from the town water supply;	Yes	Section 3.2, 3.2.2, 3.5.2	-	
Condition 21c of Schedule 3	Satisfactory (Yes/No/Partial)	Comment	Action Required	
a Groundwater Monitoring Program that includes:	Yes	Section 4.4	-	
detailed baseline data of all groundwater levels yield and quality in the area, and any privately owned groundwater bores that may be affected by the project	Partial	Baseline data - Section 5.1 and Appendix C. No monitoring of private bores	Include monitoring or agreement to monitor private bores in WMP	Satisfactory response - Section 4.4. There is no monitoring of private bores around Lidsdale Siding.
groundwater assessment criteria based upon analysis of baseline data for groundwater, including trigger levels for investigating any potentially adverse groundwater impacts; and	Partial	Section 6.1.3 and Table 6-6 mix criteria and triggers	Ensure criteria and triggers are well defined	Satisfactory response - "criteria ... including triggers levels" are required.

Lidsdale Siding – WMP Sep 2019

Reviewer: Andrew Rode andrew.ode@planning.nsw.gov.au

Date: 21 November 2019

a program to monitor and/or validate the impacts of the project on any privately-owned groundwater bores that may be affected by the project;	No	No monitoring of private bores included in WMP	Include monitoring or agreement to monitor private bores in WMP	Satisfactory response - Section 4.4. There is no monitoring of private bores around Lidsdale Siding.
Condition 21d of Schedule 3	Satisfactory (Yes/No/Partial)	Comment	Action Required	
a Surface and Ground Water Response Plan that describes the measures and/or procedures that would be implemented to:	Yes	Appendix E	-	
respond to any exceedances of the surface water, stream health, and groundwater assessment criteria; and	Yes	Appendix E	-	
mitigate and/or offset any adverse impacts on surface water and groundwater resources located within and adjacent to the site.	Partial	Appendix E addressed onsite but not adjacent groundwater impacts	Include monitoring or agreement to monitor private bores in WMP	Satisfactory response - Section 4.4. There is no monitoring of private bores around Lidsdale Siding.
Statement of Commitments Air Quality	Satisfactory (Yes/No/Partial)	Comment	Action Required	
Water sprays will be located on the main stockpile to reduce particulate emissions due to wind erosion.	Yes	Figure 3.1 illustrates dust suppression on stockpiles	-	
Water sprays will be located at the coal transfer point.	No	No details of water application provided in WMP	Include details of water application to coal trains	Completed - Section 3.4 includes details of using on-site water sources for use in applying water to coal transfer points.
Statement of Commitments Surface Water, Soils and Agriculture	Satisfactory (Yes/No/Partial)	Comment	Action Required	
Erosion and sediment controls will be implemented as per Managing Urban Stormwater: soils and construction (Landcom, 2004) during construction	Partial	ERSED included in Regional WMP not WMP. Site storages in WMP developed from Landcom 2004	Include ERSED Plan	Completed – Section 3.2.2

Lidsdale Siding – WMP Sep 2019

Reviewer: Andrew Rode andrew.ode@planning.nsw.gov.au

Date: 21 November 2019

Contaminated water will be contained on site and moved towards the containment ponds	Partial	Section 3.3.2 describes the contamination and its monitoring but no details on contamination ponds	Include contaminated water containment details	Satisfactory response - The commitment relating to containment ponds relates to contaminated (ie sediment laden) water during construction. This commitment was completed during construction and is no longer relevant.
Surface water sampling and analysis will be undertaken prior to discharge in accordance with the EPL	Yes	Section 4 and 1.2.3	-	
A site water management plan will be prepared prior to commissioning the new infrastructure.	Yes	This WMP	-	
Statement of Commitments Ground Water	Satisfactory (Yes/No/Partial)	Comment	Action Required	
Implement a groundwater management plan as part of the Construction Environmental Management Plan	Yes	Completed	-	
Apply for a water extraction licence for the construction period and adhere to any specific conditions of the licence.	Yes	Section 1.2.4 WAL 24362 obtained	-	
Statement of Commitments Contamination	Satisfactory (Yes/No/Partial)	Comment	Action Required	
The production bore construction will be altered so groundwater is not allowed to migrate between aquifers.	No	No details provided	Include details of alterations performed to production bore	Completed – Section 3.3.1
General comments:				
• Table 1-1 Include Conditions 9c, 15, 16 and 17			Added to Table 1-1.	

Lidsdale Siding – WMP Sep 2019

Reviewer: Andrew Rode andrew.ode@planning.nsw.gov.au

Date: 21 November 2019

Statement of Commitments – Include the Contamination Commitment	Added to Table 1-2.
Section 1 – Include another section on Relationship to Other Plans, as per Angus Place and WCS WMP	Section 1.4
Section 1 – Explain why Lidsdale Siding continue to discharge to the Cox's River, if Angus Place discharge was stopped as part of the Upper Cox's River Action and Monitoring Plan.	UCRAMP not approved and not binding. Discharges from Lidsdale Siding occur as a result of surface runoff due to rainfall.
Section 1 – Where are the sites ERSED commitments documented?	Section 3.2.
Table 2.1 – Who owns the adjacent registered groundwater bores and what is the groundwater used for?	Section 2.4.2. Ownership information is not publicly available.
After Section 2.5 – include details of Groundwater baseline information – See Angus Place and WCS WMPs. E.g. which way does groundwater flow across the site?	Section 2.4.1
Section 3.1. Definition of coal contact water included. Why is this term not used in the rest of the WMP, only dirty water?	Section 3.1
Figure 3.1 – Include the load out point dust suppression	Figure 3-1 includes a point for dust suppression.
Table 3.1 – Lowest point of CW2 appears to terminate near the centre of the site, how does it discharge offsite?	Table 3-1 defines the discharge of CW2 is to the facilities area within Lidsdale Siding, not offsite. CW2 diverts water away from the coal stockpile area but local topography prevents diversion around the entire site.
Table 3.2 – Include calculations as an appendix for the volume of Dirty Water Dam and the Triangle pond.	Appendix G
Table 3.2 - How have these dam volumes been confirmed?	Survey of storages was undertaken in August 2016.
Figure 3.3 – Include a similar figure to illustrate the procedure when heavy rainfall occurs	Figure 3-3 is for all rainfall events on-site
Section 3.3.2 - Include details of the alterations made to production bore in relation to the contamination	Section 3.3.1
Section 3.5.3 – How can the site discharge 21ML/day if water balance predicts 12ML/day	Average annual discharge through LDP004 at 12 ML/year which is not comparable to the predicted maximum daily discharge of 21 ML/day
Section 3.6 – Include more detail on the frequency of flooding	Section 3.7
Section 4.1 – Include a standard inspection form utilised on site as appendix. Who are these inspection reports provided to?	Appendix H
Section 4.5.1 - Include the frequency of monitoring watercourse stability?	Section 4.5.1 states that visual monitoring of Pipers Flat Creek is carried out periodically by site personnel to identify any instabilities that may form as a result of operations at Lidsdale Siding.

Lidsdale Siding – WMP Sep 2019

Reviewer: Andrew Rode andrew.ode@planning.nsw.gov.au

Date: 21 November 2019

	Due to the low frequency and volume of discharge from LDP004, it is unlikely that watercourse stability downstream of the site is affected by site discharges. The distance between the LDP004 discharge point on Pipers Flat Creek and the confluence to the Cocks River is minimal, therefore impacts on watercourse stability on Pipers Flat Creek is likely negligible.
Section 5.1 – Still confusing in this format. Highlight reference to Appendix C. Appendix C only includes median result. Consider including median, minimum and maximum in Appendix C to provide the reader with an idea of the range for all analytes in Appendix C. Table 6.1 provides an illustration of the presentation expected for baseline information for each point. Table C.2.1 also provides a good summary of results using 20th and 80 percentiles.	Appendix C
Table 5.2 – if LDP004 is monitored monthly for 9 years why are there only 26-37 records?	LDP004 is only monitored during discharge events.
Section 5.2.1 – Include description of why no monitoring undertaken for six years after approval.	Due to the low frequency and volume of discharge from LDP004, it is unlikely that watercourse stability downstream of the site is affected by site discharges.
Section 5.2.2 – Why is 2017 diversity indices if document was prepared in 2019?	2018 diversity indices have now been applied to Section 5.4.2.
Section 6.1.1 – Document upstream reference site	Section 6.1.1.
Table 6.1 EPA to review	Noted.
Section 6.1.2 – EPL limits are criteria, not triggers. Triggers should prompt action before criteria is reached.	Water quality concentration limits specified in the EPL are appropriate trigger levels for surface water
Table 6.3 – ERSED in Regional WMP – condition require in in WMP.	Section 3.2.2
Table 6-4 – Criteria are not triggers. Triggers should prompt action before criteria is reached.	"criteria ... including triggers levels" are required.
Table 6-7 – Criteria for Instream riparian vegetation do not allow for natural change – e.g. impacts of drought	Criteria updated to clarify that vegetation type and density within the range observed during previous monitoring rounds.
Table 6-7 – Include statistical value to define significant change	The typical sample size for aquatic ecology monitoring does not allow for a robust statistical analysis. Performance criteria have been updated consistent with the Western Coal Services Water Management Plan.
Table D-5 – EPA to review	Noted.
TARPS refer to exceedance of criteria which could well be non-compliances. Purpose of TARPs is to manage issues well before reaching criteria. If criteria is met or exceeded the TARP has failed. Review all TARPS to ensure trigger is well below criteria.	It is unclear in what respect non-compliances are referred to. The relevant consent conditions for Lidsdale Siding do not make a dichotomous distinction between criteria and

Lidsdale Siding – WMP Sep 2019

Reviewer: Andrew Rode andrew.ode@planning.nsw.gov.au

Date: 21 November 2019

	triggers. Rather “criteria ... including triggers levels” are required. Trigger levels are generally understood to be quantitative aspect of the performance criteria.
Appendix F – How does the criteria in Table 2 interact with the groundwater table in Table 6-2? Realise Table 6.2 is trigger however table 6-6 refers to this table.	The groundwater environment TARP refers to triggers included in Table 6.2. Table 6.6 identifies the triggers as part of the performance criteria.
Surface and Groundwater trigger levels are very different to triggers proposed in 2014 WMP. Propose EPA to review these triggers.	Noted. This WMP has been provided to EPA as part of consultation.
Table 4-1 - the Department recommends that surface water quality monitoring at the Pipers Flat Creek U/S and D/S locations is undertaken during discharge events at LDP004 (as well as quarterly).	
Table 4-2- Clarify and justify the ‘monthly during discharge’ frequency of discharge water quality monitoring at LDP004.	
Section 1.3 - reference is made to the ‘Mandalong Mine’, which appears to be incorrect.	

Lidsdale Siding – WMP Sep 2019

Reviewer: Andrew Rode andrew.ode@planning.nsw.gov.au

Date: 21 November 2019

PA 08_0223				
Condition 9c of Schedule 3	Satisfactory (Yes/No/Partial)	Comment	Action Required	Review of Sep 2019 WMP
The Proponent shall: (c) install and operate equipment capable of applying water to the surface of coal loaded onto trains prior to leaving the site;	No	No details of water application provided in WMP	Include details of water application to coal trains	Completed – Section 3.4
SOIL AND WATER	Satisfactory (Yes/No/Partial)	Comment	Action Required	
SOIL AND WATER Note: Under the Water Act 1912 and/or the Water Management Act 2000, the Proponent is required to obtain all necessary water licences for the project	Yes	Section 1.2.4	-	
Water Supply Condition 15 Schedule 3	Satisfactory (Yes/No/Partial)	Comment	Action Required	
Water Supply The Proponent shall ensure that it has sufficient water for all stages of the project, and if necessary, adjust the scale of its operations to match its available water supply, to the satisfaction of the Director-General	Yes	Section 3.5.2	-	
Condition 16 of Schedule 3	Satisfactory (Yes/No/Partial)	Comment	Action Required	
The Proponent shall preferentially use excess mine water from the Springvale Coal Mine for dust suppression at the site rather than potable town water supply	No	No details of using water from Springvale Coal Mine	Include details on water supply from Springvale Coal Mine	Completed - Lidsdale Siding does not accept or use water from Springvale Mine.
Surface Water Discharges Condition 17 of Schedule 3	Satisfactory	Comment	Action Required	

Lidsdale Siding – WMP Sep 2019

Reviewer: Andrew Rode andrew.ode@planning.nsw.gov.au

Date: 21 November 2019

	(Yes/No/Partial)			
The Proponent shall ensure that all surface water discharges from the site comply with the discharge limits (both volume and quality) set for the project in any EPL.	Yes	Section 1.2.3	-	
Condition 21 of Schedule 3	Satisfactory (Yes/No/Partial)	Comment	Action Required	
The Proponent shall prepare and implement a Water Management Plan for the project to the satisfaction of the Director-General. This plan must be prepared in consultation with the EPA, NOW and SCA by suitably qualified and experienced persons, and be submitted to the Director-General for approval within 6 months of the date of this approval. The plan must include	Yes	Initial WMP reviewed by relevant agencies	-	
Condition 21a of Schedule 3	Satisfactory (Yes/No/Partial)	Comment	Action Required	
a Site Water Balance that includes details of:	Yes	Section 3.5	-	
• sources and security of water supply;	Yes	Sources - Section 3.1, Security 3.5.2	-	
• water use on site;	Yes	Section 3.1	-	
• water management on site; and	Yes	Section 3	-	
• any water transfers to/from the site	Partial	No details of Springvale water	Include details on water supply from Springvale Coal Mine	Completed - Lidsdale Siding does not accept or use water from Springvale Mine.
Condition 21b of Schedule 3	Satisfactory (Yes/No/Partial)	Comment	Action Required	
Surface Water Management Plan that includes:	Yes	Section 3.2.	-	
• A description of the surface water management system for the project including clean water diversions, erosion and sediment controls, and water storages;	Partial	Section 3.2 includes details of surface water management, however only refers to ERSED controls in the regional WMP.	Needs to include details of ERSED	Completed - Section 3.2.2.

Lidsdale Siding – WMP Sep 2019

Reviewer: Andrew Rode andrew.ode@planning.nsw.gov.au

Date: 21 November 2019

baseline data on surface water flows and quality of Pipers Flat Creek which receives the water from the licensed discharge point identified in the site's EPL;	Partial	Section 5.1 and Appendix C contains baseline data on Piper Flat Creek however no flow details	Include flow details for Piper Flat Creek.	Section 5.1.1 – qualitative baseline data of surface water flow in Pipers Flat Creek is insufficient. The Department recommends that Centennial attempt to source flow data from the Wallerawang Sewage Treatment Plant to use and justify as a substitute for the lack of baseline flow monitoring data.
surface water quality and stream health assessment criteria, including trigger levels for investigating any potentially adverse surface water impacts	Partial	Section 6.1 are triggers Section 6.2 are Criteria. See general notes below	Ensure trigger levels are used, not criteria.	Satisfactory response - "criteria ... including triggers levels" are required.
a surface water monitoring program for surface water discharges, surface water flows and quality, and stream health and channel stability of Pipers Flat Creek; and	Yes	Section 4	-	
measures to reuse and recycle water, and to minimise potable water use from the town water supply;	Yes	Section 3.2, 3.2.2, 3.5.2	-	
Condition 21c of Schedule 3	Satisfactory (Yes/No/Partial)	Comment	Action Required	
a Groundwater Monitoring Program that includes:	Yes	Section 4.4	-	
detailed baseline data of all groundwater levels yield and quality in the area, and any privately owned groundwater bores that may be affected by the project	Partial	Baseline data - Section 5.1 and Appendix C. No monitoring of private bores	Include monitoring or agreement to monitor private bores in WMP	Satisfactory response - Section 4.4. There is no monitoring of private bores around Lidsdale Siding.
groundwater assessment criteria based upon analysis of baseline data for groundwater, including trigger levels for investigating any potentially adverse groundwater impacts; and	Partial	Section 6.1.3 and Table 6-6 mix criteria and triggers	Ensure criteria and triggers are well defined	Satisfactory response - "criteria ... including triggers levels" are required.

Lidsdale Siding – WMP Sep 2019

Reviewer: Andrew Rode andrew.ode@planning.nsw.gov.au

Date: 21 November 2019

a program to monitor and/or validate the impacts of the project on any privately-owned groundwater bores that may be affected by the project;	No	No monitoring of private bores included in WMP	Include monitoring or agreement to monitor private bores in WMP	Satisfactory response - Section 4.4. There is no monitoring of private bores around Lidsdale Siding.
Condition 21d of Schedule 3	Satisfactory (Yes/No/Partial)	Comment	Action Required	
a Surface and Ground Water Response Plan that describes the measures and/or procedures that would be implemented to:	Yes	Appendix E	-	
respond to any exceedances of the surface water, stream health, and groundwater assessment criteria; and	Yes	Appendix E	-	
mitigate and/or offset any adverse impacts on surface water and groundwater resources located within and adjacent to the site.	Partial	Appendix E addressed onsite but not adjacent groundwater impacts	Include monitoring or agreement to monitor private bores in WMP	Satisfactory response - Section 4.4. There is no monitoring of private bores around Lidsdale Siding.
Statement of Commitments Air Quality	Satisfactory (Yes/No/Partial)	Comment	Action Required	
Water sprays will be located on the main stockpile to reduce particulate emissions due to wind erosion.	Yes	Figure 3.1 illustrates dust suppression on stockpiles	-	
Water sprays will be located at the coal transfer point.	No	No details of water application provided in WMP	Include details of water application to coal trains	Completed - Section 3.4 includes details of using on-site water sources for use in applying water to coal transfer points.
Statement of Commitments Surface Water, Soils and Agriculture	Satisfactory (Yes/No/Partial)	Comment	Action Required	
Erosion and sediment controls will be implemented as per Managing Urban Stormwater: soils and construction (Landcom, 2004) during construction	Partial	ERSED included in Regional WMP not WMP. Site storages in WMP developed from Landcom 2004	Include ERSED Plan	Completed – Section 3.2.2

Lidsdale Siding – WMP Sep 2019

Reviewer: Andrew Rode andrew.ode@planning.nsw.gov.au

Date: 21 November 2019

Contaminated water will be contained on site and moved towards the containment ponds	Partial	Section 3.3.2 describes the contamination and its monitoring but no details on contamination ponds	Include contaminated water containment details	Satisfactory response - The commitment relating to containment ponds relates to contaminated (ie sediment laden) water during construction. This commitment was completed during construction and is no longer relevant.
Surface water sampling and analysis will be undertaken prior to discharge in accordance with the EPL	Yes	Section 4 and 1.2.3	-	
A site water management plan will be prepared prior to commissioning the new infrastructure.	Yes	This WMP	-	
Statement of Commitments Ground Water	Satisfactory (Yes/No/Partial)	Comment	Action Required	
Implement a groundwater management plan as part of the Construction Environmental Management Plan	Yes	Completed	-	
Apply for a water extraction licence for the construction period and adhere to any specific conditions of the licence.	Yes	Section 1.2.4 WAL 24362 obtained	-	
Statement of Commitments Contamination	Satisfactory (Yes/No/Partial)	Comment	Action Required	
The production bore construction will be altered so groundwater is not allowed to migrate between aquifers.	No	No details provided	Include details of alterations performed to production bore	Completed – Section 3.3.1
General comments:				
• Table 1-1 Include Conditions 9c, 15, 16 and 17			Added to Table 1-1.	

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Statement of Commitments – Include the Contamination Commitment	Added to Table 1-2.
Section 1 – Include another section on Relationship to Other Plans, as per Angus Place and WCS WMP	Section 1.4
Section 1 – Explain why Lidsdale Siding continue to discharge to the Cox's River, if Angus Place discharge was stopped as part of the Upper Cox's River Action and Monitoring Plan.	UCRAMP not approved and not binding. Discharges from Lidsdale Siding occur as a result of surface runoff due to rainfall.
Section 1 – Where are the sites ERSED commitments documented?	Section 3.2.
Table 2.1 – Who owns the adjacent registered groundwater bores and what is the groundwater used for?	Section 2.4.2. Ownership information is not publicly available.
After Section 2.5 – include details of Groundwater baseline information – See Angus Place and WCS WMPs. E.g. which way does groundwater flow across the site?	Section 2.4.1
Section 3.1. Definition of coal contact water included. Why is this term not used in the rest of the WMP, only dirty water?	Section 3.1
Figure 3.1 – Include the load out point dust suppression	Figure 3-1 includes a point for dust suppression.
Table 3.1 – Lowest point of CW2 appears to terminate near the centre of the site, how does it discharge offsite?	Table 3-1 defines the discharge of CW2 is to the facilities area within Lidsdale Siding, not offsite. CW2 diverts water away from the coal stockpile area but local topography prevents diversion around the entire site.
Table 3.2 – Include calculations as an appendix for the volume of Dirty Water Dam and the Triangle pond.	Appendix G
Table 3.2 - How have these dam volumes been confirmed?	Survey of storages was undertaken in August 2016.
Figure 3.3 – Include a similar figure to illustrate the procedure when heavy rainfall occurs	Figure 3-3 is for all rainfall events on-site
Section 3.3.2 - Include details of the alterations made to production bore in relation to the contamination	Section 3.3.1
Section 3.5.3 – How can the site discharge 21ML/day if water balance predicts 12ML/day	Average annual discharge through LDP004 at 12 ML/year which is not comparable to the predicted maximum daily discharge of 21 ML/day
Section 3.6 – Include more detail on the frequency of flooding	Section 3.7
Section 4.1 – Include a standard inspection form utilised on site as appendix. Who are these inspection reports provided to?	Appendix H
Section 4.5.1 - Include the frequency of monitoring watercourse stability?	Section 4.5.1 states that visual monitoring of Pipers Flat Creek is carried out periodically by site personnel to identify any instabilities that may form as a result of operations at Lidsdale Siding.

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	Due to the low frequency and volume of discharge from LDP004, it is unlikely that watercourse stability downstream of the site is affected by site discharges. The distance between the LDP004 discharge point on Pipers Flat Creek and the confluence to the Cocks River is minimal, therefore impacts on watercourse stability on Pipers Flat Creek is likely negligible.
Section 5.1 – Still confusing in this format. Highlight reference to Appendix C. Appendix C only includes median result. Consider including median, minimum and maximum in Appendix C to provide the reader with an idea of the range for all analytes in Appendix C. Table 6.1 provides an illustration of the presentation expected for baseline information for each point. Table C.2.1 also provides a good summary of results using 20th and 80 percentiles.	Appendix C
Table 5.2 – if LDP004 is monitored monthly for 9 years why are there only 26-37 records?	LDP004 is only monitored during discharge events.
Section 5.2.1 – Include description of why no monitoring undertaken for six years after approval.	Due to the low frequency and volume of discharge from LDP004, it is unlikely that watercourse stability downstream of the site is affected by site discharges.
Section 5.2.2 – Why is 2017 diversity indices if document was prepared in 2019?	2018 diversity indices have now been applied to Section 5.4.2.
Section 6.1.1 – Document upstream reference site	Section 6.1.1.
Table 6.1 EPA to review	Noted.
Section 6.1.2 – EPL limits are criteria, not triggers. Triggers should prompt action before criteria is reached.	Water quality concentration limits specified in the EPL are appropriate trigger levels for surface water
Table 6.3 – ERSED in Regional WMP – condition require in in WMP.	Section 3.2.2
Table 6-4 – Criteria are not triggers. Triggers should prompt action before criteria is reached.	"criteria ... including triggers levels" are required.
Table 6-7 – Criteria for Instream riparian vegetation do not allow for natural change – e.g. impacts of drought	Criteria updated to clarify that vegetation type and density within the range observed during previous monitoring rounds.
Table 6-7 – Include statistical value to define significant change	The typical sample size for aquatic ecology monitoring does not allow for a robust statistical analysis. Performance criteria have been updated consistent with the Western Coal Services Water Management Plan.
Table D-5 – EPA to review	Noted.
TARPS refer to exceedance of criteria which could well be non-compliances. Purpose of TARPs is to manage issues well before reaching criteria. If criteria is met or exceeded the TARP has failed. Review all TARPS to ensure trigger is well below criteria.	It is unclear in what respect non-compliances are referred to. The relevant consent conditions for Lidsdale Siding do not make a dichotomous distinction between criteria and

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	triggers. Rather “criteria ... including triggers levels” are required. Trigger levels are generally understood to be quantitative aspect of the performance criteria.
Appendix F – How does the criteria in Table 2 interact with the groundwater table in Table 6-2? Realise Table 6.2 is trigger however table 6-6 refers to this table.	The groundwater environment TARP refers to triggers included in Table 6.2. Table 6.6 identifies the triggers as part of the performance criteria.
Surface and Groundwater trigger levels are very different to triggers proposed in 2014 WMP. Propose EPA to review these triggers.	Noted. This WMP has been provided to EPA as part of consultation.
Table 4-1 - the Department recommends that surface water quality monitoring at the Pipers Flat Creek U/S and D/S locations is undertaken during discharge events at LDP004 (as well as quarterly).	
Table 4-2- Clarify and justify the ‘monthly during discharge’ frequency of discharge water quality monitoring at LDP004.	
Section 1.3 - reference is made to the ‘Mandalong Mine’, which appears to be incorrect.	

APPENDIX B – Consultation outcomes

Comment	Response
Department of Planning, Industry & Environment– Water (20 May 2019)	
No details of water application provided in WMP. Include details of water application to coal trains.	Section 3.4 updated to include details of using on-site water sources for use in applying water to coal loaded trains wagons.
No details of using water from Springvale Coal mine is provided in the WMP. Include details on water supply from Springvale Coal Mine.	Lidsdale Siding does not currently use water from Springvale Mine. The combination of on-site water storages and recycled water usage in the Fire and Service Water tank are sufficient for operational water supply. Section 3.6.2 details the preferential water use system for the site.
The Site Water Balance does not include details of water transfers to and/or from Springvale Mine. Include details on water supply from Springvale Coal Mine in the Site Water Balance.	Lidsdale Siding does not currently use water from Springvale Mine. The site water balance results include an external make-up water supply that could be supplied from Springvale Mine. However these results are based on the assumption of Lidsdale Siding operating at is full approved throughput. In reality, actual throughput is lower than the approved limit and therefore site water demands are supplied without need for external make-up water supply.
Section 3.2 includes details of surface water management, however only refers to erosion and sediment controls in the regional WMP. Include details of erosion and sediment control details in the Lidsdale Siding WMP.	The WMP includes details of the permanent dirty water management system at Lidsdale Siding in Section 3.2.3. Design parameters and typical details for any erosion and sediment control plans required for construction activities are included in Appendix J.
Section 5.1 and Appendix C contains baseline data on Piper Flat Creek however no flow details have been provided. Include flow details for Pipers Flat Creek.	Qualitative baseline data for flow in Pipers Flat Creek is included in Section 5.1.1.
Section 6.1 are triggers Section 6.2 are Criteria. Section 6.1.2 – EPL limits are criteria, not triggers. Triggers should prompt action before criteria is reached. Ensure trigger levels are used, not criteria.	The relevant consent conditions for Lidsdale Siding do not make a dichotomous distinction between criteria and triggers. Rather “criteria ... including triggers levels” are required. Water quality concentration limits specified in the EPL are appropriate trigger levels for surface water in on-site water storages prior to discharge, or during discharge as a result of rainfall such that the water quality concentration limits do not apply.

Comment	Response
Baseline data is provided in Section 5.1 and Appendix C. No monitoring of private bores is provided. Include the monitoring or agreement to monitor private bores in the WMP.	Refer to Section 4.4. There is no monitoring of private bores around Lidsdale Siding. There are no operational private bores in the vicinity of Lidsdale Siding (refer to Section 2.4.2).
Section 6.1.3 and Table 6-6 mix criteria and triggers for groundwater assessment. Ensure criteria and triggers are well defined.	The relevant consent conditions for Lidsdale Siding do not make a dichotomous distinction between criteria and triggers. Rather “criteria ... including triggers levels” are required.
No details of monitoring of private bores is included in WMP. Include monitoring or agreement to monitor private bores in WMP.	Refer to Section 4.4. There is no monitoring of private bores around Lidsdale Siding. There is no monitoring of private bores around Lidsdale Siding. There are no operational private bores in the vicinity of Lidsdale Siding (refer to Section 2.4.2). In the event that Lidsdale Siding were aware of a nearby operational private bore and groundwater was required to be extracted from PB02, Centennial would investigate monitoring nearby operational private bores.
The Surface and Ground Water Response Plan is included in Appendix E which addresses onsite, but not adjacent groundwater impacts. Include monitoring or agreement to monitor private bores in the WMP.	Refer to Section 4.4. There is no monitoring of private bores around Lidsdale Siding. There are no operational private bores in the vicinity of Lidsdale Siding (refer to Section 2.4.2). In the event that Lidsdale Siding were aware of a nearby operational private bore and groundwater was required to be extracted from PB02, Centennial would investigate monitoring nearby operational private bores.
No details of water sprays at the coal transfer point have been provided in the WMP. Include details of water application to coal trains.	Section 3.4 includes details of using on-site water sources for use in applying water to coal transfer points.
Erosion and sediment controls are included in the Regional WMP but not the Lidsdale Siding WMP. Include erosion and sediment control plan in the Lidsdale Siding WMP.	The WMP includes details of the permanent dirty water management system at Lidsdale Siding in Section 3.2.3. Design parameters and typical details for any erosion and sediment control plans required for construction activities are included in Appendix J.
Section 3.3.2 describes the contamination and its monitoring but no details are provided on containment ponds. Include details on contaminated water containment ponds.	Containment ponds are not required as part of the ongoing management of groundwater contaminated by hydrocarbons. The commitment relating to containment ponds relates to contaminated (ie sediment laden) water during construction. This commitment was completed during construction and is no longer relevant.

Comment	Response
No details have been provided on the construction alteration to the production bore. Include details of alterations performed to production bore.	The process of the construction alteration to the production bore has been included in Section 3.3.1. An original production bore PB01 was decommissioned and replaced by a second production bore PB02 circa 2014. PB02 is currently not utilised. No drawdown of groundwater has been required for several years. PB02 is currently tagged out of service as on-site storage surface water is preferentially sourced for operations.
Table 1-1 Include Conditions 9c, 15, 16 and 17.	Conditions 9c, 15, 16 and 17 have been added to Table 1-1.
Statement of Commitments – Include the Contamination Commitment.	The ‘Contamination Commitment’ on production bore construction has been added to Table 1-2.
Section 1 – Include another section on Relationship to Other Plans, as per Angus Place and WCS WMP.	Section 1.4 added to include the relationship with other plans.
Section 1 – Explain why Lidsdale Siding continue to discharge to the Cox’s River, if Angus Place discharge was stopped as part of the Upper Cox’s River Action and Monitoring Plan.	No approval of the UCRAMP has been provided by the DPIE to date, and none of the actions provided in the UCRAMP are binding. Discharges from Lidsdale Siding occur as a result of surface runoff due to rainfall.
Section 1 – Where are the sites ERSED commitments documented?	The WMP includes details of the permanent dirty water management system at Lidsdale Siding in Section 3.2.3. Design parameters and typical details for any erosion and sediment control plans required for construction activities are included in Appendix J.
Table 2.1 – Who owns the adjacent registered groundwater bores and what is the groundwater used for?	The authorised purpose (use) of the identified registered bores is provided in Section 2.4.2. Ownership information is not publically available. Bores are not operational.
After Section 2.5 – include details of Groundwater baseline information – See Angus Place and WCS WMPs. E.g. which way does groundwater flow across the site?	Section 2.4.1 provides an overview of the groundwater hydrogeology at Lidsdale Siding, including flow direction.
Section 3.1. Definition of coal contact water included. Why is this term not used in the rest of the WMP, only dirty water?	Refer to Section 3.1 which identifies both sediment laden water and coal-contact water as ‘dirty water’ as both water types are managed within the dirty water system.
Figure 3.1 – Include the load out point dust suppression	The schematic as Figure 3-1 includes a point for dust suppression. This is inclusive of stockpile, coal transfer points and coal loaded trains water suppression systems.

Comment	Response
Table 3.1 – Lowest point of CW2 appears to terminate near the centre of the site, how does it discharge offsite?	Table 3-1 defines the discharge of CW2 is to the facilities area within Lidsdale Siding, not offsite. CW2 diverts water away from the coal stockpile area but local topography prevents diversion around the entire site.
Table 3.2 – Include calculations as an appendix for the volume of Dirty Water Dam and the Triangle pond.	Included in Appendix G.
Table 3.2 - How have these dam volumes been confirmed?	Survey of storages was undertaken in August 2016. Refer to Appendix G.
Figure 3.3 – Include a similar figure to illustrate the procedure when heavy rainfall occurs	The procedure illustrated in Figure 3-3 is for all rainfall events on-site, including heavy rainfall events.
Section 3.3.2 - Include details of the alterations made to production bore in relation to the contamination	Refer to Section 3.3.1 detailing the decommissioning, sealing and relocation of the production bore in relation to the contamination findings.
Section 3.5.3 – How can the site discharge 21ML/day if water balance predicts 12ML/day	The water balance predicts the average annual discharge through LDP004 at 12 ML/year which is not comparable to the predicted maximum daily discharge of 21 ML/day. Discharges through LDP004 typically only occur during heavy rainfall events.
Section 3.6 – Include more detail on the frequency of flooding	The predicted frequency and extent of flooding at Lidsdale Siding has been included in Section 3.7. The Flood Management Plan (GHD 2016b) was provided to the NSW Department of Planning and Environment (DPIE) on 14 October 2016.
Section 4.1 – Include a standard inspection form utilised on site as appendix. Who are these inspection reports provided to?	A copy of the Lidsdale Siding inspection checklist has been included as Appendix H. The Environment and Community Coordinator is responsible for the inspection reports.

Comment	Response
Section 4.5.1 - Include the frequency of monitoring watercourse stability?	Section 4.5.1 states that visual monitoring of Pipers Flat Creek is carried out periodically by site personnel to identify any instabilities that may form as a result of operations at Lidsdale Siding. Due to the low frequency and volume of discharge from LDP004, it is unlikely that watercourse stability downstream of the site is affected by site discharges. The distance between the LDP004 discharge point on Pipers Flat Creek and the confluence to the Coxs River is minimal, therefore impacts on watercourse stability on Pipers Flat Creek is likely negligible.
Section 5.1 – Still confusing in this format. Highlight reference to Appendix C. Appendix C only includes median result. Consider including median, minimum and maximum in Appendix C to provide the reader with an idea of the range for all analytes in Appendix C. Table 6.1 provides an illustration of the presentation expected for baseline information for each point. Table C.2.1 also provides a good summary of results using 20th and 80 percentiles.	Appendix C includes all baseline data in time series plot that shown the both the range and temporal variation. Minimum and maximum values are generally not appropriate indicators as they may be affected by outliers.
Table 5.2 – if LDP004 is monitored monthly for 9 years why are there only 26-37 records?	LDP004 is only monitored during discharge events. As discharge from the site only occurs during heavy rainfall events, there are limited number of discharge events, hence only 26-37 records.
Section 5.2.1 – Include description of why no monitoring undertaken for six years after approval.	Due to the low frequency and volume of discharge from LDP004, it is unlikely that watercourse stability downstream of the site is affected by site discharges. The distance between the LDP004 discharge point on Pipers Flat Creek and the confluence to the Coxs River is minimal, therefore impacts on watercourse stability on Pipers Flat Creek is likely negligible.
Section 5.2.2 – Why is 2017 diversity indices if document was prepared in 2019?	The Upper Coxs River Aquatic Ecology Annual Report is typically finalised in quarter 2 of the year following the reporting year. 2017 diversity indices were current at the time of submission. 2018 diversity indices have now been applied to Section 5.4.2.
Section 6.1.1 – Document upstream reference site	Pipers Flat Creek U/S monitoring site has been documented in Section 6.1.1.

Comment	Response
Table 6.1 EPA to review	Noted. No response required.
Section 6.1.2 – EPL limits are criteria, not triggers. Triggers should prompt action before criteria is reached.	Water quality concentration limits specified in the EPL are appropriate trigger levels for surface water in on-site water storages prior to discharge, or during discharge as a result of rainfall exceeding the design criteria (such that the water quality concentration limits do not apply).
Table 6.3 – ERSED in Regional WMP – condition require in in WMP.	The WMP includes details of the permanent dirty water management system at Lidsdale Siding in Section 3.2.3. Design parameters and typical details for any erosion and sediment control plans required for construction activities are included in Appendix J.
Table 6-4 – Criteria are not triggers. Triggers should prompt action before criteria is reached.	The relevant consent conditions for Lidsdale Siding do not make a dichotomous distinction between criteria and triggers. Rather “criteria ... including triggers levels” are required. Trigger levels are generally understood to be quantitative aspect of the performance criteria.
Table 6-7 – Criteria for Instream riparian vegetation do not allow for natural change – e.g. impacts of drought	Criteria updated to clarify that vegetation type and density within the range observed during previous monitoring rounds.
Table 6-7 – Include statistical value to define significant change	The typical sample size for aquatic ecology monitoring does not allow for a robust statistical analysis. Performance criteria have been updated consistent with the Western Coal Services Water Management Plan.
Table D-5 – EPA to review	Noted. No response required.
TARPS refer to exceedance of criteria which could well be non-compliances. Purpose of TARPs is to manage issues well before reaching criteria. If criteria is met or exceeded the TARP has failed. Review all TARPS to ensure trigger is well below criteria.	It is unclear in what respect non-compliances are referred to. The relevant consent conditions for Lidsdale Siding do not make a dichotomous distinction between criteria and triggers. Rather “criteria ... including triggers levels” are required. Trigger levels are generally understood to be quantitative aspect of the performance criteria.
Appendix F – How does the criteria in Table 2 interact with the groundwater table in Table 6-2? Realise Table 6.2 is trigger however table 6-6 refers to this table.	It is unclear what Table 2 referred to. The groundwater environment TARPs refer to triggers included in Table 6.2. Table 6.6 identifies the triggers as part of the performance criteria.

Comment	Response
Surface and Groundwater trigger levels are very different to triggers proposed in 2014 WMP. Propose EPA to review these triggers.	Noted. No response required. This WMP has been provided to EPA as part of consultation.
Department of Planning, Industry & Environment– Water (21 November 2019)	
Section 5.1.1 – qualitative baseline data of surface water flow in Pipers Flat Creek is insufficient. The Department recommends that Centennial attempt to source flow data from the Wallerawang Sewage Treatment Plant to use and justify as a substitute for the lack of baseline flow monitoring data.	Discharge data from WSTP has been sourced and used as a substitute for Pipers Flat Creek flow monitoring. Section 5.1.1 provides a summary of WSTP discharges from March 2014.
Table 4-1 - the Department recommends that surface water quality monitoring at the Pipers Flat Creek U/S and D/S locations is undertaken during discharge events at LDP004 (as well as quarterly).	Table 4-1 has been updated so that surface water quality monitoring is undertaken during discharge from LDP004 at Pipers Flat Creek U/S and D/S locations. Monitoring during heavy rainfall events or high flow conditions in Pipers Flat Creek may be unsafe or impractical. Monitoring will be undertaken as soon as safe and practical during or following discharge events. As discharges at Lidsdale Siding are brief occurrences solely as a result of rainfall, in practice sampling will occur once on each occasion of discharge.
Table 4-2- Clarify and justify the ‘monthly during discharge’ frequency of discharge water quality monitoring at LDP004.	‘Monthly during discharge’ is the sampling frequency required by Condition M2.3 of EPL 5129. In practice, as discharge events are generally brief due to rainfall, this means that one sample is collected on each occasion of discharge.
Section 1.3 - reference is made to the ‘Mandalong Mine’, which appears to be incorrect.	The text has been amended in Section 1.3 to refer to the correct Centennial Mine Operation Site of ‘Lidsdale Siding’ and not ‘Mandalong Mine’.

Comment	Response
WaterNSW – Email dated 11 April 2019	
WaterNSW has reviewed the Lidsdale Siding Water Management Plan, which is part of Centennial Coal's Western Coal Operations Regional Water Management Plan. The site is within the Upper Cocks River catchment and there is a licensed discharge point into Pipers Flat Creek from the site. We consider the proposed management of clean and dirty water proposed as set out in the WMP appears sound and that adequate monitoring is proposed to assess their effectiveness. It is noted that there are discharges into Pipers Flat Creek upstream of the site from the Wallerawang STP. We have no other comments at this time, but are happy to discuss the above if requested.	Noted. No response required.

APPENDIX C – Baseline data

C.1 Surface water monitoring**C.1.1 Statistical summary of water quality results**

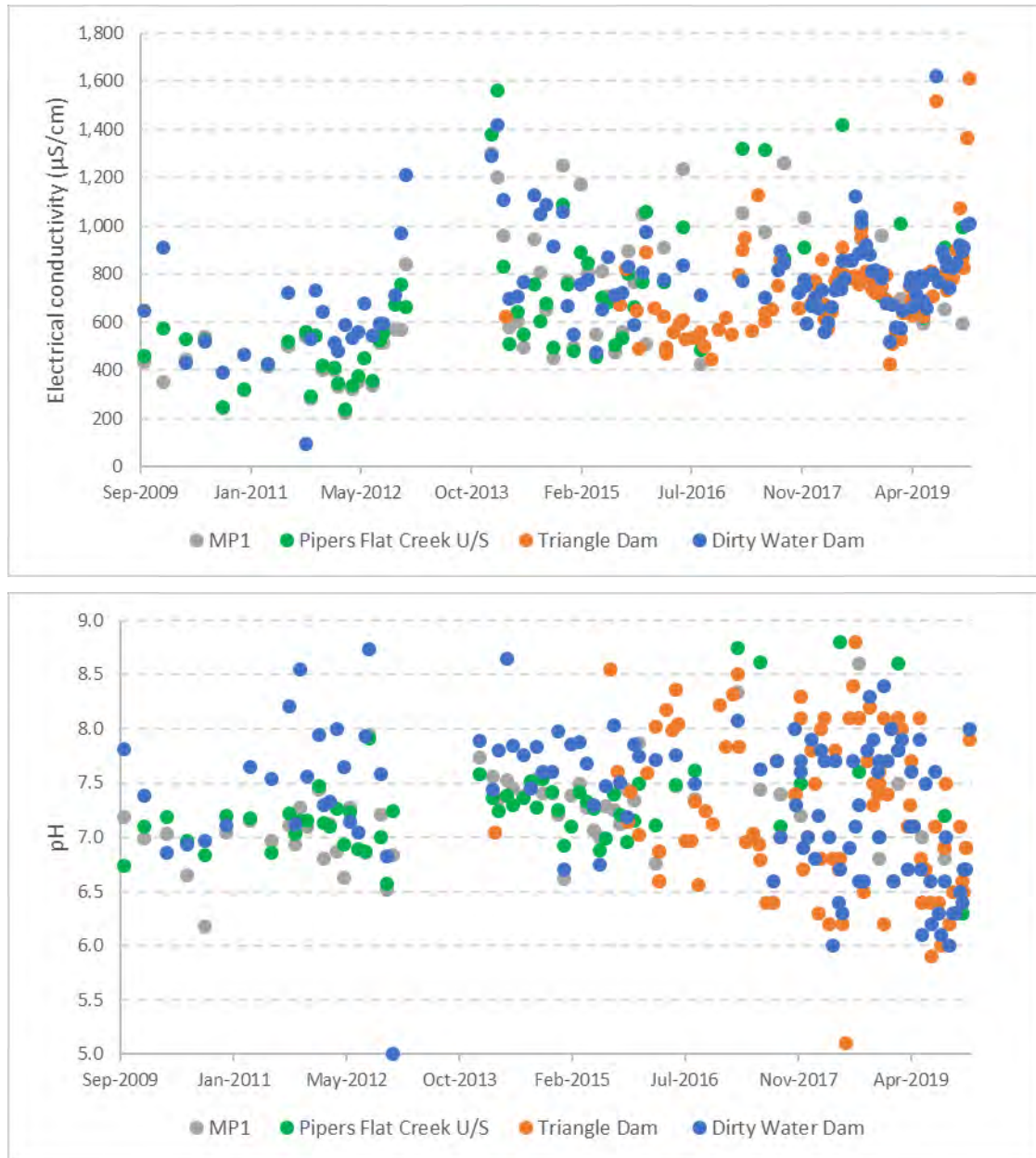
Parameter	Units	MP1		Pipers Flat Creek U/S		Triangle Dam		Dirty Water Dam	
		Count	50% ile	Count	50% ile	Count	50% ile	Count	50% ile
Physicochemical									
EC	µS/cm	62	574.5	62	630.5	105	731	116	756
pH	pH units	61	7.21	61	7.21	105	7.24	115	7.5
TSS	mg/L	60	6	60	5	76	6	88	6.7
Turbidity	NTU	45	9	45	5	24	8.6	45	18
Nutrients									
Nitrate	mg/L	57	0.03	57	0.01	9	0.01	58	0.01
Nitrite	mg/L	58	1.02	58	0.215	9	0.01	52	0.175
Nitrate + nitrite	mg/L	58	0.935	57	0.2	23	0.02	52	0.175
Major ions									
Bicarbonate alkalinity	mg/L	60	100	60	116	9	66	60	73
Carbonate alkalinity	mg/L	60	100	60	116	9	66	37	74

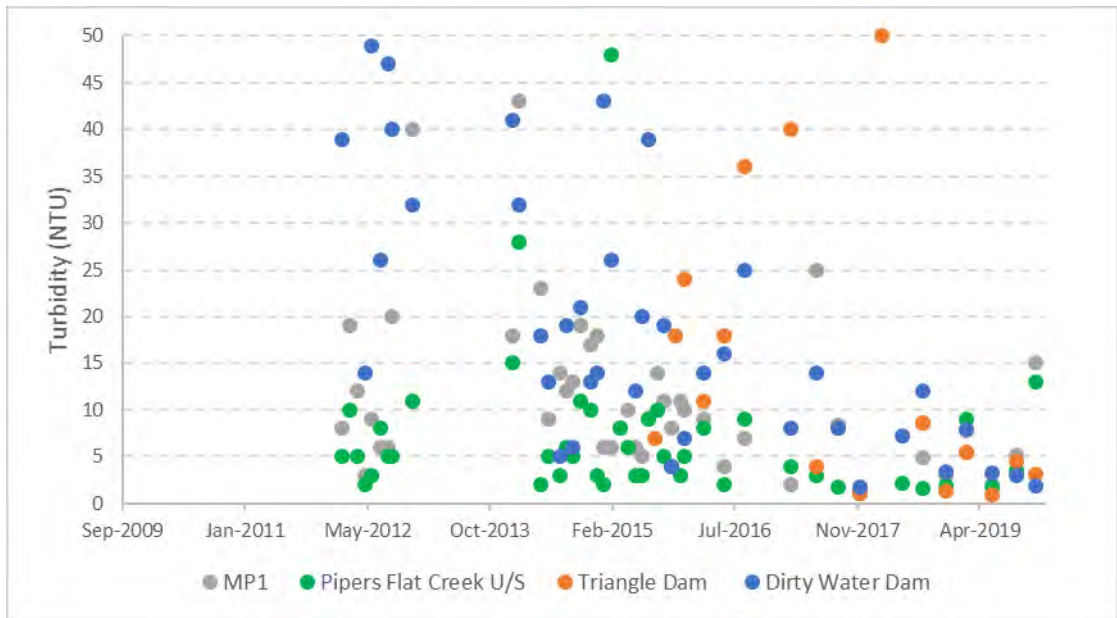
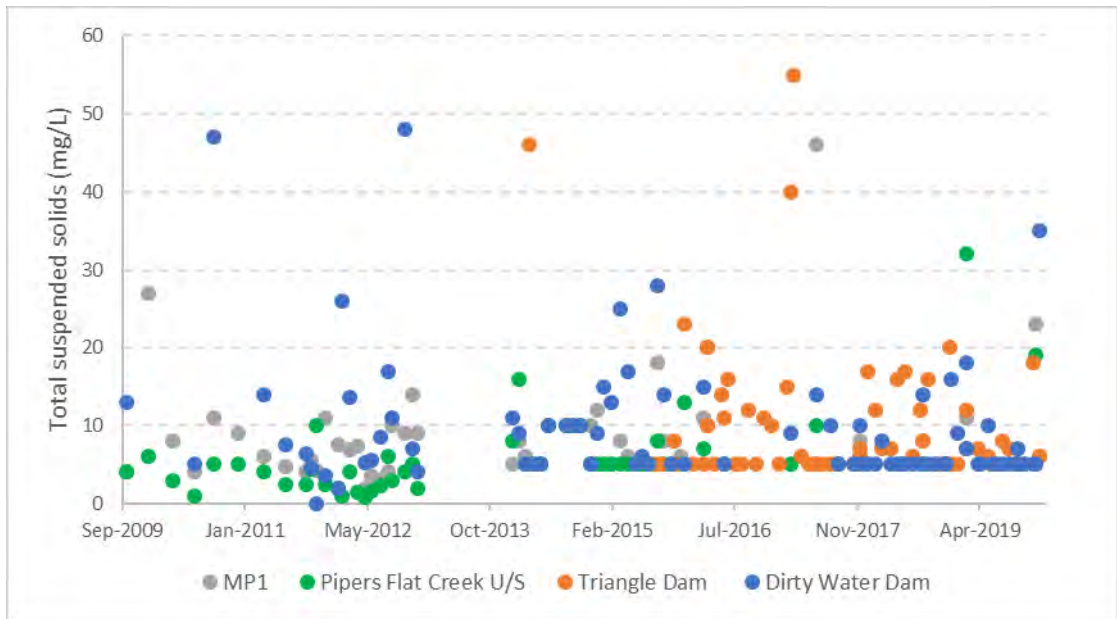
Parameter	Units	MP1		Pipers Flat Creek U/S		Triangle Dam		Dirty Water Dam	
		Count	50% ile	Count	50% ile	Count	50% ile	Count	50% ile
Hydroxide alkalinity	mg/L	60	1	60	1	9	1	60	1
Total alkalinity	mg/L	60	100	60	116	9	66	37	74
Calcium	mg/L	60	29.5	60	38	9	56	60	52
Chloride	mg/L	60	37.5	60	35.5	9	34	60	24
Magnesium	mg/L	59	15	59	21	9	30	28	24.5
Potassium	mg/L	60	7.5	60	7	9	7	53	8
Sodium	mg/L	60	58.5	60	58	9	50	53	66
Sulphate	mg/L	59	140	60	140	8	266.5	59	255
Dissolved metals									
Cadmium	mg/L	37	0.0001	37	0.0001	10	0.0001	29	0.0001
Copper	mg/L	37	0.002	36	0.001	9	0.001	29	0.001
Iron	mg/L	58	0.18	58	0.14	9	0.05	58	0.05
Manganese	mg/L	58	0.181	58	0.136	10	0.0245	58	0.1025
Nickel	mg/L	36	0.002	36	0.002	10	0.002	29	0.005

Parameter	Units	MP1		Pipers Flat Creek U/S		Triangle Dam		Dirty Water Dam	
		Count	50% ile	Count	50% ile	Count	50% ile	Count	50% ile
Other									
BTEX	µg/L	38	1	39	1	9	1	40	1
Oil and grease	mg/L	58	5	58	5	70	5	88	5
TRHs	µg/L	38	100	39	100	9	100	40	100

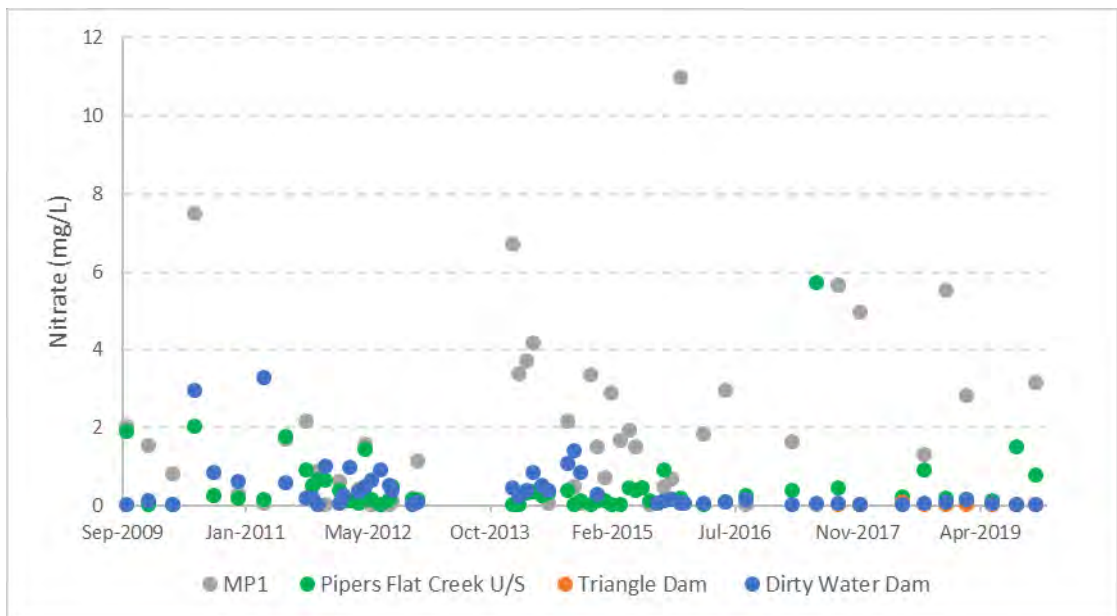
C.1.2 Time series graphs

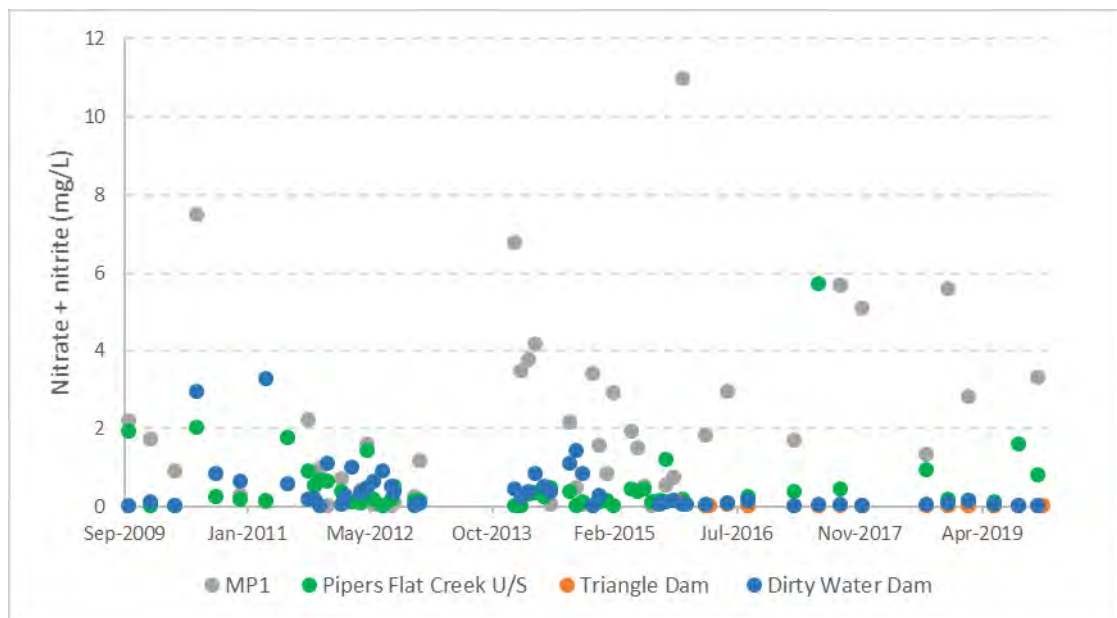
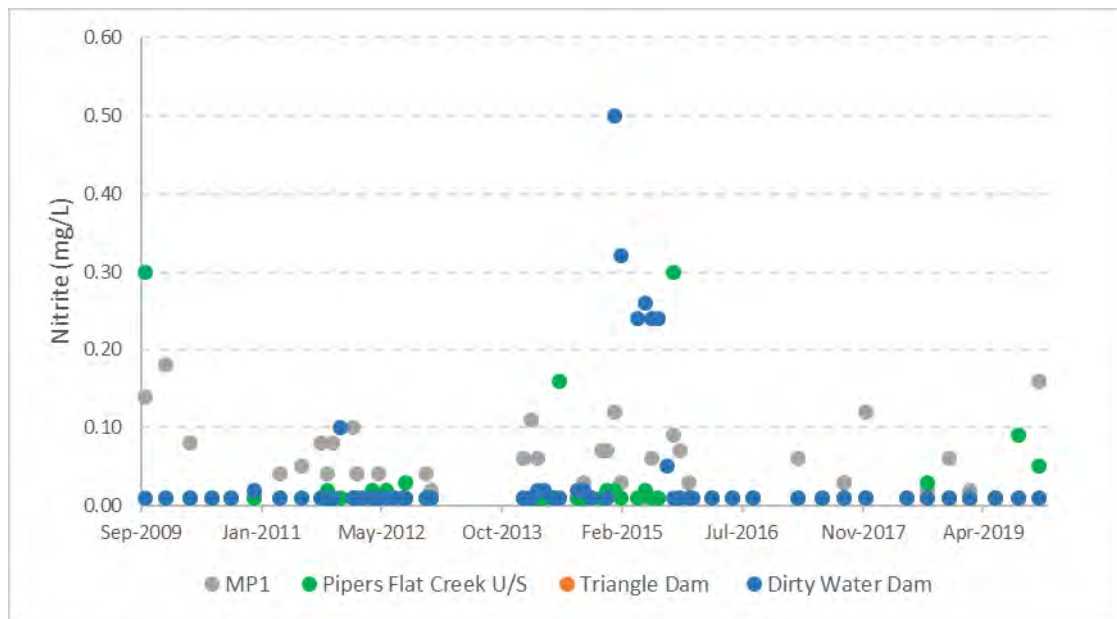
Physicochemical parameters



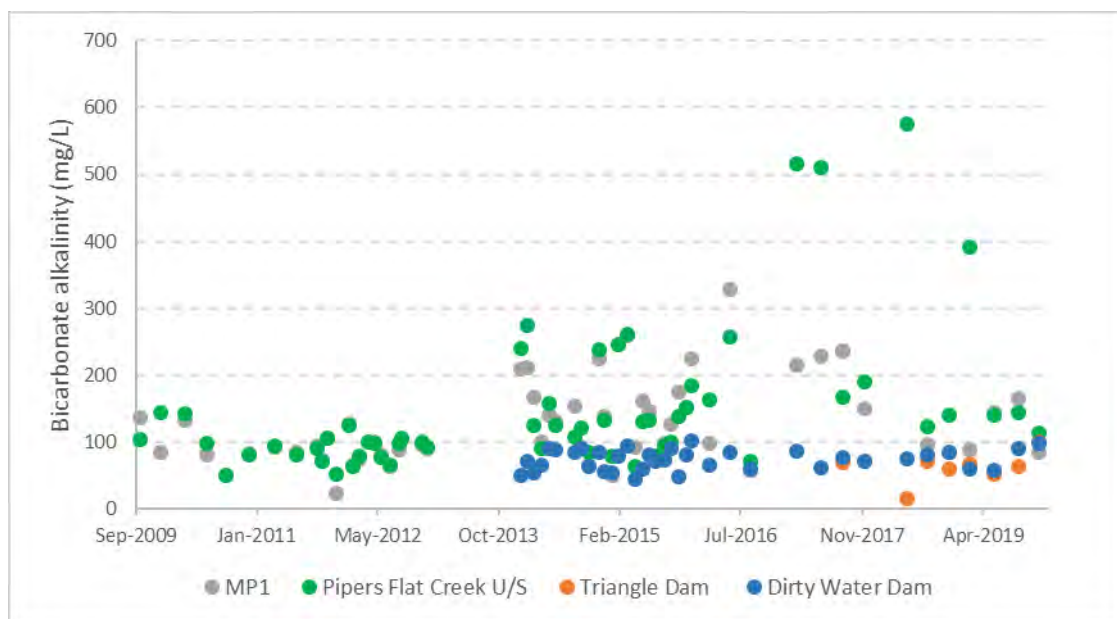


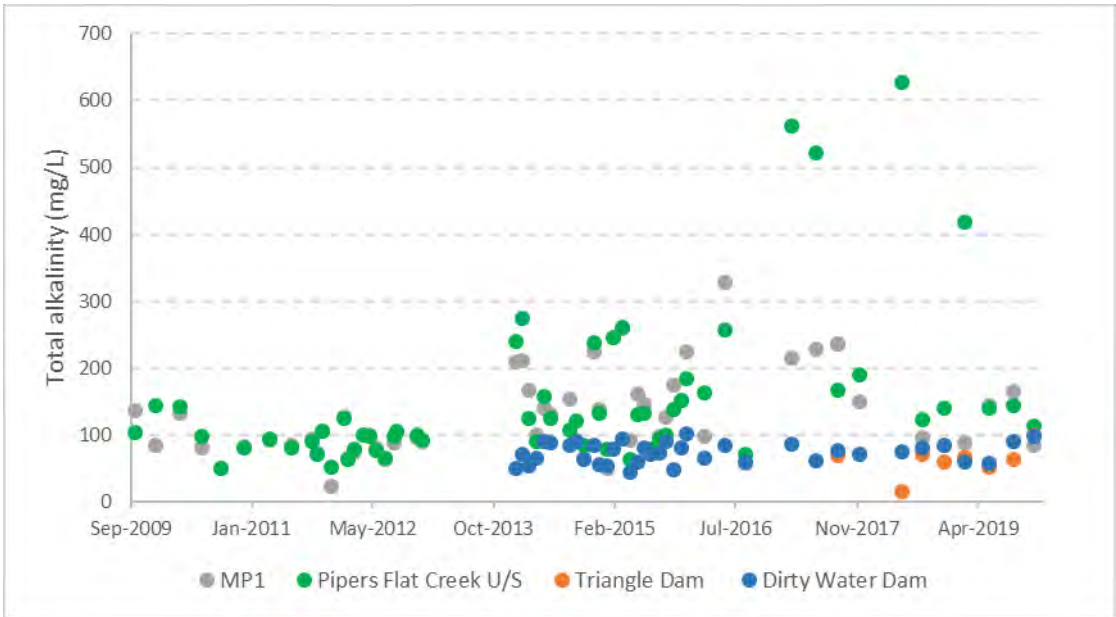
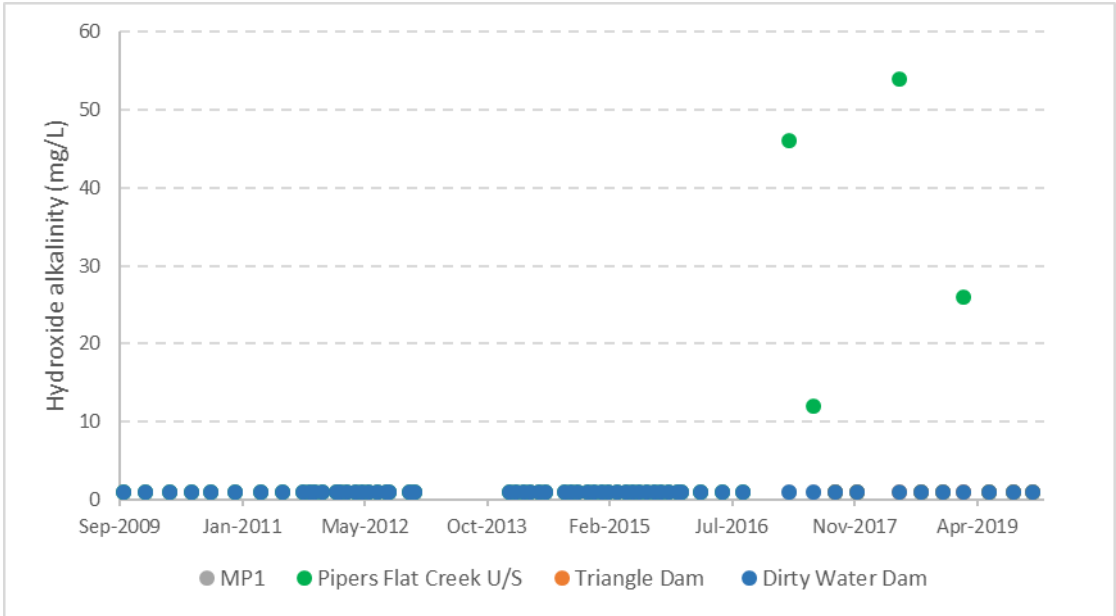
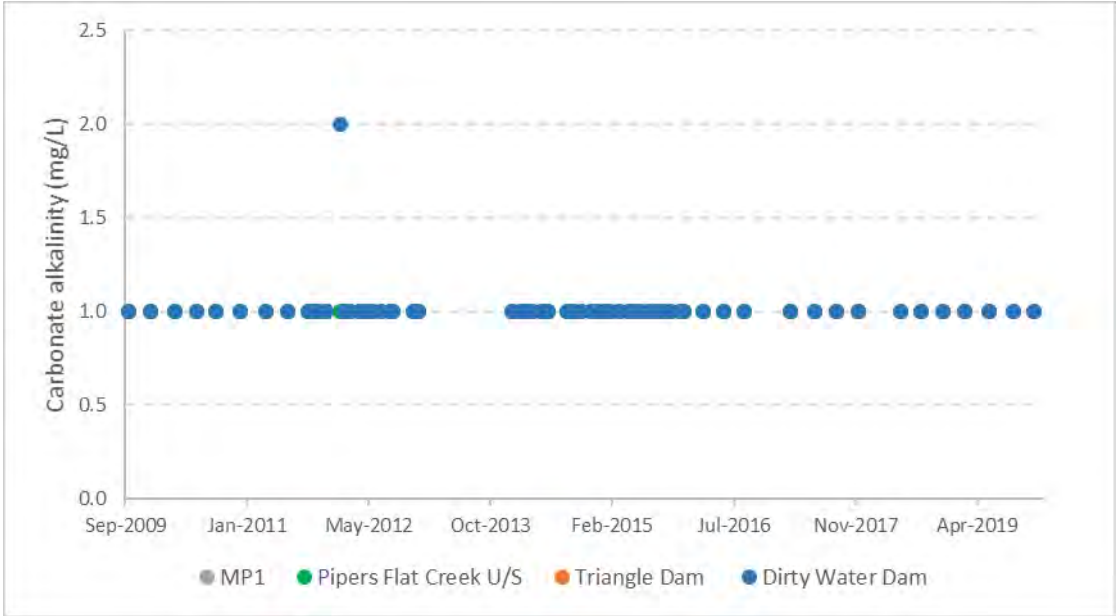
Nutrients

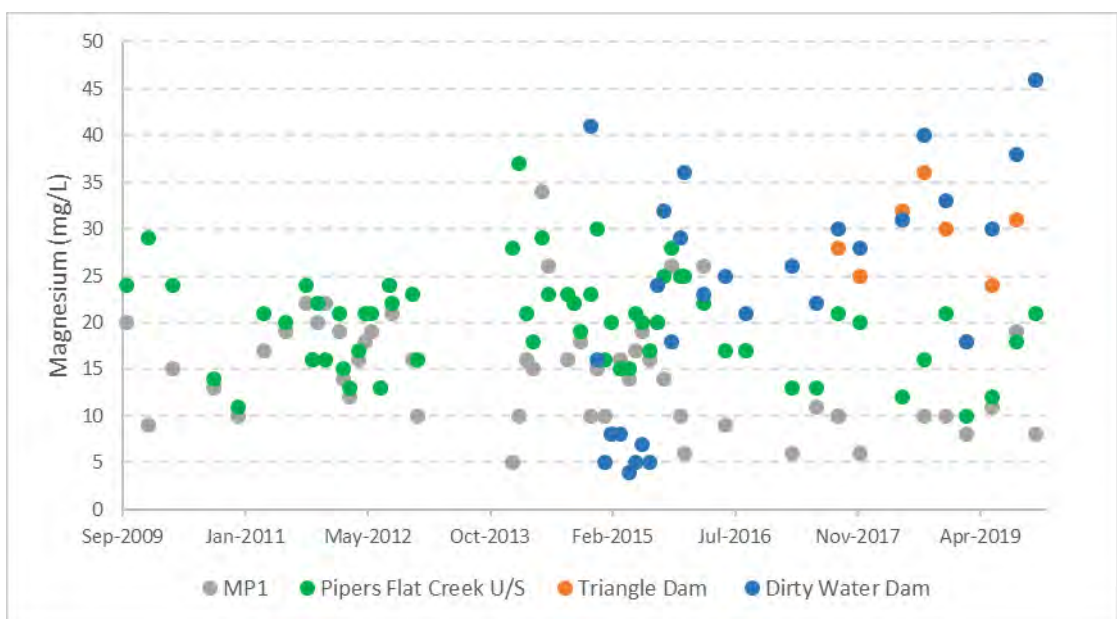
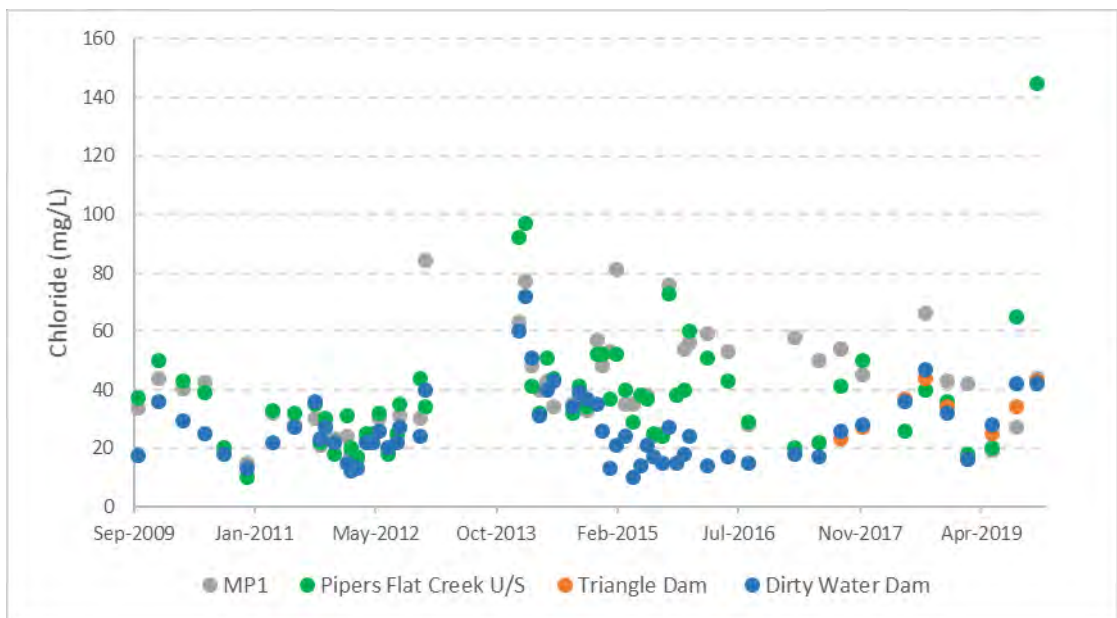
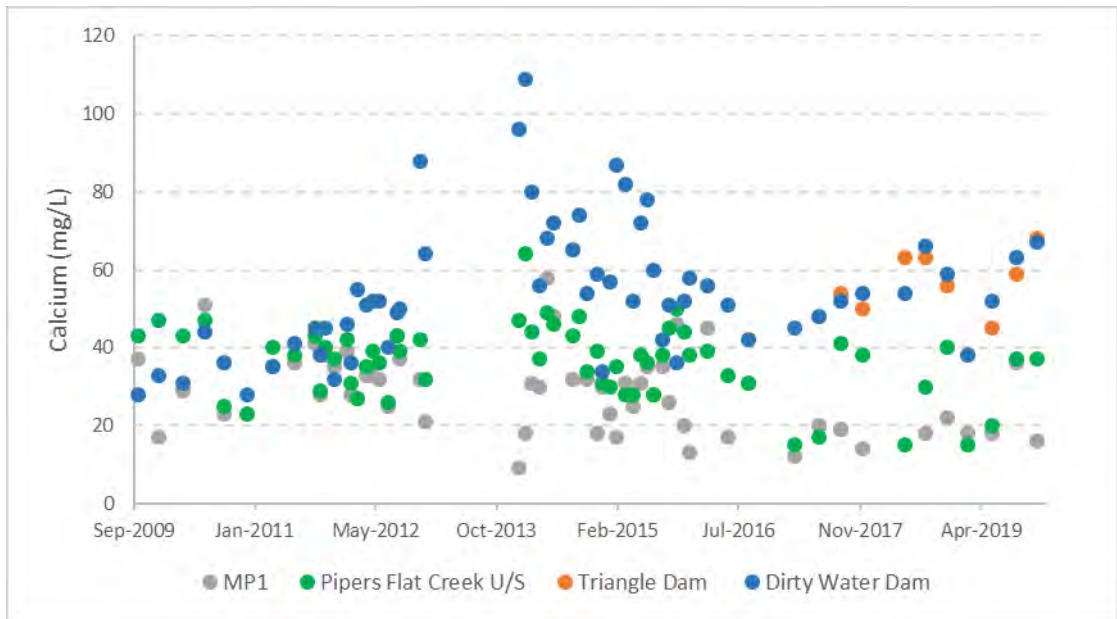


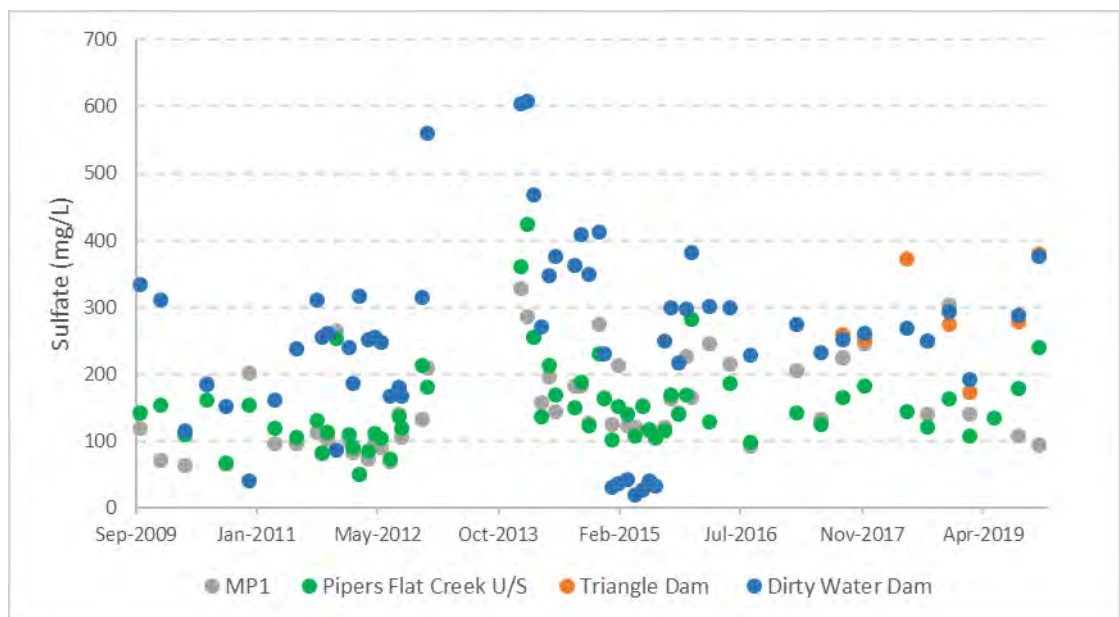
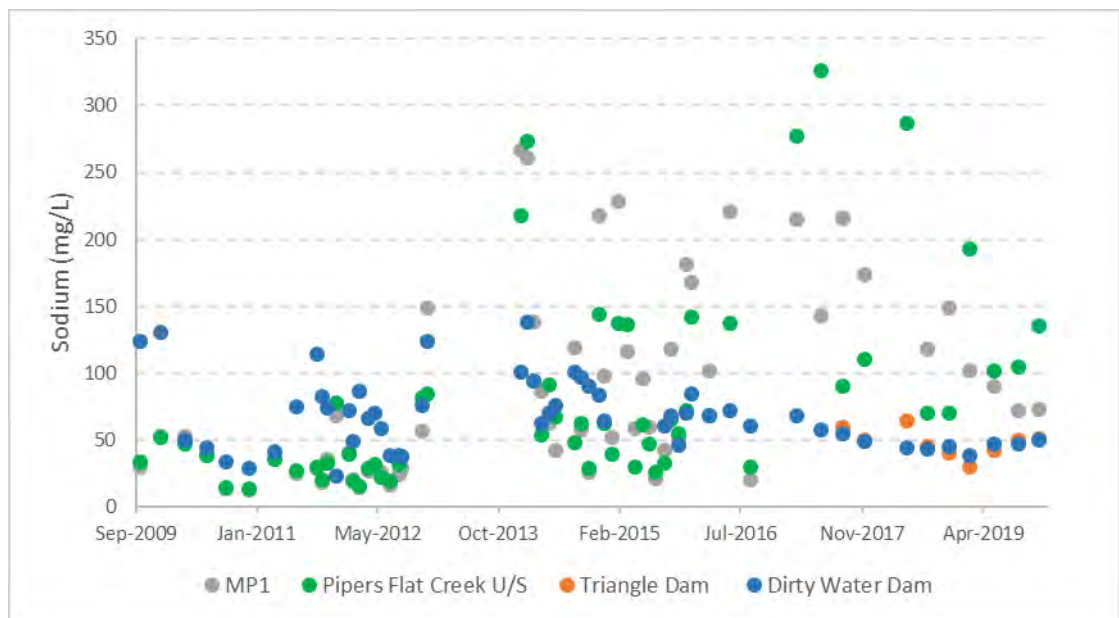
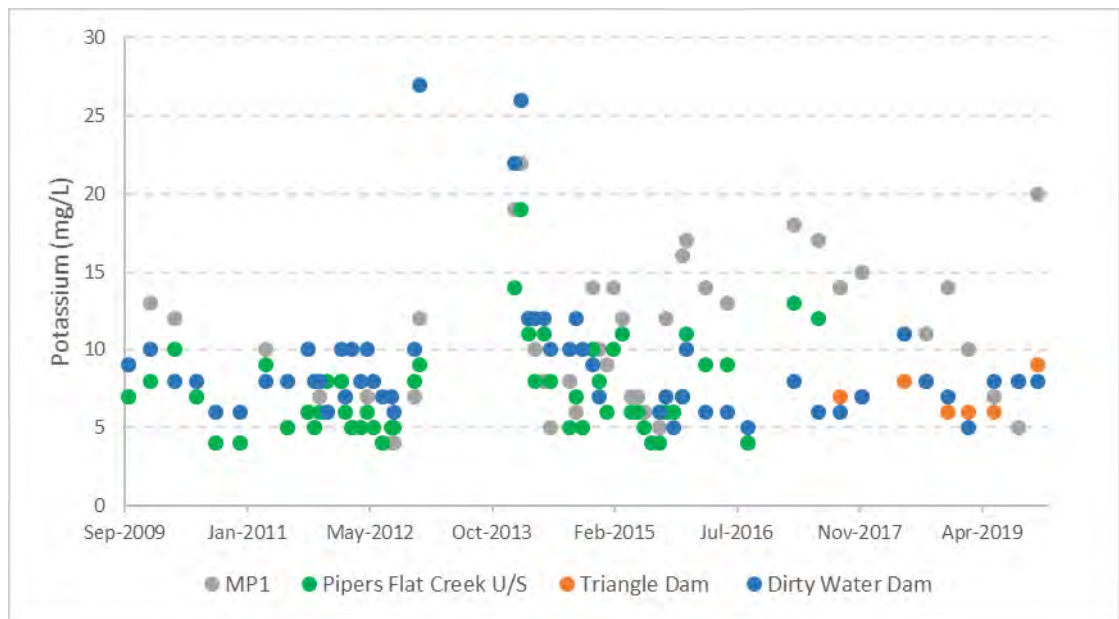


Major ions

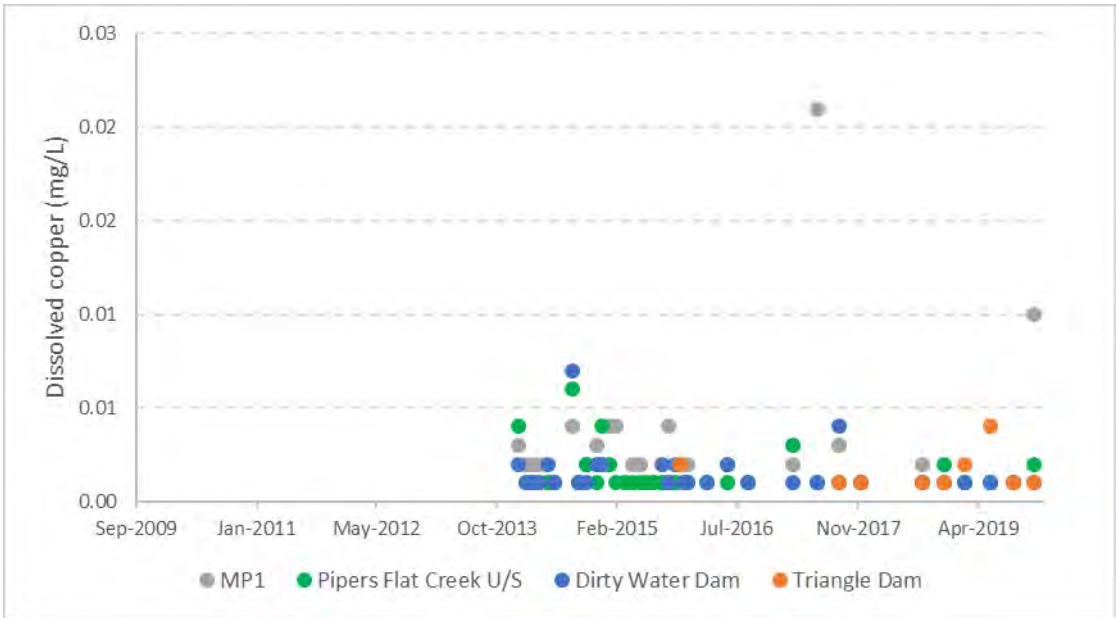
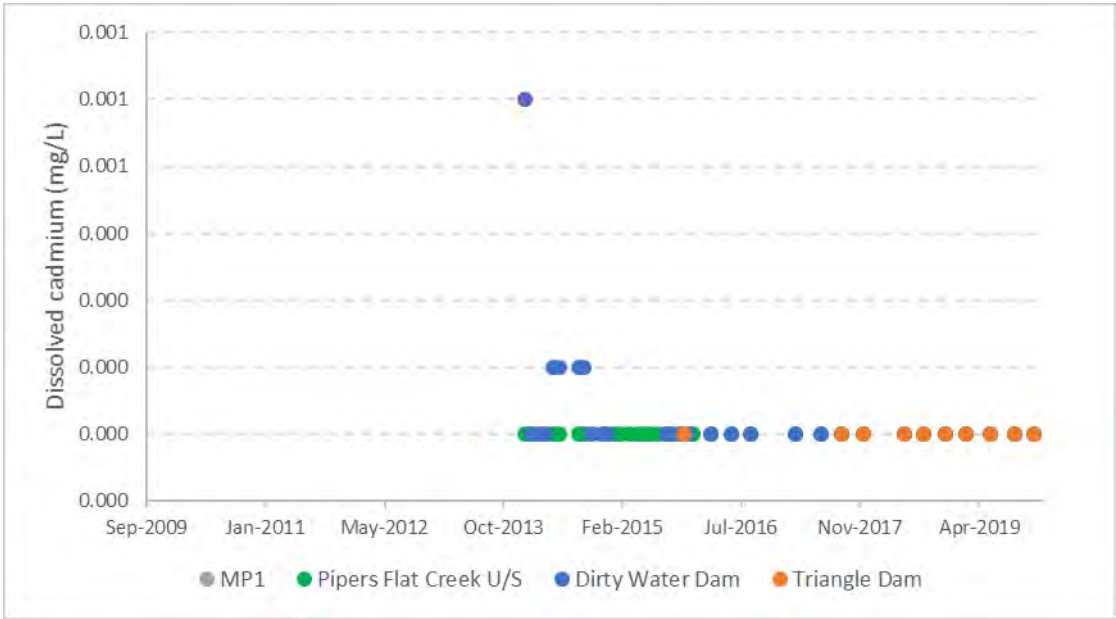


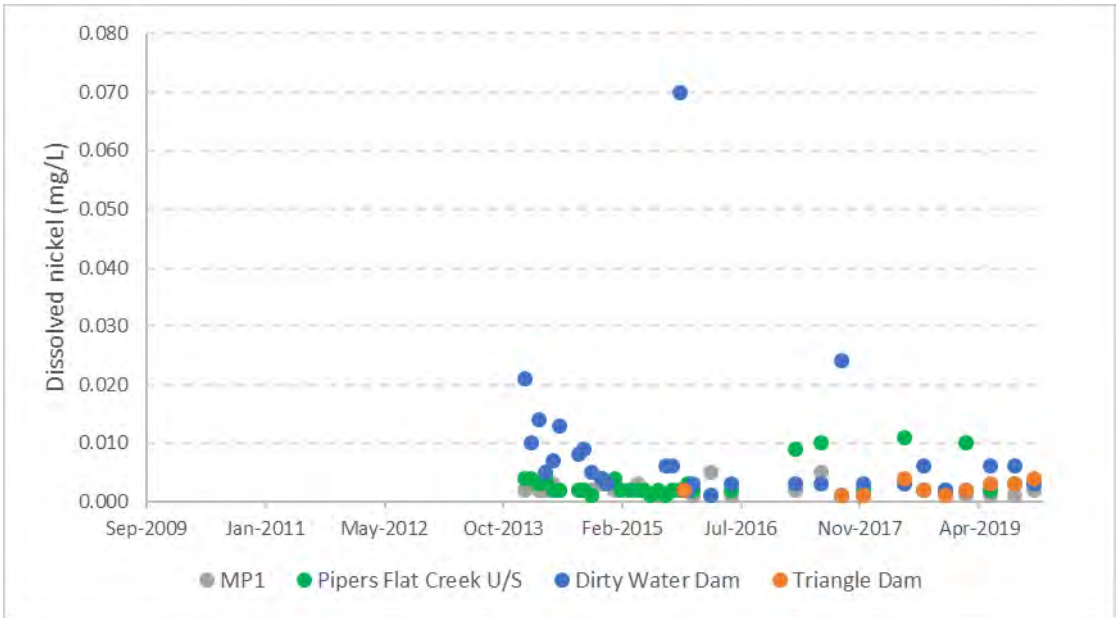
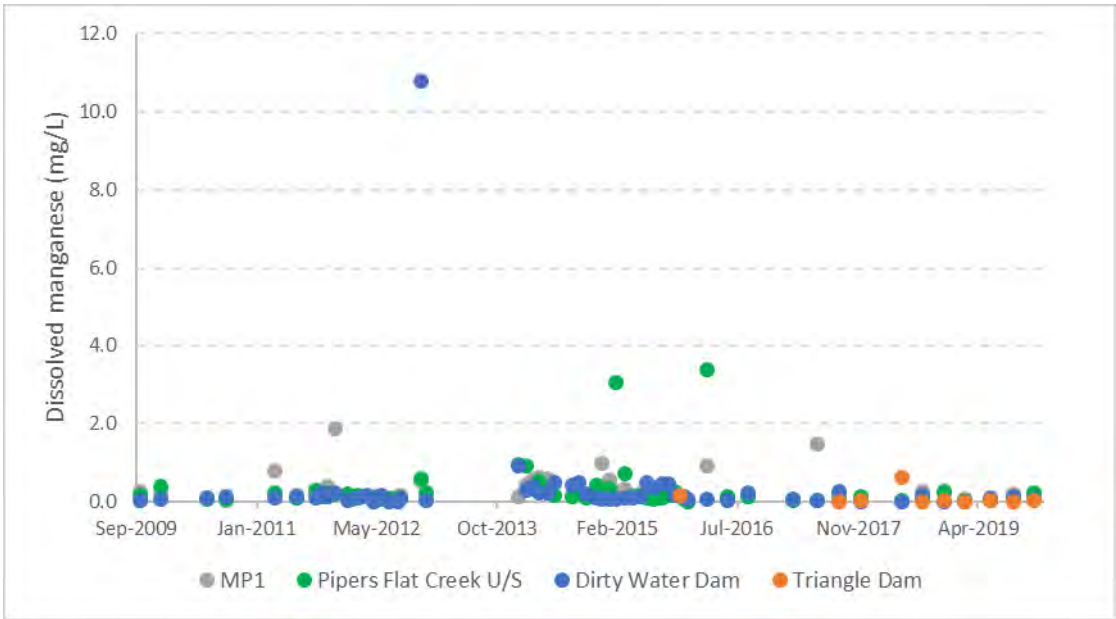




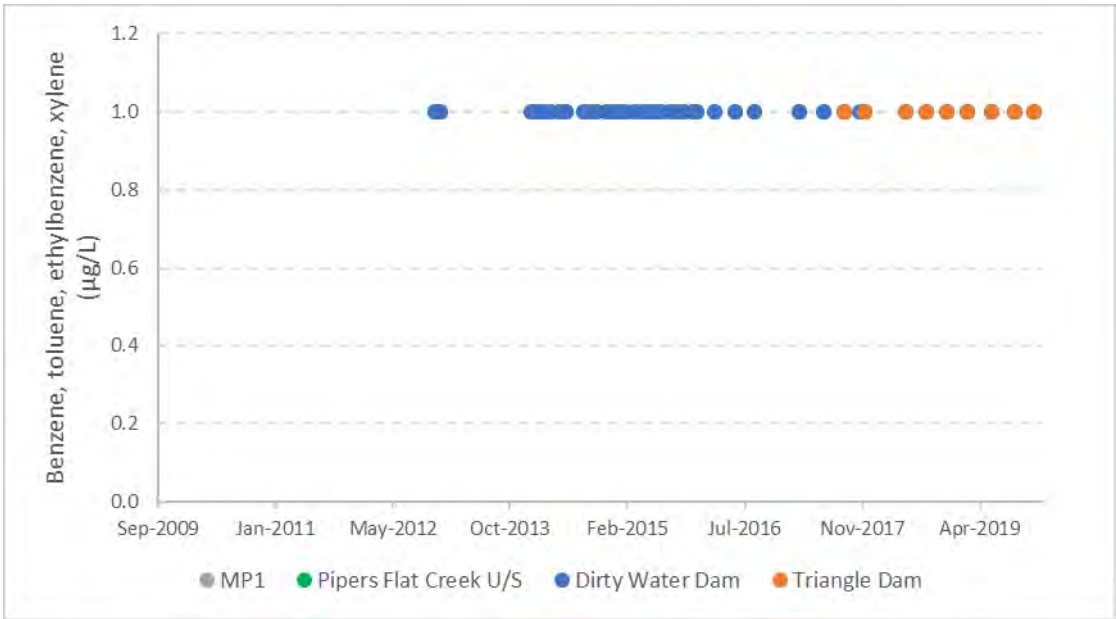


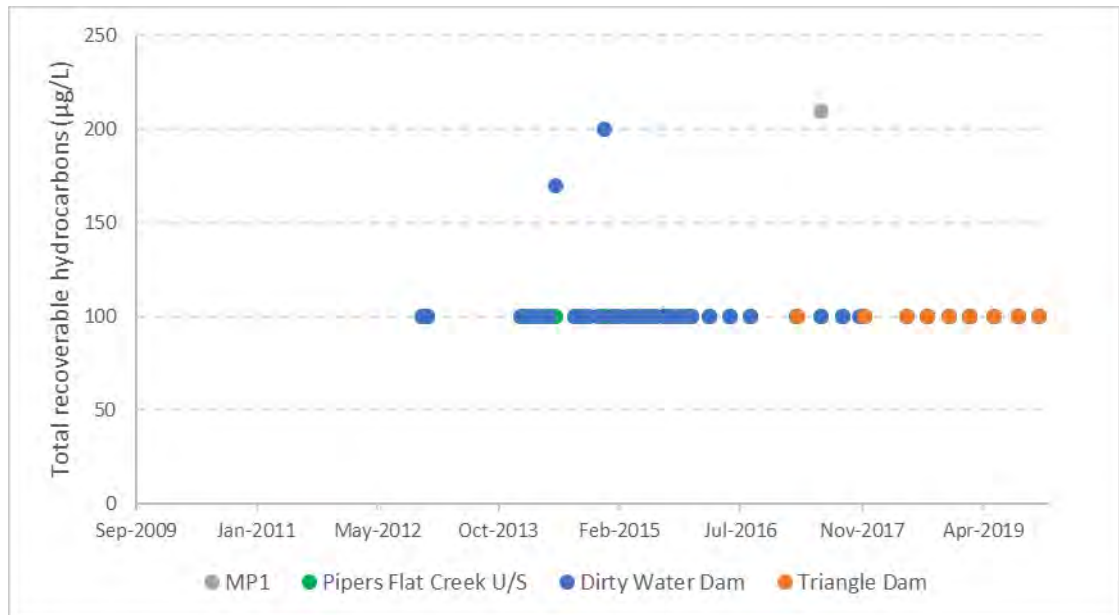
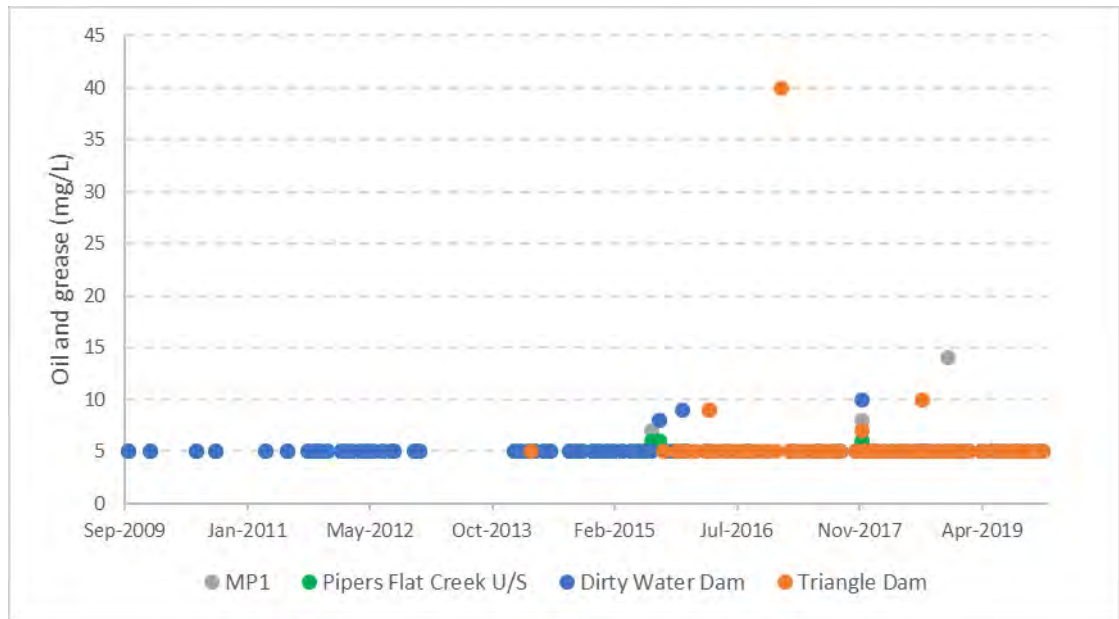
Dissolved metals





Other





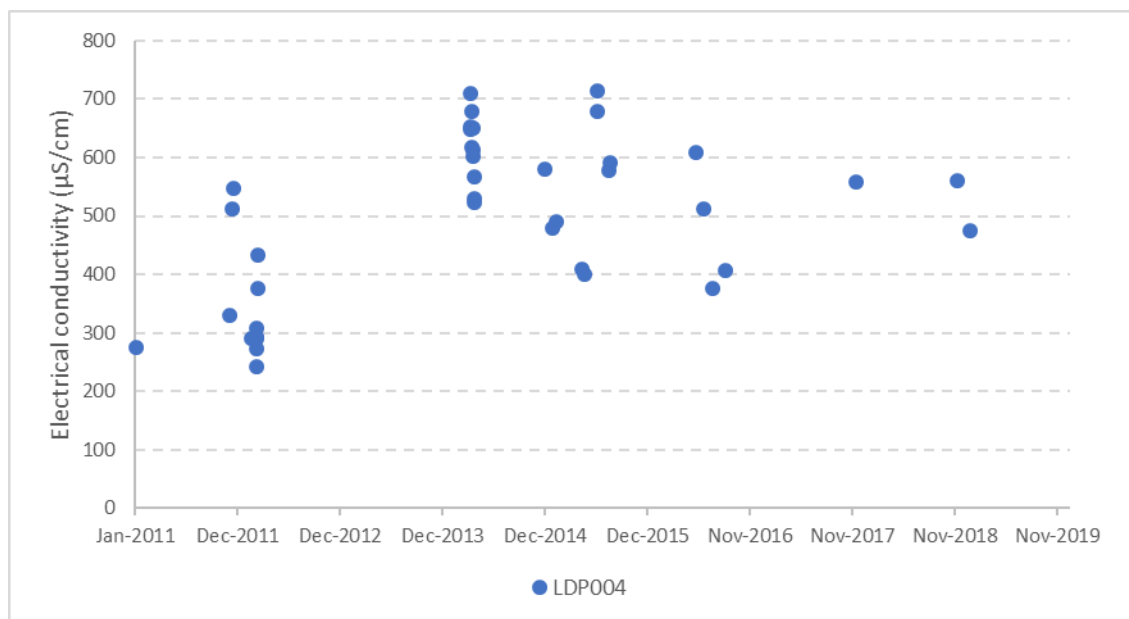
C.2 Discharge water monitoring

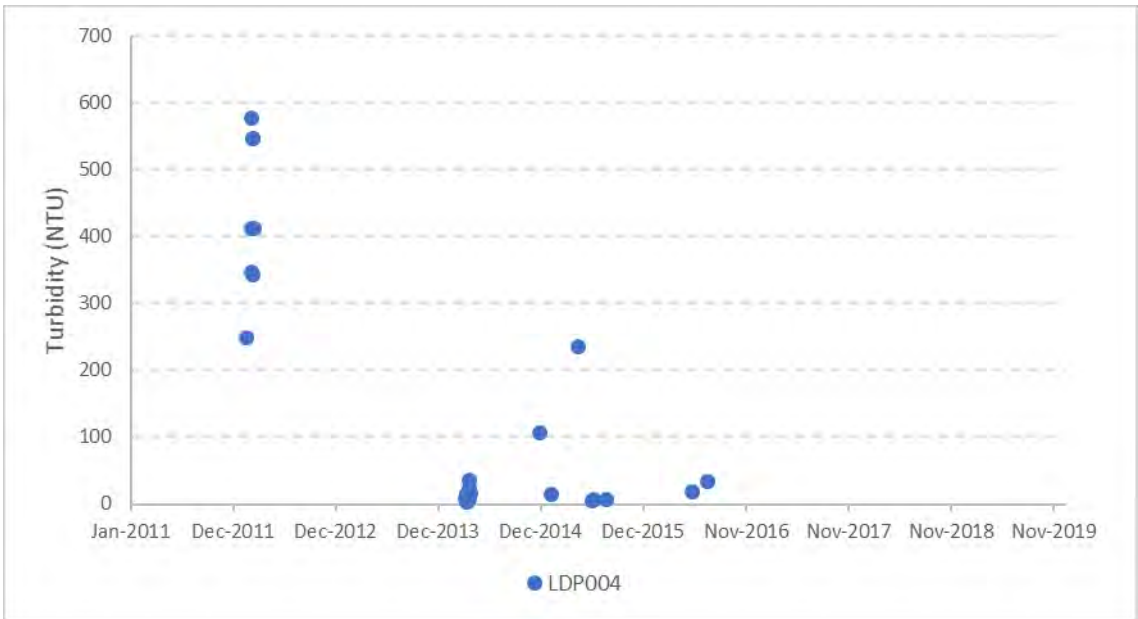
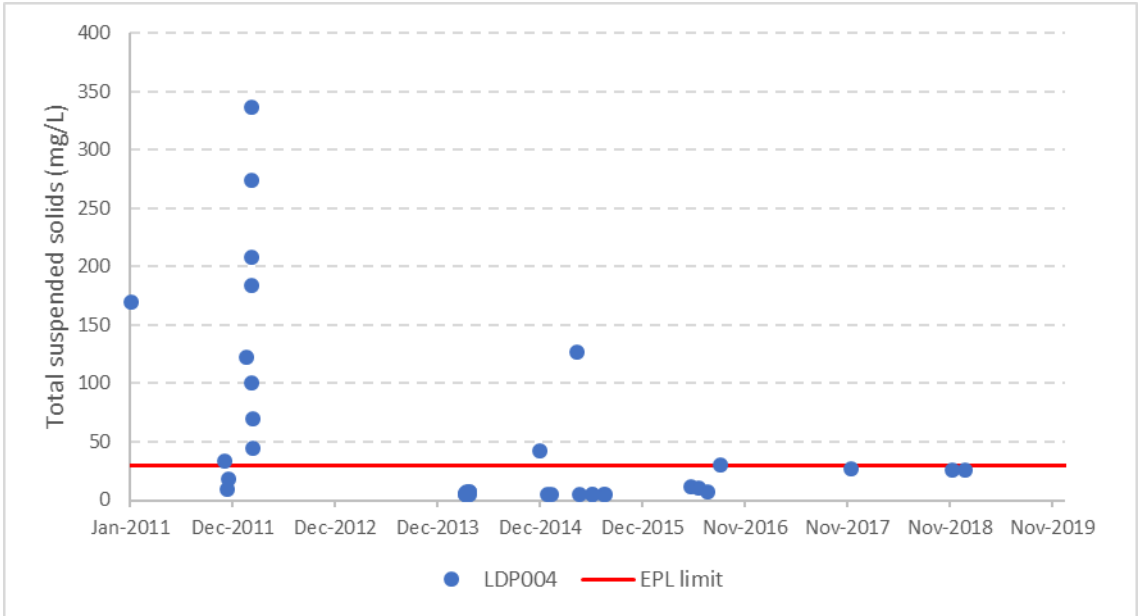
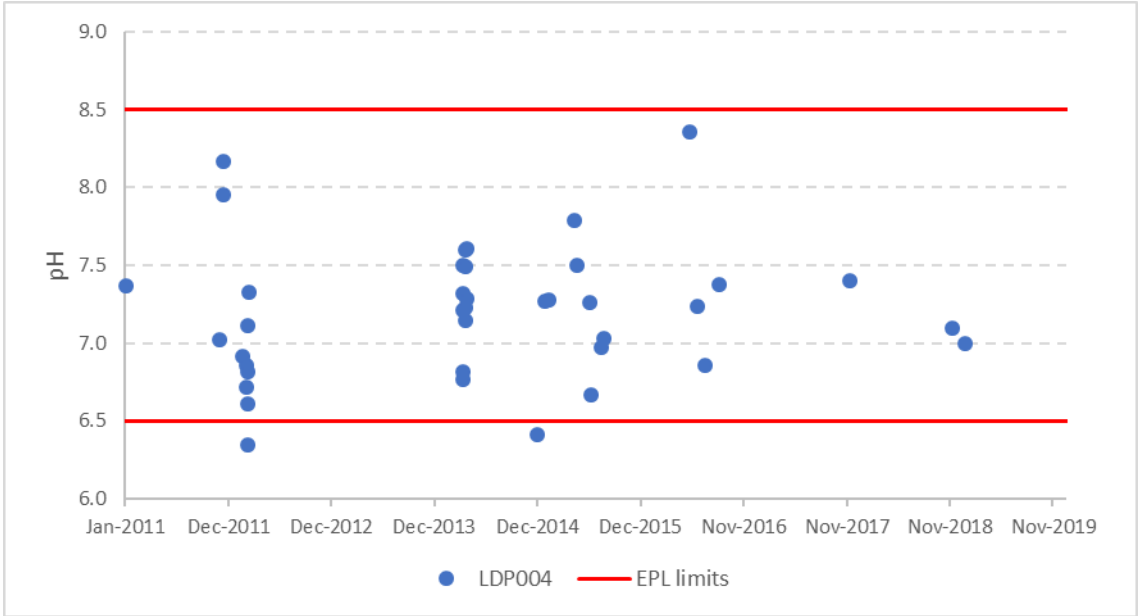
C.2.1 Statistical summary of water quality results

Parameter	Units	Count	20th percentile	Median	80th percentile
Physicochemical					
EC	µS/cm	39	357.6	524.0	615.0
pH	pH units	39	6.8	7.2	7.5
TSS	mg/L	39	5	8.8	82.1
Turbidity	NTU	26	7	20	346.0
Other					
Oil and grease	mg/L	39	5	5	5

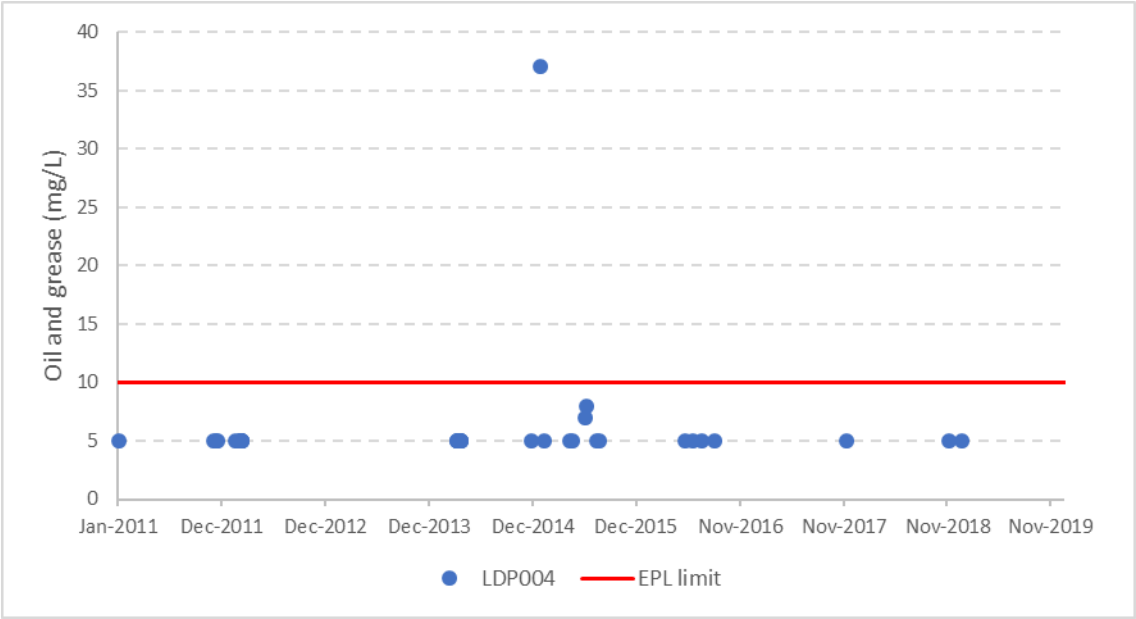
C.2.2 Time series graphs

Physicochemical parameters





Other



C.3 Groundwater monitoring

C.3.1 Groundwater quality

Statistical summary of water quality results

Parameter	Units	MW1		MW3		MW4		MW5	
		Count	Median	Count	Median	Count	Median	Count	Median
Physicochemical									
DO	mg/L	39	3.4	30	7.545	47	4.23	42	7.39
EC	μS/cm	41	580	33	229	51	587	43	279
pH	pH units	41	6.62	33	5.56	50	4.4	43	5.71
TSS	mg/L	36	737.5	28	1200	47	655	40	1120
Turbidity	NTU	28	600	21	1108	36	376	30	952
Nutrients									
Nitrate	mg/L	37	0.01	29	0.01	49	0.01	41	0.01
Nitrite	mg/L	38	0.01	30	4.02	50	0.15	41	0.33
Nitrate + nitrite	mg/L	38	0.01	30	3.7	49	0.17	40	0.33
Major ions									
Bicarbonate alkalinity	mg/L	39	225	31	10	50	1	42	6

Parameter	Units	MW1		MW3		MW4		MW5	
		Count	Median	Count	Median	Count	Median	Count	Median
Carbonate alkalinity	mg/L	39	225	31	10	50	1	42	6
Hydroxide alkalinity	mg/L	39	1	31	1	50	1	42	1
Total alkalinity	mg/L	39	225	31	10	50	1	42	6
Calcium	mg/L	39	33	31	3	50	22	42	14
Chloride	mg/L	39	5	31	26	50	17.5	42	4
Magnesium	mg/L	38	27	31	2	49	23	41	15
Potassium	mg/L	39	3	31	2	50	5	42	2
Sodium	mg/L	39	11	31	34	50	45	42	12
Sulfate	mg/L	39	2	31	39	50	238.5	41	109
Dissolved metals									
Cadmium	mg/L	28	0.0001	20	0.0001	36	0.0002	29	0.0001
Copper	mg/L	28	0.001	20	0.002	36	0.002	29	0.001
Iron	mg/L	38	21.45	29	0.06	48	0.08	40	0.05
Manganese	mg/L	38	0.752	29	0.01	48	0.4095	40	0.0145
Nickel	mg/L	27	0.001	19	0.002	35	0.028	28	0.022
Other									
BTEX	µg/L	28	3.5	20	1	37	1	29	1

Parameter	Units	MW1		MW3		MW4		MW5	
		Count	Median	Count	Median	Count	Median	Count	Median
Oil and grease	mg/L	36	5	27	5	46	5	39	5
TRHs	µg/L	28	9800	19	100	37	100	29	100

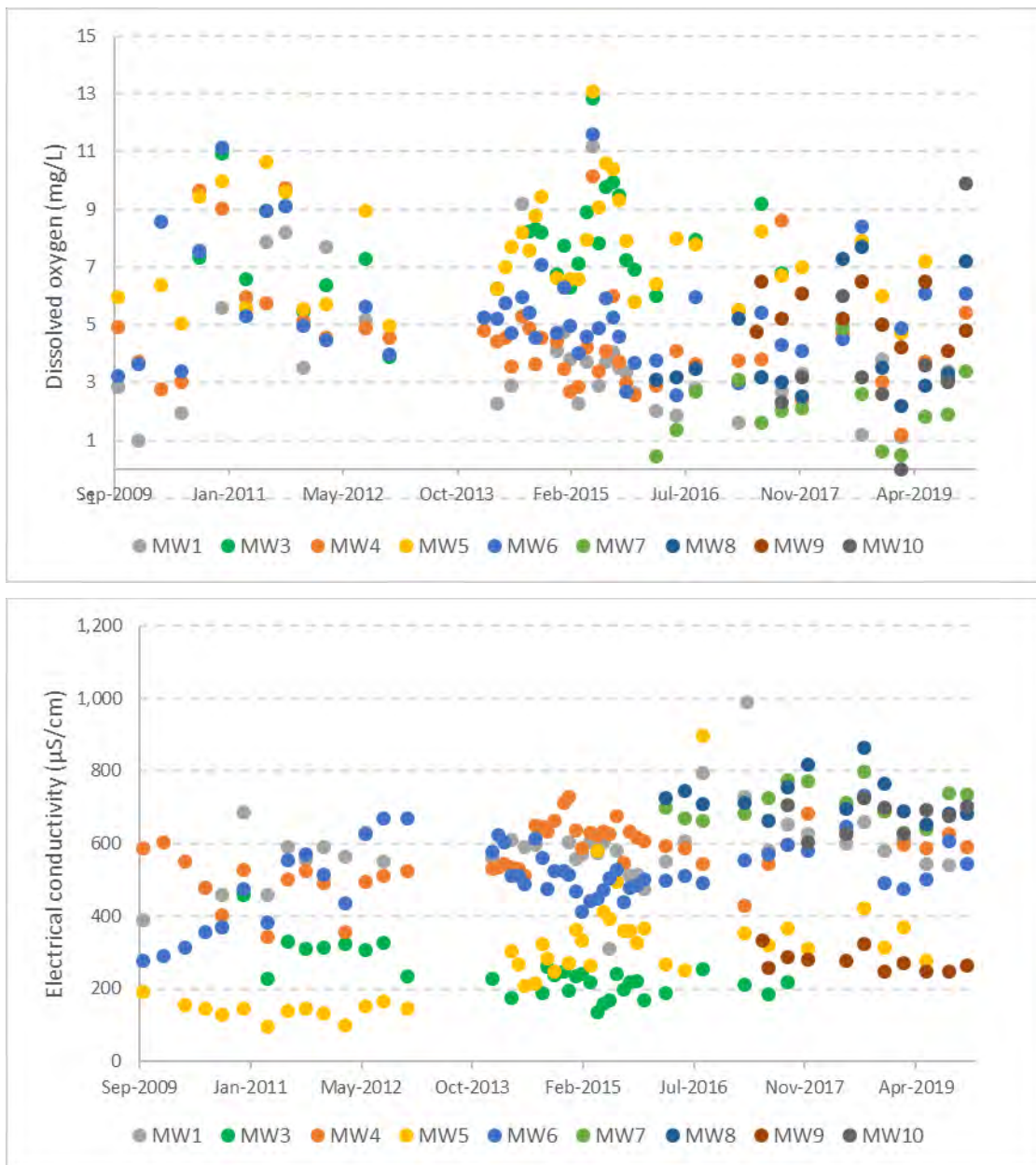
Parameter	Units	MW6		MW7		MW8		MW9		MW10	
		Count	Median	Count	Median	Count	Median	Count	Median	Count	Median
Physicochemical											
DO	mg/L	47	4.96	14	1.95	14	3.25	11	5.2	8	3.28
EC	μS/cm	51	510	14	705	14	710.5	11	279	9	696.6
pH	pH units	50	6.37	14	6.625	14	6.265	11	5.99	9	6.4
TSS	mg/L	47	602	13	1460	13	4440	11	656	9	444.8
Turbidity	NTU	35	672	11	982	10	1927.5	10	720	8	368.4
Nutrients											
Nitrate	mg/L	49	0.01	14	0.01	14	0.01	11	0.01	9	0.01
Nitrite	mg/L	50	0.845	14	0.01	14	0.065	11	0.82	9	0.04
Nitrate + nitrite	mg/L	49	0.83	14	0.01	14	0.065	11	0.82	9	0.04

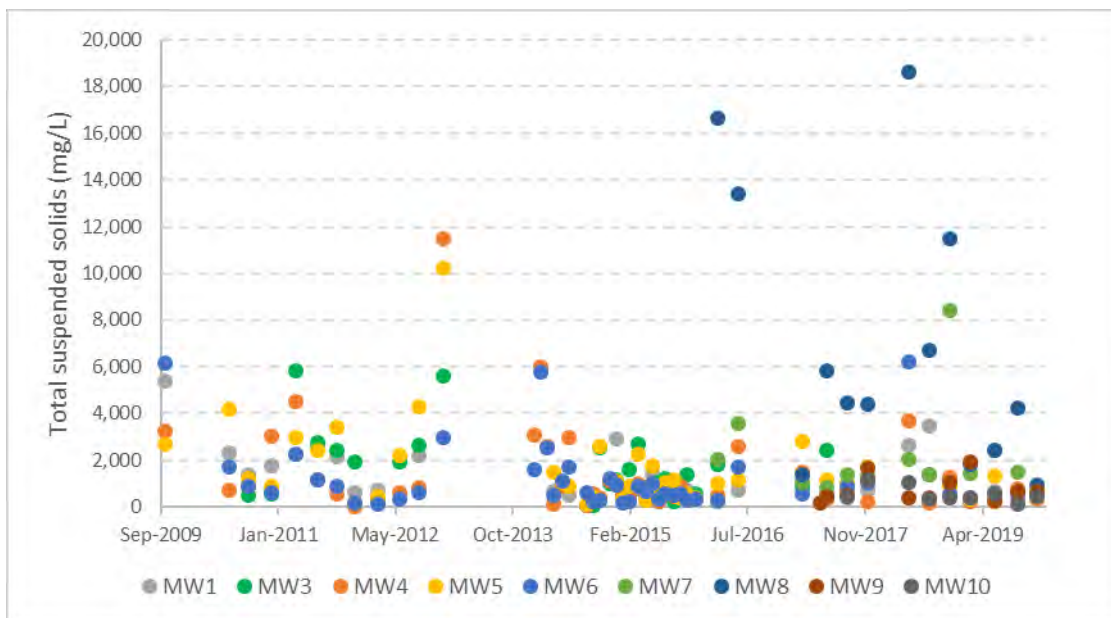
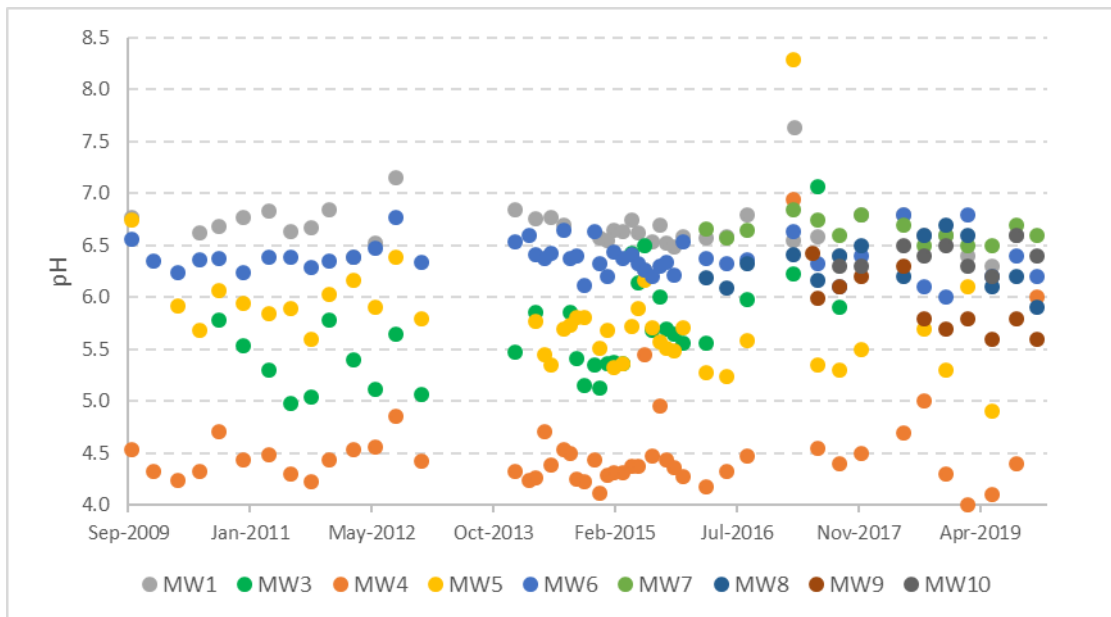
Parameter	Units	MW6		MW7		MW8		MW9		MW10	
		Count	Median	Count	Median	Count	Median	Count	Median	Count	Median
Major ions											
Bicarbonate alkalinity	mg/L	50	60.5	14	273	14	84	11	49	9	88.4
Carbonate alkalinity	mg/L	50	60.5	14	273	14	84	11	49	9	88.4
Hydroxide alkalinity	mg/L	50	1	14	1	14	1	11	1	9	1
Total alkalinity	mg/L	50	60.5	14	273	14	84	11	49	9	88.4
Calcium	mg/L	50	32	14	32.5	14	55	11	14	9	5.8
Chloride	mg/L	50	29	14	28.5	14	23.5	11	4	9	31.8
Magnesium	mg/L	49	19	14	30.5	14	20.5	11	11	9	19
Potassium	mg/L	50	4	14	8	14	6	11	6	9	6
Sodium	mg/L	50	31.5	14	34	14	50.5	11	12	9	41.6
Sulphate	mg/L	50	137.5	14	1	14	229.5	11	67	9	146.8
Dissolved metals											
Cadmium	mg/L	36	0.0001	14	0.0001	14	0.0001	11	0.0001	9	0.0001
Copper	mg/L	36	0.001	14	0.001	14	0.001	11	0.001	9	0.001

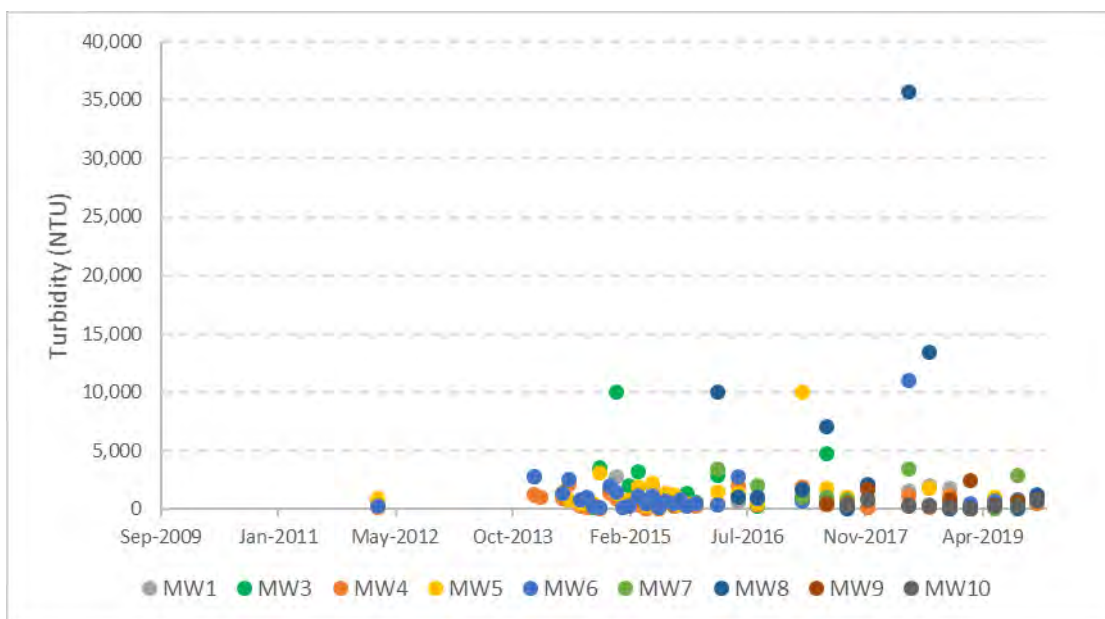
Parameter	Units	MW6		MW7		MW8		MW9		MW10	
		Count	Median	Count	Median	Count	Median	Count	Median	Count	Median
Iron	mg/L	48	0.05	14	33.95	14	0.06	11	0.07	9	74.88
Manganese	mg/L	48	0.004	14	0.8005	14	3.42	11	2.36	9	1.338
Nickel	mg/L	35	0.001	13	0.001	13	0.011	11	0.007	9	0.0058
Other											
BTEX	µg/L	37	1	14	1	14	1	11	1	9	1
Oil and grease	mg/L	47	5	13	5	13	5	10	5	8	5
TRHs	µg/L	37	100	14	10315	14	100	11	100	9	100

Time series graphs

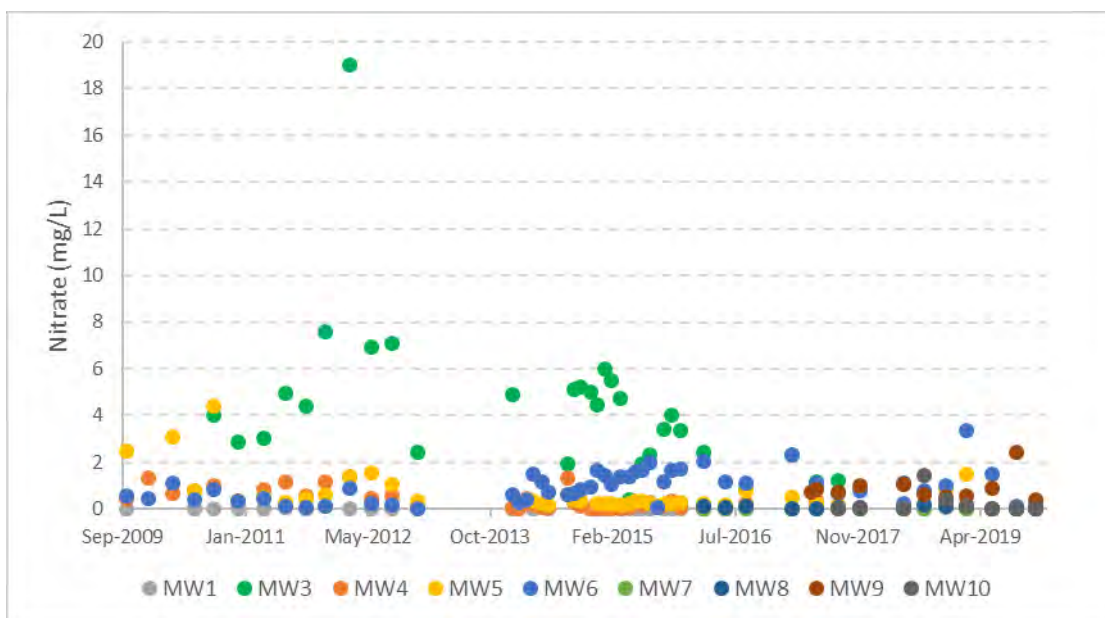
Physicochemical

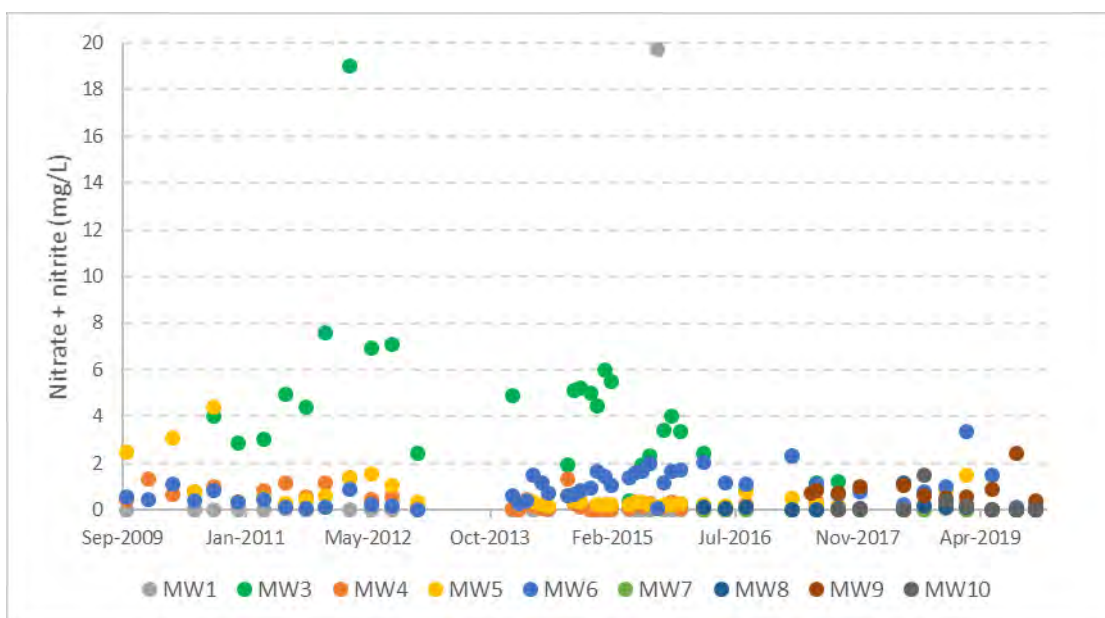
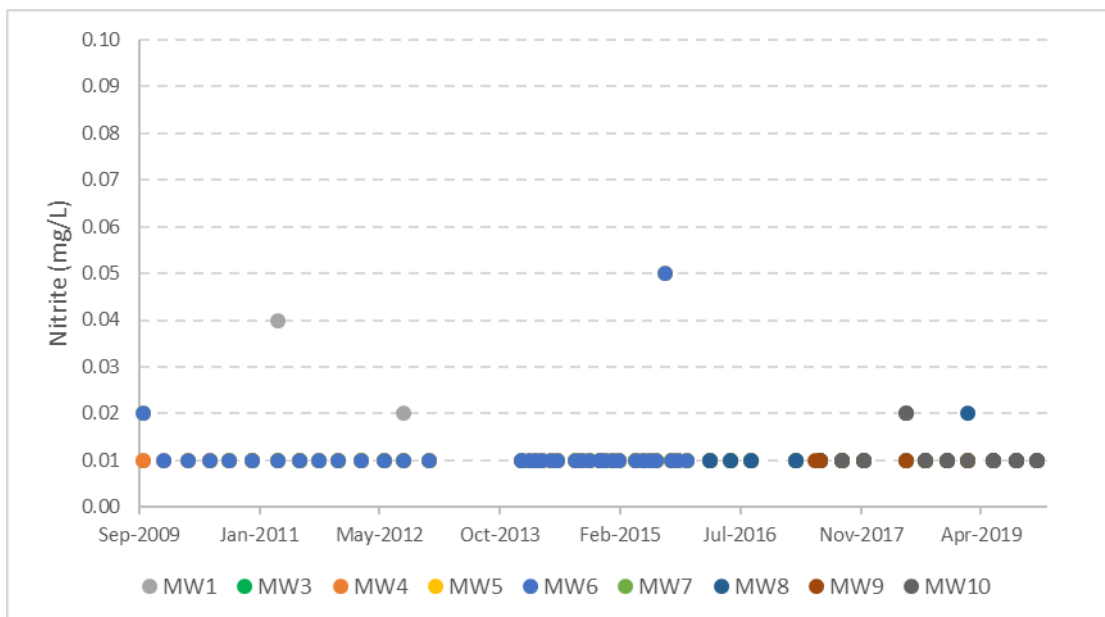




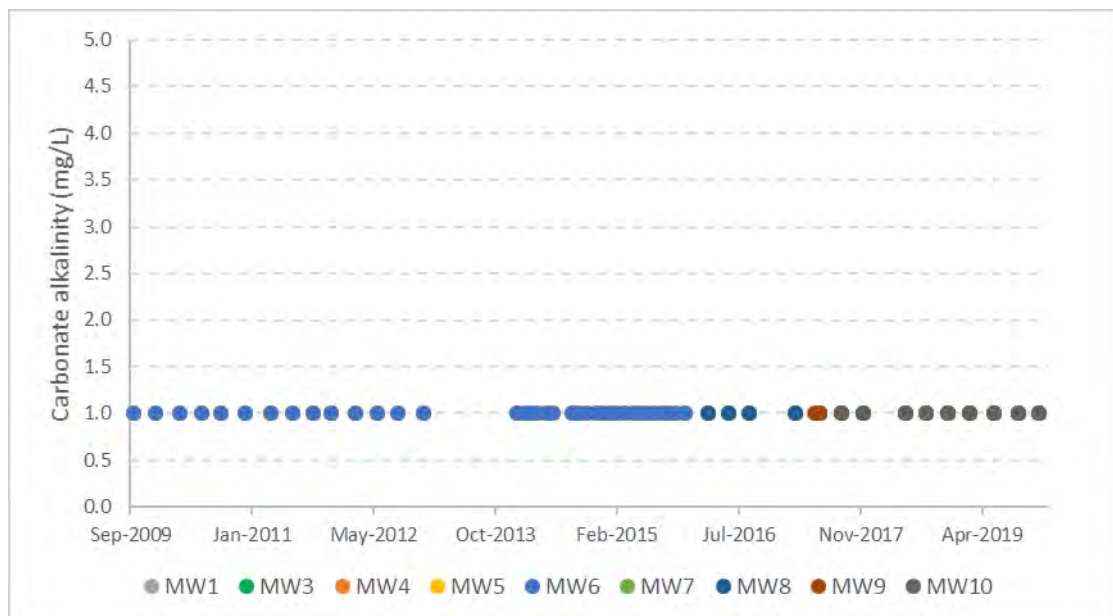
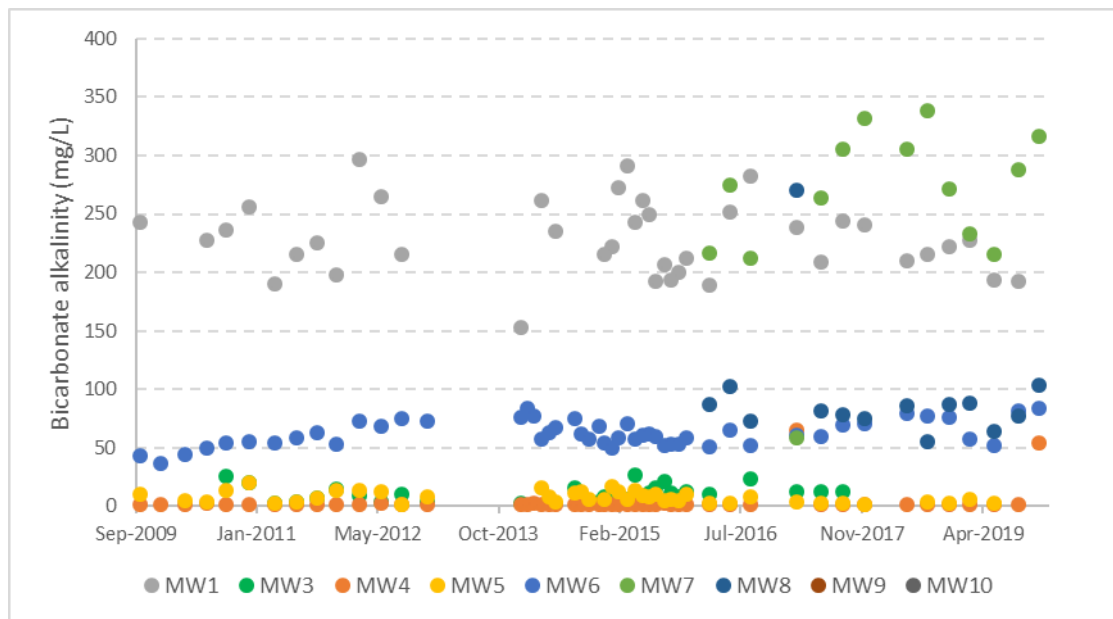


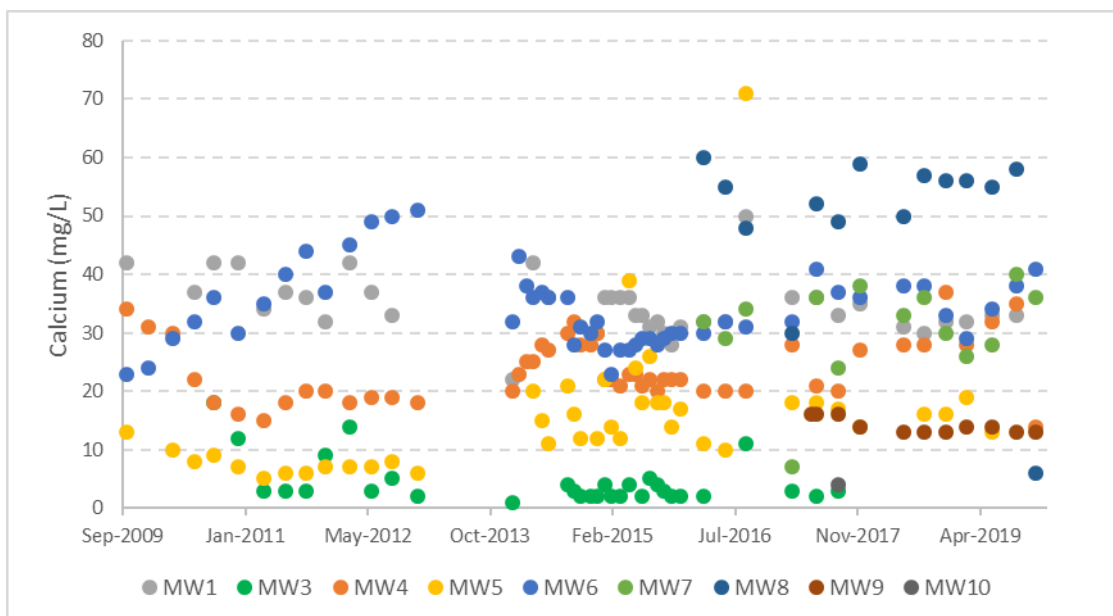
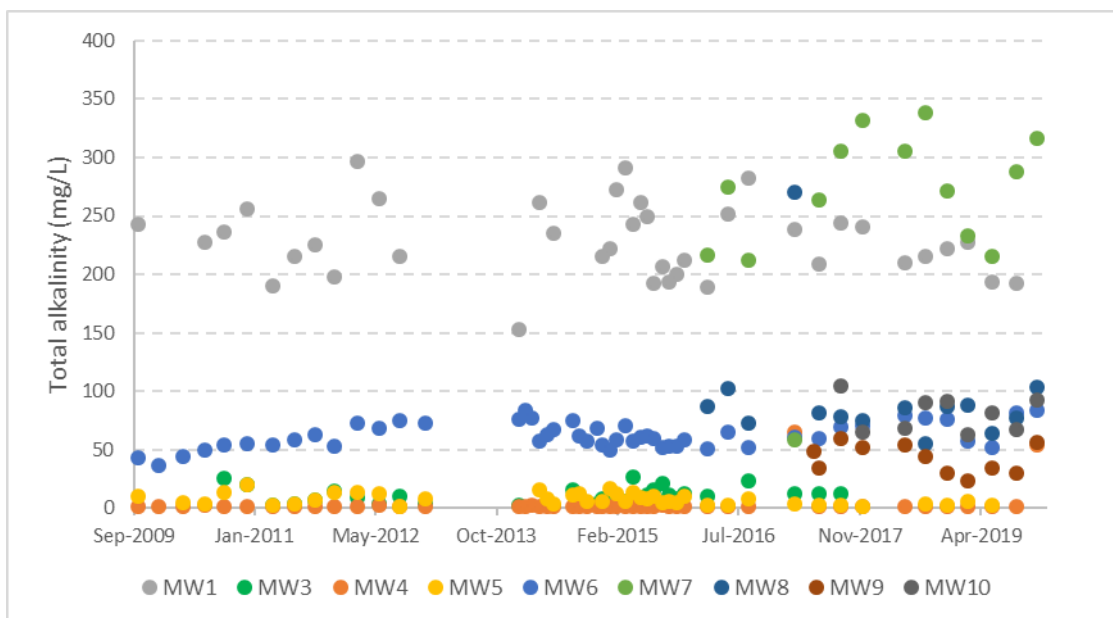
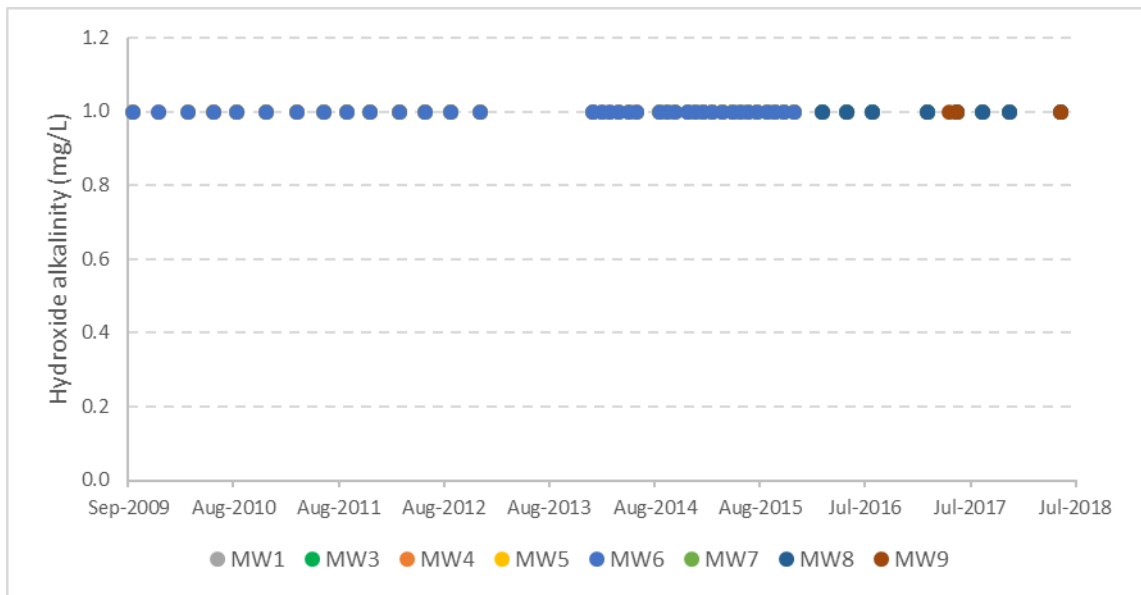
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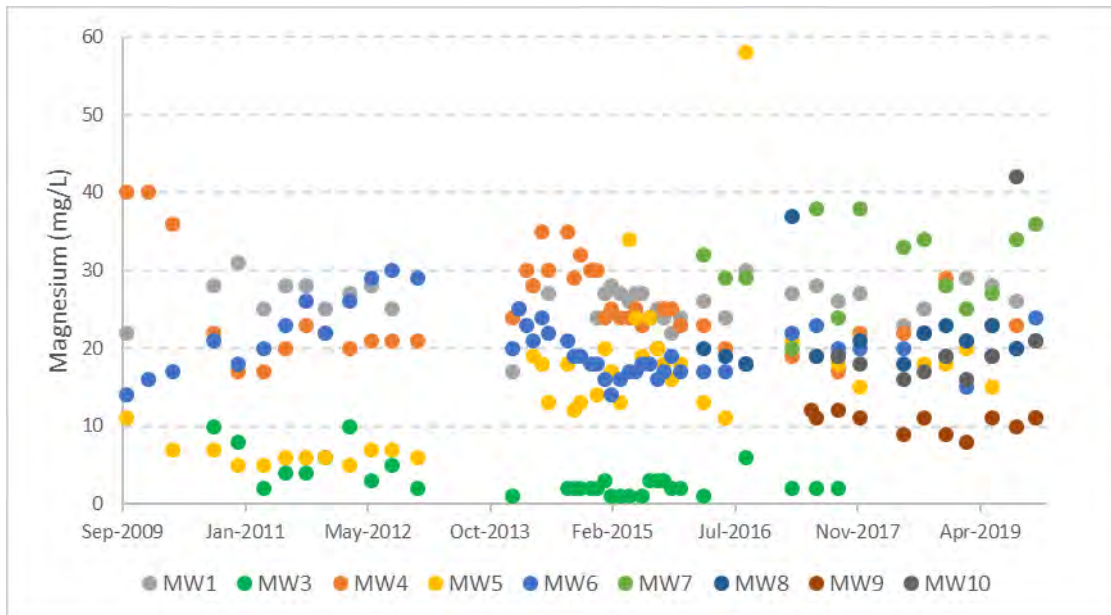
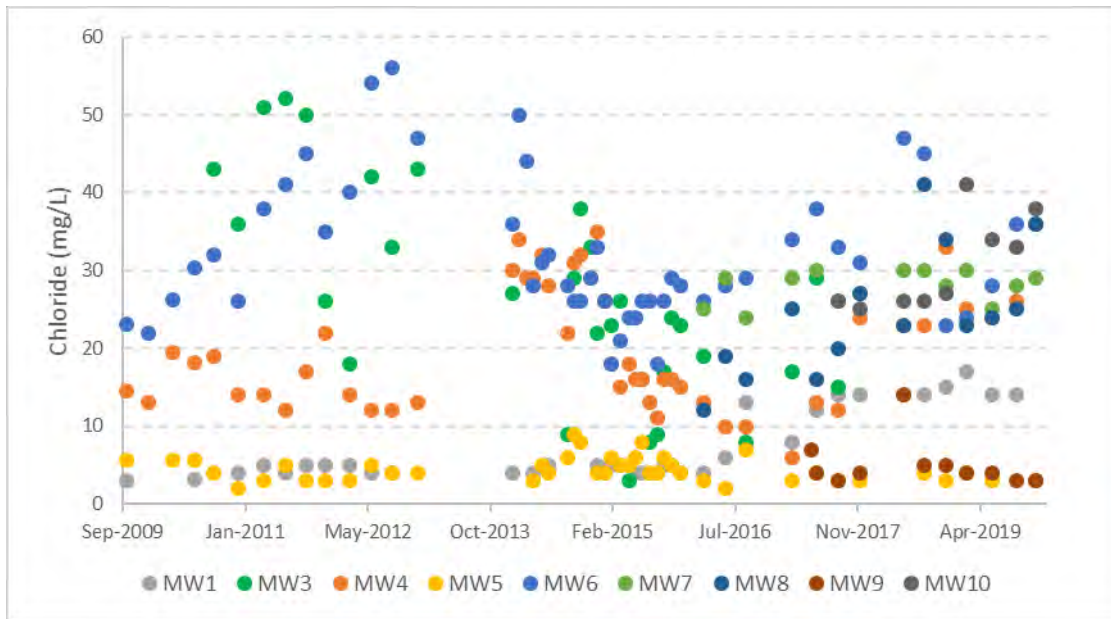


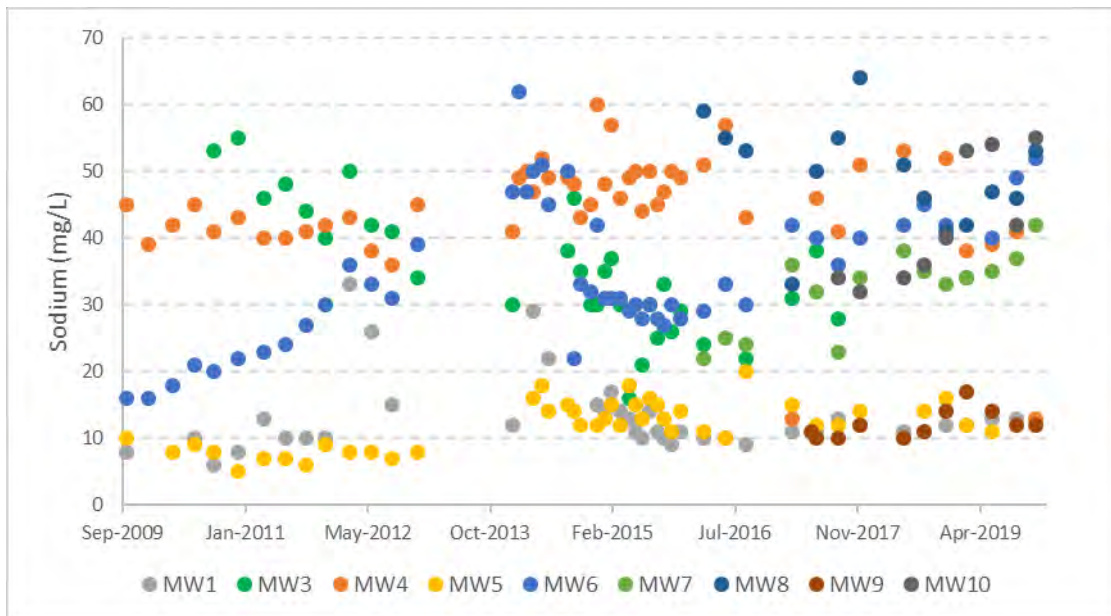
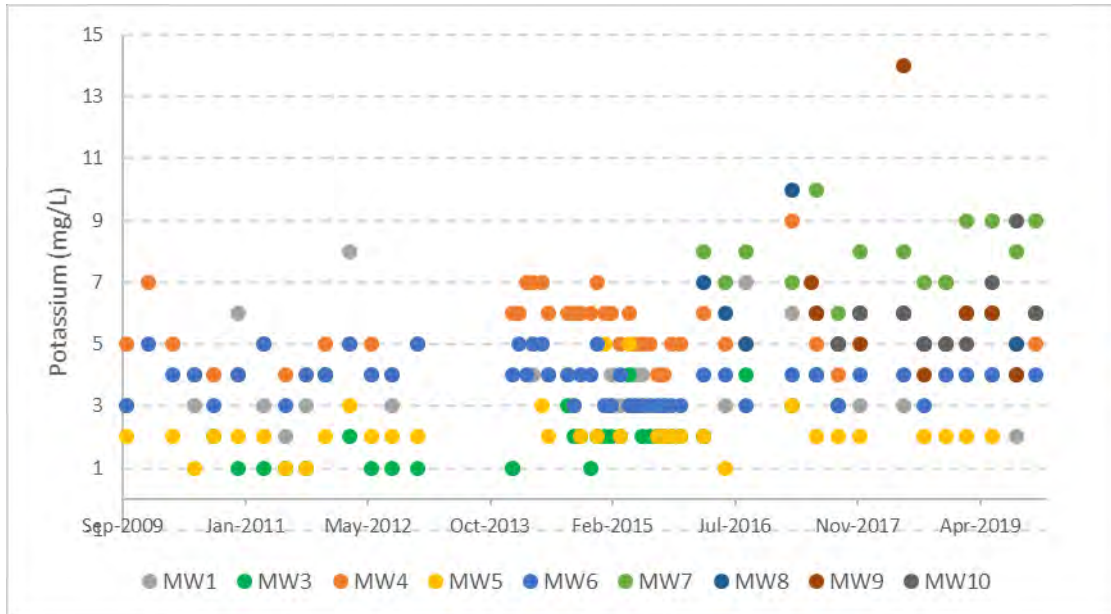


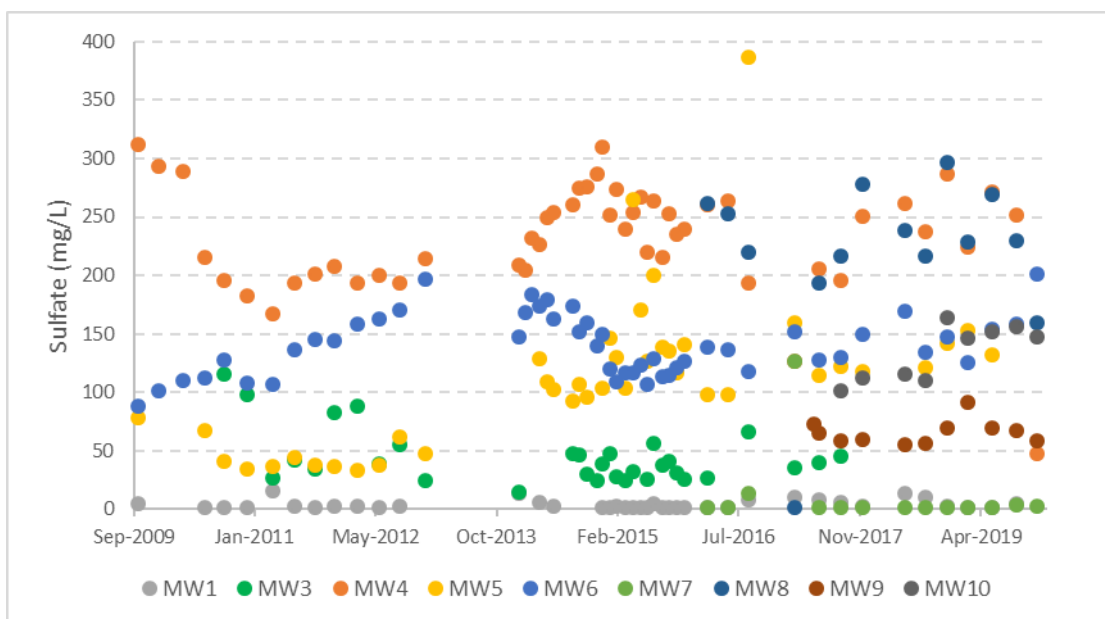
Major ions



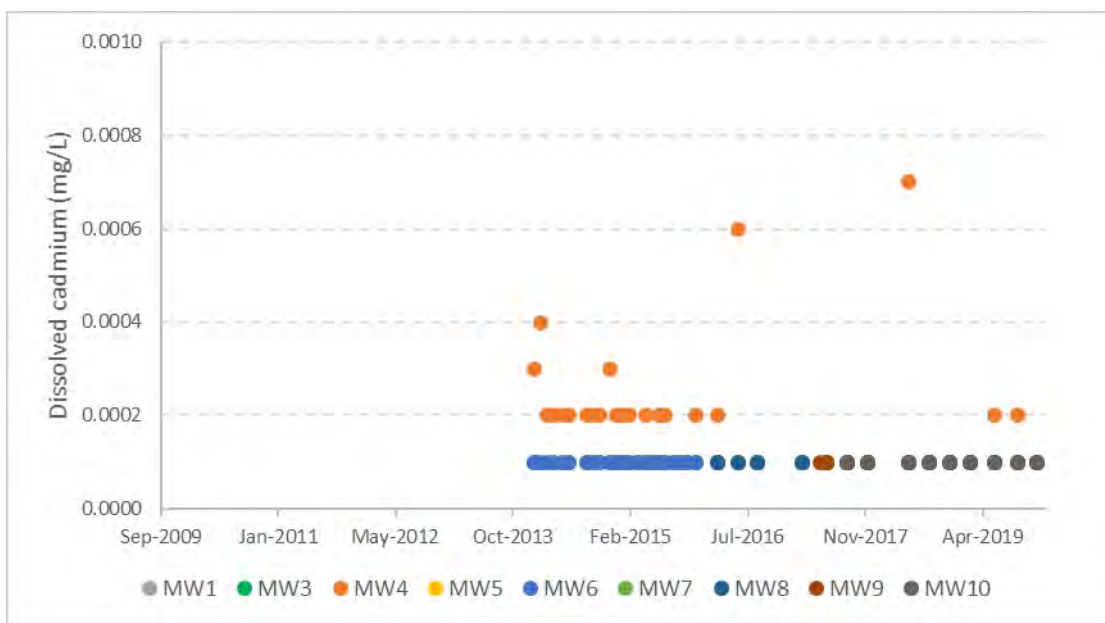


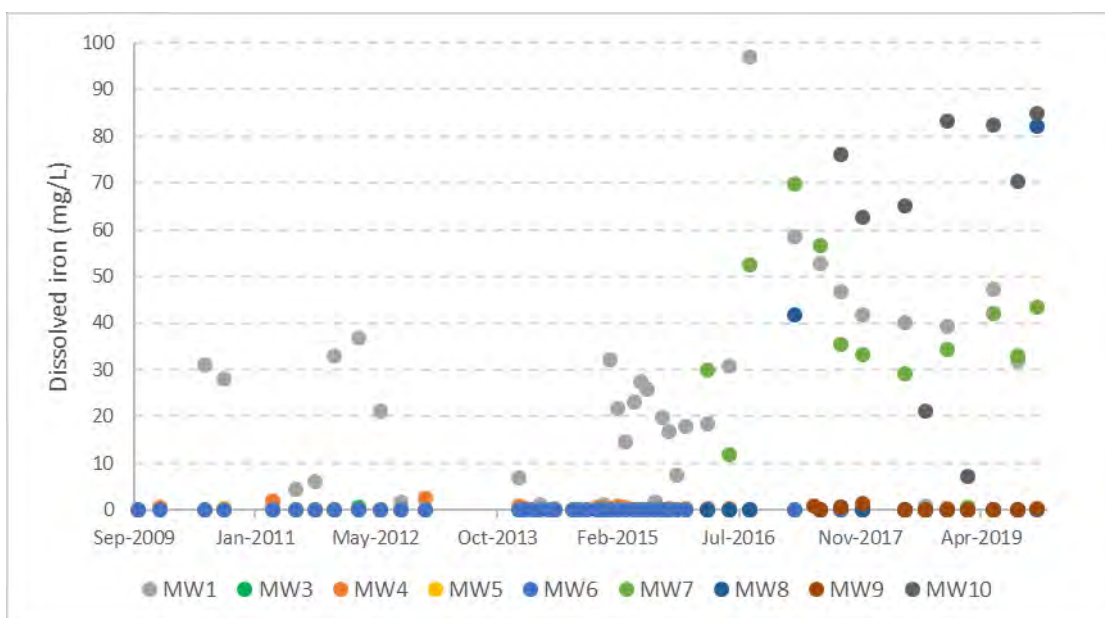
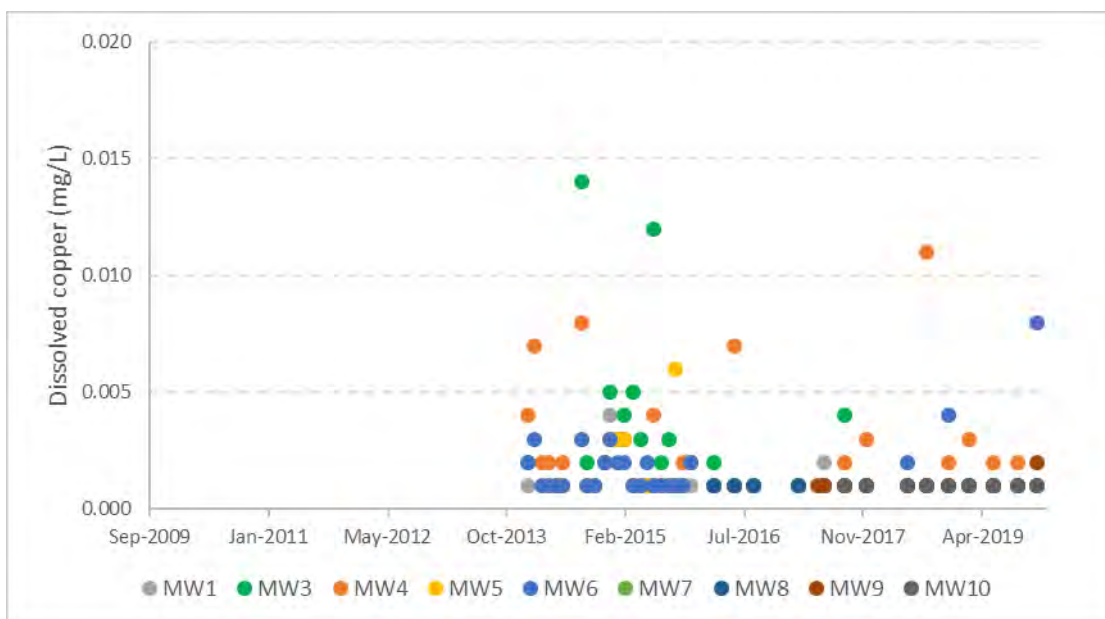


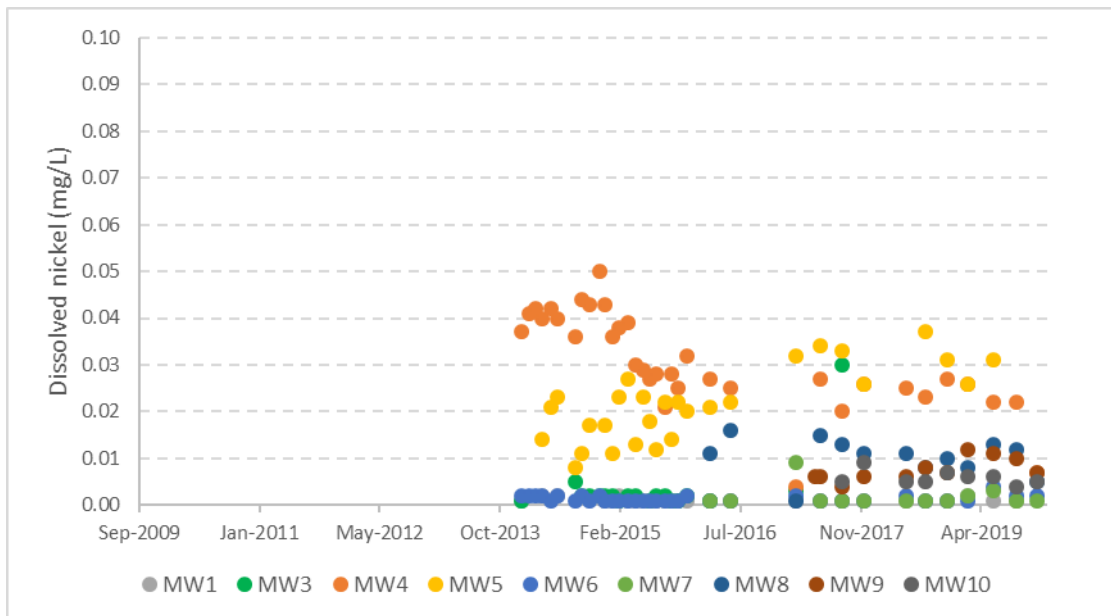
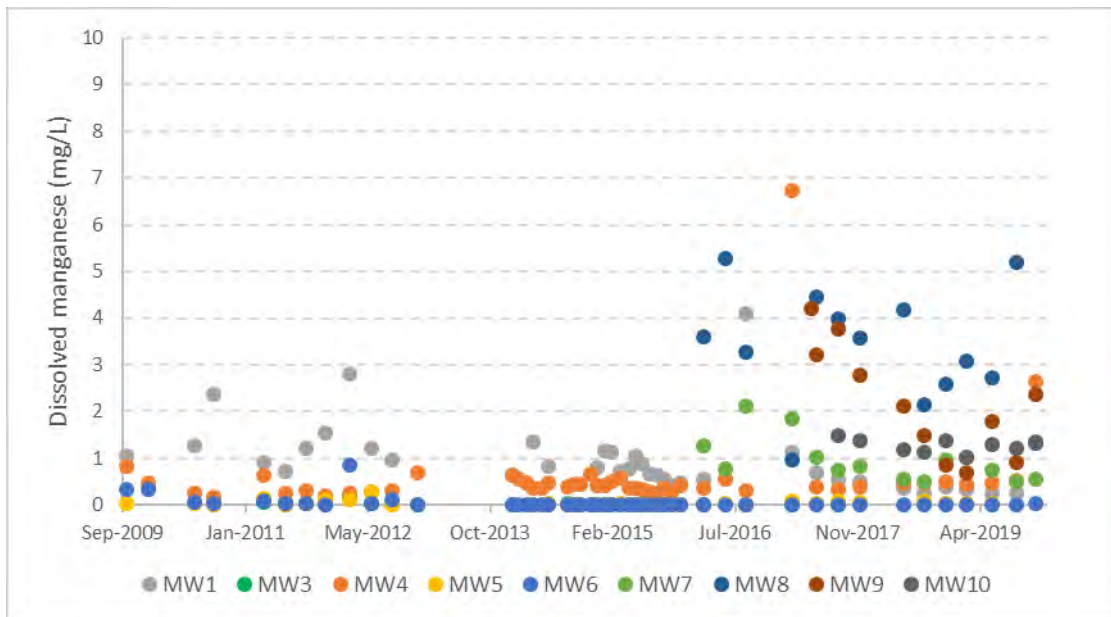




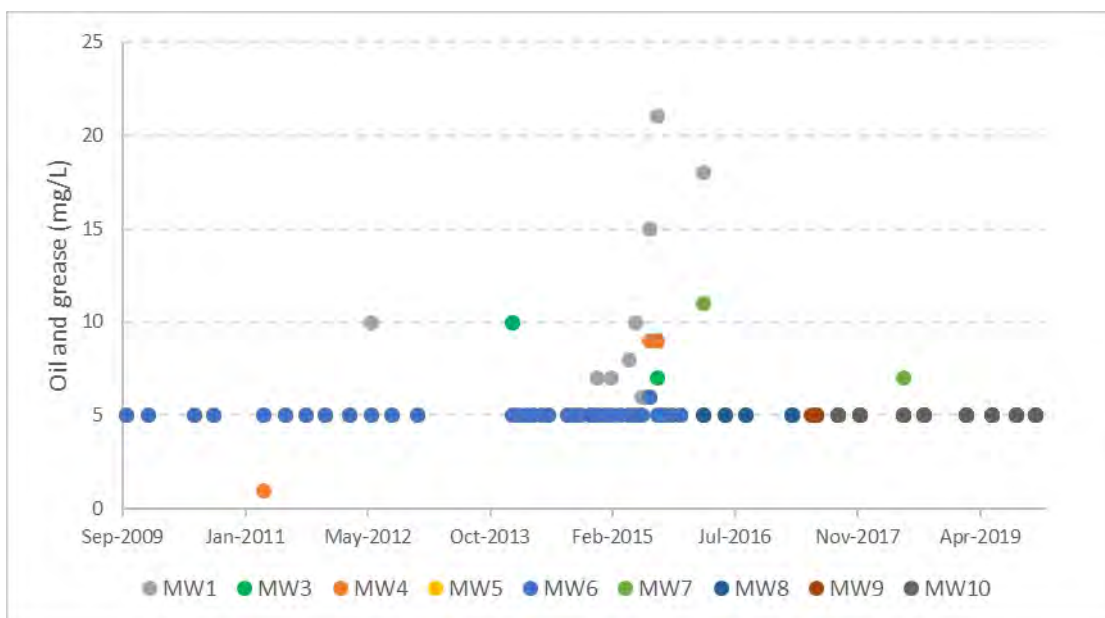
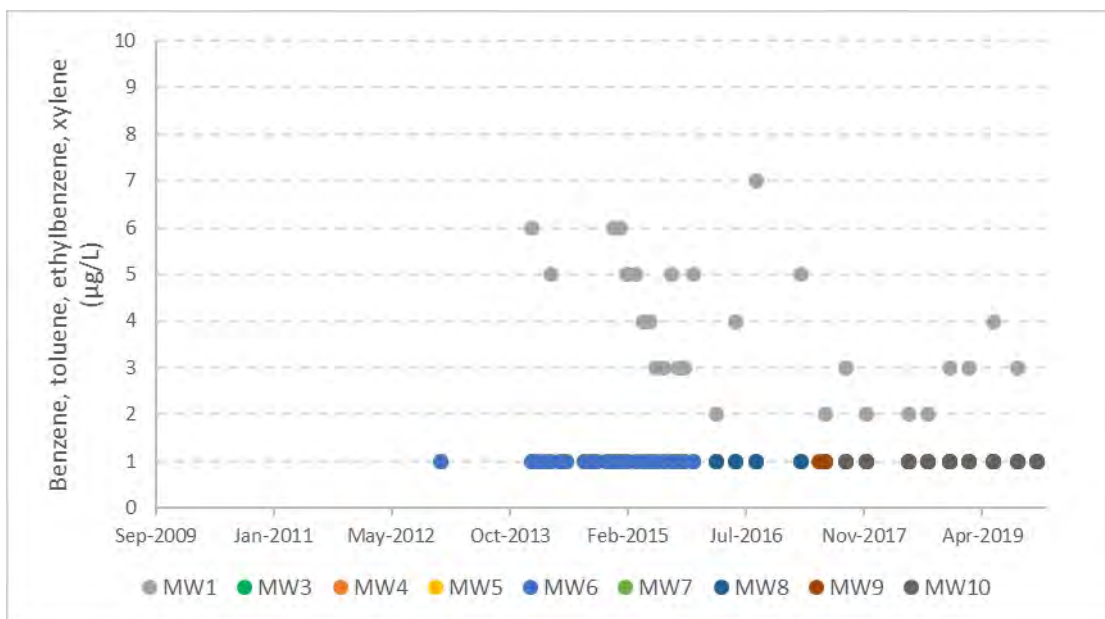
Dissolved metals

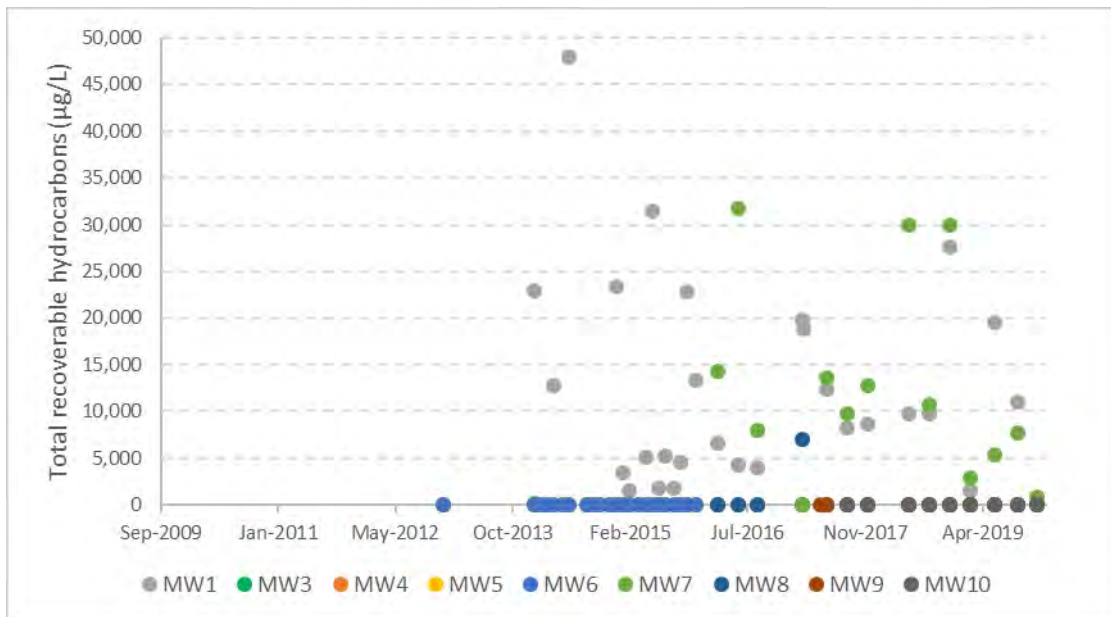




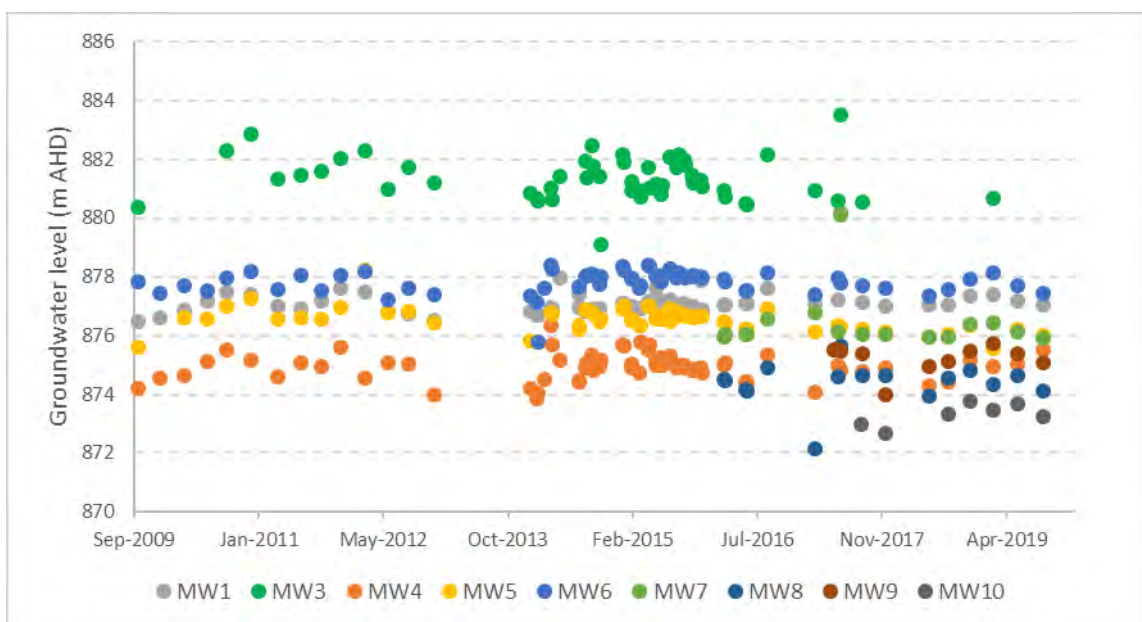


Other





C.3.2 Groundwater levels



APPENDIX D – Derivation of surface water quality triggers

D.1 Data requirements

ANZECC (2000) recommend that, for the purpose of deriving ambient concentrations and SSGVs, a sufficient amount of data needs to be collected and that it should characterise seasonal variations:

“A minimum of two years of continuous monthly data at the reference site is required before a valid trigger value can be established.”

D.2 Guideline values

Threshold guideline values may be derived from:

- ANZECC (2000) default values (consistent with water quality objectives).
- Limits specified in relevant EPLs and development consents.
- SSGVs derived or recommended using site-specific water quality monitoring data.
- Local ecotoxicity testing.

ANZECC (2000) define guideline values as:

“...the concentrations (or loads) of the key performance indicators measured for the ecosystem, below which there exists a low risk that adverse biological (ecological) effects will occur. They indicate a risk of impact if exceeded and should ‘trigger’ some action, either further ecosystem specific investigations or implementation of management/remedial actions.”

D.3 Water quality objectives

Environmental values associated with the waterways and water sources within the area surrounding Lidsdale Siding include primary industry, aquatic ecosystems, recreational users, irrigation and stock watering. In this assessment, the guideline values from the ANZECC (2000) guidelines for the protection of 95% of aquatic species have been used, as they are considered to be the most sensitive and, regardless of the current water quality present within the receiving environment, foster an improved water quality standard in the future.

D.4 Ecosystem condition

The ANZECC (2000; Section 3.1.3.1) guidelines recognise the following three categories of ecosystem condition, with a level of protection assigned to each:

- High conservation/ecological value systems.
- Slightly to moderately disturbed systems.
- Highly disturbed systems.

Pipers Flat Creek is considered to be a ‘slightly to moderately disturbed’ system, as the waterway has been adversely affected by human activities by a small to measureable degree.

D.5 Reference site

Monitoring site Pipers Flat Creek U/S has been selected as the most appropriate reference site to provide background data to derive SSGVs.

D.6 Default guideline values

Guideline values for many parameters are recommended by ANZECC (2000), which are usually derived from background assessments (physicochemical parameters and nutrients) and ecotoxicity studies (toxics) and are not specific to the site studied. These guideline values should be considered as DGVs and their suitability should be verified by establishing local background conditions. DGVs were selected from the ANZECC (2000) guidelines, with state derived guideline values preferred to regionally derived guideline values.

Within the ANZECC (2000) guidelines, Pipers Flat Creek falls into two different categories of ecosystem protection depending on the parameter reviewed, as identified in Table D-1.

Table D-1 ANZECC (2000) protection categories

Parameter	Category
Physicochemical parameters and nutrients	NSW upland river (ANZECC 2000; Table 8.2.2 to 8.2.12)
Metals and toxics	Freshwater category (ANZECC 2000; Table 3.4.1), with 95% species protection for slightly-moderately disturbed ecosystems.

A list of the DGVs recommended by ANZECC (2000) to assess water quality in the absence of adequate reference site monitoring data is presented in Table D-2. Note that no hardness correction factors have been applied to any DGVs.

Table D-2 ANZECC (2000) default guideline values

Parameter	Units	DGV	Comments
Physicochemical			
EC	µS/cm	350	NSW upland river (Table 8.2.9).
pH	pH units	6.5–9.0	NSW upland river (Table 8.2.8).
TSS	mg/L	25	NSW upland river (Table 8.2.12).
Turbidity	NTU	25	NSW upland river (Table 8.2.11).
Nutrients			
Ammonia	mg/L	0.9	Freshwater guideline for 95% species protection (Table 3.4.1). Applies for pH 8.
Nitrate	mg/L	0.7	Freshwater guideline for 95% species protection (Table 3.4.1).
Total nitrogen	mg/L	0.2	NSW upland river (Table 8.2.2).

Parameter	Units	DGV	Comments
Total phosphorus	mg/L	0.02	NSW upland river (Table 8.2.3).
Dissolved metals			
Aluminium	mg/L	0.055	Freshwater guideline for 95% species protection (Table 3.4.1). Applies for pH>6.5.
Arsenic	mg/L	0.024	Freshwater guideline for 95% species protection for As (III) (Table 3.4.1).
Boron	mg/L	0.37	Freshwater guideline for 95% species protection (Table 3.4.1).
Cadmium	mg/L	0.0002	Freshwater guideline for 95% species protection (Table 3.4.1).
Chromium	mg/L	0.001	Freshwater guideline for 95% species protection (Table 3.4.1).
Cobalt	mg/L	0.0025	Canadian guideline value.
Copper	mg/L	0.0014	Freshwater guideline for 95% species protection (Table 3.4.1).
Iron	mg/L	0.3	Canadian guideline as recommended by ANZECC (2000; Section 8.3.7.1).
Lead	mg/L	0.0034	Freshwater guideline for 95% species protection (Table 3.4.1).
Manganese	mg/L	1.9	Freshwater guideline for 95% species protection (Table 3.4.1).
Mercury	mg/L	0.0006	Freshwater guideline for 95% species protection (Table 3.4.1).
Nickel	mg/L	0.011	Freshwater guideline for 95% species protection (Table 3.4.1).
Selenium	mg/L	0.011	Freshwater guideline for 99% species protection (Table 3.4.1).
Silver	mg/L	0.00005	Freshwater guideline for 95% species protection (Table 3.4.1).
Zinc	mg/L	0.008	Freshwater guideline for 95% species protection (Table 3.4.1).

D.7 Data below the limit of reporting

When the analytical result was below the limit of reporting for a particular parameter, then the detection limit was included in the calculation. This is one of the approaches recommended by ANZECC (2000; Section 6.2.1). Table D-3 identifies the limit of reporting for each water quality parameter monitored at Pipers Flat Creek U/S used to derive SSGVs.

Table D-3 Limit of reporting for water quality parameters

Parameter	Units	Limit of reporting
Physicochemical		
EC	µS/cm	1
pH	pH units	0.1
TSS	mg/L	5
Turbidity	NTU	1
Nutrients		
Nitrate	mg/L	0.01
Dissolved metals		
Cadmium	mg/L	0.0001
Copper	mg/L	0.001
Iron	mg/L	0.05
Manganese	mg/L	0.001
Nickel	mg/L	0.001
Zinc	mg/L	0.005

D.8 Derivation of site-specific guideline values

SSGVs were derived on the basis of the methodology outlined by ANZECC (2000) by calculating the 80th percentile of data collected at the reference site (and 20th percentile for parameters reported as a range, for example pH). Table D-4 presents the surface water quality data for Pipers Flat Creek U/S. The 80th percentile values for water quality data at Pipers Flat Creek U/S have been calculated from the most recent 24 monthly samples. As samples have been collected for over two years, the dataset covers a range of seasonal, climatic and flow conditions. Where the analytical result was below the LOR for a particular parameter, then the detection limit was used in the calculation.

Table D-4 Statistical analysis of Pipers Flat Creek U/S water quality results

Parameter	Units	Count	80th percentile
Physicochemical			
EC	µS/cm	24	1,000
pH	pH units	24	7.0 ^a –7.6
TSS	mg/L	24	7.4
Turbidity	NTU	24	8.4
Nutrients			
Nitrate	mg/L	24	0.58
Dissolved metals			
Cadmium	mg/L	24	0.0001 ^b
Copper	mg/L	24	0.001 ^b
Iron	mg/L	24	0.188
Manganese	mg/L	24	0.192
Nickel	mg/L	24	0.003

^a 20th percentile value.

^b Limit of reporting.

The 80th percentile values for water quality data collected at the reference site Pipers Flat Creek U/S were then compared with the DGVs recommended by ANZECC (2000), presented in Table D-2.

Table D-5 presents the DGVs recommended by ANZECC (2000), 80th percentile values for Pipers Flat Creek U/S and the recommended SSGV.

Table D-5 Recommended guideline values

Parameter	Units	DGV (ANZECC 2000)	Pipers Flat Creek U/S 80th percentile	Recommended SSGV
Physicochemical				
EC	µS/cm	350	1,000	1,000
pH	pH units	6.5–9.0	7.0 ^a –7.6	6.5–9.0
TSS	mg/L	25	7.4	25
Turbidity	NTU	25	8.4	25

Parameter	Units	DGV (ANZECC 2000)	Pipers Flat Creek U/S 80th percentile	Recommended SSGV
Nutrients				
Ammonia	mg/L	0.9	–	0.9
Nitrate	mg/L	0.7	0.58	0.7
Total nitrogen	mg/L	0.2	–	0.2
Total phosphorus	mg/L	0.02	–	0.02
Dissolved metals				
Aluminium	mg/L	0.055	–	0.055
Arsenic	mg/L	0.024	–	0.024
Boron	mg/L	0.37	–	0.37
Cadmium	mg/L	0.0002	0.0001 ^b	0.0002
Chromium	mg/L	0.001	–	0.001
Cobalt	mg/L	0.0025	–	0.0025
Copper	mg/L	0.0014	0.001 ^b	0.0014
Iron	mg/L	0.3	0.188	0.3
Lead	mg/L	0.0034	–	0.0034
Manganese	mg/L	1.9	0.192	1.9
Mercury	mg/L	0.0006	–	0.0006
Nickel	mg/L	0.011	0.003	0.011
Selenium	mg/L	0.011	–	0.011
Silver	mg/L	0.00005	–	0.00005
Zinc	mg/L	0.008	–	0.008

^a 20th percentile value.

^b Limit of reporting.

APPENDIX E – Flood management plan



Ivanhoe Coal Pty Ltd
Lidsdale Siding
Flood Management Plan

October 2016

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1. Introduction

1.1 Purpose of this report

This report builds on works carried out by Aurecon in 2014. This report overarches the modelling works completed and connects the modelling undertaken to the Project conditions of consent (08_0223) as indicated in Table 1-1 below. Between this document and the Flood Assessment provided in Appendix B, the Project conditions of consent (08_0223) have been addressed.

Table 1-1 provides a reference to where each requirement has been addressed.

Table 1-1 Project conditions of consent (08_0223)

Requirement	Where Addressed
a) be prepared in consultation with EPA and SCA by suitably qualified and experienced persons whose appointment has been approved by the Director-General;	Section 2
(b) be submitted to the Director-General for approval within 12 months of the date of this approval; and	Original flood assessment prepared and issued within 12 months of 08_0223 approval.
(c) include: • an assessment of the risk of flooding at the site;	Flood Assessment (Aurecon 2014), Appendix B
• an assessment of the implications of flooding on operations at the site (including the functioning of the surface water management system) and the risks associated with off-site contamination;	Flood Assessment (Aurecon 2014), Appendix B Off-site contamination risk – Section 3
• modelling of the effects of proposed flood mitigation and control measures, (such as Willow removal from the channel of Pipers Flat Creek), by the use of a calibrated hydrological model;	Flood Assessment (Aurecon 2014), Appendix B
• investigation of any other measures to reduce the impacts of flooding at the site;	Flood Assessment (Aurecon 2014), Appendix B
• identify any additional reasonable and feasible flood mitigation and control measures; and	Flood Assessment (Aurecon 2014), Appendix B
• a commitment and timetable for the implementation of these measures	Section 4

Aurecon undertook flood modelling of Pipers Flat Creek to determine the existing 1, 2, 5, 10, 20 and 100 year Average Recurrence Interval (ARI) flood events that have the potential to impact on the Lidsdale Siding site.

At the time of the assessment in 2014, site works were underway for the upgrade to existing coal handling facilities. This work has now been completed and works are underway to implement flood mitigation options.

The flood maps from Aurecon's assessment have been reproduced in Appendix A.

The schedule of works related to the mitigation of potential flood impact is further discussed in Section 4.1.

1.2 Water management features and assessment extent

1.2.1 Water management features

Lidsdale Siding water management includes three key surface water features:

- Dirty Water Dam.
- Triangle Pond.
- Transfer Tank.

The Dirty Water Dam receives surface water runoff from coal stockpiles and coal loading areas as well as the return flow from the vehicle and plant washdown and dust suppression. Water is supplied to the Transfer Tank from the dam.

The Dirty Water Dam provides a primary settling and treatment function. The dam has a weir structure leading to a culvert below the access road and railway line draining to the Triangle Pond.

The Triangle Pond captures surface water runoff from the northern part of the site and overflows from the Dirty Water Dam. Water is supplied to the Transfer Tank from the pond. The Triangle Pond acts as a final sediment settling storage. Overflows from the pond occur via a spillway through LDP004 to Pipers Flat Creek during high rainfall events.

The Transfer Tank is supplied by transfers from the Dirty Water Dam and Triangle Pond as well as extractions from the production bore and make-up water sourced from the Lithgow City Council potable water supply system. Water used for vehicle and plant washdown and dust suppression is supplied from the Transfer Tank.

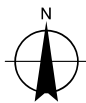
These water management features provide water quality management controls for the local site catchments.

1.2.2 Assessment extent

The assessment extent for flooding around the Lidsdale Siding site considered hydraulic conditions in both Cocks River and Pipers Flat within an area shown in Figure 1-1. The modelled extent allowed for the consideration of boundary conditions that influence creek hydraulics adjacent to the Lidsdale Siding operations.



Paper Size A4
0 25 50 100 150 200 250
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



LEGEND

- Licensed Discharge Point
- Production bore
- Transfer tank
- Water Storage
- Assessment extent
- Watercourse - Non Perennial
- Watercourse - Perennial



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Lidsdale Siding
Flood Management Plan

Job Number 22-18559
Revision 0
Date 10 Oct 2016

Site features

Figure 1-1

G:\22\010500\1\GIS\Maps\Deliverables\Western\Lidsdale Siding\2218559\Additional\Flooding\2218559_AFI019_SiteFeatures_0.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntmail@ghd.com W www.ghd.com.au

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Data source: LPI: DCDB, 2012; Centennial: LDP, 2013, Site features, 2016; Centennial: Aerial imagery, 2016; Geoscience Australia: 250k Topographic Data Series 3, 2006. Created by: smacdonald, tmorton

2. Consultation

The Lidsdale Flood Assessment was prepared in consultation with the EPA, Department of Planning and WaterNSW. The outcomes of this consultation is provided in the sections below. Evidence of consultation is provided in Appendix C

2.1 Department of Planning and Environment

A review of the Aurecon Flood Assessment (refer to Appendix B) was undertaken by Department of Planning and Environment in 2014. The review of the report resulted in the following requirements:

- Evidence of consultation with agencies.
- An assessment of the risks associated with off-site contamination in the event of flood events.
- Specific commitment and timetable for the implementation of the recommendations.

These requirements requested by Department of Planning and Environment have been addressed as part of this report.

2.2 Environment Protection Authority

The Environment Protection Authority (EPA) NSW reviewed the flood study model report by Aurecon in 2014.

EPA indicated, via a letter dated 10 July 2014, that they had no comments on the document but indicated that they support any works required to prevent Pipers Flat Creek from entering the Lidsdale Siding site.

2.3 WaterNSW

WaterNSW, (then Sydney Catchment Authority), via email dated 1 July 2014, stated that the Aurecon Flood Assessment satisfactorily responded to their recommendations, in particular, the need to include an assessment and response to the impact on the facility's stormwater management systems.

WaterNSW supports the approach to construct a new bund along the rail line, inclusive of additional earthworks and bunding downstream in the affected flood areas, to mitigate the risk of coal fines and sediment entering the waterways.

WaterNSW further supports the proposed Willow Tree and debris removal from Pipers Flat Creek to improve channel flow capacity.

3. Contamination risk assessment

3.1 Background

A number of contamination assessments have been undertaken at Lidsdale Siding between 2009 and 2014. These have included:

- AECOM (2009) – *Contamination Investigation: Lidsdale Coal Loader and Rail Siding Facility*.
- Centennial Ivanhoe (2009) – *Lidsdale Siding Hydrocarbon Contamination*.
- AECOM (2013) – *Updated Phase 2 Contamination Assessment: Lidsdale Siding Upgrade Project*.
- SLR (2014a) – *Land Contamination Advice: Lidsdale Siding Upgrade Project*.
- SLR (2014b) – *Supplementary Contamination Delineation Assessment and Remedial Action Plan: Lidsdale Siding Upgrade Project*.

3.2 Sources of potential impact to water quality

Given the site is primarily a stockpile area for export via the rail, there is a potential risk of coarse coal material being transported off-site if flood water inundates stockpile areas and achieve a velocity substantial enough to transport material offsite. Along with coal material, the site has a proportion that is not sealed and hence total suspended solids are likely to become mobile with areas of the facilities that become inundated.

3.3 Known areas of on-site contamination

A diesel spill of approximately 20,000 L occurred at a former above ground storage tank (AST) at Lidsdale Siding in the 1970's. Some remedial works were undertaken at the time of the spill, however residual petroleum hydrocarbon contamination is present in soils at the spill site and in groundwater underlying the site. SLR (2014b) estimated an area of environmental concern, which is shown in Figure 3-1, based on soil sampling and analysis of petroleum hydrocarbon contaminants. The contamination was found to extend across an area of at least 1,500 m² and was present to depths of between 0.3 m and 3.8 m (SLR 2014b).

Groundwater monitoring of the hydrocarbon contamination has been undertaken biannually since 2009 for monitoring bores MW1 to MW8, as shown on Figure 3-1. Monitoring has tracked attenuation of hydrocarbon contamination. The development of a Trigger Action Response Plan indicated that if a positive result for total recoverable hydrocarbons (TRH) in any down gradient bore occurs (i.e MW4, MW7 and MW8) a full suite of TPH and BTEX sampling will be undertaken.

A summary of the monitoring results over the last two years (up to February 2016) has generally indicated:

- Production bore quality indicated concentrations greater than limit of reporting for the C15 - C28 fraction during August to October 2014. No sampling has been undertaken on the bore since.
- MW1 monitoring indicated sustained concentrations of TRH for the C6 to C36 fractions along with BTEX concentrations between 2 to 6 mg/L.
- MW2 monitoring has now ceased.

- MW4 has had no results greater than limit of reporting for BTEX since July 2015. With no recent result greater than limit of reporting for TRH fractions of C6 to C36.
- MW7 and MW8 have only had one round of monitoring (February 2016) since being installed. They indicate a positive result for concentrations of TRH in the fraction C10-C36 for MW7 but results less than the limit of reporting for MW8.

The Water Management Plan developed by RPS (2014) indicated that due to natural attenuation, isolated nature of the source, and the distance to Pipers Flat Creek, off-site migration is highly unlikely in average conditions. This is further supported by the development of a conceptual model for the evaluation how flooding may influence this outcome. Figure 3-2 presents the conceptual model.

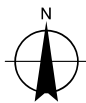
As part of the Water Management Plan (RPS 2014) a model was developed to quantify how off-site migration might occur. A simple one dimensional advection-dispersion model (not verified by GHD) was developed to determine the potential travel times for a contaminant plume to migrate from MW1 to MW8. It was determined that migration off-site would be in the order of 8 to 11 years with a peak plume expected around 19 to 24 years. The critical assumptions in the development of this time frame are the actual aquifer permeability which may increase the predicted timeframes given a series of conservative assumptions already taken by RPS in their predictions.

Commitments made within the current Water Management Plan are to monitor for TRHs for the life of operations. Until it is demonstrated that levels of contamination are attenuating across the monitoring wells monitoring for TRHs will continue.

Monitoring programs are under revision with all requirements and commitments outlined within the Lidsdale Siding site specific water management plan.



Paper Size A4
0 25 50 100 150 200 250
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



LEGEND

- Licensed Discharge Point
- Groundwater monitoring bore
- Water Storage
- Assessment extent

- Watercourse - Non Perennial
- Watercourse - Perennial
- Contamination area (SLR 2014)
- Conceptual model cross section (refer Figure 3-2)



Centennial Coal

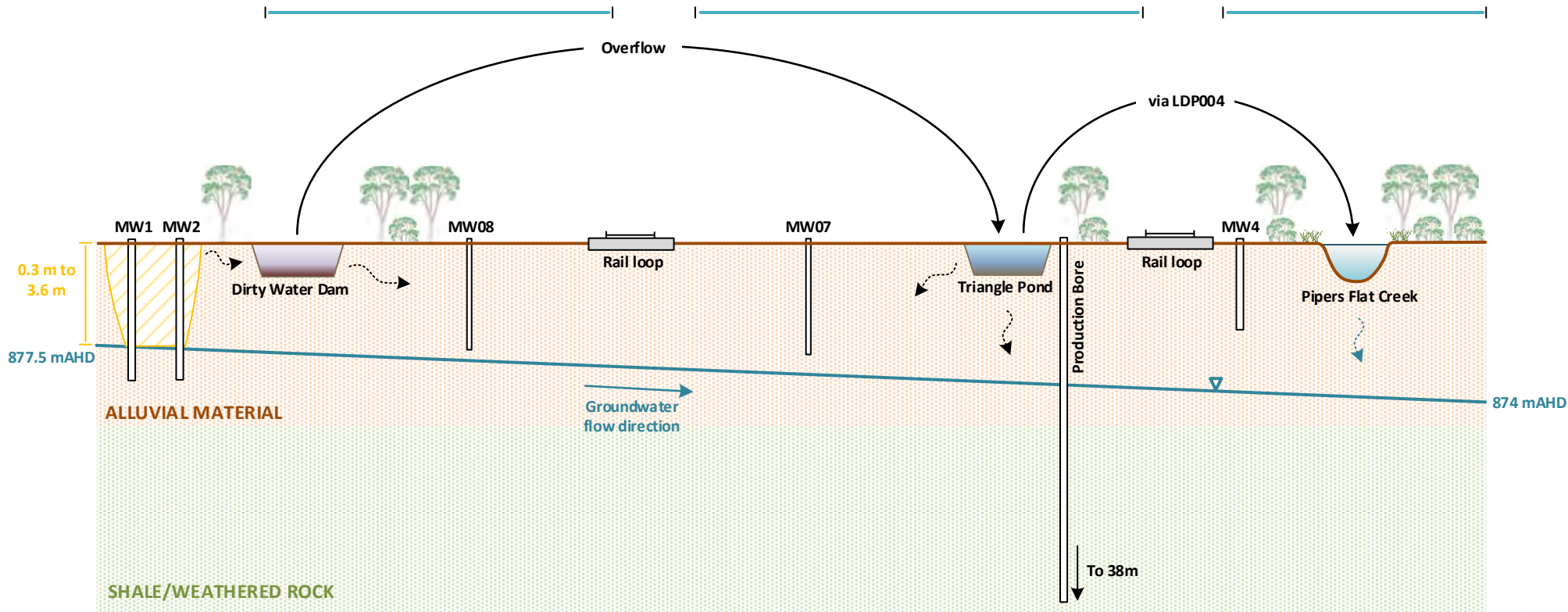
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Lidsdale Siding
Flood Management Plan

Areas of known site
contamination

Job Number 22-18559
Revision 0
Date 10 Oct 2016

Figure 3-1

APPROXIMATE FLOOD IMPACT EXTENTS:



SOIL LANDSCAPE CATEGORIES:



- Migration pathway
- Groundwater flow direction
- Contamination study area
- Area subject to flooding

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LOCATION	Lidsdale Siding
SEAM	NA
DRAWN	SM
CHECKED	LH
APPROVED	LH
SCALE	NTS

Ivanhoe Coal Pty Ltd
Lidsdale Siding
Flood Management Plan
Conceptual Model for Contamination Risk



Centennial Coal

DATE Oct 2016 Figure 3-2

3.4 Flooding frequency and extent

To aid in the understanding of the flood dynamics and extents, each set of predictions from the events modelled were summarised below.

For the 1 year ARI event:

- Flooding dominated by local site runoff to minor drainage lines.
- No flooding within the rail triangle.
- Velocity highest within channelised areas.

For the 2 year ARI event:

- Flooding cross the railway south of the Lidsdale Siding facilities area
- Velocities within channelised areas increase slightly.

For the 5 year ARI event:

- Flooding within rail triangle occurs.
- Extended flooding south of the Lidsdale Siding facilities area.
- Backwater effects from Pipers Flat begin to influence the southern portions of the facilities area but not impede on operational areas.
- Velocities in flood flow paths fringing the site occur between 1 to 2 m/s.

For the 10 year ARI event:

- Slightly increased flood depth and extent to 5 year ARI predictions.
- Backwater effects from Pipers Flat influence the southern portions of the facilities area but not impede on operational areas.

For the 20 year ARI event:

- Flooding impedes on stockpile and coal handling area from the south at a shallow depth. Stockpile and coal handling pad elevation has been since raised to be outside of the inundation area. Works undertaken following completion of Aurecon Flood Assessment.
- No flooding of reclaim tunnel occurs.

For the 100 year ARI event:

- Railway extensively overtopped along the western boundary of the operations area.
- Operational pad area inundated but below the invert of the reclaim tunnel. Pad elevation has been since raised to be outside of the inundation area. Works undertaken following completion of Aurecon Flood Assessment.
- Velocity over operational area is less than 0.5 m/s, however small flows paths up to 1.5 m/s velocity were predicted.

3.5 Risk Assessment

A risk assessment was undertaken for flooding resulting in contamination off-site. The criteria for the assessment is provided in Section 3.5.1 with the outcomes from the assessment provided in Section 3.5.2.

3.5.1 Criteria

The following consequence criteria in Table 3-1 were developed in response to the need to apply a risk rating to contamination being transported by flood waters.

Table 3-1 Criteria for Consequence

Consequence Level	Negligible	Minor	Moderate	Major	Extreme
Impact descriptor	Negligible on-site/off-site environmental impact and of low significance	On-site/off-site environmental localised impact, immediately contained	On-site/off-site environmental short term impact, immediately recoverable	On-site/off-site environmental medium term impact or repeated non-compliance with potential in some jurisdictions for prosecution	Significant on-site/off-site environmental long term harm that is not recoverable. Significant fines and prosecution at company and individual level may apply in some jurisdictions
Typical extent	Very localised scale	Zone of influence is tens of metres	Zone of influence is several kilometres	Zone of influence is several kilometres	Zone of influence is several kilometres

With respect to the probability of likelihood a range from very unlikely through to almost certain was adopted, where a 1 year ARI event can be seen to be a likely occurrence and 100 year ARI event a very unlikely likelihood.

The resulting risk rating matrix is provided in Table 3-2.

Table 3-2 Risk rating matrix

Frequency/Consequence	Negligible	Minor	Moderate	Major	Extreme
Almost certain (typically <1 year ARI)	Low	Moderate	Significant	Extreme	Extreme
Likely (typically 1 to 2 year ARI)	Low	Low	Moderate	Significant	Extreme
Possible (5 to 10 year ARI)	Negligible	Low	Moderate	Significant	Extreme
Unlikely (≥ 20 year ARI)	Negligible	Negligible	Low	Moderate	Significant
Very unlikely (≥ 100 year ARI)	Negligible	Negligible	Low	Moderate	Moderate

3.5.2 Assessment

The adoption of the above criteria was applied to the two key potential contamination mechanisms that may occur as a result of flooding. These are assessed in the Sections below.

Sources of potential impact to water quality

The specific gravity of coal was considered in the likely thresholds of velocity where coal stockpiles are likely to become mobile. Based on a permissible velocity of gravel 30 – 50 mm in diameter, velocity thresholds can vary between 0.8 to 1.8 m/s (Fischenich 2001) where a likely specific gravity of 2.8 was adopted, representative of basalt (Edumine 2016).

Based on the difference in specific gravity for coal (1.3) a likely corrected permissible velocity for stockpiles could be between 0.4 to 0.8 m/s. Given the predicted velocity of different events and the extent of flooding predicted, the likelihood of coal migration in a flood event is negligible (1 year ARI) to low (100 year ARI).

Flooding generally enters the site in events greater than or equal to a 20 year ARI. With the likelihood of any potential off-site impact occurring from coal or TSS being immediately recoverable following the event, the consequence category was determined to be low and hence risk ratings are also low.

Known areas of contamination

The site is constructed on 2 to 6 metres of alluvial material with some imported material throughout. The migration pathway from the contamination area into the dirty water storage is key to the potential migration to the triangle pond and potential risk off site. In the event of a 20 year ARI event, flooding is likely to create backwater impacts into the dirty water dam. The surface of the contamination area is unlikely to become flood effected in any of the flood events considered however the water levels within the adjoining dirty water dam may increase.

The flooding of the surface is unlikely to increase the speed at which contaminants can migrate through the site with groundwater flow during periods of flooding becoming slower as boundary heads increase. The risk rating for flooding increasing the risk of contaminants moving off-site is considered to be low as a result of risk occurring in events equal to and greater than a 20 year ARI and the identification of potential contaminant pathways.

4. Schedule of Works

4.1 Works

Works for the Willow removal (Option 1 in Aurecon 2014) commenced in July 2016. These works will be ongoing until December 2017.

Localised bunding options for the operations area started early 2016. Further investigations in mitigating backwater effects from Pipers Flat Creek are being undertaken throughout 2016 with implementation in 2017. These investigations will consider the potential implementation of floodgates, construction of diversion channels and the removal of existing bunding, as already indicated by Aurecon (2014) as option 2. Works relating to the removal of existing bunding within Pipers Flat Creek is likely to occur following the first stage of Willow removal.

The resultant flood afflux from the implementation of works options are shown on Figures provided in Section A3 of Appendix A.

4.2 Program

The schedule of works program is provided in Figure 4-1.

Lidsdale Flood Management Plan Task Name	2016												2017											
	Quarter 1			Quarter 2			Quarter 3			Quarter 4			Quarter 1			Quarter 2			Quarter 3			Quarter 4		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Engineering structures																								
Engineering investigations																								
Construction of localised bunding and investigations to mitigate backwater effects																								
Willow tree removal																								
<u>Stage 1</u>																								
Poison willows																								
Cut, removal, chip and transport willows																								
<u>Stage 2</u>																								
Poison remaining willows																								
Cut, removal, chip and transport remaining willows																								

Figure 4-1 Schedule of works

5. Management requirements and reviews

5.1 Surface water management

Lidsdale siding has a site-specific water management plan implemented on site (RPS; 2014). This management plan provides the framework for surface water monitoring and infrastructure management. The plan provides guidance and controls on the following:

- Site water management requirements.
- Monitoring requirements.
- Baseline data for the derivation of site management triggers.
- Roles and responsibilities.
- Response plans.

This plan is to be updated with the outcomes of the flood assessment and additional works within next 12 months.

5.2 Surface and groundwater monitoring

The current surface and groundwater monitoring undertaken at Lidsdale siding is provided in Table 5-1.

Table 5-1 Current surface and groundwater monitoring programs

Site Point	Sample location	Frequency	Parameters
LDP004	Sample taken from Triangle Pond	Monthly or daily during discharge	Daily: pH, EC, O&G, TSS Monthly: pH, EC, O&G, TSS
DWD	Dirty Water Dam	Quarterly	Quarterly: pH, EC, DO, NO ₃ , Na, K, Ca, Mg, Cl, SO ₄ , HCO ₃ , CO ₃ As, B, Cr, Cd, Cu, Fe, Mn, Ni, Pb, Zn
PFUp	Pipers Flat Creek upstream	Quarterly	
PFDn	Pipers Flat Creek downstream	Quarterly	
PB1	Production Bore	Continuous to quarterly	Continuous: Extraction volume Quarterly: water level, pH, EC, DO, NO ₃ , Na, K, Ca, Mg, Cl, SO ₄ , HCO ₃ , CO ₃ As, B, Cr, Cd, Cu, Fe, Mn, Ni, Pb, Zn
MW1 to MW6	Monitoring Wells 2 to 6	Quarterly to biannually	Quarterly: water level, pH, EC, DO Biannually: pH, EC, DO, NO ₃ , Na, K, Ca, Mg, Cl, SO ₄ , HCO ₃ , CO ₃

Site Point	Sample location	Frequency	Parameters
			As, B, Cr, Cd, Cu, Fe, Mn, Ni, Pb, Zn TPH and BTEX (MW1 and MW2 only)*
MW7 to MW8	Monitoring Wells 7 to 8	Biannually	Total recoverable hydrocarbons

* Subject to attenuation effects proving that monitoring is no longer required.

5.3 Stream health monitoring

Centennial currently monitor stream health through site specific aquatic ecology and waterway stability monitoring. These programs are outlined below.

5.3.1 Aquatic Ecology

Monitoring at PFUp and PFDn is to continue as part of existing monitoring programs. These sites are located around the LDP004 location but serve as suitable monitoring locations for assessing potential change in habitat condition and community abundance and diversity associated with works to be completed within Pipers Flat Creek.

The monitoring locations and monitoring frequency are summarised in Table 5-2 below.

Table 5-2 Stream health monitoring program

Catchment	Site	X	Y	Frequency	Description
Pipers Flat Creek	PFUp	227738	6300763	Bi-annually (Spring and Autumn)	Pipers Flat Creek monitoring site located around 650 m upstream from the confluence with Coxs River.
	PFDn	228119	6300988		Pipers Flat Creek monitoring site located around 90 m upstream the confluence with Coxs River, where LDP004 discharges into Pipers Flat Creek

5.3.2 Waterway stability monitoring

Waterway stability monitoring has not been considered as part of existing management plans. With the removal of Willows from the riparian zone the potential for geomorphic change is higher than current levels. The development of a stability monitoring program should be established prior to the first stage of Willow removal.

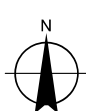
The proposed extent of monitoring is shown in Figure 5-1.

5.4 Flood assessment reviews

Flooding predictions will be reviewed on an as needed basis following flooding events or installation of mitigation measures. The review process should consider revision to hydraulic modelling, an evaluation of the hydrology model calibration and revision of flood depth, velocity and hazard mapping.



Paper Size A4
0 35 70 140 210 280 350
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



LEGEND

- Licensed Discharge Point
- Water Storage
- Assessment extent
- Watercourse - Non Perennial
- Watercourse - Perennial
- Willow Management Boundary (RPS, 2016)
- Stability monitoring
- Willow Rehabilitation Area (RPS, 2016)



Centennial Coal

Ivanhoe Coal Pty Ltd
Lidsdale Siding
Flood Management Plan

Waterway stability
monitoring extent

Job Number 22-18559
Revision 0
Date 10 Oct 2016

Figure 5-1

6. References

Aecom (2013) *Updated Phase 2 Contamination Assessment, Lidsdale Siding Upgrade Project, Wallerawang NSW*, prepared for Centennial Coal, Sydney

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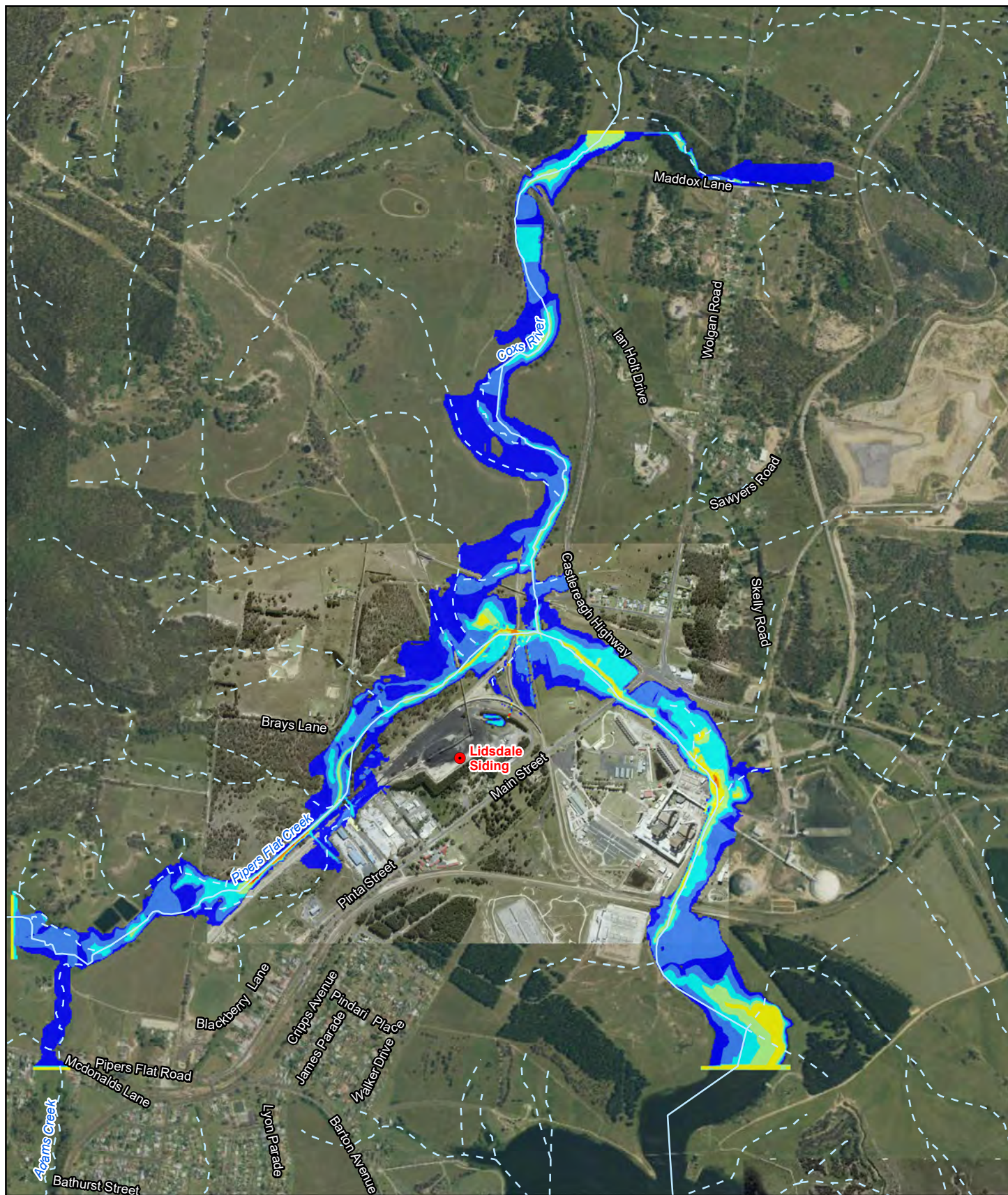
SLR (2014) *Supplementary Contamination Delineation Assessment and Remedial Action Plan, Historical Diesel AST Spill, Lidsdale Siding Upgrade Project*, prepared for Centennial Ivanhoe Pty Ltd.

RPS (2014) *Lidsdale Siding, Water Management Plan*, prepared for Centennial Coal, Sydney

Appendices

Appendix A – Flooding Assessment Figures

A1 Existing flood depth and velocity



LEGEND

Flood depth (m)

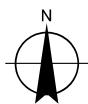
	< 0.5		1.5 - 2
	0.5 - 1		2.0 - 2.5
	1.0 - 1.5		2.5 - 3
			> 3.0

Centennial Site Location

Watercourse - Non Perennial

Watercourse - Perennial

Paper Size A4
0 70 140 280 420 560 700
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



Centennial Coal

Ivanhoe Coal Pty Ltd
Lidsdale Siding
Flood Management Plan
1 Year ARI
flood water depth

Job Number 22-18559
Revision 0
Date 10 Oct 2016

Figure A1-1

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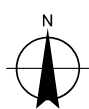
Data source: LPI: Aerial Imagery, 2015; LPI: DCDB, 2012; Centennial: Aerial imagery, 2016. Aurecon Flood Assessment: Flood data, 2014. Created by: tmorton



LEGEND

Velocity (m/s)			● Centennial Site Location
< 0.5	1.5 - 2	2.0 - 2.5	Watercourse - Non Perennial
0.5 - 1	2.5 - 3		Watercourse - Perennial
1.0 - 1.5	> 3.0		

Paper Size A4
0 70 140 280 420 560 700
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



Centennial Coal

Ivanhoe Coal Pty Ltd
Lidsdale Siding
Flood Management Plan
1 Year ARI
flood velocity

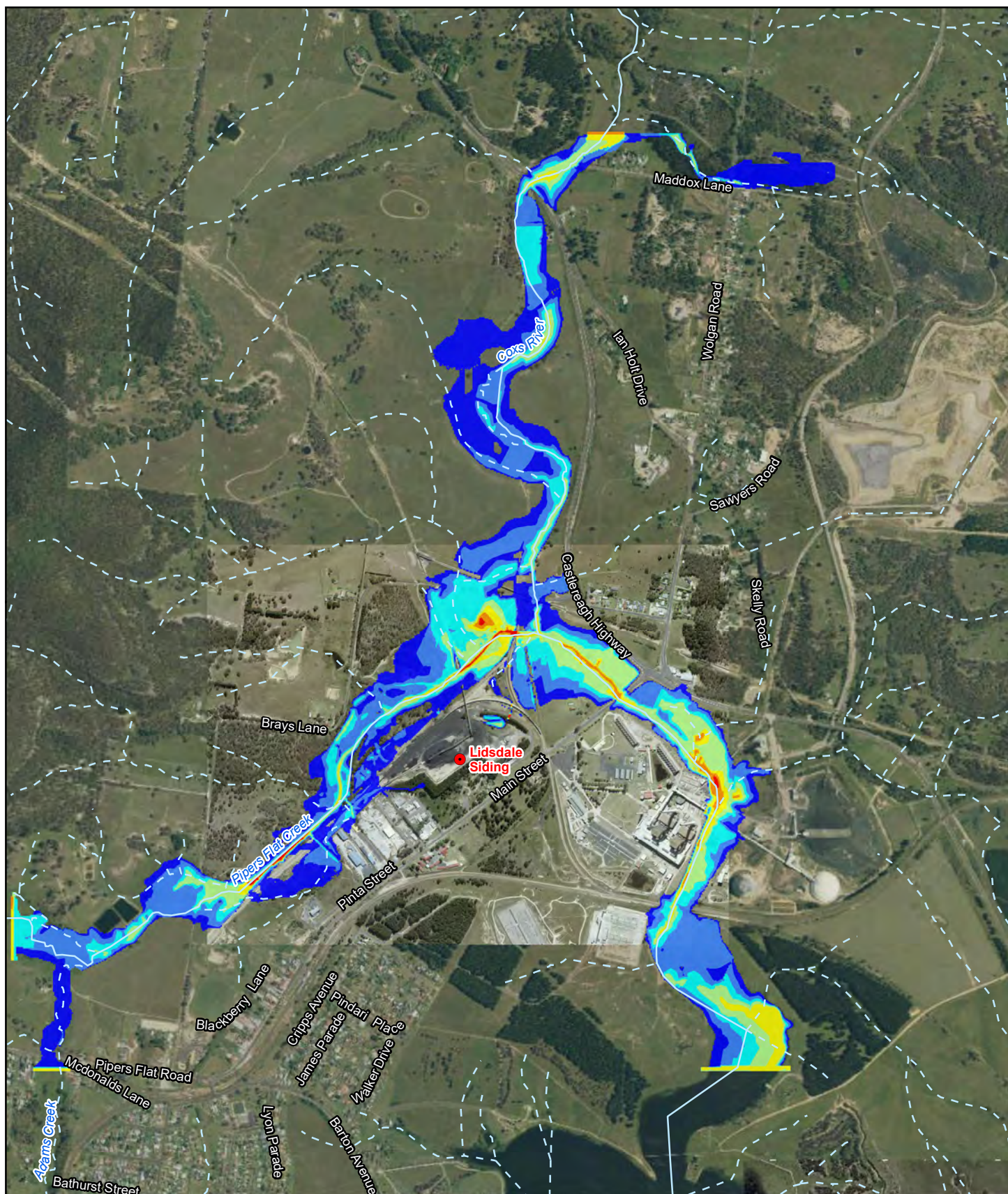
Job Number 22-18559
Revision 0
Date 10 Oct 2016

Figure A1-2

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com W www.ghd.com.au
G:\22\0105001\GIS\Maps\Deliverables\Western\Lidsdale Siding\2218559\AdditionalFlooding\2218559_AFI002_1YR_AR1_FloodVelocity_0.mxd

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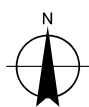
Data source: LPI: Aerial Imagery, 2015; LPI: DCDB, 2012; Centennial: Aerial imagery, 2016. Aurecon Flood Assessment: Flood data, 2014. Created by: tmorton



LEGEND

Flood depth (m)	1.5 - 2	Centennial Site Location
< 0.5	2.0 - 2.5	Watercourse - Non Perennial
0.5 - 1	2.5 - 3	Watercourse - Perennial
1.0 - 1.5	> 3.0	

Paper Size A4
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 Metres
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 56



Centennial Coal

Ivanhoe Coal Pty Ltd
 Lidsdale Siding
 Flood Management Plan
 2 Year ARI
 flood water depth

Job Number 22-18559
 Revision 0
 Date 10 Oct 2016

Figure A1-3

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E entlmail@ghd.com W www.ghd.com.au
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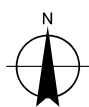
Data source: LPI: Aerial Imagery, 2015; LPI: DCDB, 2012; Centennial: Aerial imagery, 2016. Aurecon Flood Assessment: Flood data, 2014. Created by: tmorton



LEGEND

Velocity (m/s)		
< 0.5	0.5 - 1	1.5 - 2
0.5 - 1	1.0 - 1.5	2.0 - 2.5
		2.5 - 3
		3.0 - 3.5
		> 3.5
		Centennial Site Location
		Watercourse - Non Perennial
		Watercourse - Perennial

Paper Size A4
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Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



Centennial Coal

Ivanhoe Coal Pty Ltd
Lidsdale Siding
Flood Management Plan
2 Year ARI
flood velocity

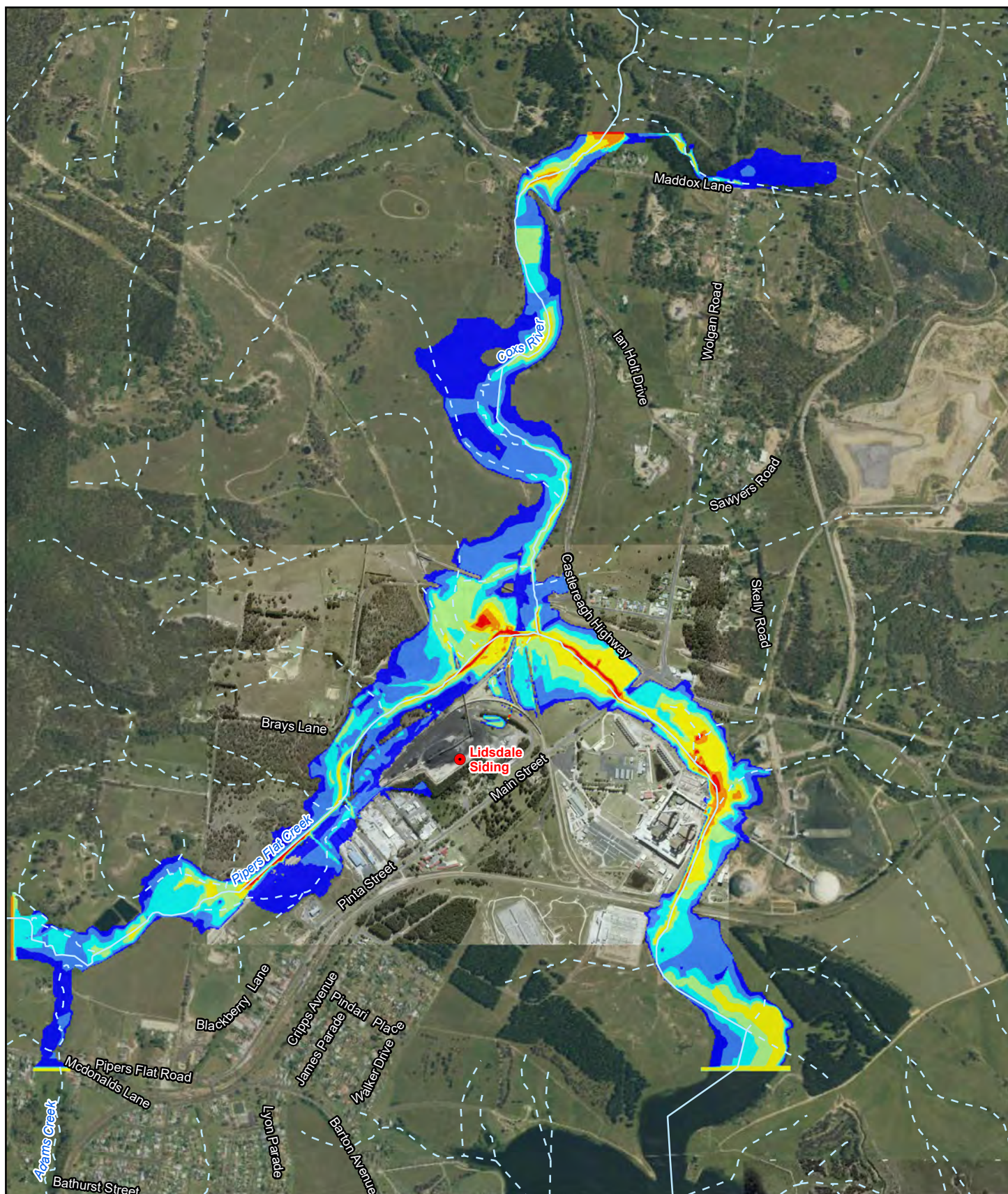
Job Number 22-18559
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Date 10 Oct 2016

Figure A1-4

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com W www.ghd.com.au
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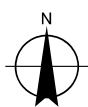
Data source: LPI: Aerial Imagery, 2015; LPI: DCDB, 2012; Centennial: Aerial imagery, 2016. Aurecon Flood Assessment: Flood data, 2014. Created by: tmorton



LEGEND

Flood depth (m)		
 < 0.5	 1.5 - 2	 Centennial Site Location
 0.5 - 1	 2.0 - 2.5	 Watercourse - Non Perennial
 1.0 - 1.5	 2.5 - 3	 Watercourse - Perennial
	 > 3.0	

Paper Size A4
 0 70 140 280 420 560 700
 Metres
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 56



Centennial Coal

Ivanhoe Coal Pty Ltd
 Lidsdale Siding
 Flood Management Plan

5 Year ARI
 flood water depth

Job Number 22-18559
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 Date 10 Oct 2016

Figure A1-5

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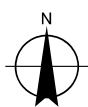
Data source: LPI: Aerial Imagery, 2015; LPI: DCDB, 2012; Centennial: Aerial imagery, 2016. Aurecon Flood Assessment: Flood data, 2014. Created by: tmorton



LEGEND

Velocity (m/s)	1.5 - 2	> 3.5
< 0.5	2.0 - 2.5	Centennial Site Location
0.5 - 1	2.5 - 3	Watercourse - Non Perennial
1.0 - 1.5	3.0 - 3.5	Watercourse - Perennial

Paper Size A4
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Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



Centennial Coal

Ivanhoe Coal Pty Ltd
Lidsdale Siding
Flood Management Plan

5 Year ARI
flood water velocity

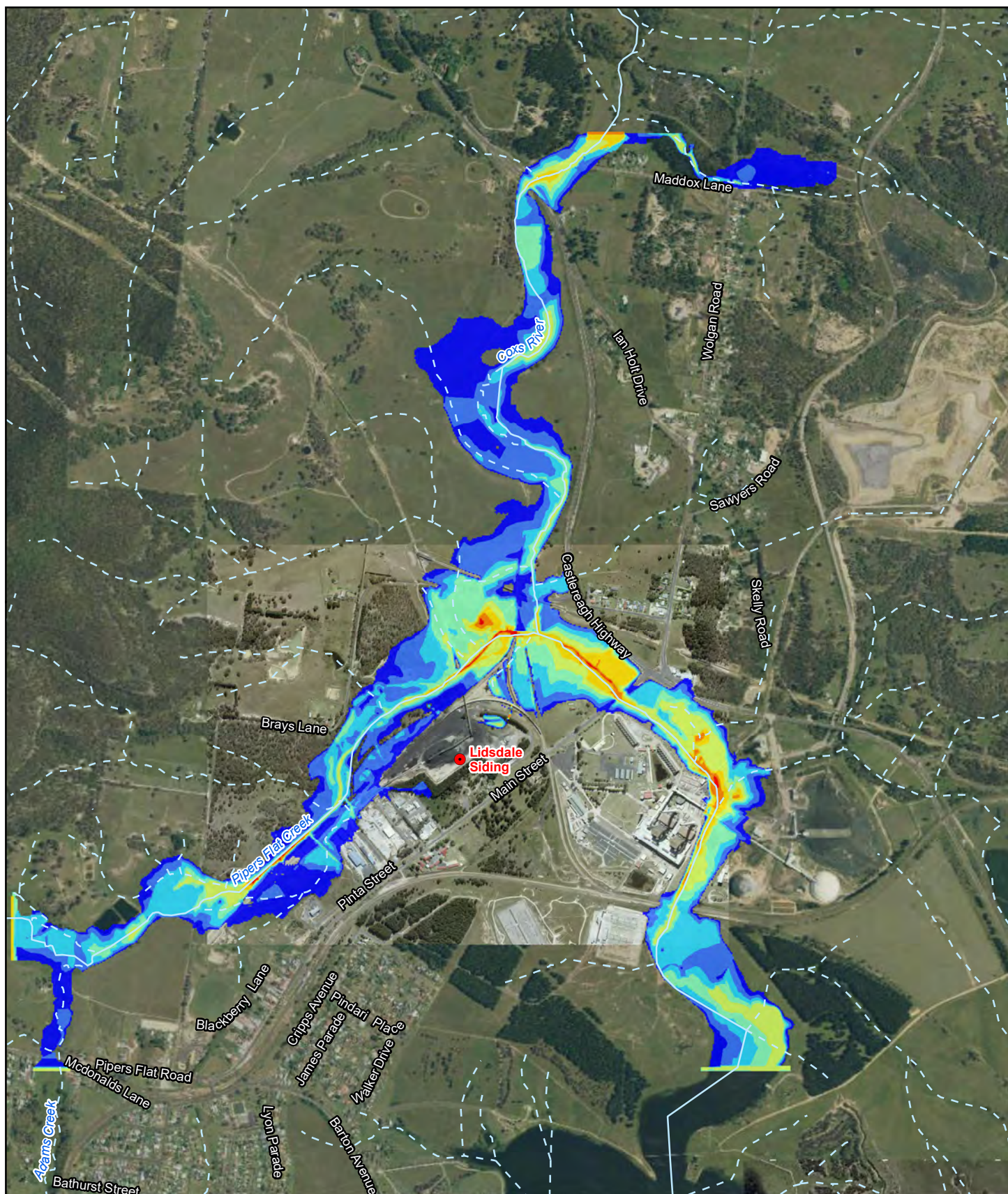
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Figure A1-6

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com W www.ghd.com.au
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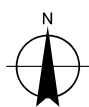
Data source: LPI: Aerial Imagery, 2015; LPI: DCDB, 2012; Centennial: Aerial imagery, 2016. Aurecon Flood Assessment: Flood data, 2014. Created by: tmorton



LEGEND

Flood depth (m)		Centennial Site Location
< 0.5	2.0 - 2.5	Centennial Site Location
0.5 - 1	2.5 - 3	Watercourse - Non Perennial
1.0 - 1.5	3.0 - 3.5	Watercourse - Perennial
1.5 - 2	> 3.5	

Paper Size A4
 0 70 140 280 420 560 700
 Metres
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 56



Centennial Coal

Ivanhoe Coal Pty Ltd
 Lidsdale Siding
 Flood Management Plan
 10 Year ARI
 flood water depth

Job Number 22-18559
 Revision 0
 Date 10 Oct 2016

Figure A1-7

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com W www.ghd.com.au
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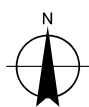
Data source: LPI: Aerial Imagery, 2015; LPI: DCDB, 2012; Centennial: Aerial imagery, 2016. Aurecon Flood Assessment: Flood data, 2014. Created by: tmorton



LEGEND

Velocity (m/s)	1.5 - 2	> 3.5
< 0.5	2.0 - 2.5	Centennial Site Location
0.5 - 1	2.5 - 3	Watercourse - Non Perennial
1.0 - 1.5	3.0 - 3.5	Watercourse - Perennial

Paper Size A4
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Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



Centennial Coal

Ivanhoe Coal Pty Ltd
Lidsdale Siding
Flood Management Plan
10 Year ARI
flood velocity

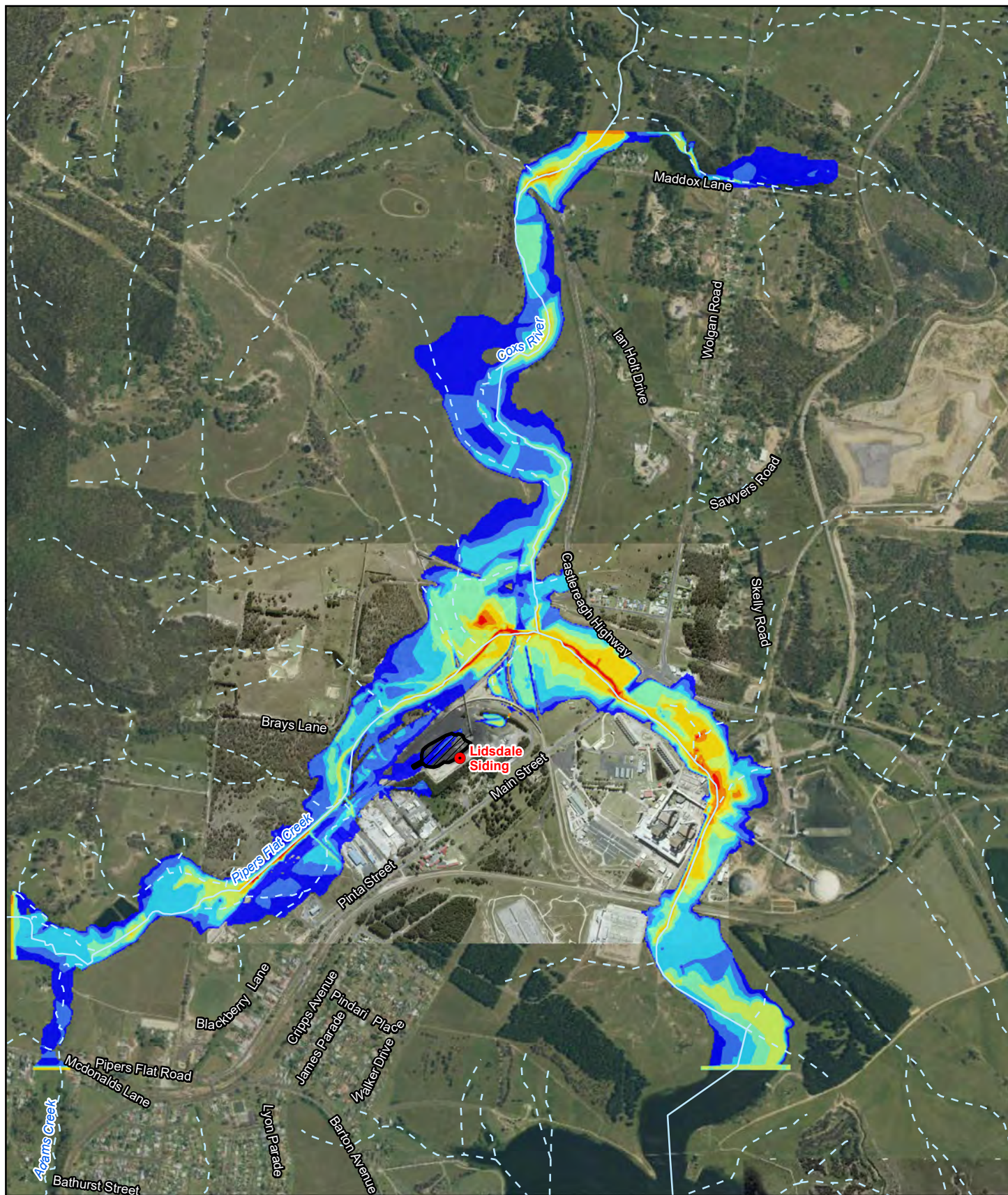
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Date 10 Oct 2016

Figure A1-8

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Data source: LPI: Aerial Imagery, 2015; LPI: DCDB, 2012; Centennial: Aerial imagery, 2016. Aurecon Flood Assessment: Flood data, 2014. Created by: tmorton



LEGEND

Flood depth (m)

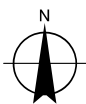
	< 0.5		> 3.5
	0.5 - 1		3.0 - 3.5
	1.0 - 1.5		2.5 - 3
	1.5 - 2		2.0 - 2.5

- Centennial Site Location
- Watercourse - Non Perennial
- Watercourse - Perennial
- Upgraded pad area

NOTE:

Civil works have been undertaken following Aurecon 2014 Flood Assessment that have raised the coal stockpile and related coal handling infrastructure levels above the predicted 100 year ARI flood height.

Paper Size A4
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Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



Centennial Coal

Ivanhoe Coal Pty Ltd
Lidsdale Siding
Flood Management Plan

20 Year ARI
flood water depth

Job Number 22-18559
Revision 0
Date 10 Oct 2016

Figure A1-9

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com W www.ghd.com.au
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Data source: LPI: Aerial Imagery, 2015; LPI: DCDB, 2012; Centennial: Aerial imagery, 2016. Aurecon Flood Assessment: Flood data, 2014. Created by: tmorton



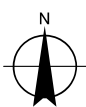
LEGEND

Velocity (m/s)			
< 0.5	1.5 - 2	3.5 - 4	Centennial Site Location
0.5 - 1	2.0 - 2.5	4.0 - 4.5	Watercourse - Non Perennial
1.0 - 1.5	2.5 - 3	4.5 - 5	Watercourse - Perennial
	3.0 - 3.5	> 5.0	Upgraded pad area

NOTE:

Civil works have been undertaken following Aurecon 2014 Flood Assessment that have raised the coal stockpile and related coal handling infrastructure levels above the predicted 100 year ARI flood height.

Paper Size A4
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Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



Centennial Coal

Ivanhoe Coal Pty Ltd
Lidds Siding
Flood Management Plan

20 Year ARI
flood velocity

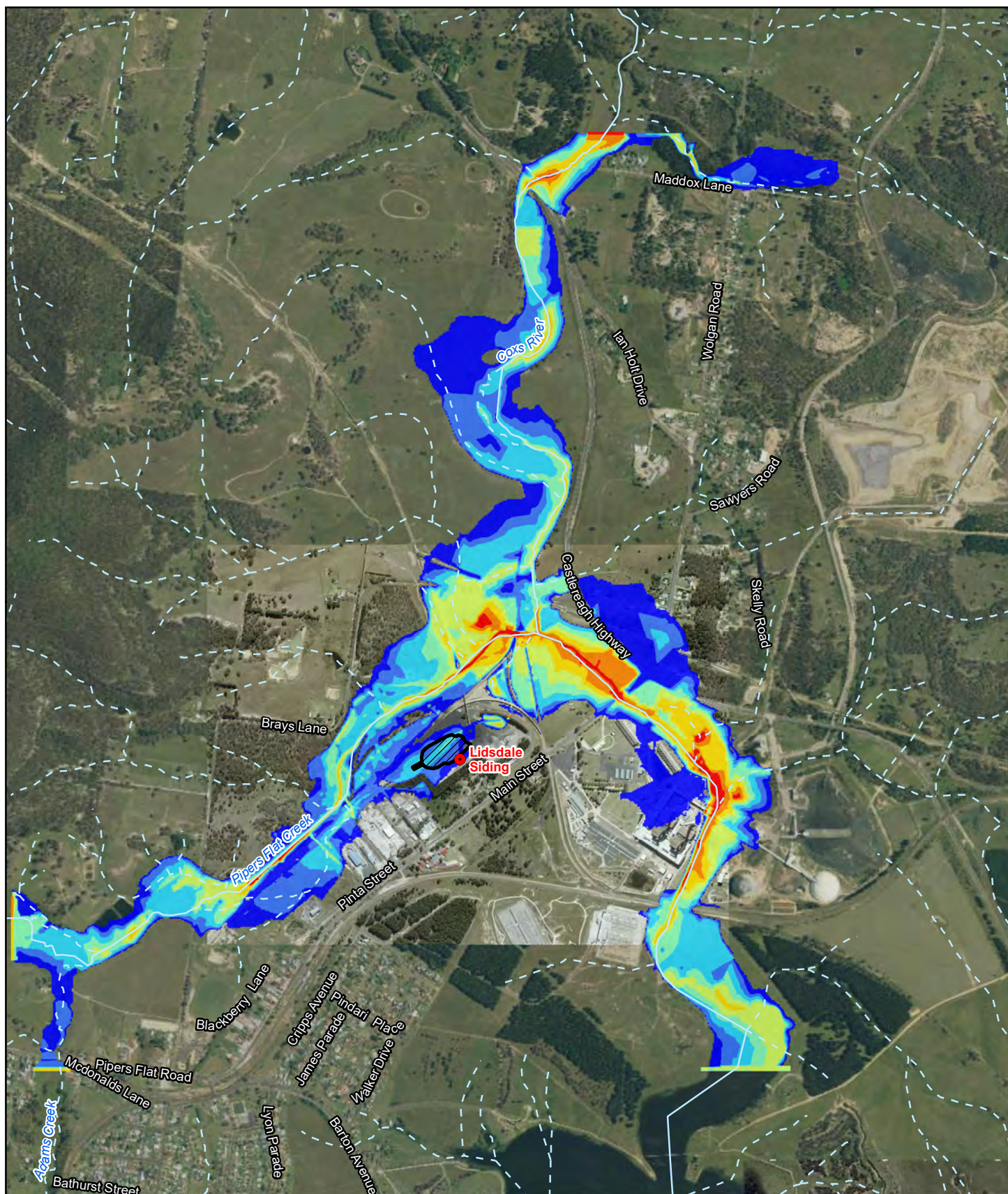
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Figure A1-10

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Data source: LPI: Aerial Imagery, 2015; LPI: DCDB, 2012; Centennial: Aerial imagery, 2016. Aurecon Flood Assessment: Flood data, 2014. Created by: tmorton



LEGEND

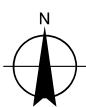
Flood depth (m)	1.5 - 2	> 3.5
< 0.5	2.0 - 2.5	Centennial Site Location
0.5 - 1	2.5 - 3	Watercourse - Non Perennial
1.0 - 1.5	3.0 - 3.5	Watercourse - Perennial

Upgraded pad area

NOTE:

Civil works have been undertaken following Aurecon 2014 Flood Assessment that have raised the coal stockpile and related coal handling infrastructure levels above the predicted 100 year ARI flood height.

Paper Size A4
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Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



Centennial Coal

Ivanhoe Coal Pty Ltd
Lidsdale Siding
Flood Management Plan
100 Year ARI
flood water depth

Job Number 22-18559
Revision 0
Date 10 Oct 2016

Figure A1-11

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Data source: LPI: Aerial Imagery, 2015; LPI: DCDB, 2012; Centennial: Aerial imagery, 2016. Aurecon Flood Assessment: Flood data, 2014. Created by: tmorton



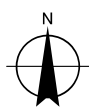
LEGEND

Velocity (m/s)			
< 0.5	1.5 - 2	3.5 - 4	Centennial Site Location
0.5 - 1	2.0 - 2.5	4.0 - 4.5	Watercourse - Non Perennial
1.0 - 1.5	2.5 - 3	4.5 - 5	Watercourse - Perennial
	3.0 - 3.5	> 5.0	Upgraded pad area

NOTE:

Civil works have been undertaken following Aurecon 2014 Flood Assessment that have raised the coal stockpile and related coal handling infrastructure levels above the predicted 100 year ARI flood height.

Paper Size A4
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Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



Centennial Coal

Ivanhoe Coal Pty Ltd
Lidsdale Siding
Flood Management Plan
100 Year ARI
flood velocity

Job Number 22-18559
Revision 0
Date 10 Oct 2016

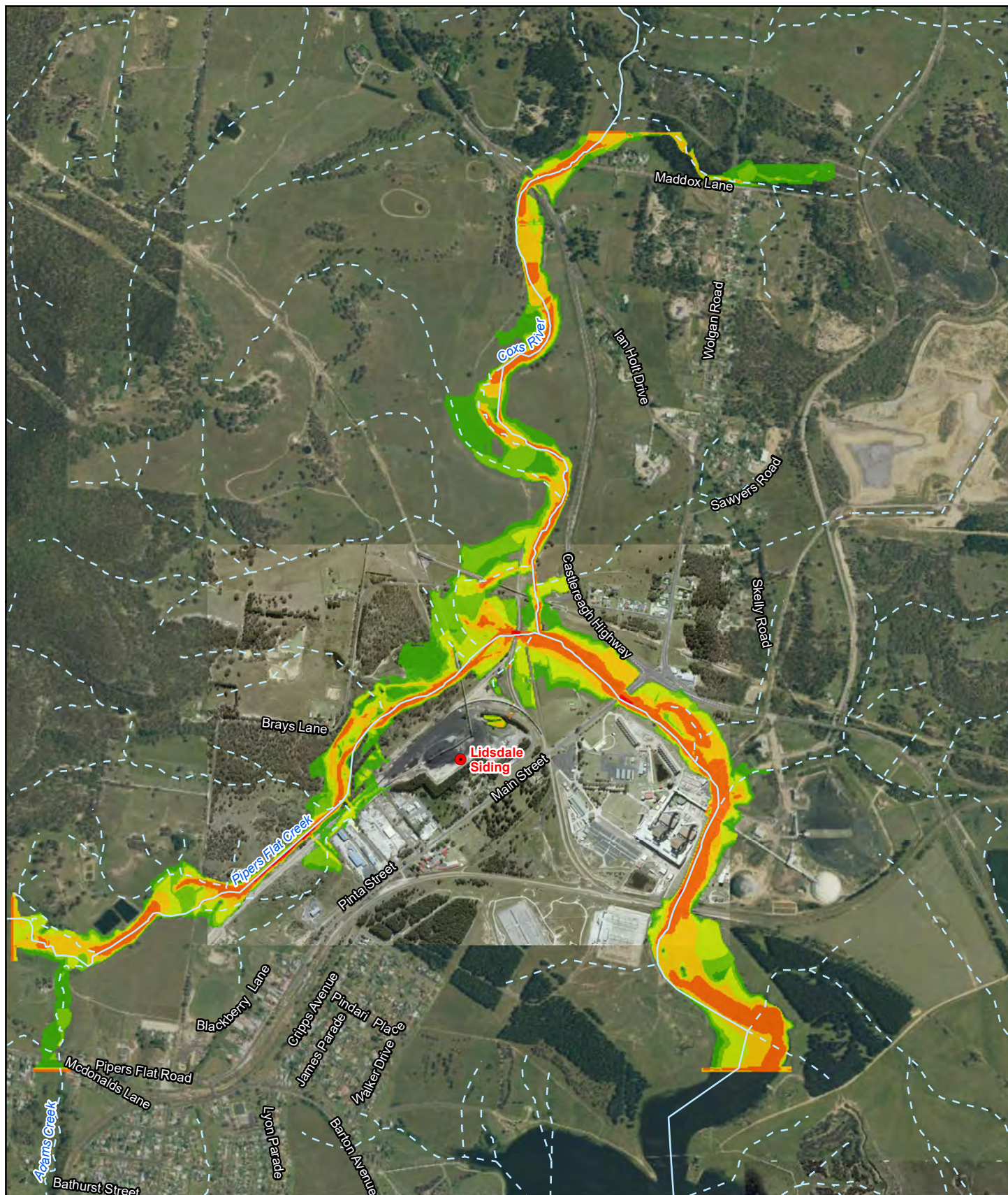
Figure A1-12

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Data source: LPI: Aerial Imagery, 2015; LPI: DCDB, 2012; Centennial: Aerial imagery, 2016. Aurecon Flood Assessment: Flood data, 2014. Created by: tmorton

A2 Flood hazard mapping



LEGEND

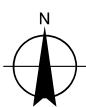
Hazard

- H1 - no restrictions
- H2 - unsafe for small vehicles
- H3 - unsafe for vehicles, children and the elderly

- H4 - unsafe for people and vehicles
- H5 - unsafe for people or vehicles. Buildings require special engineering design and construction

- H6 - not suitable for people, vehicles or buildings
- Centennial Site Location
- Watercourse - Non Perennial
- Watercourse - Perennial

Paper Size A4
0 70 140 280 420 560 700
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



Centennial Coal

Ivanhoe Coal Pty Ltd
Lidsdale Siding
Flood Management Plan
1 Year ARI
flood hazard

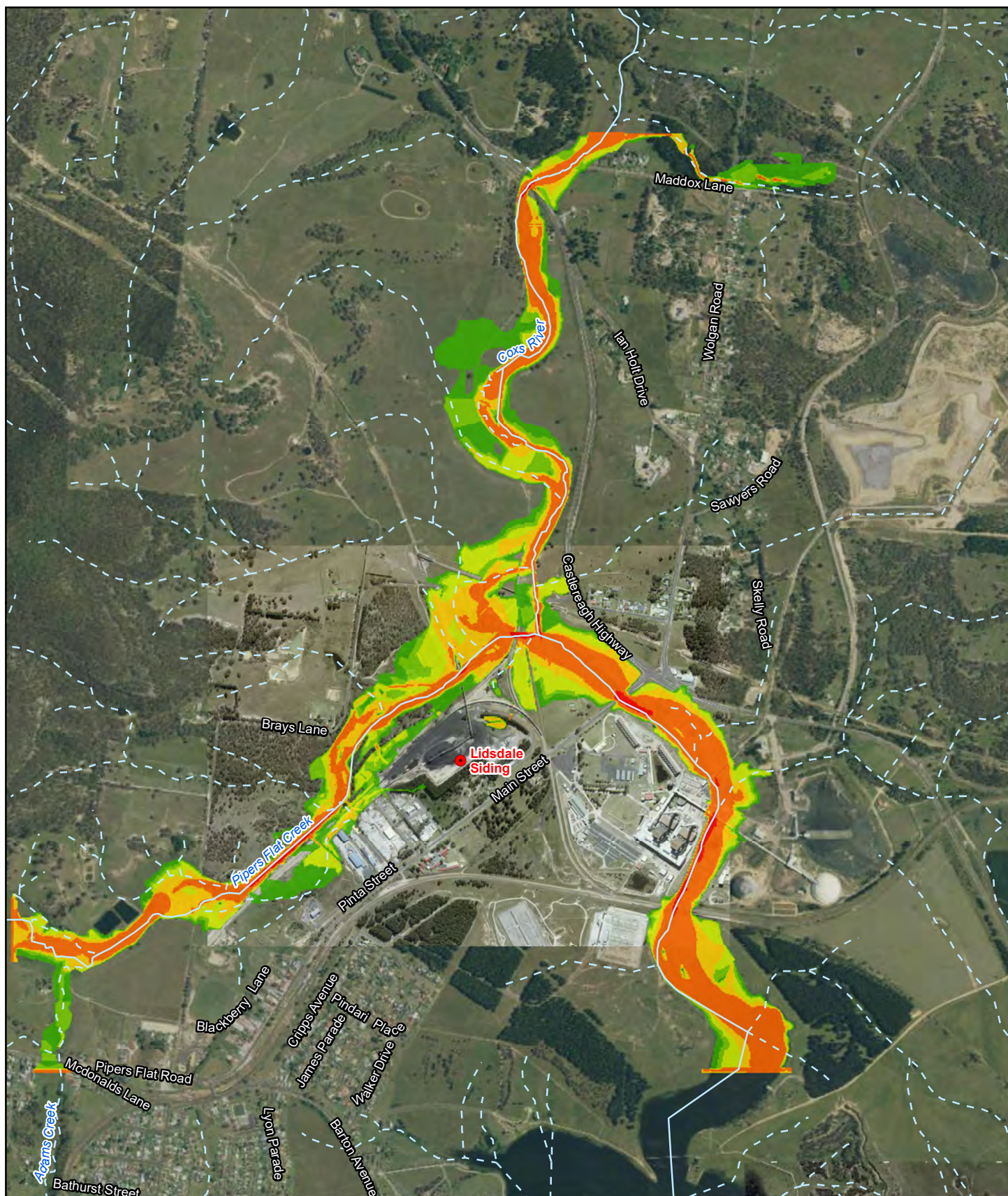
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Figure A2-1

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E entmail@ghd.com W www.ghd.com.au
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Data source: LPI: Aerial Imagery, 2015; LPI: DCDB, 2012; Centennial: Aerial imagery, 2016. Created by: tmorton



LEGEND

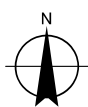
Hazard

- H1 - no restrictions
- H2 - unsafe for small vehicles
- H3 - unsafe for vehicles, children and the elderly

- H4 - unsafe for people and vehicles
- H5 - unsafe for people or vehicles. Buildings require special engineering design and construction

- H6 - not suitable for people, vehicles or buildings
- Centennial Site Location
- Watercourse - Non Perennial
- Watercourse - Perennial

Paper Size A4
 0 70 140 280 420 560 700
 Metres
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 56



Centennial Coal

Ivanhoe Coal Pty Ltd
 Lidsdale Siding
 Flood Management Plan
 2 Year ARI
 flood hazard

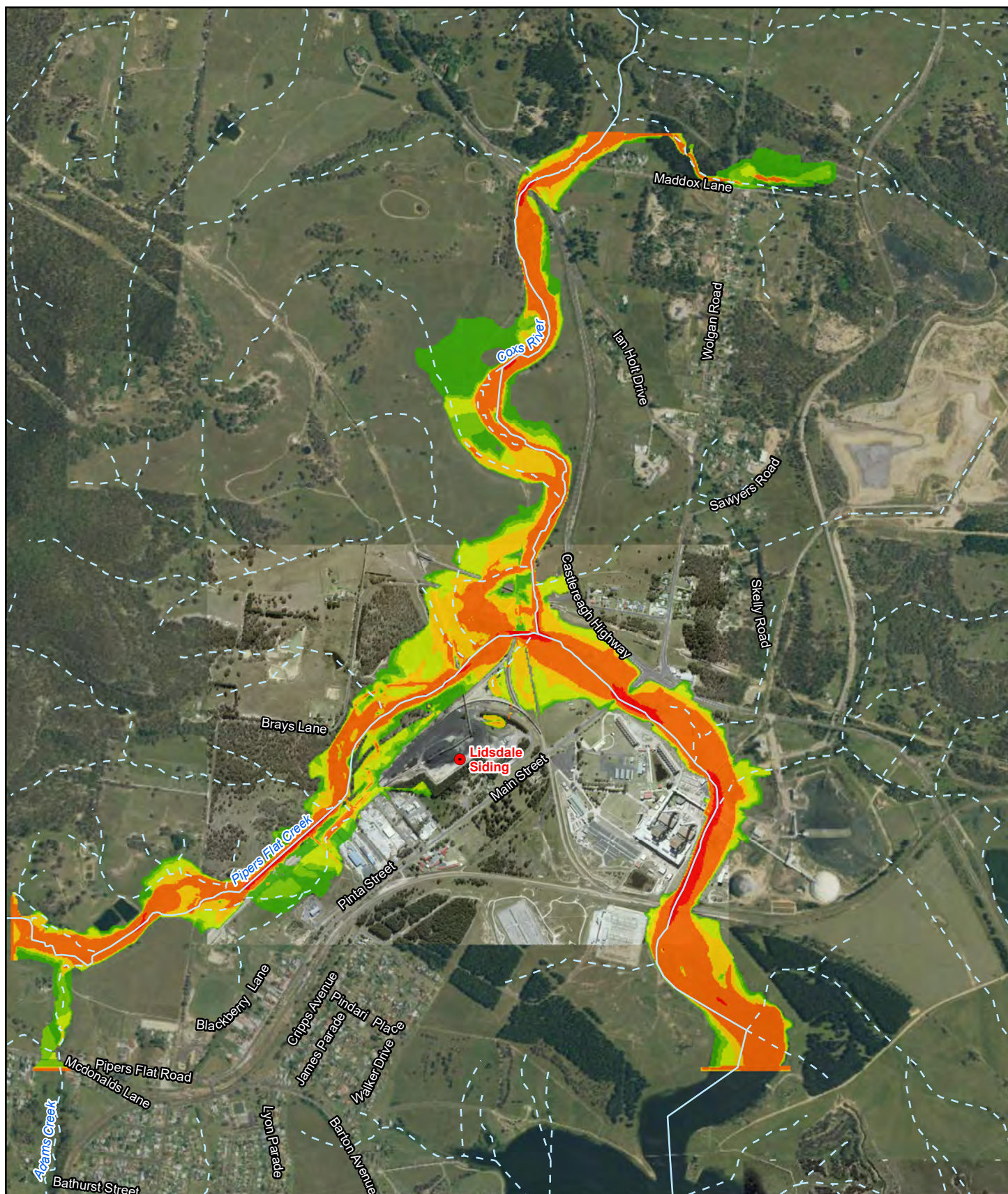
Job Number 22-18559
 Revision 0
 Date 10 Oct 2016

Figure A2-2

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E entmail@ghd.com W www.ghd.com.au
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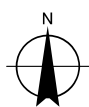
Hazard

- H1 - no restrictions
- H2 - unsafe for small vehicles
- H3 - unsafe for vehicles, children and the elderly

- H4 - unsafe for people and vehicles
- H5 - unsafe for people or vehicles. Buildings require special engineering design and construction

- H6 - not suitable for people, vehicles or buildings
- Centennial Site Location
- Watercourse - Non Perennial
- Watercourse - Perennial

Paper Size A4
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 Metres
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 56



Centennial Coal

Ivanhoe Coal Pty Ltd
 Lidsdale Siding
 Flood Management Plan
 5 Year ARI
 flood hazard

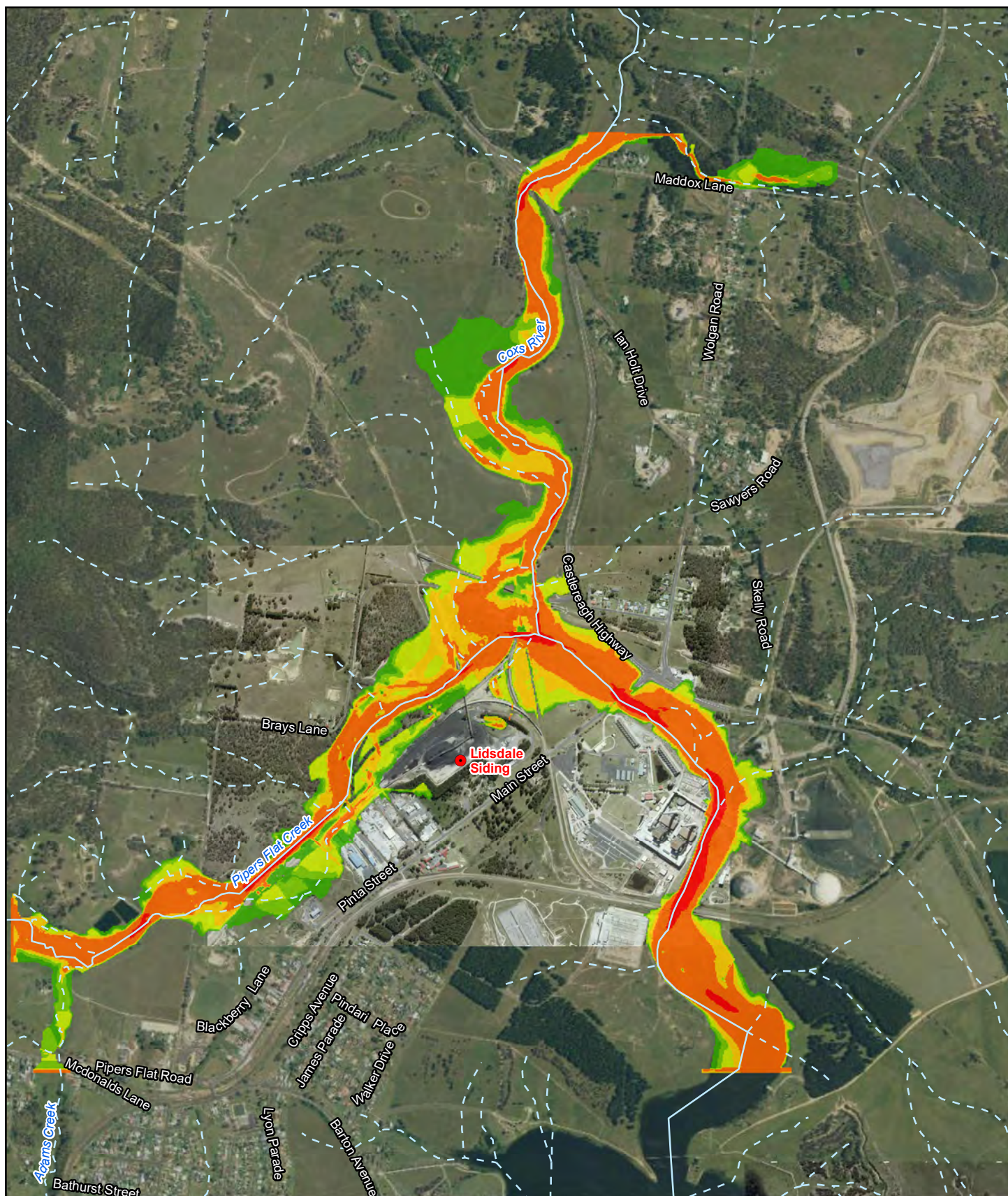
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Figure A2-3

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Hazard

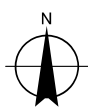
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- H3 - unsafe for vehicles, children and the elderly

- H4 - unsafe for people and vehicles
- H5 - unsafe for people or vehicles. Buildings require special engineering design and construction

- H6 - not suitable for people, vehicles or buildings

- Centennial Site Location
- Watercourse - Non Perennial
- Watercourse - Perennial

Paper Size A4
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Centennial Coal

Ivanhoe Coal Pty Ltd
Lidsdale Siding
Flood Management Plan
10 Year ARI
flood hazard

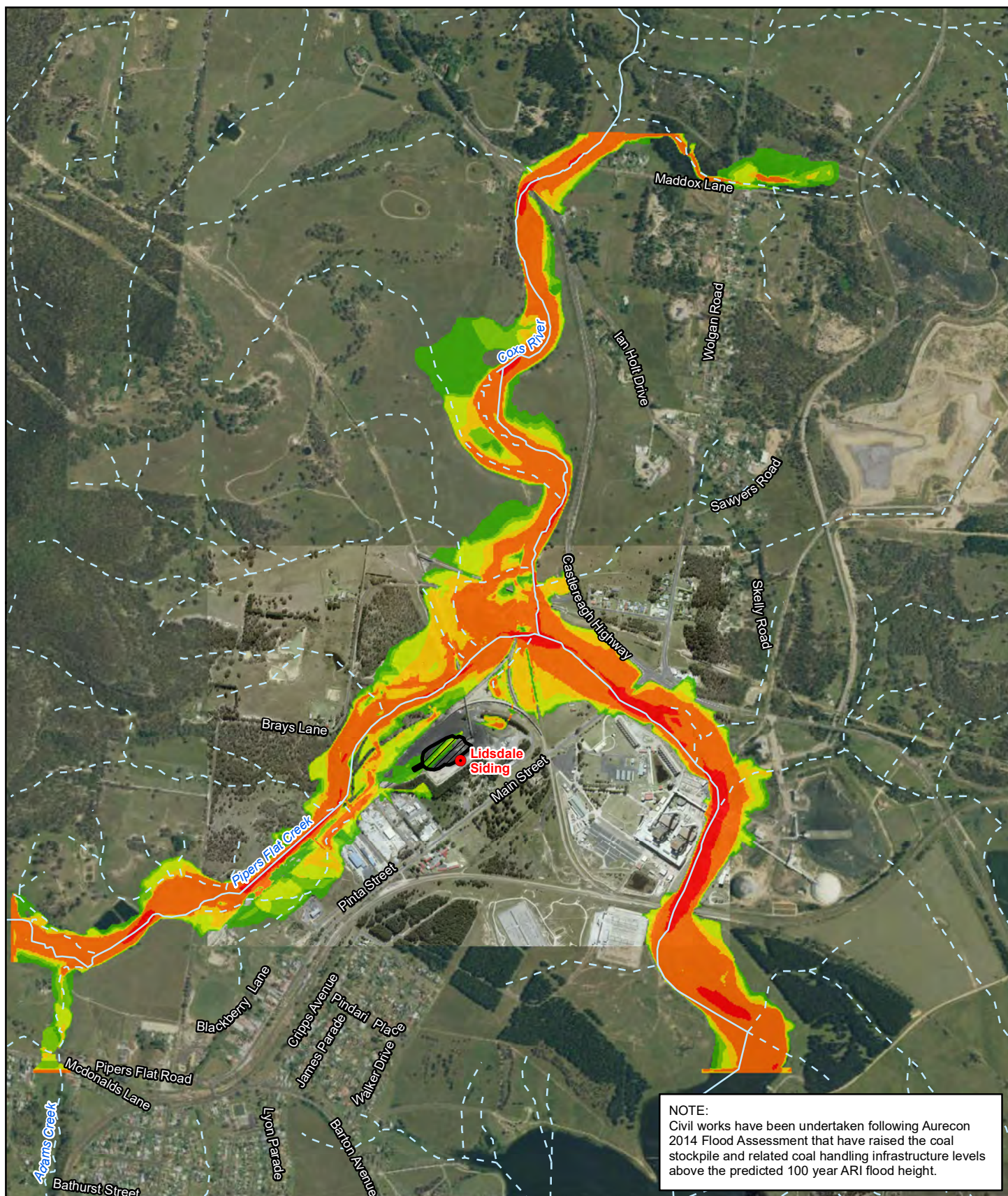
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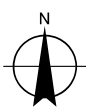
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- H4 - unsafe for people and vehicles
- H5 - unsafe for people or vehicles. Buildings require special engineering design and construction

- H6 - not suitable for people, vehicles or buildings
- Centennial Site Location
- Watercourse - Non Perennial
- Watercourse - Perennial

Upgraded pad area

Paper Size A4
0 70 140 280 420 560 700
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



Centennial Coal

Ivanhoe Coal Pty Ltd
Lidsdale Siding
Flood Management Plan
20 Year ARI
flood hazard

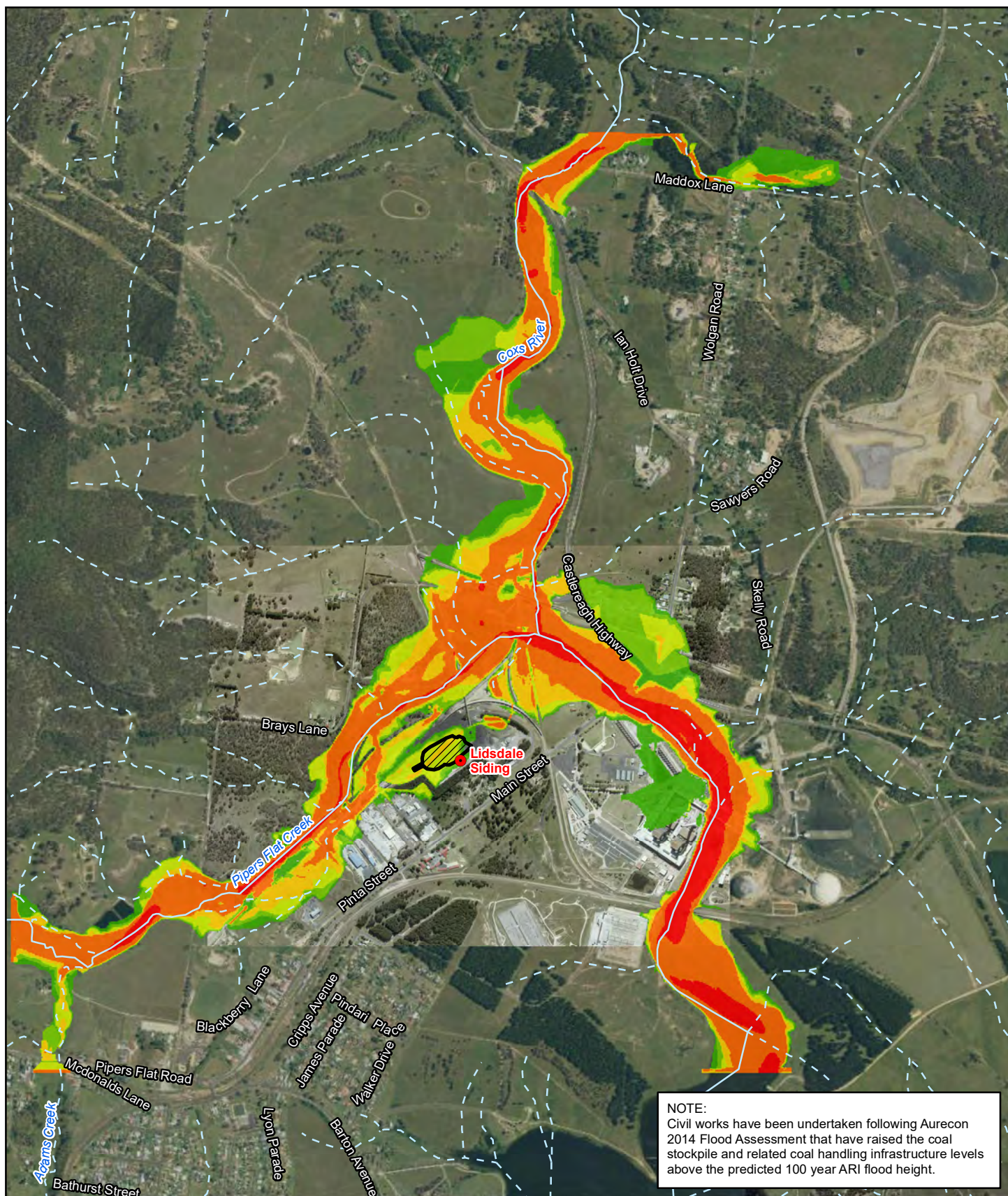
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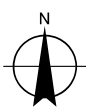
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- H4 - unsafe for people and vehicles
- H5 - unsafe for people or vehicles. Buildings require special engineering design and construction
- H6 - not suitable for people, vehicles or buildings

- Centennial Site Location
- Watercourse - Non Perennial
- Watercourse - Perennial

Upgraded pad area

Paper Size A4
0 70 140 280 420 560 700
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



Centennial Coal

Ivanhoe Coal Pty Ltd
Lidsdale Siding
Flood Management Plan
100 Year ARI
flood hazard

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Figure A2-6

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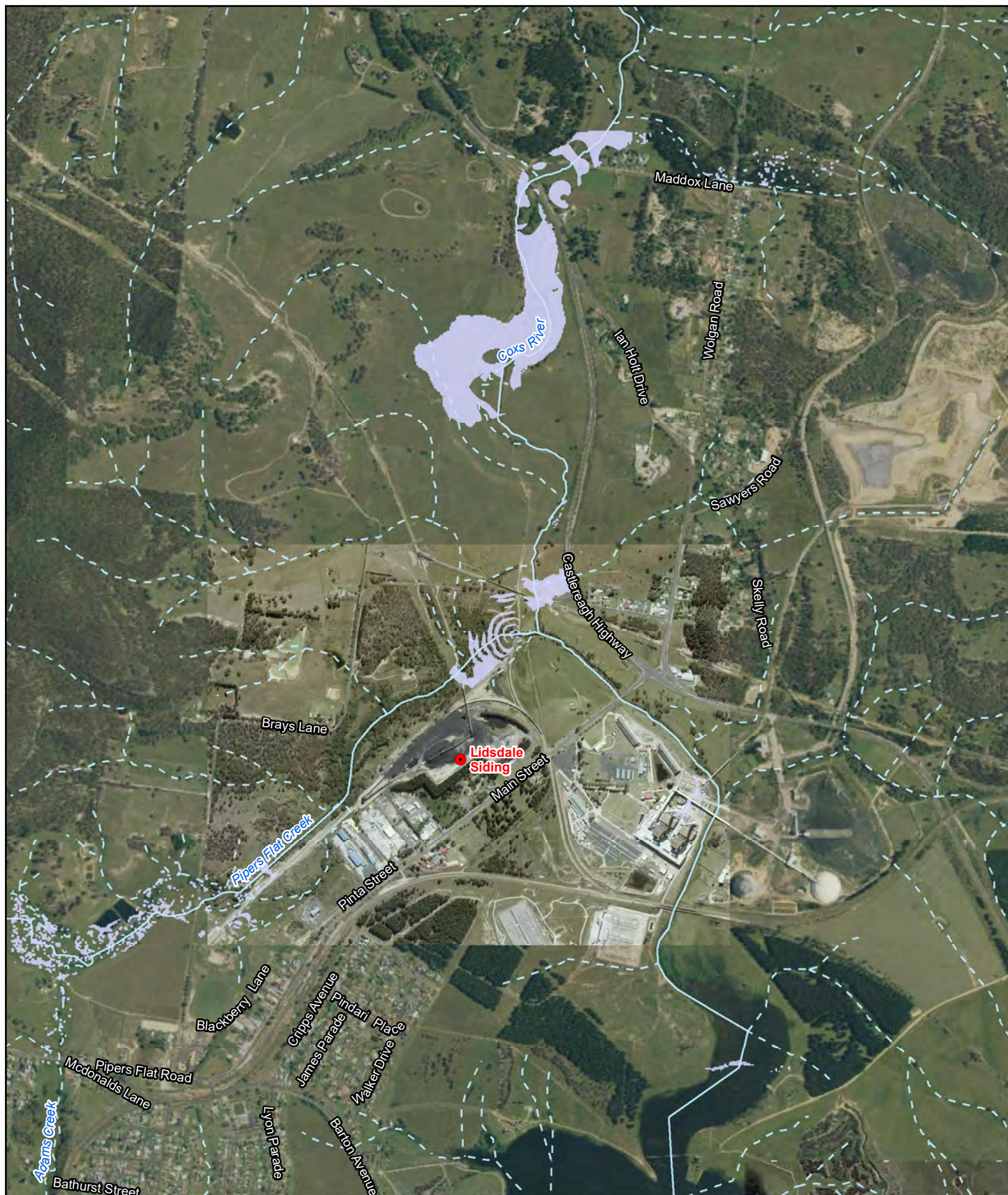
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A3 Mitigation options change in flood depth and velocity

Option 1

Option 2



LEGEND

Flood depth (m)

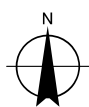
- 0 - 0.025
- 0.025 - 0.05
- 0.05 - 0.5

● Centennial Site Location

--- Watercourse - Non Perennial

--- Watercourse - Perennial

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Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



Centennial Coal

Ivanhoe Coal Pty Ltd
Lidsdale Siding
Flood Management Plan

Option 1 - 100 Year afflux
flood water depth

Job Number 22-18559
Revision 0
Date 10 Oct 2016

Figure A3-1

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Data source: LPI: Aerial Imagery, 2015; LPI: DCDB, 2012; Centennial: Aerial imagery, 2016. Aurecon Flood Assessment: Flood data, 2014. Created by: tmorton



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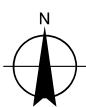
Velocity (m/s)

0 - 0.25	1.0 - 4
0.25 - 0.5	Centennial Site Location
0.5 - 0.75	Watercourse - Non Perennial
0.75 - 1	Watercourse - Perennial
	Upgraded pad area

NOTE:

Civil works have been undertaken following Aurecon 2014 Flood Assessment that have raised the coal stockpile and related coal handling infrastructure levels above the predicted 100 year ARI flood height.

Paper Size A4
0 70 140 280 420 560 700
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



Centennial Coal

Ivanhoe Coal Pty Ltd
Liddale Siding
Flood Management Plan

Job Number 22-18559
Revision 0
Date 10 Oct 2016

Option 1 - 100 Year afflux
flood velocity

Figure A3-2

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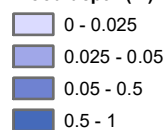
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LEGEND

Flood depth (m)



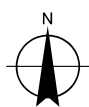
1.0 - 2

Centennial Site Location

Watercourse - Non Perennial

Watercourse - Perennial

Paper Size A4
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Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



Centennial Coal

Ivanhoe Coal Pty Ltd
Lidsdale Siding
Flood Management Plan

Job Number 22-18559
Revision 0
Date 10 Oct 2016

Option 2 - 100 Year afflux
flood water depth

Figure A3-3

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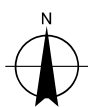


LEGEND

Velocity (m/s)

	1.0 - 4
	0 - 0.25
	0.25 - 0.5
	0.5 - 0.75
	0.75 - 1
	Centennial Site Location
	Watercourse - Non Perennial
	Watercourse - Perennial

Paper Size A4
0 70 140 280 420 560 700
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56



Centennial Coal

Ivanhoe Coal Pty Ltd
Lidsdale Siding
Flood Management Plan

Job Number 22-18559
Revision 0
Date 10 Oct 2016

Option 2 - 100 Year afflux
flood velocity

Figure A3-4

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Appendix B – Aurecon Flood Assessment (2014)



Lidsdale Siding Upgrade

Lidsdale Siding Flooding Assessment Report

Centennial Coal

30 April 2014

Revision: 2

Reference: 233327

Document control record

Document prepared by:

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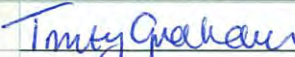
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Document ID		233327-0000-REP-WW-0001	Project number		233327	
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Rev	Date	Revision details/status	Prepared by	Author	Verifier	Approver
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1	17 April 2014	Final Draft for Client Comment	C Smyth	U Baeumer	G Mellor	T Graham
2	30 April 2014	Final issue	C Smyth	U Baeumer	G Mellor	T Graham
Current revision		2				

Approval			
Author signature		Approver signature	
Name	Urs Baeumer	Name	Trinity Graham
Title	Senior Civil Engineer	Title	Technical Director



Date 30 April 2014
Reference 233327
Revision 2

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Executive summary

Flood modelling has been undertaken for the Lidsdale Siding Upgrade works and this has produced flood maps for the existing 1, 2, 5, 10, 20 and 100 year peak ARI events for the site. The purpose of the modelling was to establish flood levels and protection requirements for the proposed infrastructure and operation of the site. Flood maps have been created to indicate the extent of flooding.

The main areas of concern can be summarised as:

- Existing nuisance flooding at the culvert connection through the siding to Pipers Flat Creek
- Impacts from the proposed additional siding
- The need for a mitigation strategy for the areas affected by flooding
- Protection of above ground structures and the entry to the proposed underground elevating coal conveyor
- The impact of clearing of willow trees along Pipers Flat Creek
- The Sydney Catchment Authority (SCA) and Environmental Protection Authority (EPA) consent conditions

The outcomes of the flood modelling have indicated that the Lidsdale site has minor to medium flooding issues up to the 2 year ARI peak event. Pipers Flat Creek overtops its banks during a 2 year ARI peak event and more extensive flooding of the site occurs with increasing ARI. During a 100 year ARI peak event the rail triangle is inundated and flooding then occurs across most of the site.

Some of the proposed mitigation measures include minor earthworks, clearing, de-silting and bunding. The modelling results show that the construction of a bund along the northern side of the rail siding can provide the coal handling and storage facility with immunity in excess of 100 year ARI. The proposed additional siding works are unlikely to increase flooding and reduce storage provided the existing levels are maintained and the existing culvert connection to Pipers Flat Creek is retained.

The protection to above ground structures and protection to the underground coal conveyor can be achieved by designing for velocities of 3.0 m/s and providing local bunds and a temporary bund across the rail line above the 100 year flood level of approximately RL 880.5. Strict safety and operations procedures and a Safety in Design process during detailed design need to be in place to ensure that the rail line remains closed while the temporary bund is in place.

Surface water quality measures are already in place but some areas along the proposed siding may require investigation and additional measures may be required to conform to EPA and SCA consent conditions to contain coal fines runoff from the site.

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Appendix B

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Appendix C

Catchment plan

Appendix D

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Appendix E

Modelling extents

Appendix F

Peak water surface levels

Appendix G

Afflux

Appendix H

Peak velocities

Appendix I

Lidsdale underground elevator conveyor and silo general arrangement

Appendix J

Water quality ponds

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1 Introduction

Lidsdale Siding is located on the northern edge of Wallerawang Township. The site has been continually used as a coal storage and rail loading facility since 1974.

The site is primarily used to export coal from Centennial's Western Region mines to Port Kembla Coal Terminal. Coal is delivered to Lidsdale Siding via a conveyor linking Springvale Coal Services. The site is also capable of receiving coal by road.

Coal is currently delivered to the site by conveyor, after which it is moved by front end loader to a train loading stockpile and loaded into coal wagons for export.

Centennial Coal is currently upgrading the existing coal loading facility to a more modern operation. The coal loading will be automated with a conveyor fed, elevated silo bin located over the rail siding to fill the coal wagons.

The original alignment of Pipers Flat Creek was diverted to the west in the 1950s and recent high rainfall events have caused flooding to the siding and coal stockpile areas due to restricted flow and backwater effects. An element of risk exists with the facility upgrade and this flood study was required to determine the impacts and extent of potential flooding on the Centennial site.

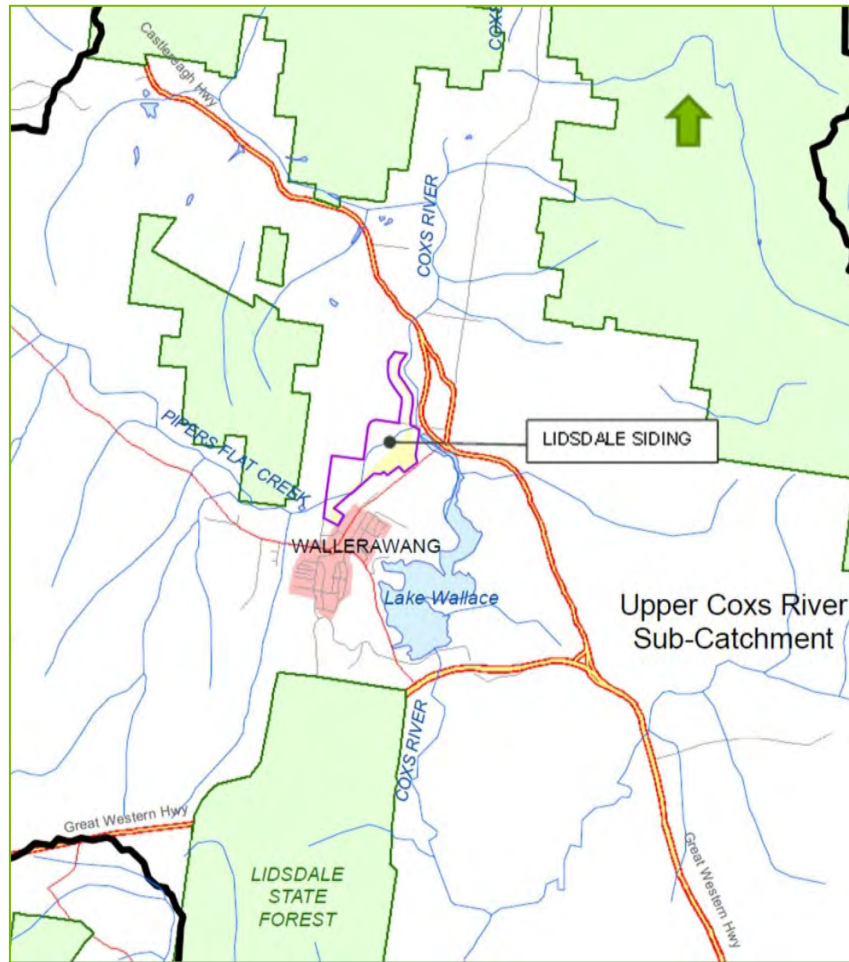


Figure 1 | Location plan

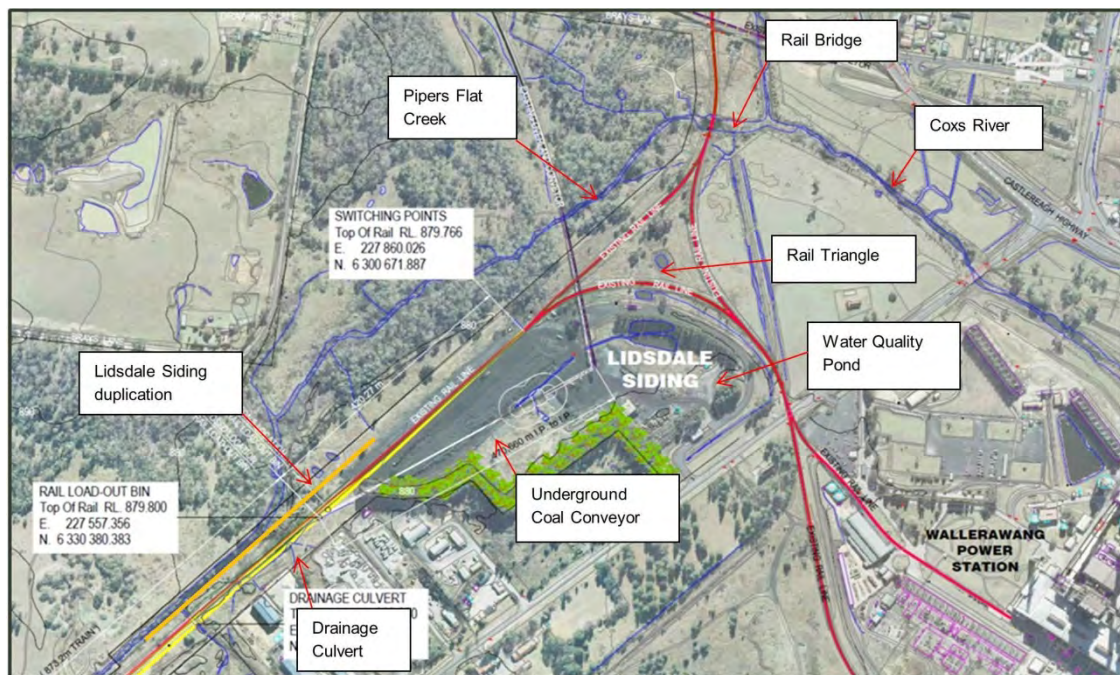


Figure 2 | Site plan (Reference: Lidsdale Siding Site Plan, Drawing L89-SK-1650, Laing O'Rourke 2012)



2 Investigation scope and objectives

2.1 Scope

The scope of work defined for this study includes:

- Site Visit
- Development of a calibrated XP-RAFTS hydrological model for the Pipers Flat Creek and Coxs River and their tributaries upstream of the Lidsdale Siding site to derive the 1, 5, 10, 20, and 100 year Average Recurrence Interval (ARI) peak flow hydrographs
- Develop a MIKE21 hydraulic model to determine the existing flood water levels and velocities within Pipers Flat Creek in the vicinity of the site for the various events, with reference to the surrounding sites and watercourses
- Flood inundation maps for the 1, 5, 10, 20 and 100 year peak ARI events
- Discussing and modelling of two flood mitigation requirements for the proposed loading silo structure and entrance to the underground coal conveyor
- A brief discussion regarding the Sydney Catchment Authority requirements for the site
- Discussing impacts from the proposed additional siding works
- Recommending potential solutions for flood mitigation of the site

2.2 Objectives

- Quantify the peak flood levels within and around the site with respect to flooding in Pipers Flat Creek, Coxs River and local site runoff
- Provide an assessment of development impacts from the proposed rail siding and associated coal silo structure and coal conveyor entrance
- Provide comment on possible flood mitigation options for the site including:
 - Provision of a levee to eliminate overtopping of the rail embankment adjacent to Pipers Flat Creek
 - Removal of the Willows from Pipers Flat Creek



3 Background information

3.1 Site description

The site is located approximately 0.5 km south-west of the confluence of Coxs River and Pipers Flat Creek on the northern edge of Wallerawang. A portion of the site occupies part of what was the original flow path of Pipers Flat Creek which has been diverted to accommodate the current rail siding. The creek runs approximately parallel to the north western boundary of the site before its confluence with Coxs River. Coxs River then runs in a southerly direction to the east of the site, past Wallerawang Power Station and into Lake Wallace. There are a number of hydraulic structures crossing the water courses which are discussed further in Section 5.2.7 of the report. There are also several culverts beneath the embankment to allow for stormwater discharge from neighbouring sites into Pipers Flat Creek.

3.2 Previous flood studies

Previous flood studies have been undertaken for part of Pipers Flat Creek, the upstream end of Coxs River and Sawyers Swamp Creek Ash Dam. These reports have been used as references for this study and, where appropriate information from these previous studies has been used for this analysis.

The previous flood study reports are:

- Sawyers Swamp Creek Ash Dam, Review of Probable Maximum Flood, Pacific Power, July 1995
- Neubecks Creek and Coxs River Flood Study, Enhance Place Pty Limited, Pine Dale Coal Mine, WRM Water and Environment Pty Ltd, Dec 2005
- Western Rail Coal Unloader, Mt Piper Power Station, Flood Study, Appendix D, SKM, 2007

3.3 Available survey and mapping data

The following datasets were utilised for the hydrologic and hydraulic modelling exercise

- Site detail survey
- 1 m contour data
- 2 m contour data
- 10 m contour data



4 Existing site drainage conditions

The proposed Lidsdale Siding is located between Pipers Flat Creek, Coxs River and Main Street, Wallerawang. Surface drainage of the site is generally to the north towards the confluence of Pipers Flat Creek and Coxs River. Local catchments comprise commercial/industrial areas to the south and perimeter farmland pastures and bushland for the other surrounding areas. Topography varies with steeper sections to the south and flatter grades to the north and east. A floodplain extends from the Coxs River confluence towards the Wallerawang Power Station site. Several rail, road and conveyor bridges intercept the waterways and eventually Coxs River empties into Lake Wallace to the south.

Bunding has been constructed around the existing site in several areas to divert surface flows and screen the activities of the operations and therefore some flows have increased in existing areas. Perimeter bunding occurs at the back of the current coal stockpile area and diverts upstream catchment flows to a culvert under the siding connecting into Pipers Flat Creek. A large bund has been also constructed on the northern side of the siding (adjacent to Pipers Flat Creek) which runs parallel to it. This mound has a significant gap along its length and stops short of the rail triangle.

An existing abandoned culvert is located towards the end of the siding which was part of the previous Pipers Flat Creek Crossing before the creek was diverted. This culvert no longer connects with Pipers Flat Creek but may fill up and overtop the siding in peak storm events from the catchment flows upstream.

Piper Flat Creek is largely overgrown with various tree species, and in some areas willows impede larger storm flows. Debris such as fallen trees, logs and branches all contribute to restricting the water flow. Sediment deposits are also evident.

The current site flooding issues occur where the existing culverts cross the existing siding into Pipers Flat Creek (approximately half way up the siding). A combination of silting, shallow depth and potential downstream blockage has contributed to regular backwater flooding at this location.

Water quality management controls have been implemented at the site to capture contaminated surface water and silt from the current coal stockpile area adjacent and inside the rail triangle by the construction of water quality ponds (Refer to Appendix J for the layout). These ponds are monitored in accordance with EPA requirements. Discharge of the treated water is towards Pipers Flat Creek after the rail bridge.

(Refer to the annotated site sketch and photos in Appendices A and B respectively for location of the site features discussed).

5 Flood modelling, calculations and results

5.1 Hydrologic analysis

A detailed hydrologic model was set up for the Pipers Flat Creek, Neubecks Creek and Coxs River catchments using the hydrological modelling software RAFTS. RAFTS is a general runoff and stream flow routing program used to calculate flood hydrographs from rainfall data and catchment parameters such as slope and impervious areas. It subtracts losses from rainfall to produce rainfall-excess and routes this through the catchment to produce runoff hydrographs at required locations.

The XP-RAFTS model covers a total catchment area of approximately 190 km² and is comprised of 37 subcatchments. The layout of the model is based on the catchment plan presented in Appendix C.

It should be noted that there are known to be a number of storages within the catchments such as dams and other water bodies which are not reflected in the XP-RAFTS model due to insufficient information regarding their storage characteristics. By discounting the attenuation effects of these water bodies, the results from the hydrologic model are expected to be conservative.

5.1.1 Rainfall data

Intensity- Duration-Frequency (IDF) coefficients for the site were obtained from the Bureau of Meteorology (BOM). This data was used to undertake the hydrologic analysis. Table 1 below shows adopted IFD coefficients.

Table 1 | IFD coefficients

Parameters	IFD coefficient
Reference Storm 2yr – 1hr	23.72mm/hr
Reference Storm 2yr – 12hr	5.13mm/hr
Reference Storm 2yr – 72 hr	1.75mm/hr
Reference Storm 50yr – 1hr	43.66mm/hr
Reference Storm 50yr – 12hr	9.21mm/hr
Reference Storm 50yr – 72hr	2.79mm/hr
Geographical Factor F2	4.31
Geographical Factor F50	15.72
Regional Skewness	0.16

5.1.2 Hydrologic model setup

An XP-RAFTS model was developed to determine the peak flows in Pipers Flats Creek and the upstream part of Coxs River to the approximately confluence with Pipers Flat Creek.

The overall catchment area for Pipers Flat Creek and Coxs River were delineated from existing survey information and from the available 1 m, 2 m and 10 m contour information. Total catchment areas of 81 km² and 109 km² respectively were estimated.

The catchment areas were further divided into subcatchments based on the topographic features of each catchment. Subcatchment slopes were determined based on the equal area methodology as outline in the AR&R, the manning's 'n' roughness and percentage impervious was estimated using aerial photography.

The catchment maps and adopted subcatchment parameters are included in Appendices C and D respectively.

5.1.3 Model calibration

Calibration of the XP-RAFTS model has been undertaken based on historical rainfall records and gauging data for the catchment. Gauging records were obtained at the river station in Coxs River adjacent to Wallerawang Power Station (NSW Office of Water site 212054). Rainfall data was obtained from Centennial Coal for four rainfall stations, being:

- Springvale
- Angus Place
- Springvale Coal Services
- Ivanhoe 2

The hydrologic model was calibrated against the rainfall event that occurred between 29 February 2012 and 3 March 2012. The hydrograph from the hydrologic model was compared against the recorded flow data at the Coxs River stream gauge station. RAFTS parameters and initial and continuous loss rates have been adjusted to fit the calculated hydrograph to the recorded discharge curve. Table 2 summarises the adopted RAFTS parameters, Figure 3 shows that a good match between calculated and recorded data has been achieved.

Table 2 | RAFTS parameters

RAFTS parameters	Adopted value
Initial loss	33mm
Continuous loss rate	2.5mm/hr
RAFTS storage coefficient B	1.0

The values in Table 2 are in accordance with recommendations by Australian Rainfall and Runoff (ARR) and have been adopted for the estimation of design events.

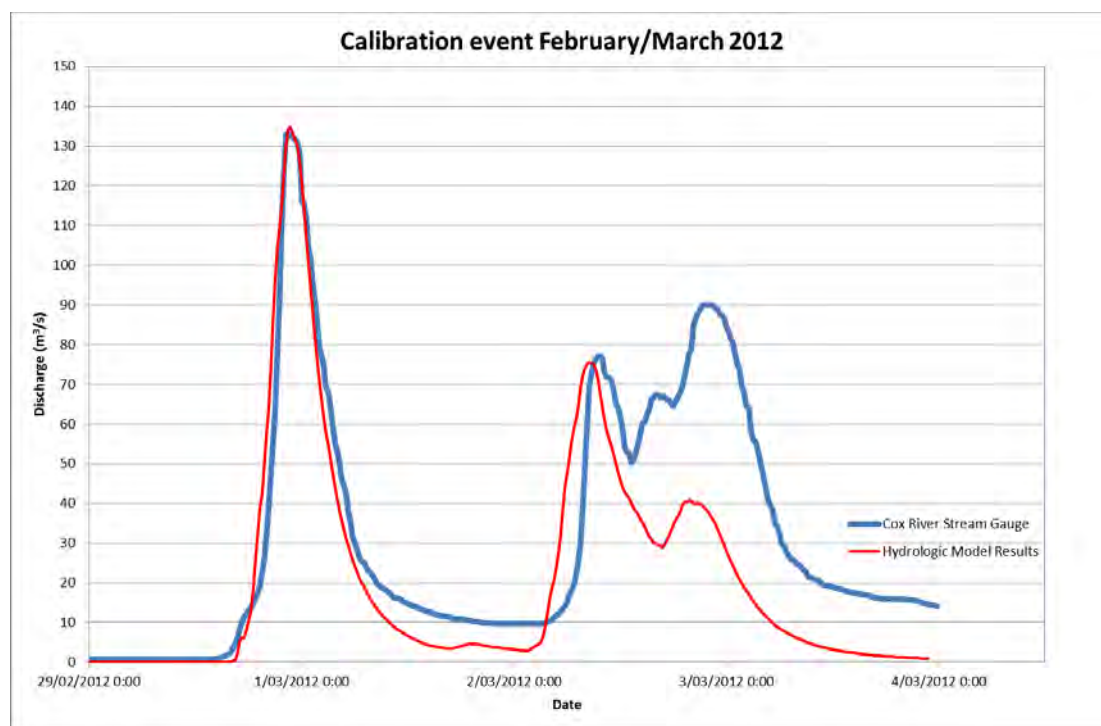


Figure 3 | Calibration event February/March 2012

It is noted that stream flow records were obtained at the river station with a view to undertaking a flood frequency analysis for model validation purposes. However, the period of record for this station is relatively short with records starting from 1992 only. Furthermore, a number of recent peak annual water level records for this station are notated as 'large uncertainty', leaving a resultant 13 annual peak data points relevant for analysis. As this assessment covers rainfall events from 1 to 100 year ARI, it was determined that the gauge data would not provide a reliable flood frequency analysis. The hydrologic analysis therefore relies on the adopted catchment characteristics for calculation of design event runoff.

5.1.4 RAFTS model results

For each of the nominated return periods, storm durations from 10 minutes to 72 hours were simulated to determine the critical duration and the peak discharges immediately upstream of the mine site. Critical durations were found to be in the range between 2160 and 2880 minutes for each return period. Peak discharge results for Cox's River and Pipers Flat Creek are shown in Table 3 and Table 4.

Table 3 | Cox's River peak inflows

Return period (years)	XP-RAFTS model peak discharge (m ³ /s)	Critical duration (min)
1	77	2880
2	126	2880
5	171	2880
10	195	2160
20	233	2160
100	297	2160

Table 4 | Pipers Flat Creek peak inflows

Return period (years)	XP-RAFTS model peak discharge (m ³ /s)	Critical duration (min)
1	70	2880
2	118	2880
5	170	2880
10	196	2880
20	238	2160
100	314	2160

5.2 Hydraulic modelling

5.2.1 Methodology

Hydraulic modelling was undertaken using the 2011 version of the MIKE 21 2d hydraulic simulation package. MIKE 21 is a comprehensive modelling system for two-dimensional free surface flows. The water levels and flows are resolved on a rectangular grid covering the area of interest when provided with the bathymetry (topography), bed resistance coefficients; hydrographic boundary conditions etc. The following sections detail the set-up of the MIKE 21 model.

5.2.2 Model extents

Model extents were established some distance from the area of interest so as to minimise the sensitivity of the model results to boundary conditions. The overall model domain encompasses a grid of approximately 3.7 km by 3.5 km with a 5 m grid spacing adopted. The site is located at the approximate centre of the model area. The extent of the hydraulic model is presented in Appendix E.

5.2.3 Topography

The MIKE 21 model topography was established using the following datasets in descending order of precedence:

- Site detail survey
- 1 m contours
- 2 m contours

The site survey provides coverage of the site itself as well as immediately surrounding properties, railways and structures. 1 m contours provide an additional coverage area of approximately 2.9 x 2.9 km and the 2 m contours were used to define the outer edge of the model area.

It is noted that a portion of Pipers Flat Creek to the south, near the culvert crossing under the existing siding, was not surveyed due to it being inaccessible by the surveyors. Topography of this portion was estimated based on aerial photographs and survey information at the adjacent ends of the watercourse.

5.2.4 Roughness values

Roughness values were estimated using aerial photography of the model catchment area with reference to industry accepted references such as Chow 1959. Adopted roughness values are shown below in Table 5.

Table 5 | MIKE21 roughness values

Type of vegetation/land use	Manning's roughness values
Pasture and open paddock	0.030
Low density trees	0.045
Residential areas and medium/high density trees	0.060
Coal storage areas	0.030
Lagoon/creek	0.035
Heavily vegetated creek	0.05
Buildings	0.15

5.2.5 Inflow hydrographs

Inflow hydrographs for each of the nominated design events were extracted from the XP-RAFTS model and used in the MIKE 21 model for the upstream boundary condition. In addition, inflow hydrographs for the subcatchments within the MIKE 21 model were added as internal point source inflows. A range of storm durations were run through the MIKE 21 model to ensure that any storage affects were taken into account that may impact upon the critical storm duration and also to allow for any variation in the critical storm duration between the upstream and downstream end of the MIKE 21 model.

5.2.6 Tailwater conditions

A tailwater condition of RL 872 m AHD was adopted as the tailwater level in upper receiving waters of Lake Wallace based on the TWL of RL 871.5 m AHD, as shown in Figure 4. For the MIKE 21 model lower boundary condition, an additional 0.5 m has been added to account for hydraulic grade of water moving through the system under flood conditions. The tailwater impacts were tested for the 100 year ARI rainfall event and the results indicated negligible difference upstream for the Lidsdale site flood levels.

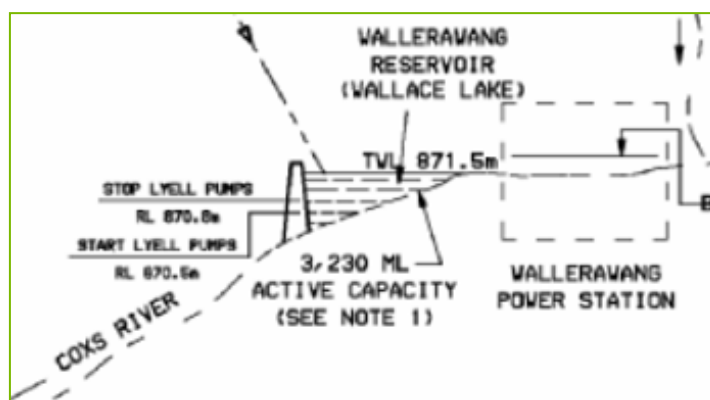


Figure 4 | Lake Wallace operating water levels

5.2.7 Hydraulic structures

A number of bridges and culvert structures are present in the hydraulic model domain, in particular in Cocks River downstream of the site. Major hydraulic structures are listed in ascending order downstream in Table 6. Hydraulic modelling aspects of the above structures are discussed below in Section 5.2.8.

Table 6 | Hydraulic structures

	Total span	Soffit	Top	Substructure
Pipes Flat Creek rail bridge	26	876.7	877.8	2 x 1.5m piers
Main Street road bridge	46	875.4	876.6	7 x 0.4m piers
Wallerawang PS pipe bridge	150	875.5	880	4 x 1m piers
Wallerawang PS road culvert	14.5	871.8	872.4	NA
Rail bridge Wallerawang PS	140	876.1	878.5	12 brick arches

5.2.8 HEC-RAS hydraulic structure check

For economy of the MIKE 21 modelling effort, a one dimensional HEC-RAS model was established. This incorporated the major bridge crossings, with a view to identifying those structures that were significant to the MIKE 21 model results so that they could be included in the MIKE 21 model domain. The analysis indicated that the key structures influencing flood levels at the site were the rail bridge immediately upstream of the Coxs River/Pipers Flat Creek confluence and the Main St road bridge. The HEC-RAS model included an estimation of hydraulic losses across each structure which was compared to losses calculated in the MIKE 21 model. To perform the check, the MIKE21 Model was run with a steady state discharge of 300 m³/s flowing through Pipers Flat Creek.

The following structure schematization approaches provided good agreement between the MIKE 21 and HEC-RAS models for the 100 year ARI event:

- The Rail Bridge was modelled as a culvert/weir structure in MIKE 21 with an opening width of 22 m, and a weir level of RL 877.8 m AHD
- The Main Street road bridge was modelled as a topographic opening with no bridge structure incorporated. The opening width was adjusted to approximate hydraulic losses calculated using HEC-RAS under the in the 100 year ARI peak discharge
- All other structures were modelled as topographic openings with no bridge structures incorporated in the 2d modelling regime

Calculated head losses across hydraulic structures are shown below in Table 7.

Table 7 | Hydraulic structures head loss calculations

Structure ID	100 year ARI peak conveyance (m ³ /s)	Hydraulic loss (m)	
		HEC-RAS	MIKE21
Pipes Flat Creek rail bridge	245	0.6	0.7
Main Street rail bridge	298	0.2	0.2

From the table, it can be seen that similar losses are calculated at the Pipers Flat Creek rail bridge which is the primary hydraulic structure in terms of modelling the site flood behaviour. Furthermore it can be seen that by modelling the Main Street bridge as an open flow constriction, MIKE 21 calculates head loss across the structure comparable to that calculated by HEC-RAS under peak flow conditions in the 100 year ARI event. Inclusion of an actual bridge or culvert in the modelling regime was therefore not undertaken.

6 Model results and identified flooding issues

6.1 Peak water level results

Peak water levels for each of the design storm events are shown in Appendix F. The model results show the expected increase in peak water levels throughout the system with increasing ARI and provide an indication of flood immunity for various areas within and around the site. The following critical infrastructure levels have been provided by Centennial Coal:

- Reclaim tunnel entrance: RL879.80
- Henry's workshop: RL880.93
- New Stockpile Pad: RL881.41
- Floor of reclaim tunnel: RL875.07

With regard to the results shown in Appendix F, the following flooding characteristics are noted for a range of storm events:

6.1.1 1 year ARI

Flooding within and around the site appears minor in nature and is largely dictated by local site runoff, although high tailwater levels within Pipers Flat Creek are likely to contribute to site flooding issues. Peak water levels around the proposed coal silo bin are approximately RL 879.4. The rail formation level in this area is approximately RL 879.0, indicating inundation of the ballast during this design storm event. Inundation of the Lidsdale Siding rail triangle is not predicted.

6.1.2 2 year ARI

Water levels of approximately RL 882.5 are predicted within the realigned portion of Pipers Flat Creek. Figure F-2 shows some overtopping of the rail embankment in the location of the unoccupied original watercourse to the south of the railway. Inundation of properties to the south of the rail embankment becomes more extensive.

6.1.3 5 year ARI

Overtopping of several hundred metres of the rail siding adjacent to the unoccupied land is predicted, resulting in flooding to a level of approximately RL880.5 within the western corner of the developed sites. Backwater through the existing rail culverts is likely to contribute to inundation significantly. Water levels near the culvert crossing are approximately RL 879.9. The coal handling and storage facility is not inundated by this event.



6.1.4 10 year ARI

Flooding extents are comparable to those calculated for the 5 year ARI events, with slightly more encroachment of flood waters within the site and neighbouring sites. The coal handling and storage facility is still not inundated by this event.

6.1.5 20 year ARI

Inundation of the site is predicted to occur. Peak water levels entering the site are predicted to be RL 879.40 to 879.50. The entrance of the Reclaim Tunnel is at RL 879.80 and therefore flood water does not enter the tunnel during a 20 year ARI event.

6.1.6 100 year ARI

The site becomes substantially inundated to a level of approximately RL879.5. The entrance of the reclaim tunnel the workshop and the new stockpile pad are all above the 100 year ARI level. Some flooding within the rail triangle is predicted and the rail line to the north is inundated. It is noted that substantial increases in water levels adjacent to the rail triangle are not predicted from the 10 to 100 year events. This is most likely due to the more extensive flooding to the north of the site with flows from Piper's Flat Creek being conveyed over the northern portions of the rail line.

6.2 Peak velocities

Peak velocity maps have been produced for the 5, 20 and 100 year ARI events to provide an indication of scour and erosion risks within the flood path. These are shown in Appendix H.

Generally, the results show concentrations of higher velocities through the realigned portion of Pipers Flat Creek as well as through hydraulic structures and various other flow constrictions through the model domain. Velocities of up to 4 m/s are calculated in the section of the creek upstream of the site, adjacent to the rail siding and vacant land. Where the overgrown creek meanders to the north through the overgrown section of willows, where the flow pattern is less concentrated, peak velocities are correspondingly lower. In the vicinity of the rail triangle, silos and control rooms, typical peak velocities for the 100 year ARI event are in the order of 1 m/s. However, there are localised sections of flow concentration within this area where velocities of up to 2.6 m/s are predicted, particularly at the point where Pipers Flat Creek converges with the western point of the rail triangle. Any proposed infrastructure within this area should be designed accordingly.

7 Flood mitigation

In discussion with Centennial Coal, two options have been identified to mitigate flooding within the coal handling and storage facility. These options have been assessed using the hydraulic model and are discussed below.

7.1 Option 1: Removal of willows – Pipers Flat Creek

7.1.1 Proposed works

It is understood that through the meander of Pipers Flat Creek adjacent the rail siding, there is a portion that is significantly congested with willows and that it is possible that these could be removed.

7.1.2 Outcomes of the analysis

Modelling of this scenario has been undertaken with a decreased roughness value in the hydraulic model in the area of dense vegetation. However in the event that the willows were substantially thinned out, only a small improvement of approximately 60 mm reduction in peak water levels under a 100 year ARI event would be achieved. Peak water level and afflux maps are shown in Figures F7 and G1.

7.2 Option 2: Local bunding

7.2.1 Proposed works

A substantial bund runs parallel to the siding on the western side downstream of the culvert crossing and it is assumed that this was put in place to help alleviate previous flooding. However, this bund constricts the floodplain and elevates water levels at the rail siding during flood events. In order to provide additional flow capacity, it is proposed to remove a section of the existing bund near the existing culvert and to construct a new bund parallel to the rail line to protect the rail and the site from flooding from Pipers Flat Creek. The area between the new bund and the existing bund provides a second flow path during flood events. During significant rainfall events, the rail line will need to be closed and a small temporary bund will need to be constructed over the rail line to connect the new bund with the existing bund on the southern side of the rail to prevent runoff entering the site along the rail line. This temporary bund has been constructed during past rainfall events as shown in Figure 6. Strict safety and operations procedures and a Safety in Design process during detailed design need to be in place to ensure that the rail line remains closed while the temporary bund is in place. It is proposed to construct the new bund to a level of 880.50, which is approximately 500 mm above the 100 year ARI level. Figure 5 shows the schematics of Option 2.



Figure 5 | Mitigation option 2



Figure 6 | Temporary bund across rail line



7.2.2 Outcomes of the analysis

Figure F8 shows that with this mitigation option the Lidsdale Siding site can be protected from flooding from Pipers Flat Creek for flood in excess of the 100 year ARI event. Figure G2 shows that this option does not impact on water levels upstream of the siding and therefore has no negative impacts on neighbouring properties. However, as this option includes the construction of a temporary bund across the rail line, the practicality of this option depends on the monitoring and forecasting of significant rainfall events and procedures to close the rail line and construct the temporary bund before water levels reach critical levels. There is a safety risk and a risk of failure of this measure if the procedures are not implemented correctly.



8 Flood impacts

8.1 Rail siding duplication

It is understood that duplication of the existing rail siding is proposed to the south-east of the existing siding. At the time of assessment, topographic data was not available for the proposed alignment and as such, developed case modelling has not been undertaken. However it is considered likely that, provided that locations and sizes of culverts are similar to those beneath the existing alignment and existing rail levels are maintained, flood impacts of the proposed duplication would be minimal. This is likely for the following reasons:

1. The proposed duplication alignment is parallel and directly adjacent to an existing rail alignment
2. The Volume of the associated earthworks are likely to be insignificant in terms of impacts on local flood storage volumes
3. Development levels for the proposed siding are likely to be comparable to the existing siding

With regard to point number three above, it is noted that some additional flood immunity for minor to intermediate storm events may be gained by raising the embankment. However, as shown in the figures in Appendix F, general inundation of the surrounding rail network during significant storm events would appear to make significant embankment raising redundant, given that rail access would generally be not available during moderate flooding.

8.2 Mitigation options

The results of the assessment of the removal of Willow Trees within Pipers Flat Creek showed that peak water levels could be lowered by approximately 60 mm under a 100 year ARI event. However, the coal processing and handling area would still be inundated under this event and local measures would need to be undertaken to protect flooding of the site. No impacts on neighbouring properties are expected with this mitigation option.

Modelling results indicate the existing flood immunity of the coal handling and storage area is currently between 10 and 20 years ARI, with significant inundation of the siding only occurring in events greater than 20 years ARI. This immunity can be raised to above 100 year ARI if parts of the existing bund are removed and a new bund is constructed along the siding and a small temporary bund constructed across the rail line during significant flood events. The proposed works would have minimal adverse hydraulic impacts upstream and therefore not affect neighbouring properties.



9 Sydney Catchment Authority requirements and EPA approvals

The Sydney Catchment Authority (SCA) has provided specific consent conditions for the proposed Lidsdale Siding development regarding water quality of surface waters and ground water beyond the boundaries of the site. The relevant items and actions are summarized below:

- A flood study for the site should be undertaken that identifies, amongst other things, the impact on the facilities stormwater management systems
- The SCA suggests that willow trees within Pipers Flat Creek should be removed within two years of the completion of construction activities
- The SCA requests that a detailed erosion and sediment control plan for the construction of the rail siding be prepared to ensure disturbance impacts to the Pipers Flat Creek banks and direct inflows are avoided or minimized

The Environmental Protection Authority (EPA) has also recommended conditions of approval in regards to surface water management. The relevant items and actions are summarized below:

- Potential for flood waters from the adjacent Pipers Flat Creek to mobilise coal, coal fines and other sediments from the site into the Coxs River
- The EPA recommends that the proponent commits to the construction of an appropriate designed flood levee between Pipers Flat Creek and the rail siding/rail line within the project area

9.1 Stormwater management systems

The main current site stormwater management system consists of a dirty water settling pond, middle pond and a triangle pond which are located at the rail triangle (refer to Appendix I). Flood modelling indicates that this area is currently protected up to a 20 year peak ARI event.

Other smaller ponds are located to the north on the other side of the existing siding but may be inundated in more frequent events. Reports outlining the system have been produced by Connell Hatch, Aurecon and RPS Aquaterra.

9.2 Willow Tree removal

Observations on site indicated that willow trees located within Pipers Flat Creek have been uprooted and pushed downstream during larger storm events blocking the creek. The tree roots form in mats and the water lifts these up and this in turn causes resistance to the flow causing upstream water levels to rise. The removal of willows and fallen trees will improve the creek flows and reduce the incidence of local flooding on the site (Refer to Section 8 in the report).



9.3 Erosion control plans

Erosion control plans should conform to 'Soil and Construction' – volume 1 – 4th edition, March 2004.

9.4 Surface water management and flood water impacts

Results from the flood modelling indicate that surface flood impacts to the proposed works will be limited mainly to the upper half of the proposed siding area and existing culvert crossing locations. Future tree and debris clearing works within Pipers Flat Creek will help alleviate the current existing flooding issues and appropriate dirty water ponds. The construction of a new bund along the rail line would give the site flood immunity in excess of 100 year ARI and therefore the risk of coal sediment entering the waterways would be minimal.

Some additional earthworks and bunding can be located downstream in the unaffected flood areas to mitigate sediments and coal fines migrating into the waterways (refer to Appendix J for the existing site features and existing pond arrangement). Some small existing ponds along the northern section of the siding are currently being used for surface water management and should be retained.



10 Climate change impacts

A report was released in 2004 by the CSIRO and Bureau of Meteorology on behalf of the NSW Government which investigated likely future changes to the climate in NSW. In summary the predictions by the year 2030 regarding rainfall intensity and frequency were:

- Annual total rainfall decline by an average of 14 mm per decade
- Largest declines in rainfall near the coast due to the increase in El Nino
- Extreme rainfall intensity and frequency decreased throughout much of the state
- Extreme rainfall may become more intense in central and south-east NSW
- Rainfall runoff and stream flows will be reduced
- Droughts are likely to be more severe

While much of NSW shows a tendency towards drier seasonal-average conditions under enhanced greenhouse conditions, it does not necessarily follow that extreme daily rainfall events will become less frequent or severe. Previous studies have indicated marked increases between 10-15% in the intensity and frequency of extreme daily rainfall events under enhanced greenhouse conditions for the Australian region.

From the CSIRO report predictions it is unlikely that any immediate significant impacts will result from climate change scenarios for the Lidsdale site in regards to flooding. Additional factors created by the surrounding mining activity regarding water storage, distribution of water and diversion of catchments will also play a part in surface water allocation to the existing catchments for the Lidsdale site. These factors have not been assessed as part of this report.

It should be noted that more frequent prolonged rainfall events are predicted with associated extended dry spells. Climate change has not been factored into this report but a conservative approach should be exercised when assessing flood depths for the site and adopting free board of not less than 500 mm for structures.



11 Summary and recommendations

The flood study undertaken has shown that the Lidsdale Siding site has minor to medium flooding issues up to the 5 year ARI peak event. Pipers Flat Creek overtops its banks during a 2 year ARI peak event and more extensive flooding of the site occurs with increasing ARI. During a 100 year ARI peak event the rail triangle is inundated and most of the site floods.

Some of the flooding issues can be attributed to backwater effects from the railway bridge and debris, constrictions, willows and silting along Pipers Flat Creek. To mitigate the flooding, clearing, minor earthworks and mounding are recommended interim solutions.

The proposed additional siding works are unlikely to increase flooding and reduce storage provided the existing levels are maintained and the existing culvert connection to Pipers Flat Creek is retained.

The protection of structures and the entry to the proposed underground elevating coal conveyor can be achieved by designing a new bund along the northern side of the rail line. A temporary bund across the rail line will need to be constructed during significant flood event to prevent water entering the coal handling and storage facility along the rail line. The works would also further minimise the risk of contamination of the downstream waterways with coal particles beyond the surface water quality measures that are already in place.



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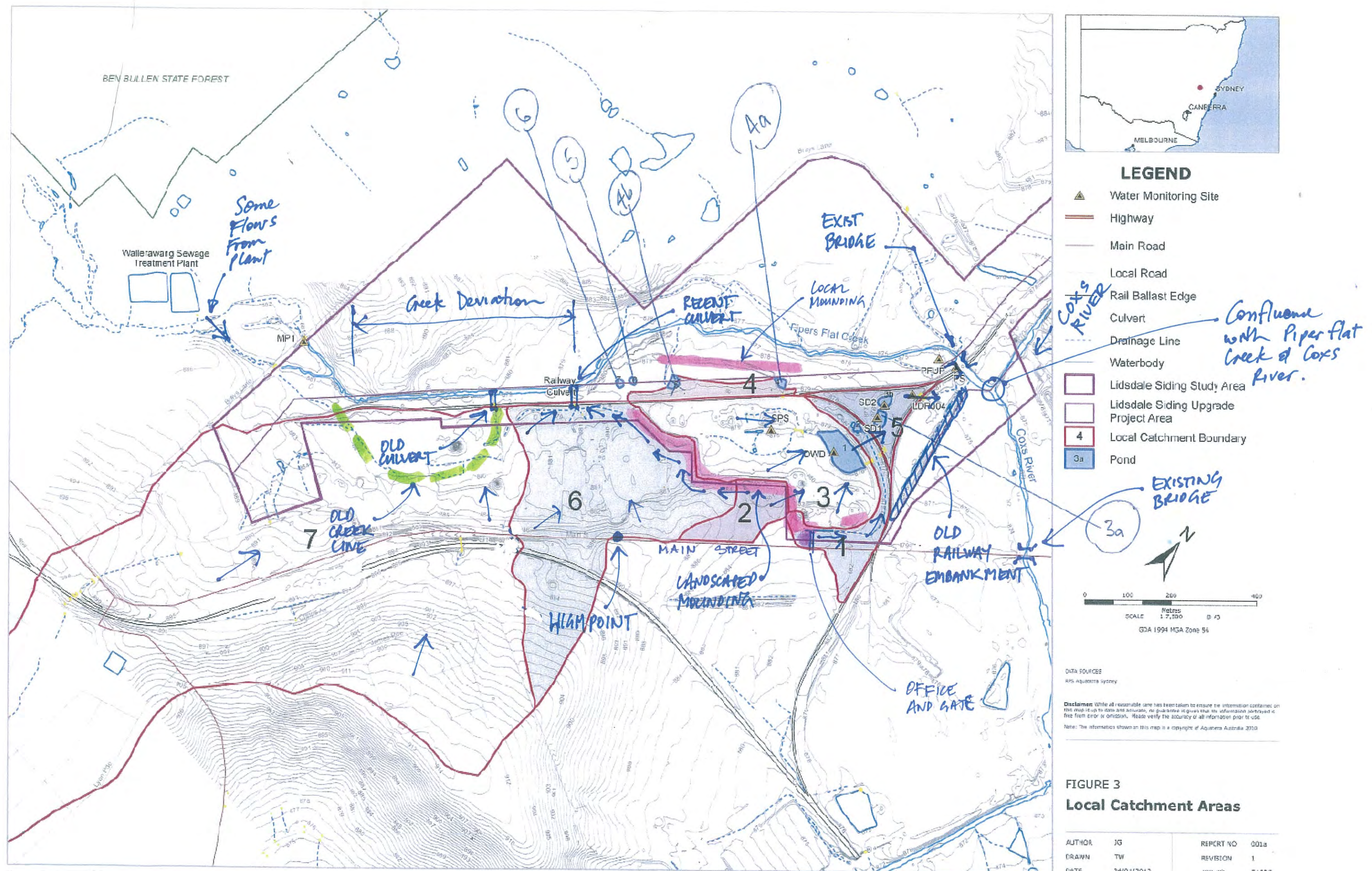
Appendices

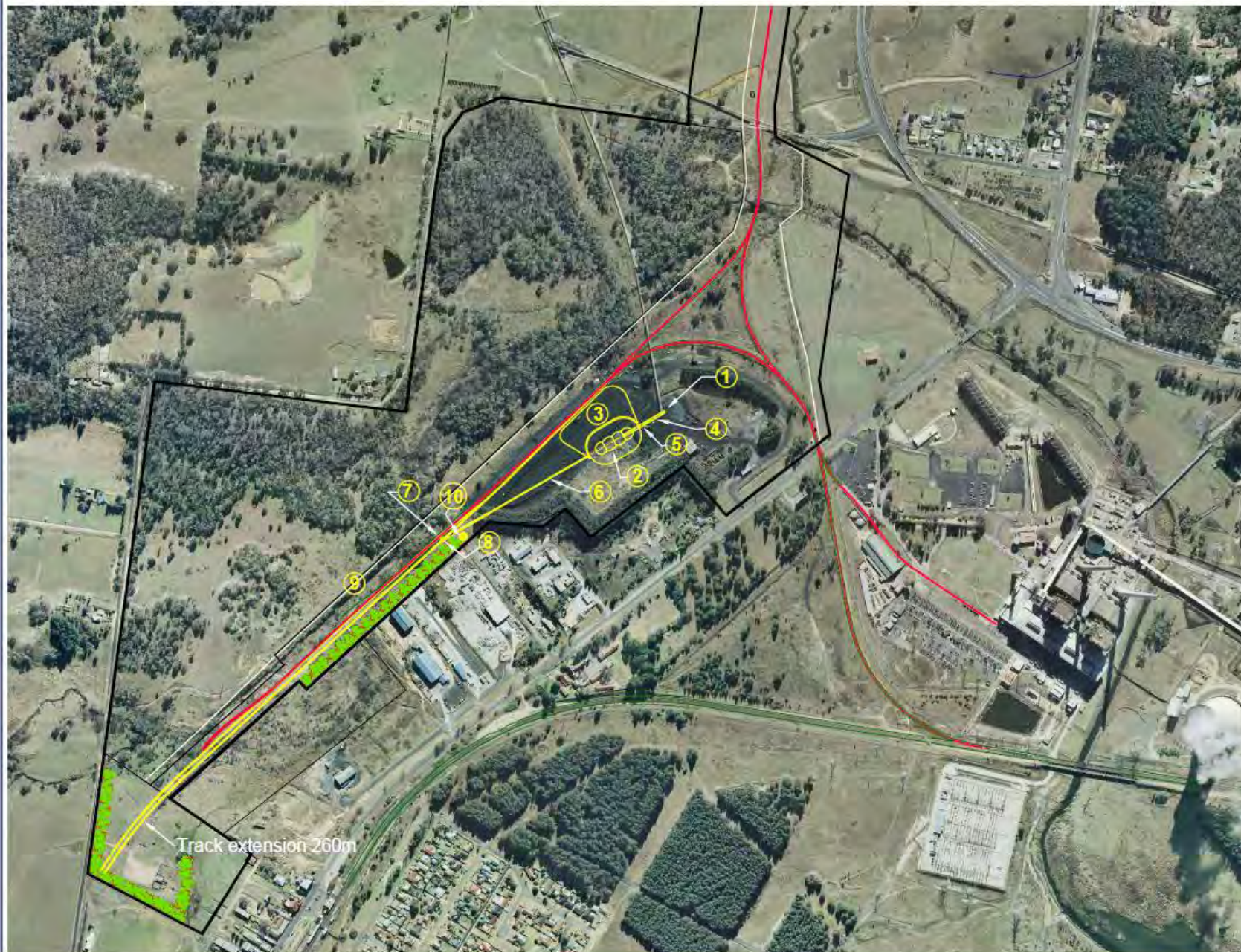




Appendix A

Site sketch and plans





Proposed Components:

- ① Diversion chute at the end of the existing overland conveyor (Auxiliary Stockpile beneath)
- ② 50 000 t elongated conical stockpile
- ③ General Pushout Area for elongated conical stockpile
- ④ Elevating conveyor to elongated conical stockpile
- ⑤ Reclaim tunnel beneath the stockpile.
- ⑥ Ground conveyor from the reclaim tunnel, elevating to the train loading bin
- ⑦ A train loading bin (nominal 250 tonne capacity)
- ⑧ Control room adjacent to the loading bin
- ⑨ Notional alignment of New Rail Line and adjacent shunt
- ⑩ Self bunded transportable fuel tank

- Lidsdale Siding Study Area
- EXISTING RAIL LINE
- PROPOSED COMPONENTS
- LANDSCAPING BUFFER

0 100 200 300 400
SCALE 1 : 7000 (A3)

TITLE: LIDSDALE SIDING UPGRADE PROJECT
FIGURE 4 PROPOSED COMPONENTS

LOCATION: WALLERAWANG

DATUM: (GDA 94)
PROJECTION: MGA Zone 56

20TH AUGUST 2012
ENV. ASSESSMENT

AUTOCAD REF: 110912 UPGRADES TO PROJECT AREA 3
VERSION (PLAN BY): PROPOSED 2

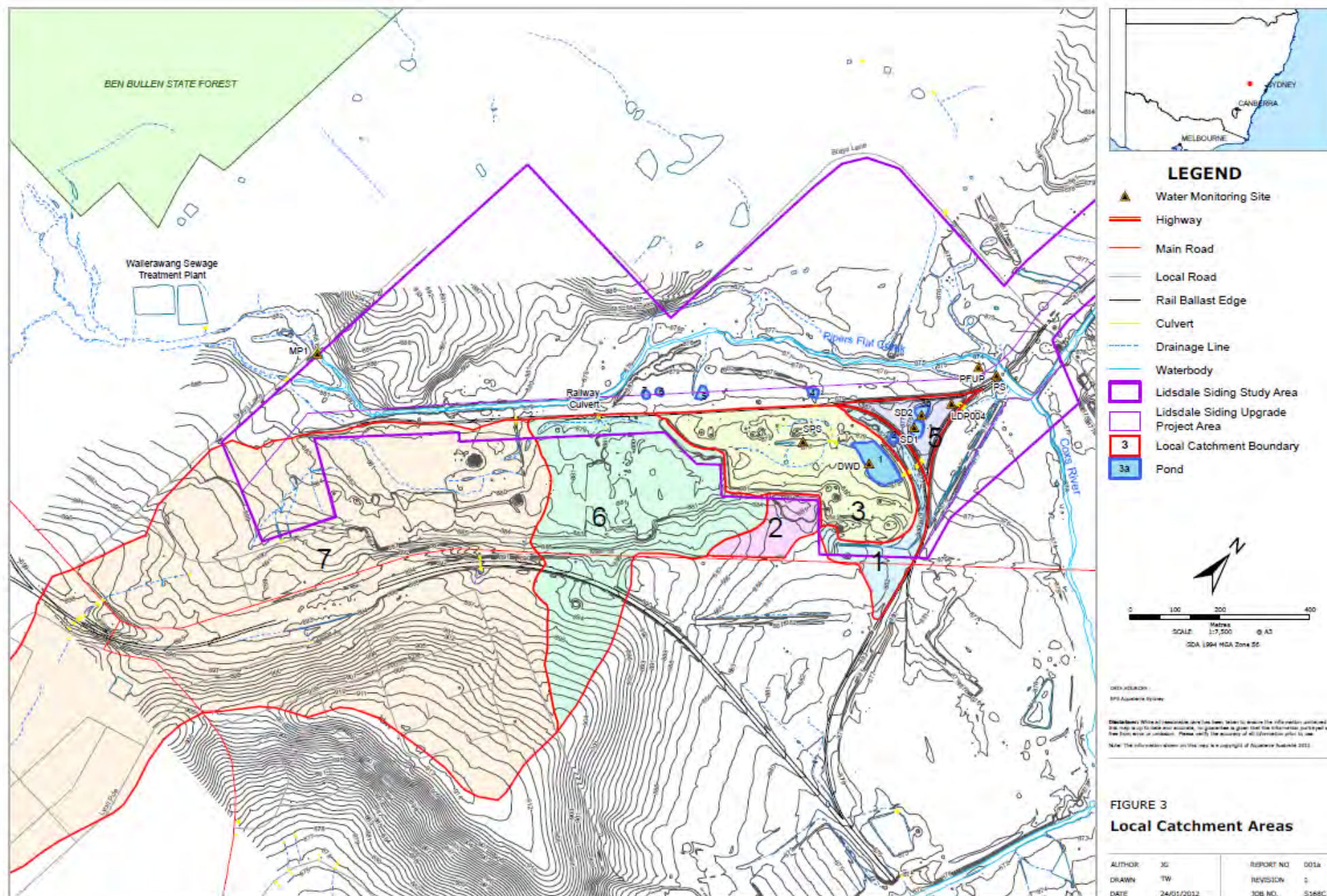
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JOB REF: 110912

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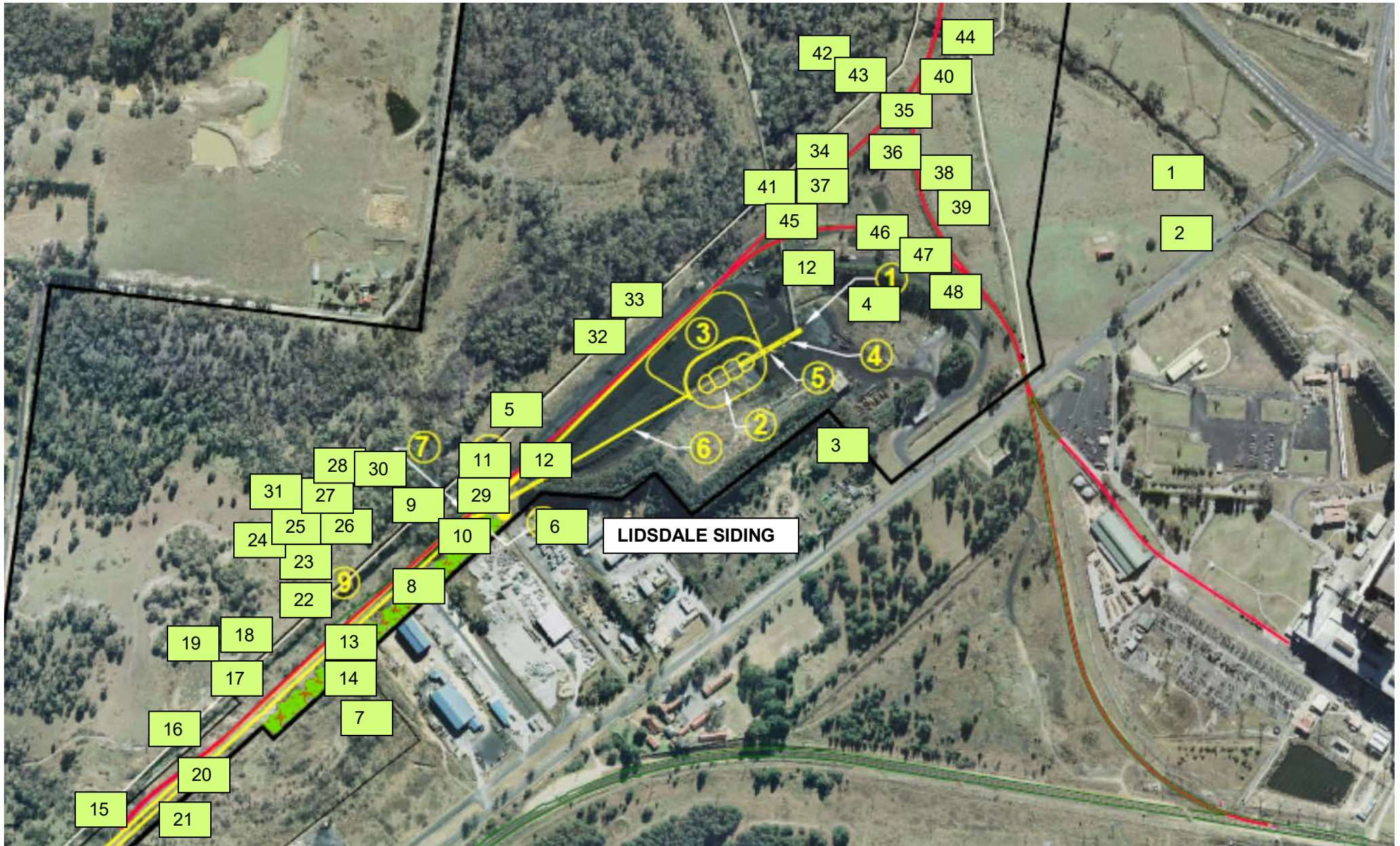
RPS



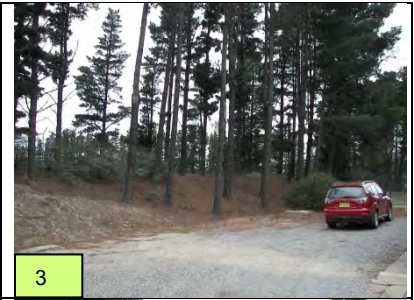


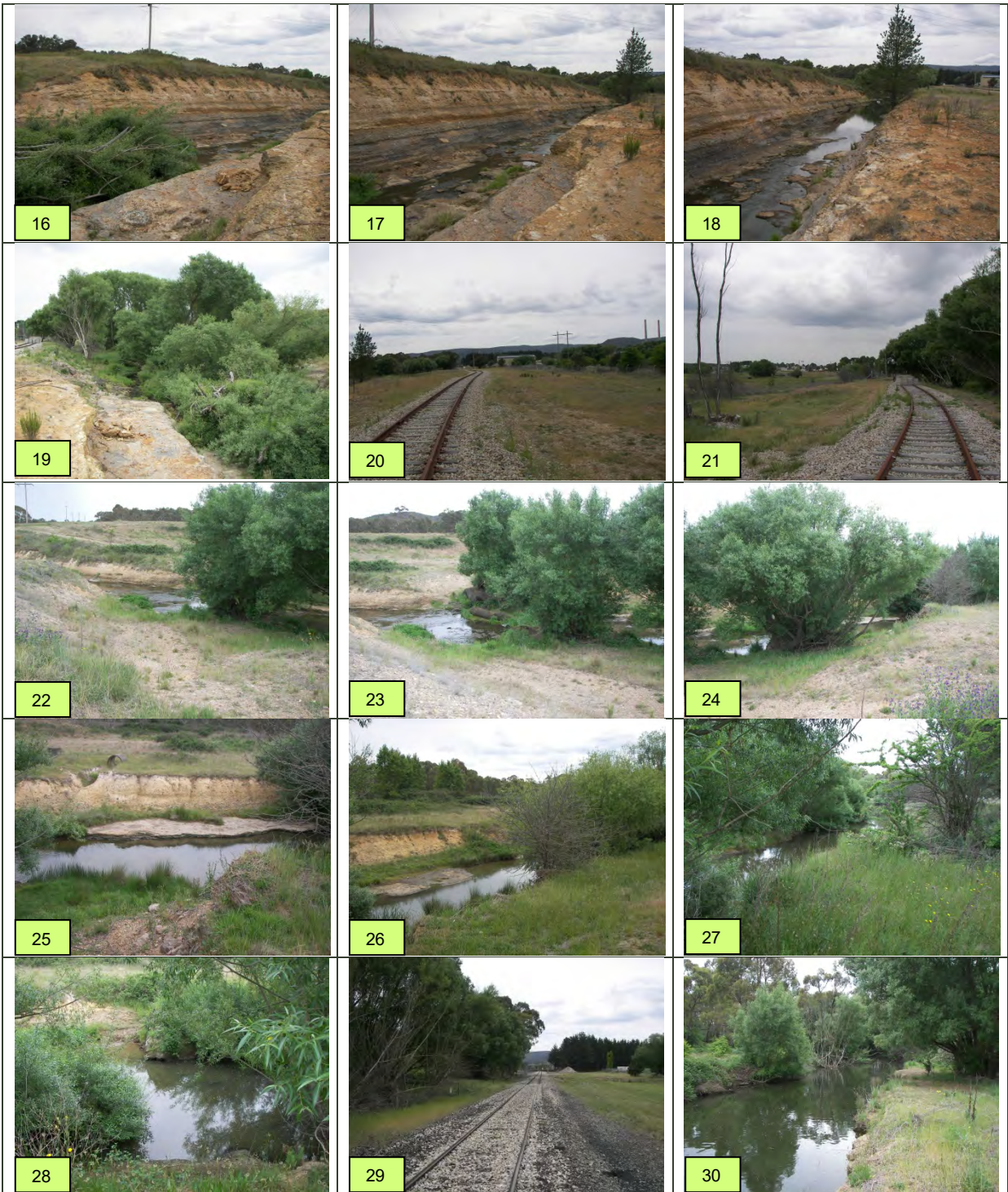
Appendix B

Site photos



Approximate Location of Site Photos





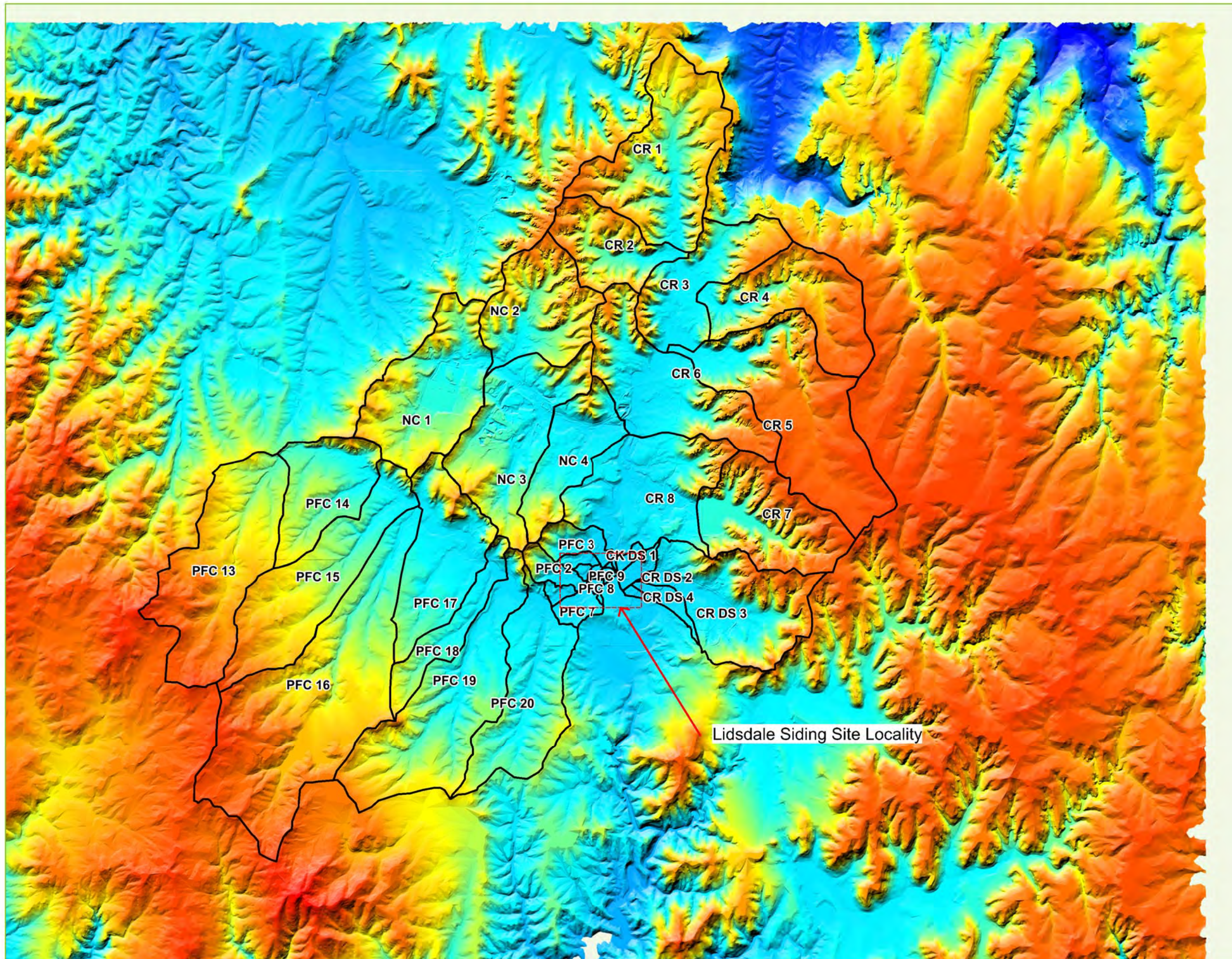






Appendix C

Catchment plan



Legend

 Catchment Boundary



0 5000 (m)

Scale 1:100,000 (m) (@ A3 size)

Date: 14/04/2014 Version: 0
Projection: MGA Zone 56

Mount Piper Area - Western Centennial Area - Lidsdale Siding

Lidsdale Siding Flooding Assessment Report

Figure C-1

Catchment Map



Appendix D

Adopted catchment parameters

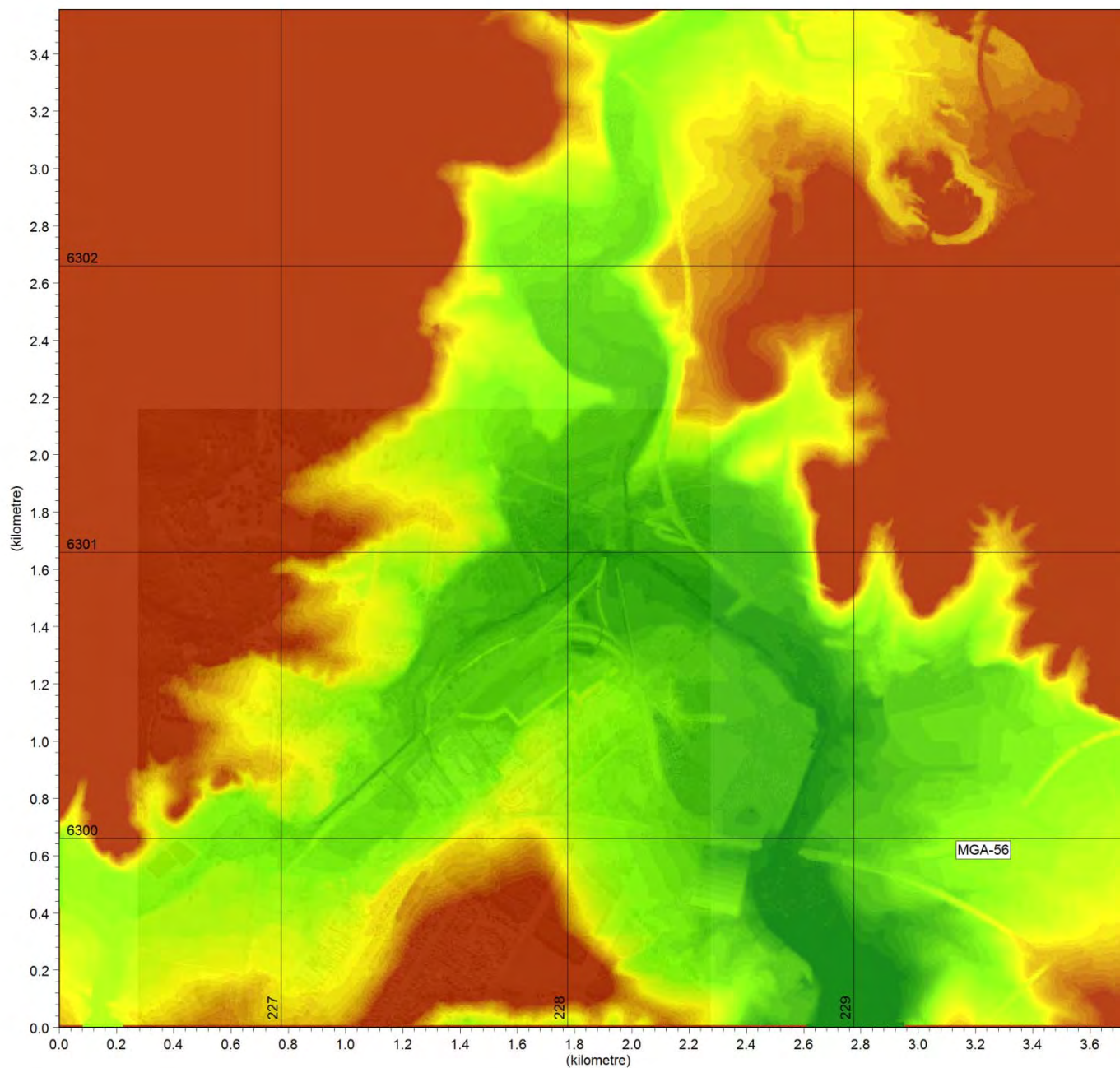
Adopted Catchment Parameters

Catchment ID	Total Area (km ²)	Catchment Slope (%)	Catchment Mannings 'n'
CR 1	10.92	1.2	0.04
CR 2	4.69	2.7	0.1
CR 3	6.37	1.2	0.1
CR 4	7.83	2.7	0.06
CR 5	13.13	2.5	0.1
CR 6	9.03	2	0.06
CR 7	7.82	4.7	0.075
CR 8	8.99	1.5	0.04
CR DS 1	0.29	1.8	0.03
CR DS 2	0.51	3.3	0.03
CR DS 3	8.74	1.7	0.08
CR DS 4	0.66	2	0.04
CR DS 5	0.14	2	0.03
NC 1	8.98	1.1	0.06
NC 2	6.96	2.5	0.08
NC 3	8.98	1.5	0.06
NC 4	4.98	2	0.07
PFC 1	0.3	1.4	0.04
PCF 2	0.93	3.6	0.08
PFC 3	1.33	2.6	0.045
PFC 4	0.31	2.3	0.05
PFC 5	0.13	0.1	0.07
PFC 6	0.09	1	0.05
PCF 7	0.8	1.1	0.035
PCF 8	0.16	2.7	0.035
PFC 9	0.09	0.4	0.04
PFC 10	0.02	2.6	0.035
PFC 11	0.05	1.3	0.035
PFC 12	0.05	2	0.035
PFC 13	11.59	2	0.04
PFC 14	5.61	1.8	0.04
PFC 15	9.38	2	0.04
PFC 16	19.76	1.5	0.04
PFC 17	7.33	1.6	0.045
PFC 18	3.12	1.5	0.04
PFC 19	11.69	1.1	0.04
PFC 20	7.89	1	0.04



Appendix E

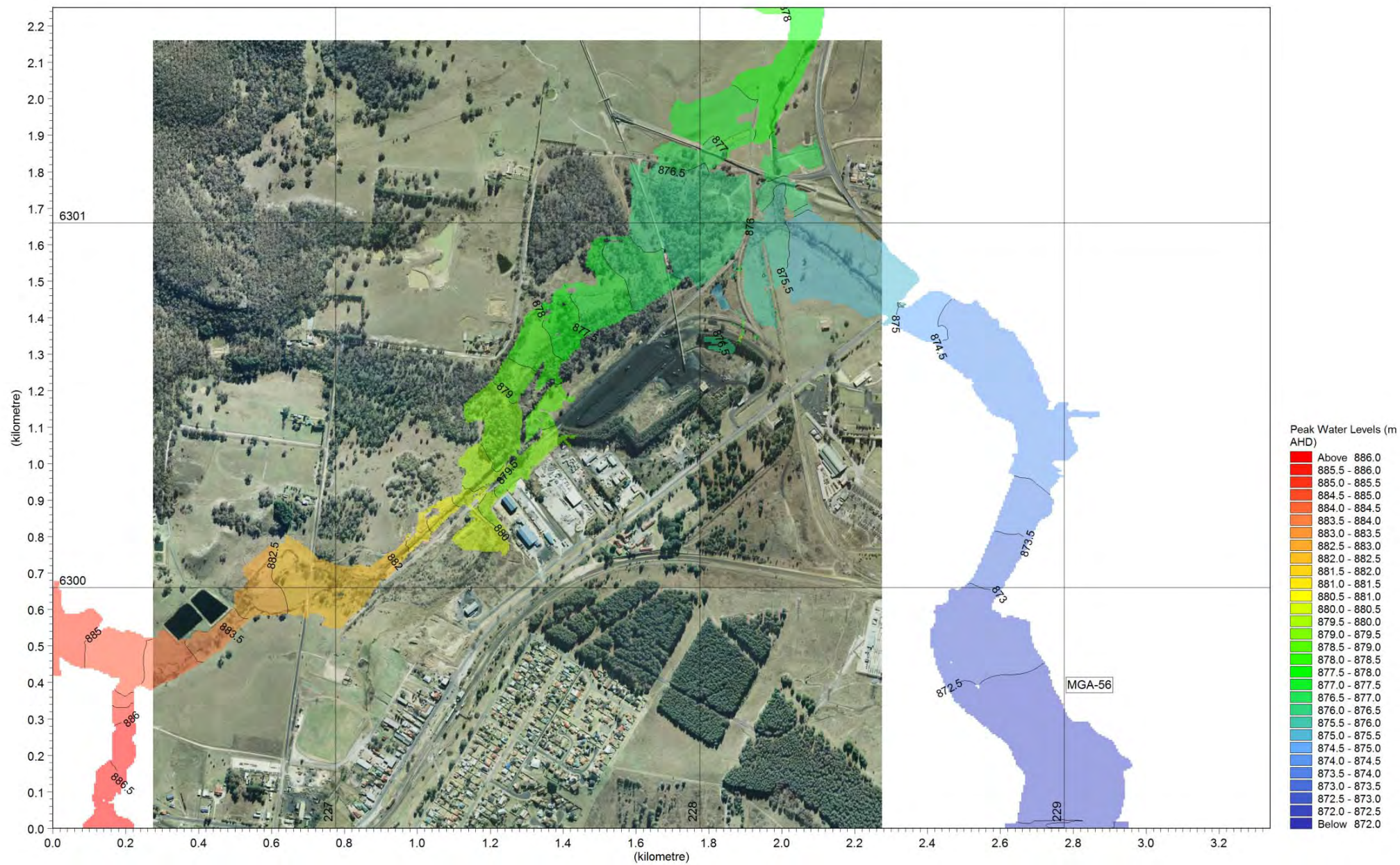
Modelling extents

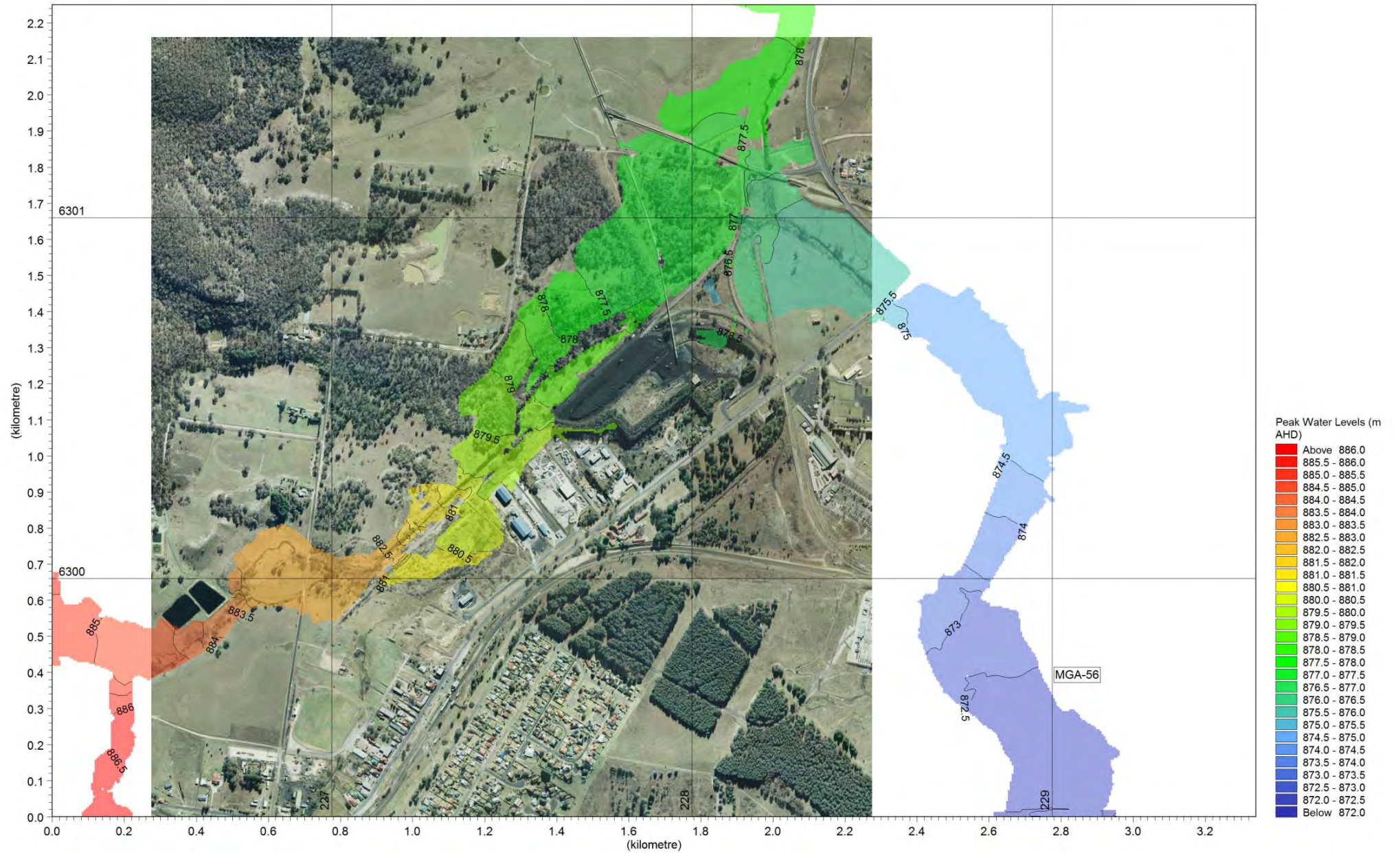


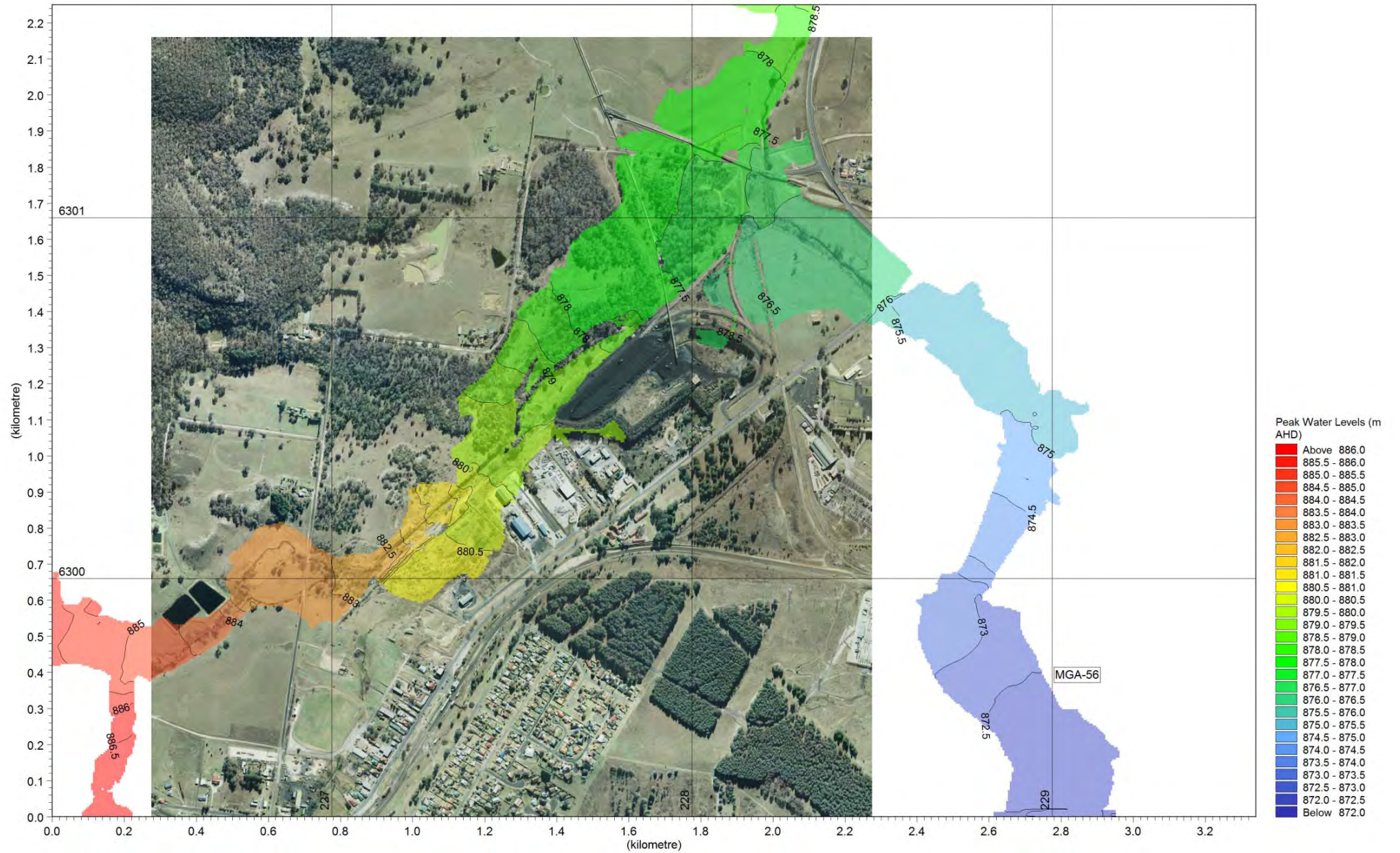


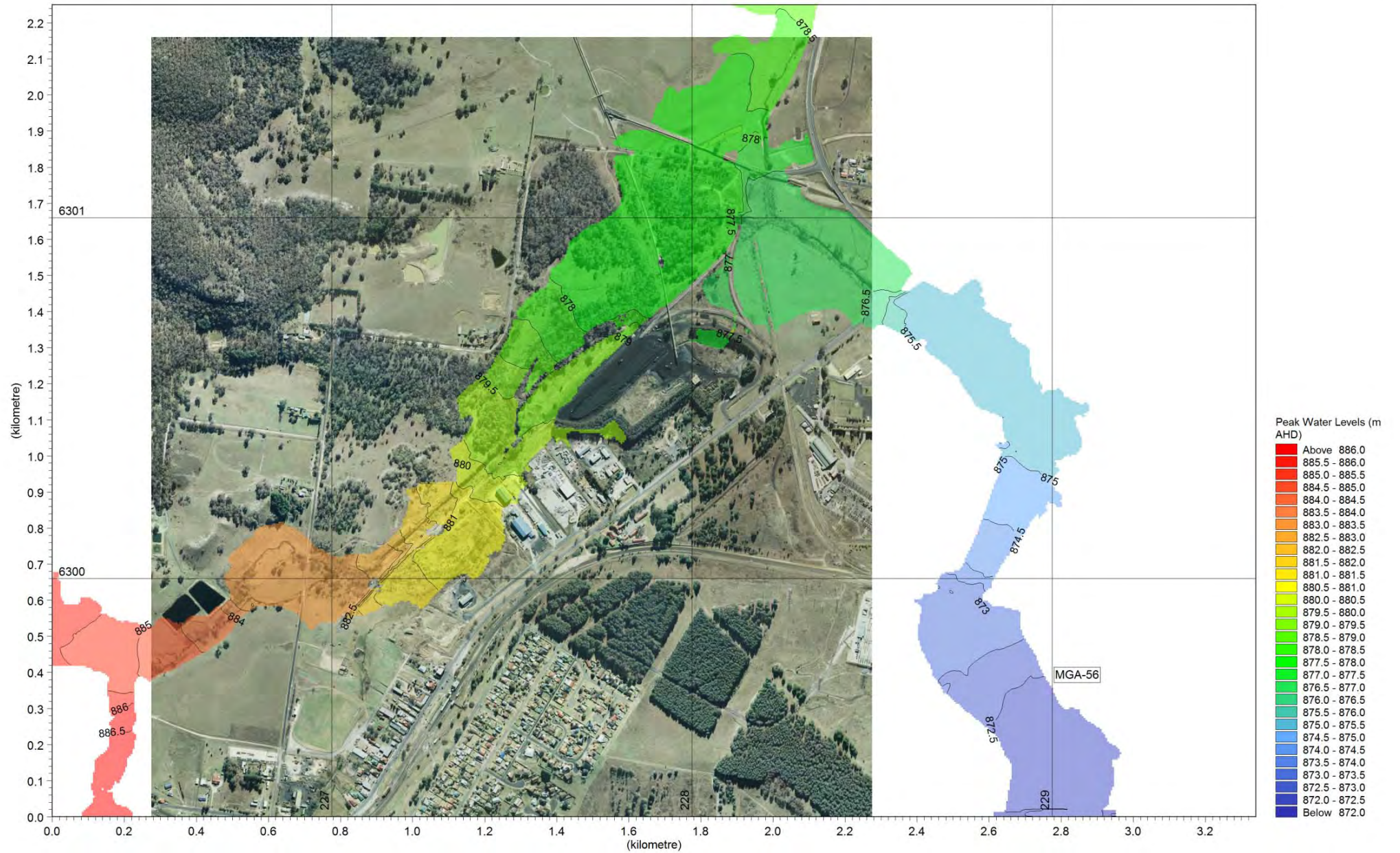
Appendix F

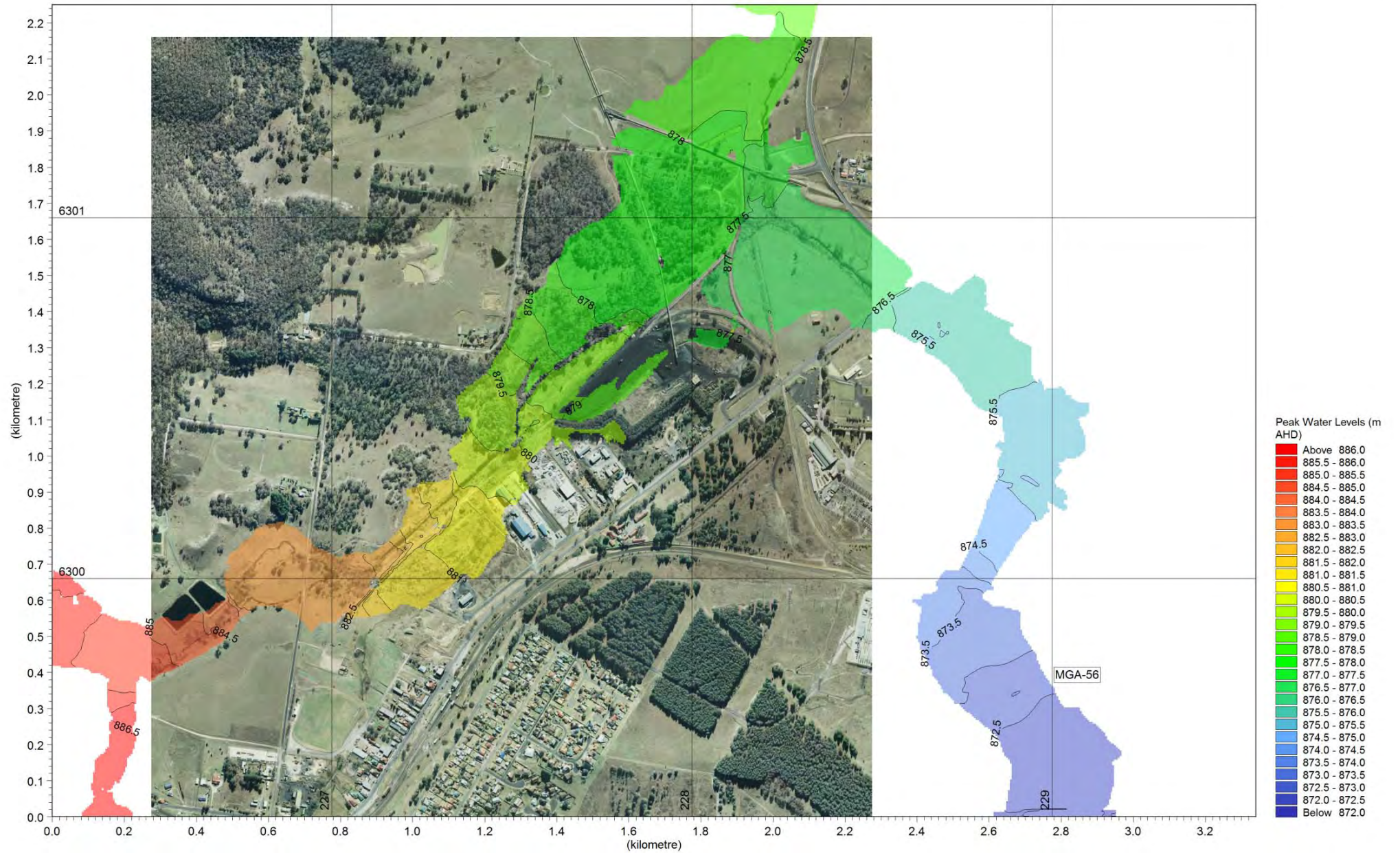
Peak water surface levels











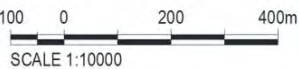


Figure F-6 Existing Case - 100 year ARI Peak Water Level

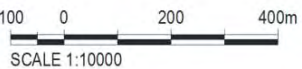
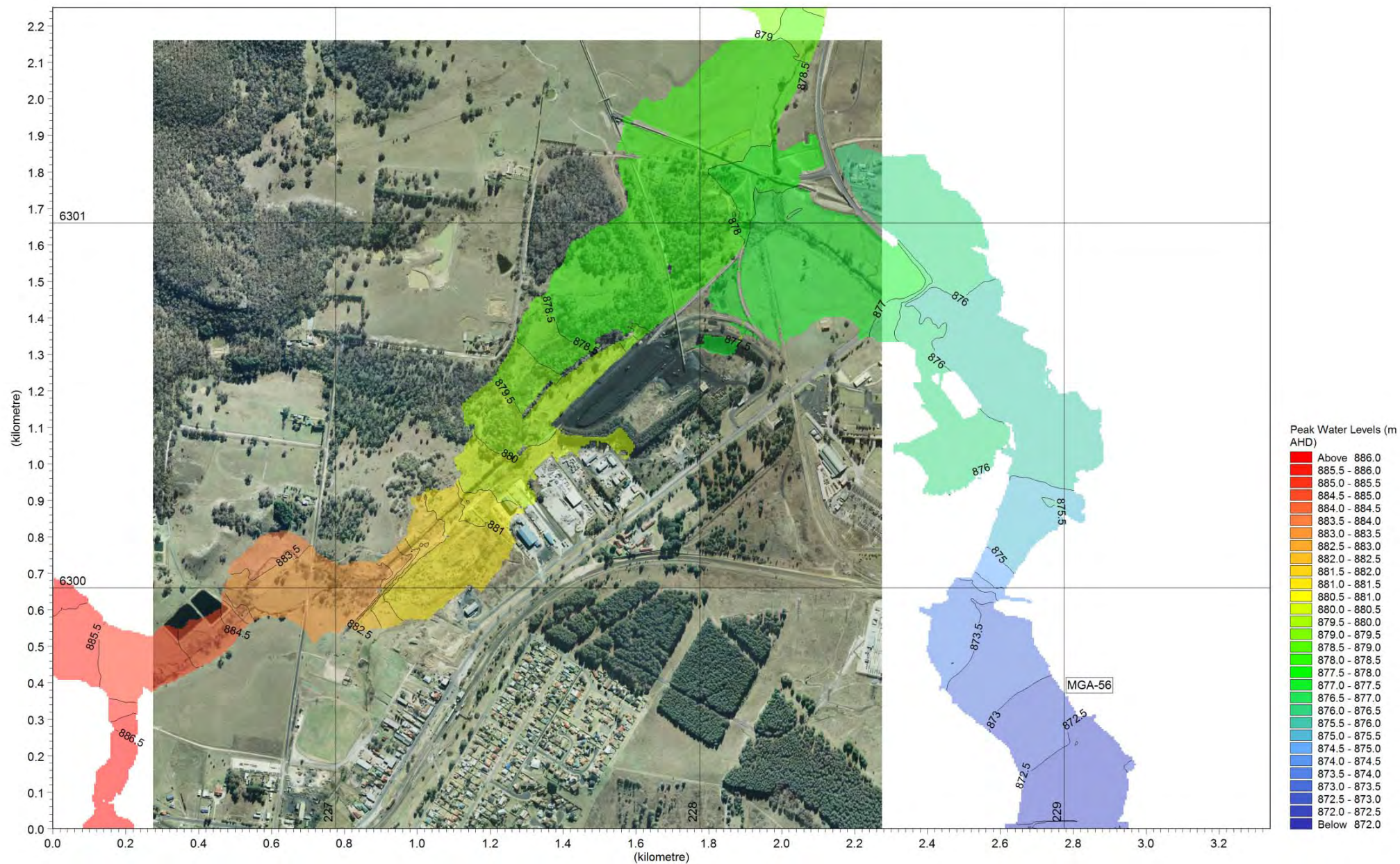


Figure F-7 Mitigation Option 1 - 100 year ARI Peak Water Level





Appendix G

Afflux

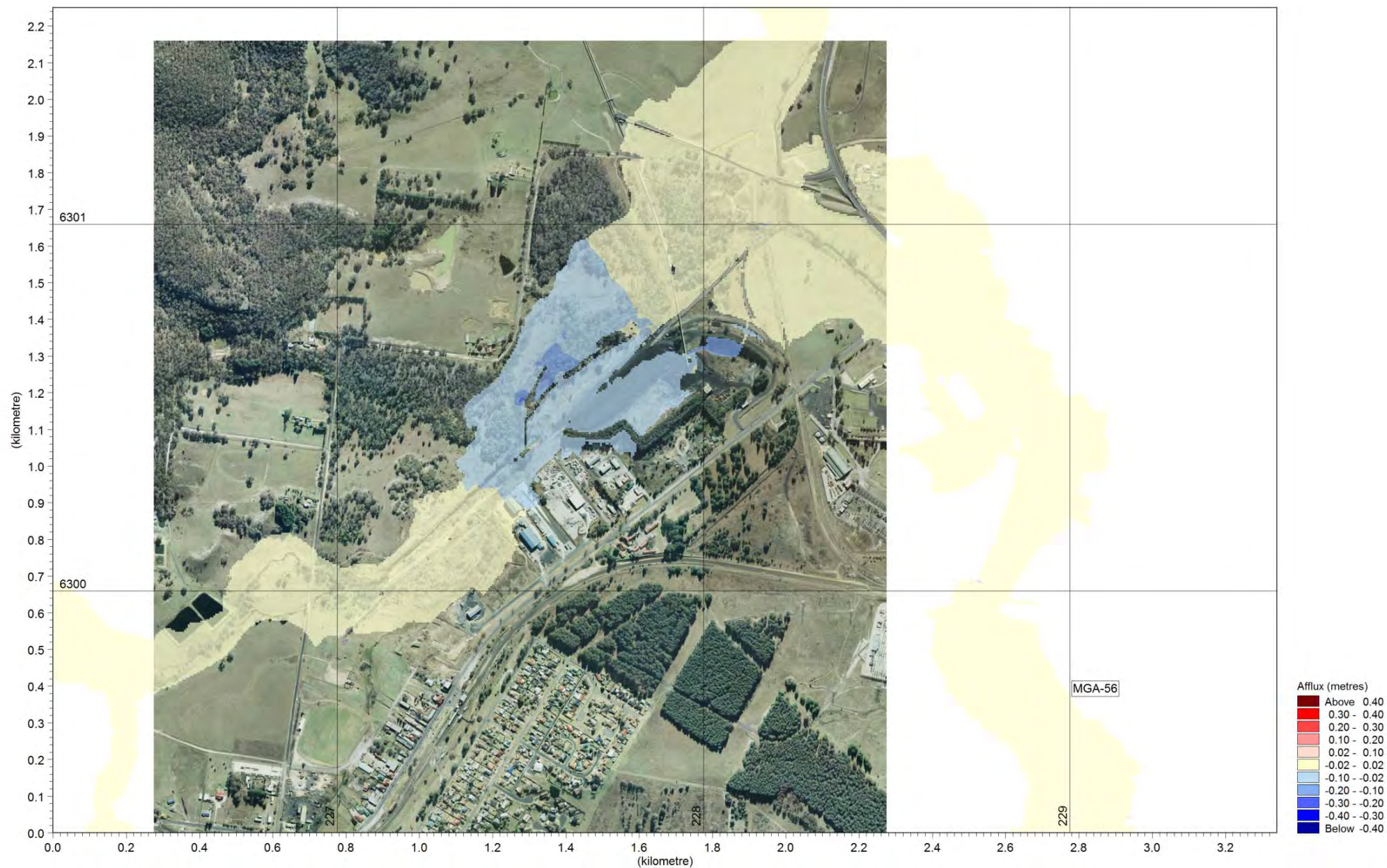
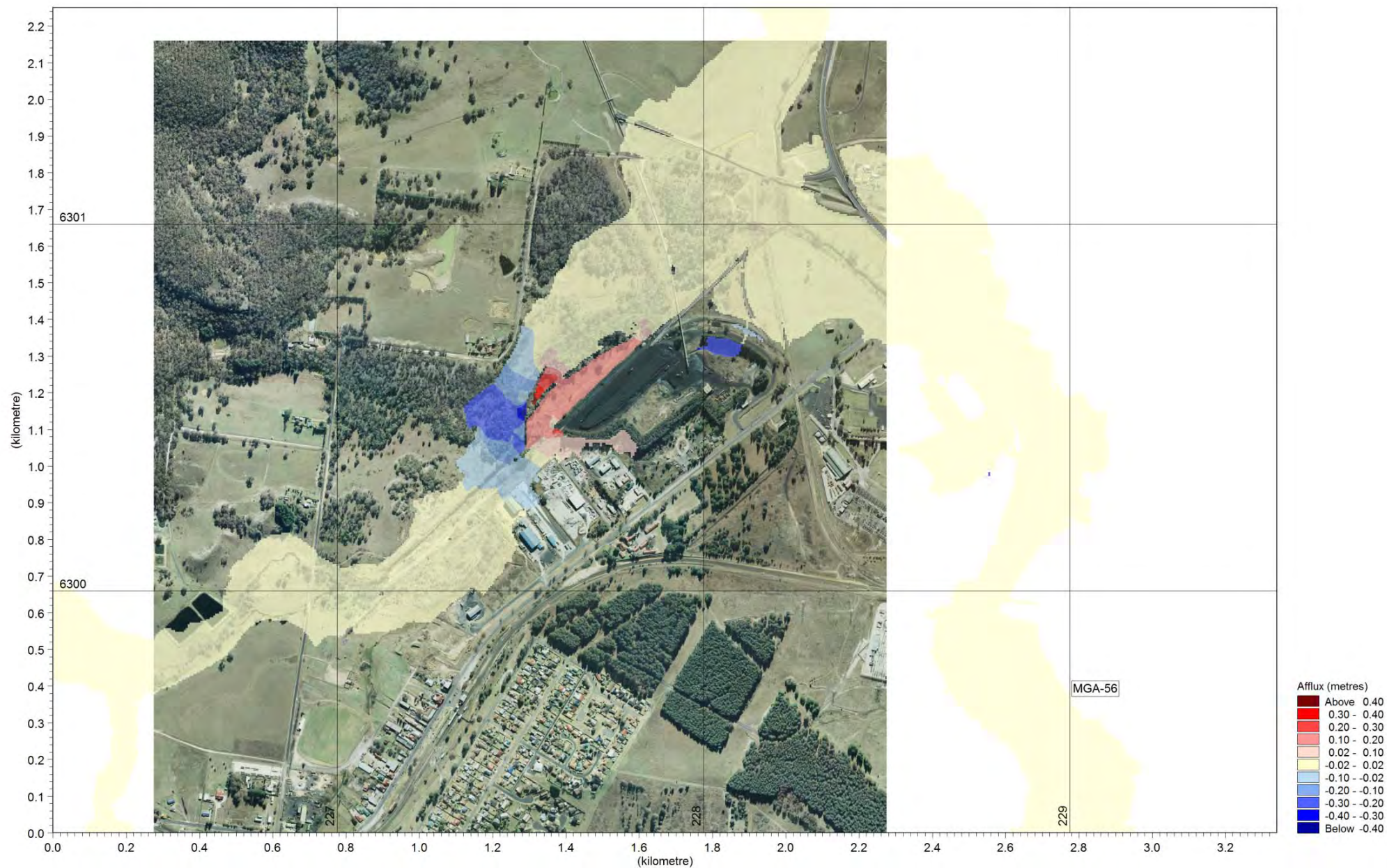


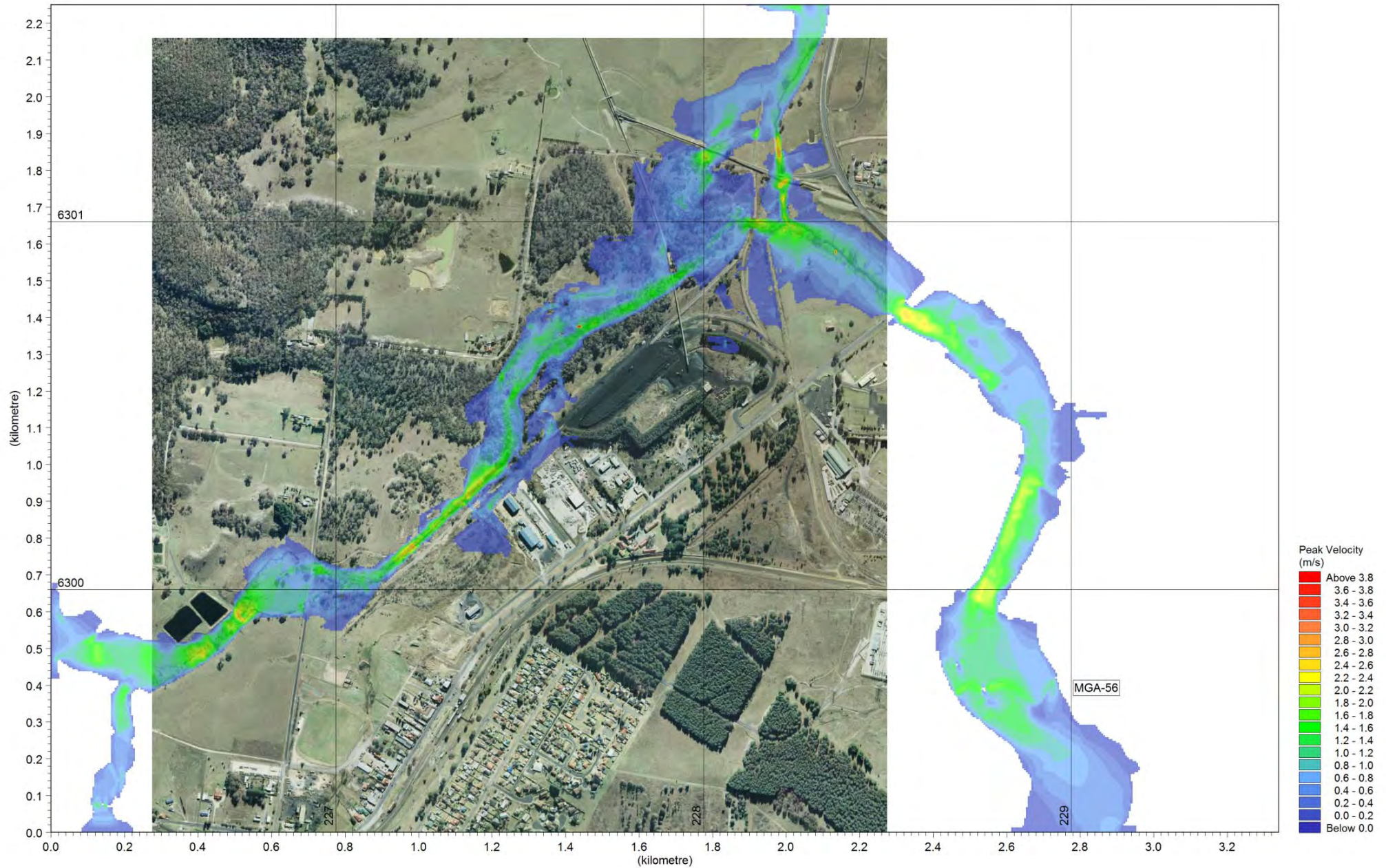
Figure G-1 Mitigation Option 1 - 100 year ARI Afflux

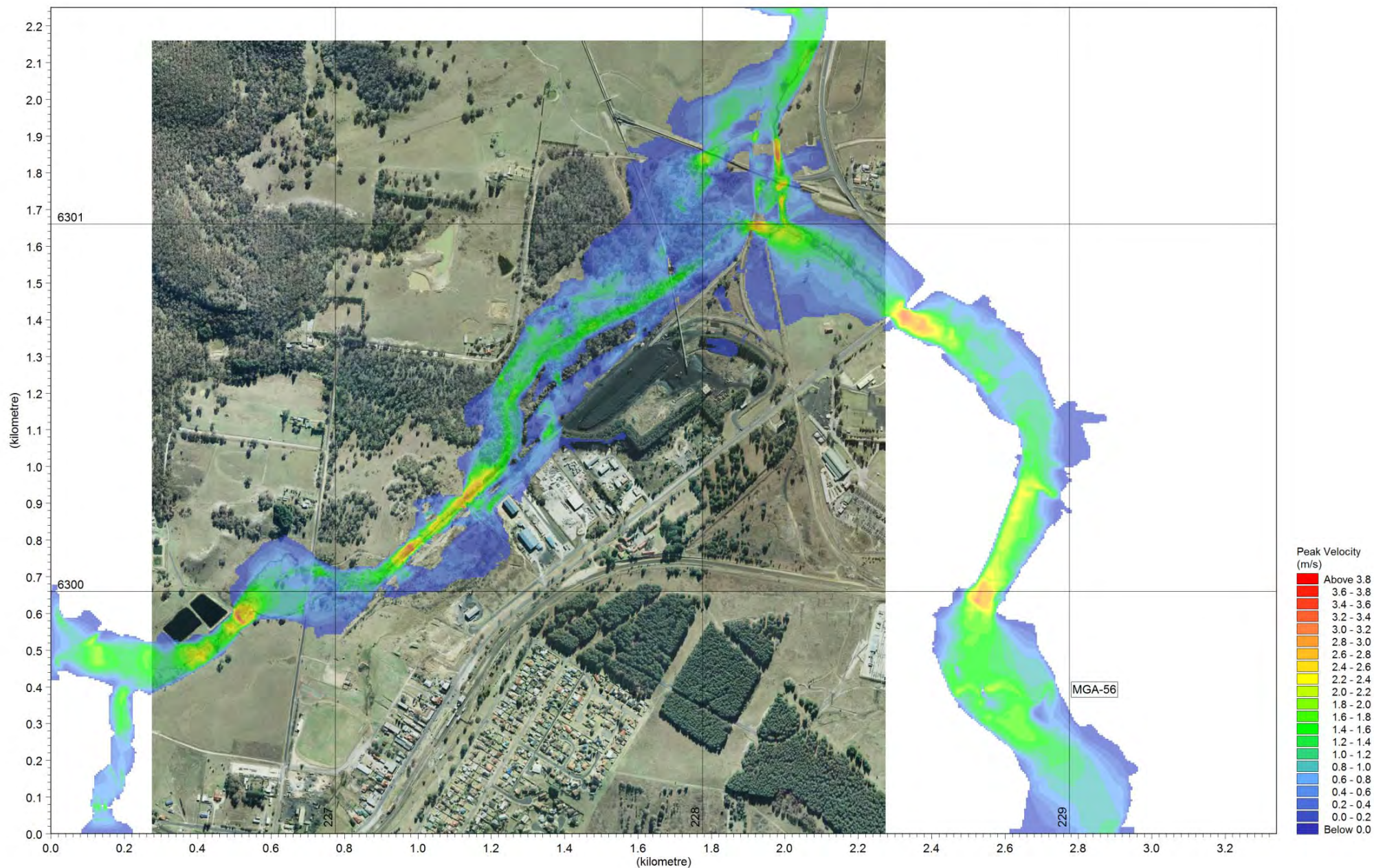


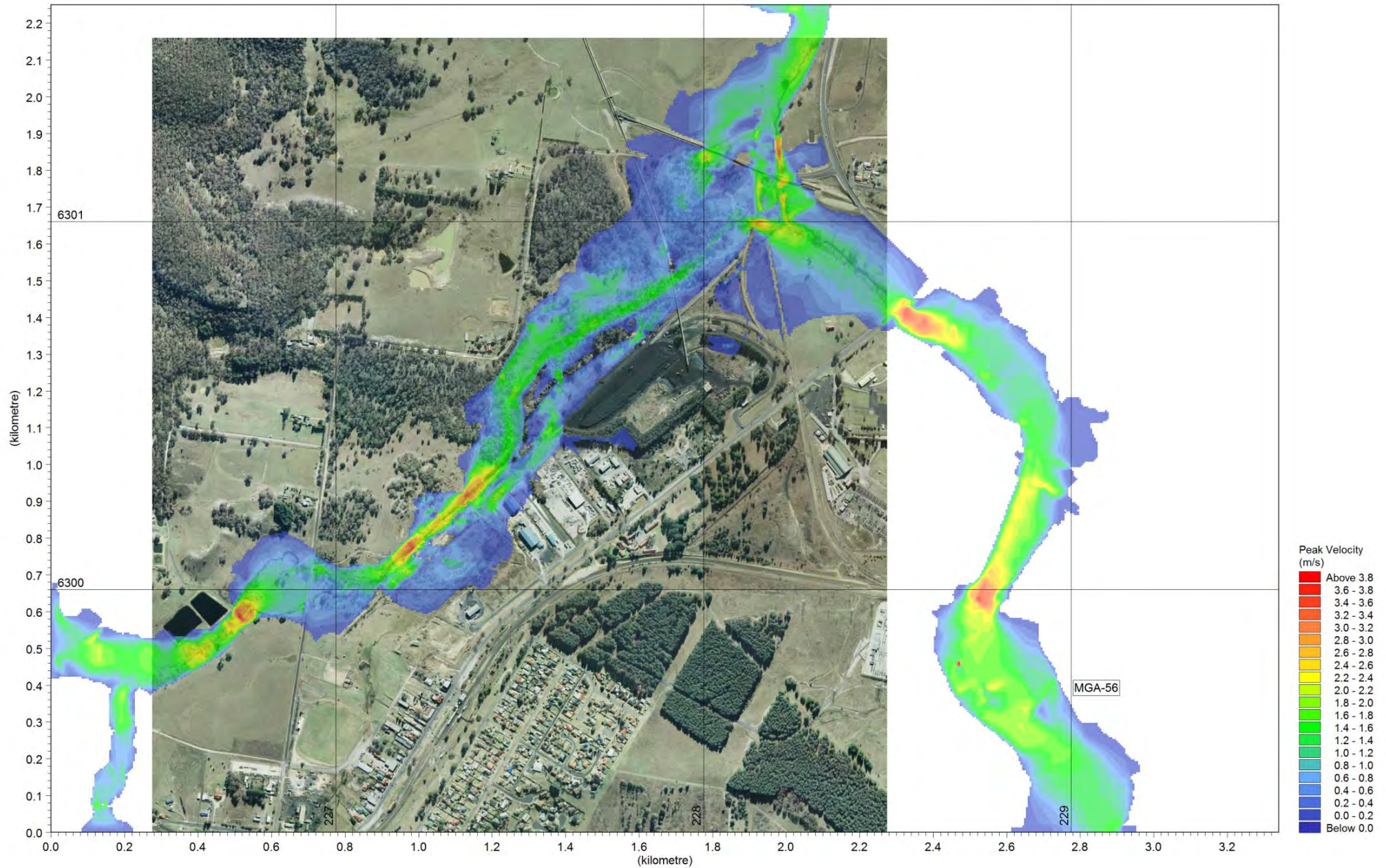


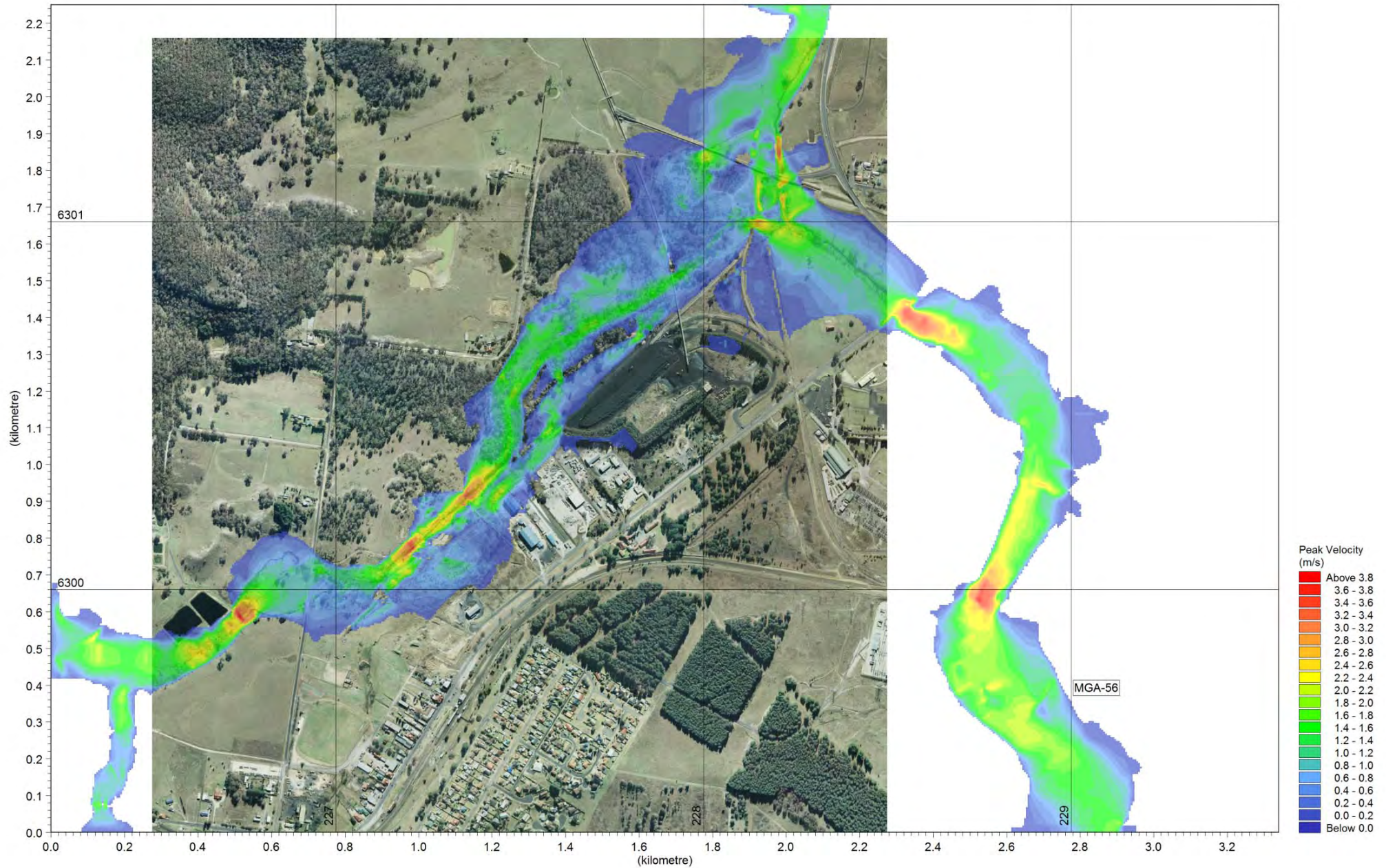
Appendix H

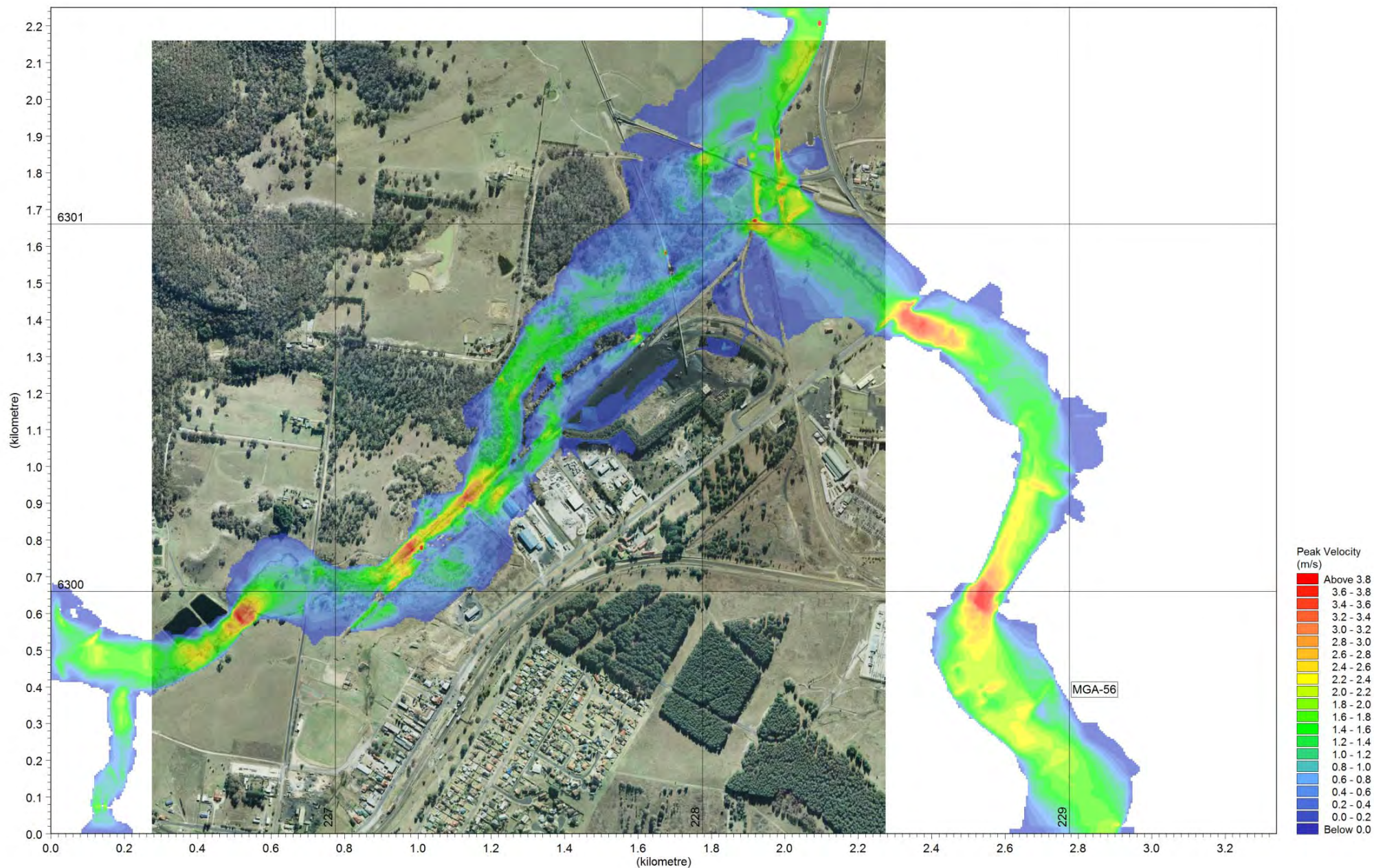
Peak velocities

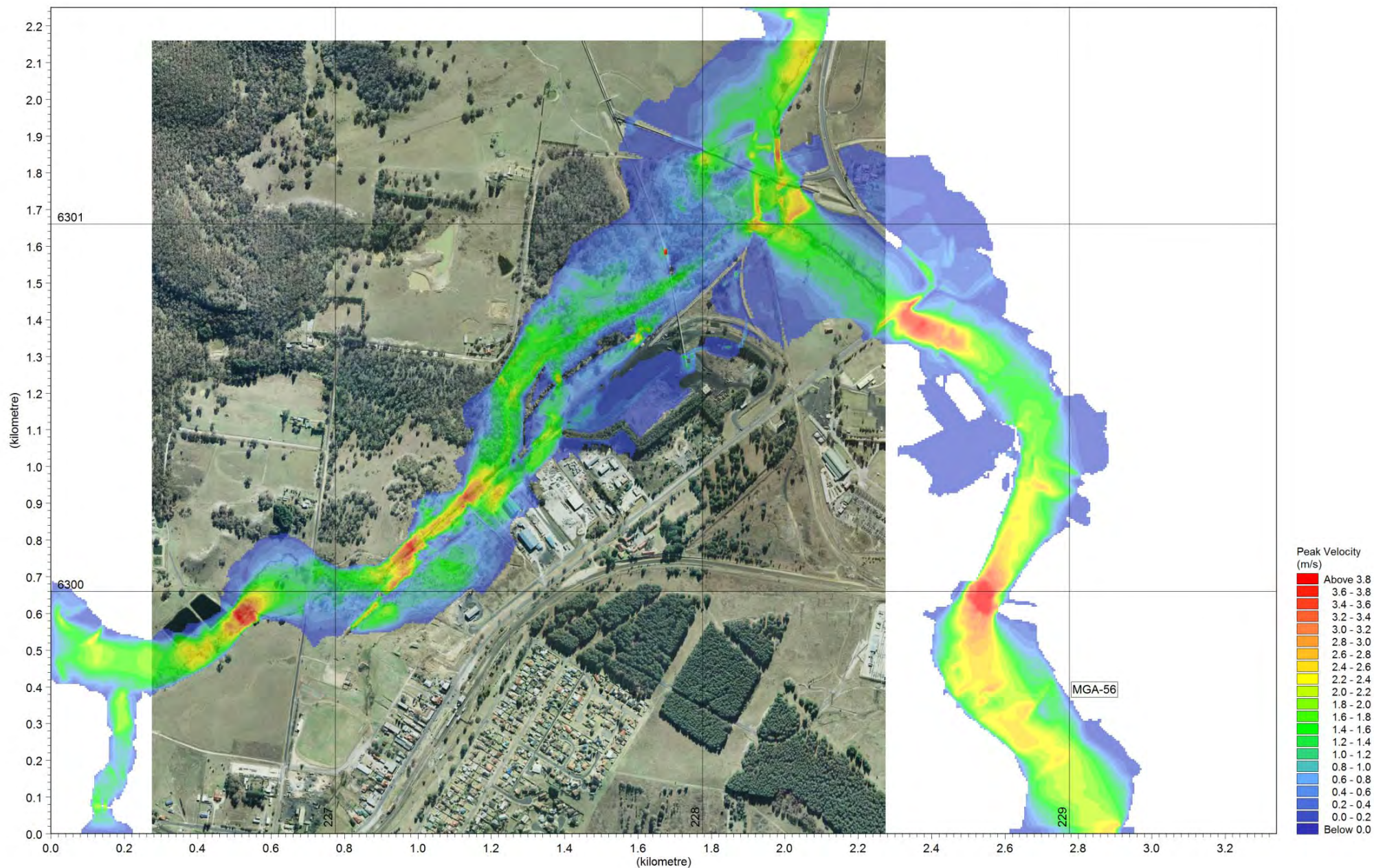


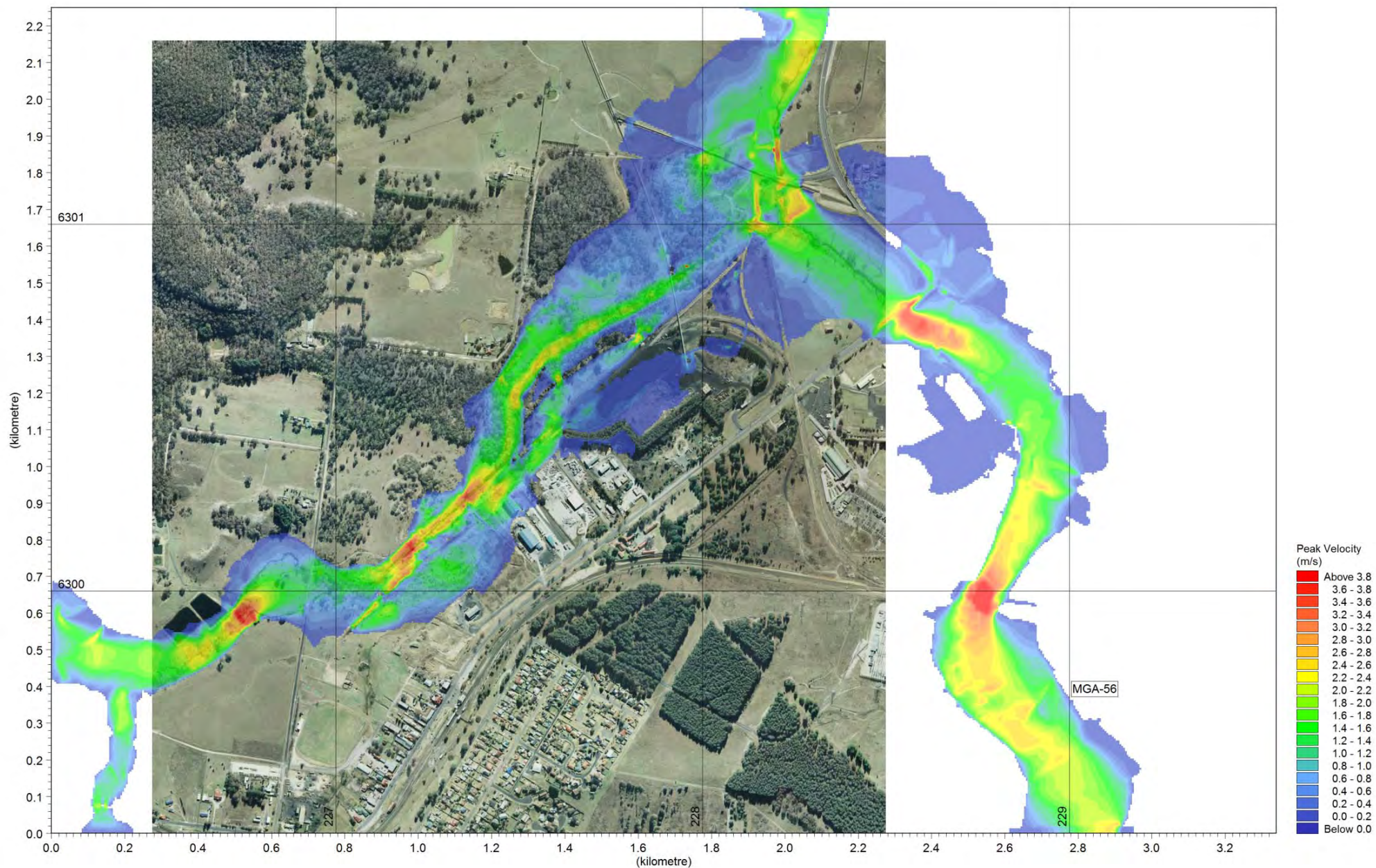


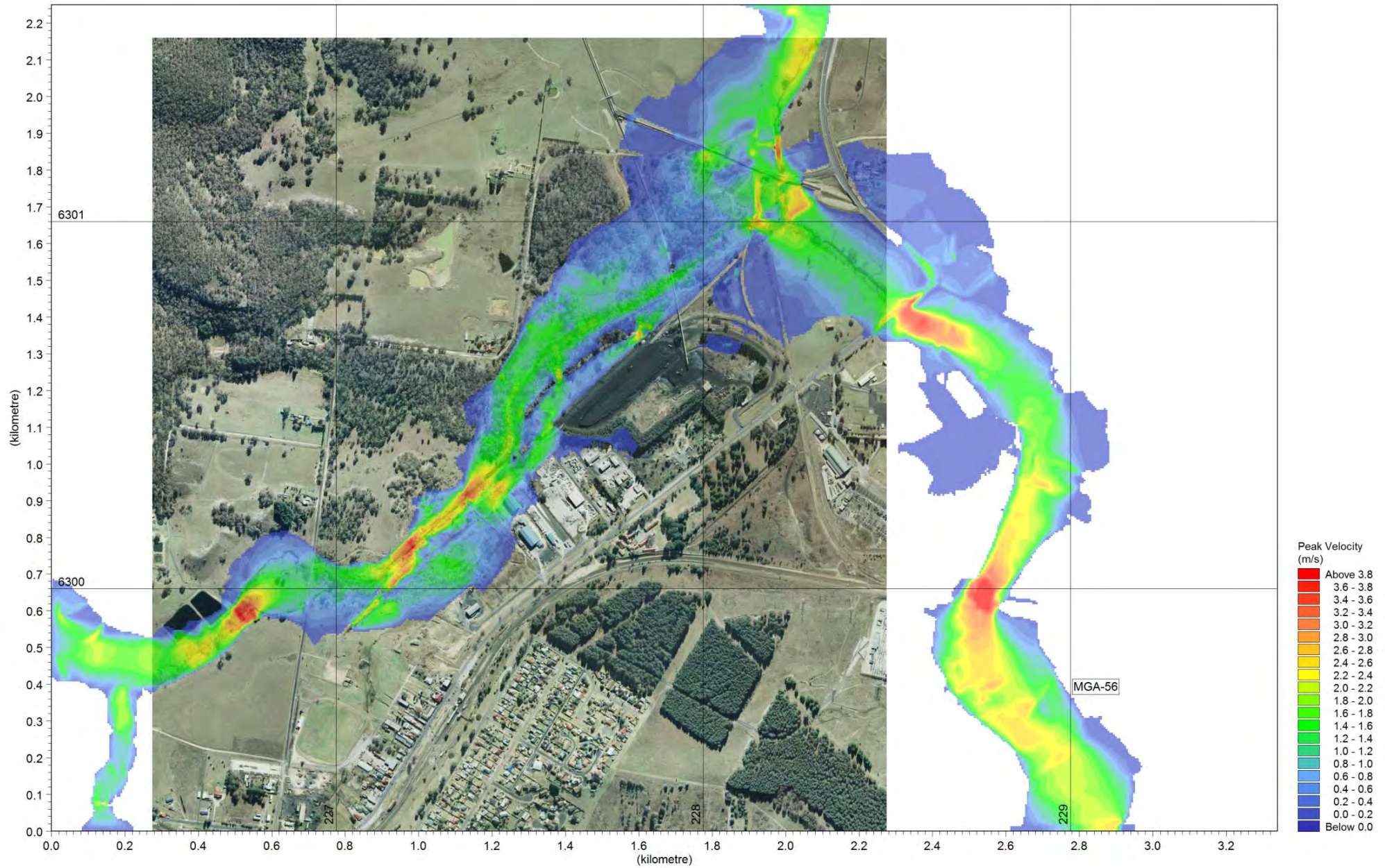














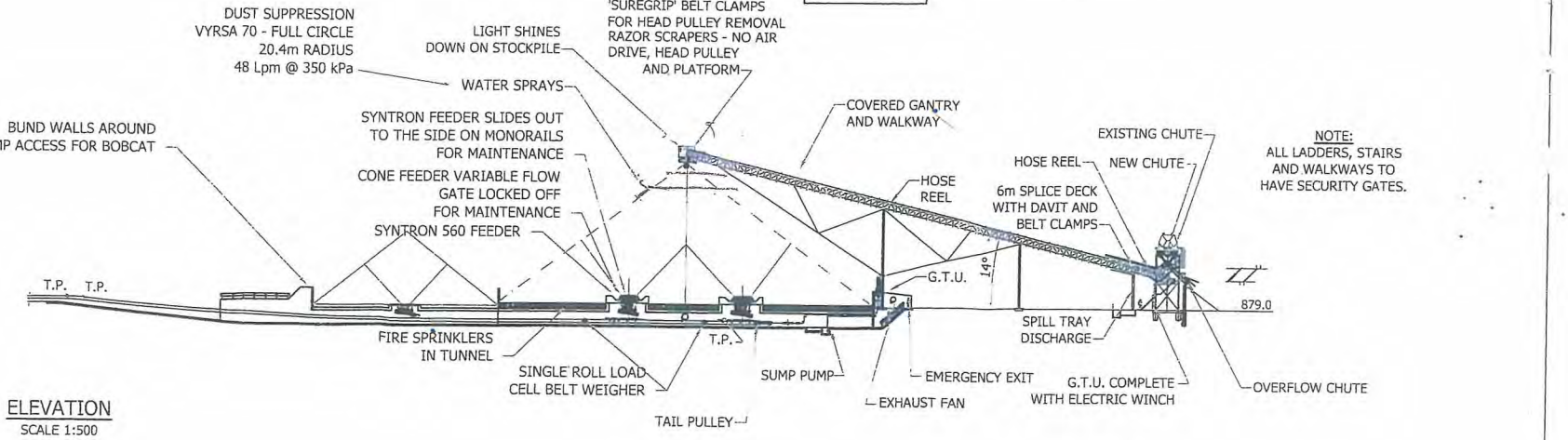
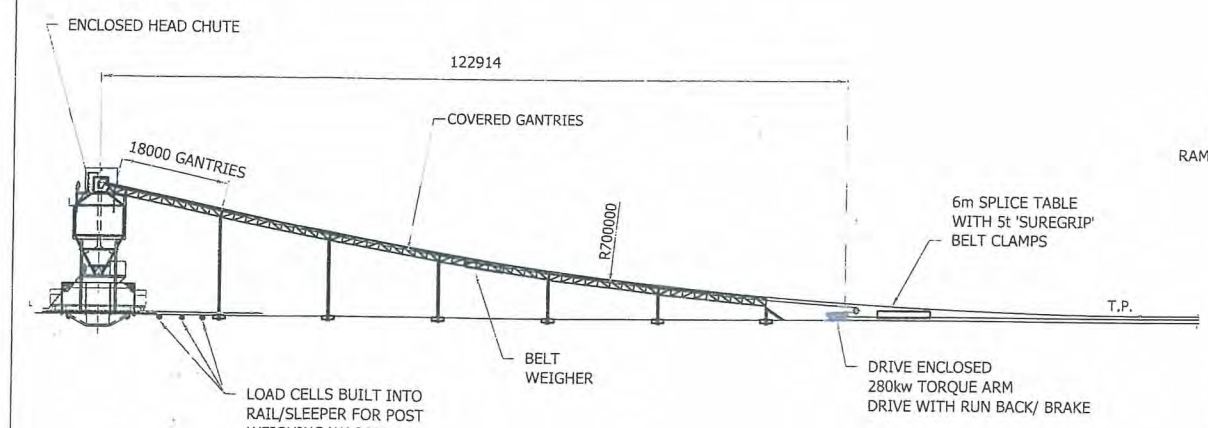
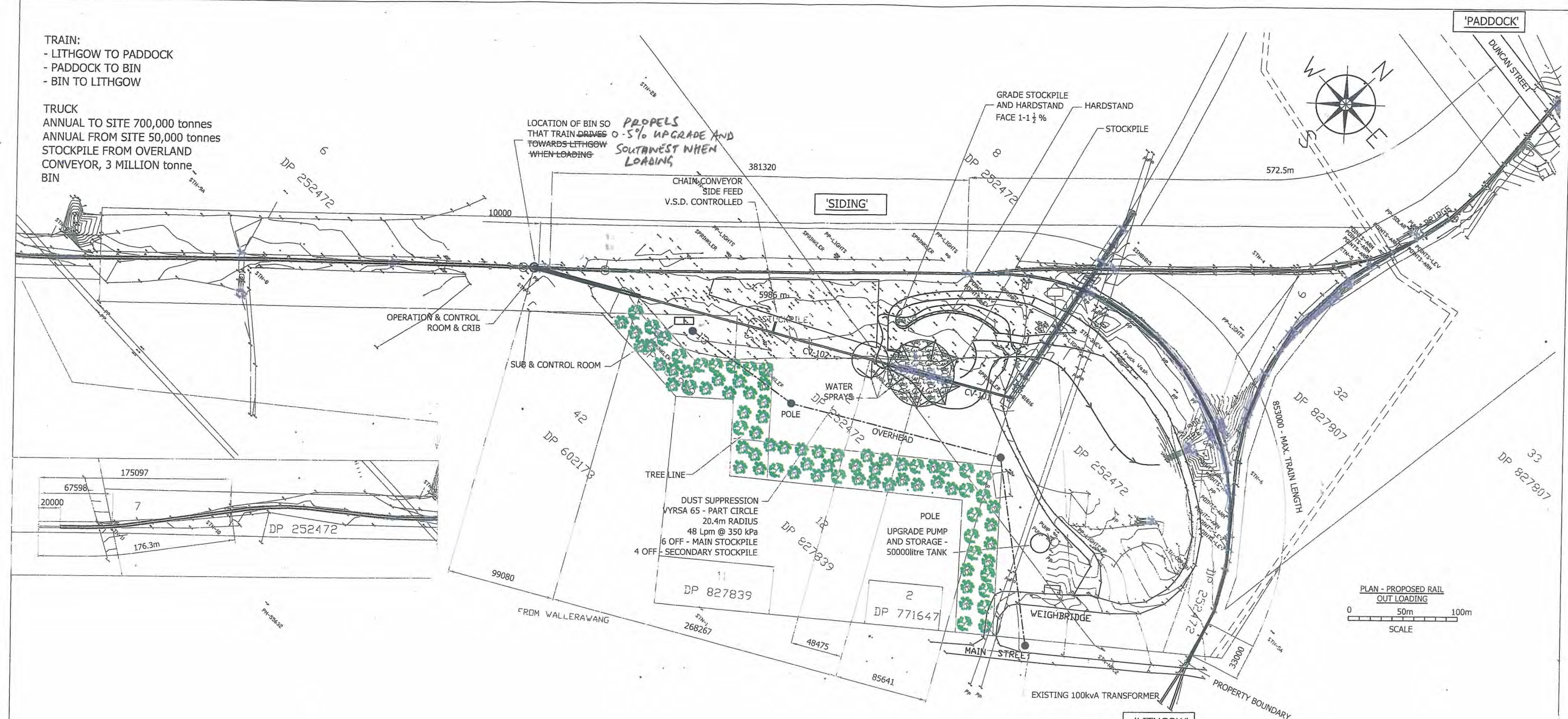
Appendix I

Lidsdale underground elevator conveyor and silo general arrangement

TRAIN:
- LITHGOW TO PADDOCK
- PADDOCK TO BIN
- BIN TO LITHGOW

TRUCK
ANNUAL TO SITE 700,000 tonnes
ANNUAL FROM SITE 50,000 tonnes
STOCKPILE FROM OVERLAND
CONVEYOR, 3 MILLION tonne
BIN

LOCATION OF BIN SO
THAT TRAIN DRIVES
TOWARDS LITHGOW
WHEN LOADING
**PROPELS
0.5% UPGRADE AND
SOUTHWEST WHEN
LOADING**



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Appendix J

Water quality ponds



LEGEND

- Water Monitoring Site
- Weather Station
- Highway
- Main Road
- Local Road
- Culvert
- Drainage Line
- Waterbody
- Contour - 50cm Interval
- Lidsdale Siding Study Area
- Lidsdale Siding Upgrade Project Area
- Pond

Proposed Features

- Drainage Line
- Stockpile
- Pump and Tank
- Road

0 37.5 75 150
Metres
SCALE 1:3,000 @ A3
GDA 1994 MGA Zone 56

DATA SOURCES
RPS Aquaterra Sydney

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Please verify the accuracy of all information prior to use.

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FIGURE 4
Site Layout and Surface
Water Monitoring Locations

AUTHOR	JG	REPORT NO	001a
DRAWN	TW	REVISION	1
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Swaziland, Tanzania, Thailand, Uganda,
United Arab Emirates, Vietnam.

Appendix C - Consultation

From: Geoff Metcalfe <Geoff.Metcalfe@CENTENNIALCOAL.com.au>
Sent: Wednesday, 24 August 2016 3:06 PM
To: Lachlan Hammersley
Subject: Fw: Lidsdale Siding Flood Study

Regards

Geoff Metcalfe
Environmental Coordinator

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----- Forwarded by Geoff Metcalfe/Contractor/CentennialCoal on 24/08/2016 03:05 PM -----

FW: Lidsdale Siding Flood Study			
Margaret Kirton	to:	Tony Nolan	14/09/2015 03:28 PM

Hi Tony,

Here’s the first email we sent about the Flood Study, Margaret

From: Margaret Kirton
Sent: Friday, 9 May 2014 3:09 PM
To: Martin Howe
Cc: Colin Phillips
Subject: Lidsdale Siding

Hi Martin,
The Department has undertaken a preliminary review of the Flood Study (submitted by Centennial on 1 May 2014) against the requirements of condition 20 in Schedule 3 of the Project Approval (08_0223).

The Department considers that the Flood Study needs to be amended to include:

-) evidence of consultation with agencies;
-) an assessment of the risks associated with off-site contamination in the event of flooding; and
-) a specific commitment and timetable for the implementation of the recommendations (ie removal of willow from Pipers Flat Creek and construction of an on-site bund).

With regard to the third point, the Department notes Centennial aims to have the proposed mitigation controls in place by April 2016. It would be appreciated if Centennial would consider how this timing fits in with the staging of the removal of the willows suggested in Section 3.4.4 of the Response to Submissions.

Please give me a call in you have any questions.

Regards Margaret

Margaret Kirton
Senior Planner
Mining Projects
Department of Planning & Environment
GPO Box 39 | Sydney NSW 2001
T 9228 6289
E Margaret.Kirton@planning.nsw.gov.au

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Our reference: EF13/3156: DOC14/126161-01
Contact: Andrew Helms (02) 6332 7604

Coal Distribution Manager – West
Ivanhoe Coal Pty Limited
PO Box 198
WALLERAWANG NSW 2845

Attention: Mr Martin Howe

10 July 2014

Dear Mr Glazebrook

LIDSDALE SIDING – FLOOD STUDY

I refer to an e-mail from Mr Martin Howe of Ivanhoe Coal to Andrew Helms of the Environment Protection Authority (EPA) of 10 July 2014 requesting comment from the EPA on a flood study prepared for the Lidsdale Siding site. I understand that this request is based on a requirement of Lidsdale Siding's Project Approval 08_0223 as granted by the then Department of Planning and Infrastructure on 3 May 2013.

The EPA encourages the development of these plans to ensure that proponents have determined how they will meet their statutory obligations and environmental objectives as specified by conditions of the operator's project approval and environment protection licence. However the EPA generally does not review these plans (except in circumstances deemed necessary) as our role is to set environmental objectives for environmental management, not to be directly involved in the development of strategies or plans to achieve those environmental objectives.

In this instance, to avoid risk of pollution arising from flooding, the EPA supports the adoption of all necessary measures to preventing Pipers Flat Creek from entering the Lidsdale Siding site.

Should you have any enquiries in relation to this matter please contact Mr Andrew Helms at the EPA's Central West (Bathurst) Office by telephoning (02) 6332 7604.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Darryl Clift'.

DARRYL CLIFT
Head Central West Unit
Environment Protection Authority



Lidsdale Siding Flood Study

Greg Greene

to:

'martin.howe@centennialcoal.com.au'

01/07/2014 12:12 PM

Cc:

Girja Sharma, Frances Kelly

Hide Details

From: Greg Greene <Greg.Greene@sca.nsw.gov.au>

To: "'martin.howe@centennialcoal.com.au'" <martin.howe@centennialcoal.com.au>,

Cc: Girja Sharma <Girja.Sharma@sca.nsw.gov.au>, Frances Kelly

<frances.kelly@sca.nsw.gov.au>

Hi Martin,

Thank you for forwarding the Lidsdale Siding Flooding Assessment Report to the Sydney Catchment Authority (SCA) as required under the Lidsdale Siding Project Approval 08_0223.

The SCA has reviewed the Flood Study and considers it satisfactorily responds to the SCA's recommendations, including the need to assess and respond to the impact on the facility's stormwater management systems.

It is noted that the construction of a new bund along the rail line and some additional earthworks and bunding downstream in the affected flood areas are recommended measures to minimise the risk of sediment and coal fines entering waterways. The SCA supports this approach. The SCA also supports the proposed Willow Tree and debris removal from Pipers Flat Creek as a means of improving channel flow capacity.

Regards

Greg

Greg Greene

A/Senior Manager, Planning and Environment

Sydney Catchment Authority

Ph. (02) 4724 2446

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38443/https://projects.ghd.com/OC/Newcastle/lidsdalefloodingassi/Delivery/Documents/2218559-REP-0_FloodManagementPlan.docx

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	L Hammersley	S Gray		S Gray		10/10/2016

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APPENDIX F – Hydrocarbon monitoring summary – Environmental Management Plan

3 EMP REQUIREMENTS

3.1 Detailed Baseline Data

Baseline data for the Site with specific focus on impacts originating from the former diesel AST and associated fuel dispensing infrastructure are summarised in **Section 2.2.1 and 2.2.2** of this EMP.

Detailed baseline data are provided in ES/Arcadis (2017), which should be read in conjunction with this EMP.

3.2 Relevant Statutory Requirements

3.2.1 EMP Notification

The EMP is publicly notified on the Section 149 certificate for the property available from Lithgow City Council.

3.2.2 EMP Approval

Approval of Site operations to be managed under the EMP shall be contingent on meeting the requirements of the conditions for consent provided within NSW DPI (May 2013) - Application Number: 08_0223.

Centennial is responsible for obtaining other licences, approvals and permits required under the legislative framework, however none are known to be required at the time of preparation of this EMP.

It should be noted that while this EMP is made under the legislation listed, future updates to legislative requirements may lead to corresponding updates needing to be made to this EMP and/or general site management practices.

3.2.3 EMP Implementation

3.2.3.1 The Responsible Party

The responsible party will implement and maintain all aspects of the EMP. The responsible party for the Site is currently Centennial and will continue to be so, upon completion of site development and upgrade works.

The responsible party is required to implement / assure the following:

- All workers and subcontractors, including intrusive site workers, Council workers or construction workers involved in the ongoing management and maintenance of the site, are inducted to the management principles of the EMP and understand the potential contamination issues related to the site.
- Maintaining records of the following throughout the life of the project:
 - Details of all inducted personnel approved to undertake work on the site;
 - Records of unexpected finds on the site;
 - Assessment reports for the classification of soil waste;

- Approvals to remove or dispose soil from the site;
- Soil tracking information for material that is either removed from the site or imported to the site for use.
- Records of inductions, site monitoring and non-compliance and corrective actions will be kept by the responsible parties.

3.2.3.2 Site Workers and Subcontractors

All workers and subcontractors, including intrusive site workers, Council workers or construction workers engaged to carry out work at the site will be required to comply with the EMP by:

- Ensuring that they are inducted and have a sound understanding of the health and safety requirements outlined in the EMP;
- Ensuring they are inducted per the management principles outlined in the EMP; and
- Reporting to the responsible party any occurrences of material suspected to contain hydrocarbons;

3.3 Performance Criteria

The selected groundwater performance criteria for this EMP, are based upon NEPM (2013) Table 1C for Fresh Water.

- NEPM (2013) Groundwater Investigation Levels (GILs) Fresh Waters, based on ANZECC /ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh Water.

Table 2 below, lists only the CoPC where NEPM (2013) 'Levels' have been calculated and as applied to the site ESA investigation by Arcadis 2017. Trigger values for further investigation of groundwater are based upon the following;

- Trigger Value defaults to the NEPM Investigation 'Level' where the Arcadis 2017 result reported was Non-Detect; or
- Trigger Values are equal to the Arcadis 2017 maximum analysis result + 10%.

Monitoring and laboratory analysis results must be equal to or greater than the 'Trigger Values', as listed below in Table 2, for a period of four (4) consecutive monitoring events in order to trigger a management response. The management response for further investigation may include a formal Environmental Site Assessment (ESA) or development of a RAP.

Table 2. Groundwater Performance Criteria (µg/L)

Group	Contaminant of Potential Concern (CoPC)	NEPM 2013 Table 1C GILs, Fresh Waters	Maximum Analysis Arcadis 2017 (if applicable)	Trigger Value for further investigation refer (a) and (b)
Metals	Cadmium (Filtered)	0.2 ^{#1}	0.1	1
	Copper (Filtered)	1.4 ^{#1}	2	20
	Lead (Filtered)	3.4 ^{#1}	ND	3.4

Group	Contaminant of Potential Concern (CoPC)	NEPM 2013 Table 1C GILs, Fresh Waters	Maximum Analysis Arcadis 2017 (if applicable)	Trigger Value for further investigation refer (a) and (b)
	Manganese (Filtered)	1,900 ^{#4}	6,150	61,500
	Mercury (Filtered)	0.06 ^{#2}	ND	0.06
	Nickel (Filtered)	11 ^{#1}	20	200
	Zinc (Filtered)	8 ^{#1}	51	510
BTEX	Benzene	950	ND	950
	Xylene (o)	350	ND	350
PAH	Naphthalene	16	ND	16
TPH/TRH	Petroleum hydrocarbons	-	ND	Detection

ND = Non-Detect.

Environmental Standards - Comments

#1: Values calculated using hardness of 30 mg/L CaCO₃. Refer ANZECC & ARMCANZ (2000) for site specific hardness guidance.

#2: Chemical for which possible bioaccumulation and secondary poisoning effects should be considered, refer to ANZECC & ARMCANZ (2000) for further guidance.

3.4 Performance Indicators

3.4.1 Groundwater

The general performance indicators to be adopted as part of the implementation of this EMP are as follows:

- Ongoing groundwater monitoring of all existing wells at regular intervals as specified in **Section 3.6**;
 - Should either of the following occur the hierarchy of management measures as set out in **Section 3.5** of this EMP will be implemented;
 - An increase in any of the CoPC of at least one order of magnitude, at any monitoring well, over four consecutive monitoring events; or
 - Detection of hydrocarbons in any well installed along the downgradient (western) Site boundary.

3.4.2 Soil

In the event that excavation cannot be avoided within the former AST hydrocarbon impact area or within the footprint of the DWD, then a health and safety and environmental monitoring strategy is required to be prepared ensure the safety of onsite personal and protect the environment.

- During any excavations within the area of identified impact, a 'lower explosive limit' (LEL) sensors and / or photoionization detector (PID) may be used to screen the air and soils for the presence of volatile organic compounds (VOC).
 - However, the hydrocarbon contamination in soils arising from the former AST at the site is firstly diesel and aged, factors that are likely reduce the effectiveness of using PID / LEL for screening.

- Due to the potential limitations of monitoring equipment it will be critical that staff undertaking any intrusive works remain diligent and make regular visual and olfactory assessment as to the presence of hydrocarbons in the soil;
 - If it is assessed that the soils being excavated are impacted with hydrocarbons, the workers shall make all reasonable attempts to segregate the impacted material from any 'clean' materials, and manage the impacted material so as to limit the potential for risk to human health or the environment.
 - Measures which may be employed depending on the volume, apparent concentration and location include;
 - Sediment and erosion control;
 - Diversion of surface waters;
 - Prevention of infiltration;
 - Odour control;
 - Planned reinstatement.

3.5 Management Measures

This section provides detail as to the hierarchy of management measures to be employed on the Site during ongoing operations in order to comply with the relevant statutory requirements, limits, or performance measures/criteria.

3.5.1 Compliance with Performance Indicators

In the event that performance indicators as set out in Section 3.4 of this EMP are met, the following shall be the main management measures to be implemented:

- As the impacts in soil are not considered to pose a direct risk to human health, in response to the ES/Arcadis (2017) limited ESA findings. Centennial intend to *limit to the extent practicable further disturbance of the area of hydrocarbon impact originating from the former AST and associated fuel*, leaving the residual hydrocarbon impact in situ; and
- Conduct regular, ongoing monitoring of existing groundwater wells as per **Section 3.6** screening for changes in groundwater quality, to assess the potential for migration of the detected impacts in groundwater.

3.5.2 Non-compliance with Performance Indicators

In the event that performance indicators as set out in **Section 3.4** of this EMP are not met, the following shall be the management measures to be implemented, in order of escalation, should any measure fail to adequately manage risk to human health or the environment.

3.5.2.1 Sampling and/or additional monitoring

- This will assist to understand whether detected impacts materially represent an increase in risk; and/or
- This will assist to ascertain if impacted material is suitable to;
 - Remain on site in the current location; or

- Is suitable to be reused on site, in the same or another location under planned reinstatement; or
- Is suitable for appropriate offsite disposal.

3.5.2.2 Further investigation

- This will assist to understand whether the detected impacts;
 - Are originating from the vicinity of the former AST and associated fuel dispensing infrastructure; and/or
 - Are originating from an as yet, unidentified source which may be either;
 - On site (and so due to existing Site conditions and/or operations); and/or
 - Off site (and potentially due to offsite operations or conditions which are impacting the Site).

3.5.2.3 Development of a remedial action plan (RAP)

- This will inform any remedial works required to be implemented in order to render risk on the Site as being acceptable to human health and/or the environment.

3.6 Monitoring Program

The following monitoring program will be implemented as part of this EMP:

- Groundwater monitoring;
 - Samples to be collected from all existing monitoring wells and analysed for the listed CoPC following the implementation of this EMP;
 - Every two (2) months for the first 12 months;
 - Every quarter for the period of two (2) – four (4) years;
 - Every six (6) months for the period of five (5) -10 years; and
 - Annually after 10 years or until results indicate no potential for increase of risk occurs.

3.7 Reporting Program

As part of the implementation of this EMP the following will be required to be reported after each monitoring round or scope of works associated with the implementation of any management measure:

- Results of each round the monitoring program against the performance criteria commencing with the first round following implementation until completion of site management under this EMP;
 - Data is to be reported as both;
 - a stand-alone factual report for the specific monitoring round last completed; and
 - Cumulatively for all monitoring rounds completed;
- Summary as to whether the performance indicators for each monitoring round have been met;

- If not, what management measures are required to be implemented prior to the next round of monitoring;
 - A summary as to the whether the management measures employed have achieved the desired outcome including;
 - Evidence in the form or measurements, data and observations that the management measure has been employed successfully;
 - Recommendations for the employment of alternative or escalated management measures in the instance that the selected measure employed was not successful;
 - o This shall include a root cause analysis as to why the selected management measure failed;
- Summary of any other proposed works or issues which may require implementation of additional management measures.

APPENDIX C SAMPLING PROGRAM

The following section details the groundwater monitoring program that must be implemented as part of this EMP. The program has been developed in general accordance with relevant guidelines and standards. The following includes detail on the monitoring and sampling requirements:

- Monitoring frequency;
- Sampling method;
- Sample locations; and
- Contaminants of Potential Concern (CoPC).

Information gathered during monitoring will then be used to assess groundwater conditions against the this EMP, specifically, Section 3.4 Performance Indicators and 3.5 Management Measures etc.

Monitoring Frequency

Samples to be collected from all existing monitoring wells and analysed following the implementation of this EMP. Existing monitoring wells are to be sampled on the following frequency, Table 3 below also serves to illustrate this frequency;

- Every two (2) months for the first 12 months;
- Every quarter for the period of two (2) – four (4) years;
- Every six (6) months for the period of five (5) -10 years; and
- Annually after 10 years or until results indicate no potential for increase of risk occurs.

Table 3. Groundwater Monitoring Frequency*

Period / Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC						
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		
11																		
12						tbc												

* Orange shading indicates month in which groundwater sampling is required.

Groundwater Sampling Method

The following groundwater sampling method has been developed in in general accordance with the NSW EPA guideline:

NSW DEC (2007) Guidelines for the Assessment and Management of Groundwater Contamination.

The following method is to be applied in full to ensure field data and samples collected are representative of the site at the time of sampling. This method will also be used to inform whether quality assurance quality control (QA/QC) principles have been applied / met during sampling and analysis. Sampling personnel conducting the works are required to be appropriately trained and experienced in groundwater sampling.

Groundwater monitoring wells are to be sampled using the following method:

- Prior to sampling all wells are to be gauged with an oil-water interface probe to measure the depth to product (if present), depth to water and depth to the base of the well.
- Each well is to be purged using a peristaltic low-flow pump at a rate of less than < 1 L per minute.
- The field water quality meter must be calibrated and calibration certificates retained for reporting.
- Purge water passed through an in-line flow cell with water quality probes measuring the groundwater physico-chemical parameters:
 - dissolved Oxygen (DO);
 - electrical conductivity (EC);
 - acidity (pH);
 - reduction oxidation potential (redox); and
 - temperature (temp).
- Once the physico-chemical parameters stabilised to within +/- 10% for three (3) consecutive readings, the groundwater can then be sampled;
 - dissolved oxygen +/-10%;
 - electrical conductivity +/-3%;
 - pH +/-0.1;
 - redox +/-10%); and
 - temperature +/-10%.
- Groundwater monitoring 'field sheets' should be completed for each well sampled and retained for reporting purposes. Details on the groundwater monitoring field sheets must include:
 - Well ID;
 - Date;
 - Project name and number;
 - Depth to water, depth to product and depth to base of the well;
 - Details of the sampling equipment;
 - Physico-chemical parameters;
 - Sample time;
 - Analysis;

Environmental Management Plan

- QC sample details, if taken.
- Physical indicators such as the presence (and percentage) of suspended solids, colour, the presence/absence and nature of odours and the presence/absence of slicks or sheens on purge water should be recorded on all field sheets.
- Groundwater samples must be collected in clearly labelled laboratory supplied and preserved sample bottles. Samples for dissolved metals analysis are to be filtered in the field using a 0.45-micron filter.
- All sample bottles must be completely filled to avoid the loss of volatile organic compounds (VOCs).
- All sample bottles must be immediately placed in an ice-filled cooler for transport to the laboratory.
- Decontamination must be observed during groundwater sampling as follows:
 - Single use disposable nitrile gloves for sample handling and replaced between each sampling location;
 - Dedicated Teflon® lined LDPE tubing used for each groundwater monitoring well;
 - Interface probe decontaminated between gauging events with a phosphate free detergent (Decon 90®) and rinsed with potable water.
- QAQC samples are to be collected to enable an assessment of field and laboratory quality control measures. The following QAQC samples are required:
 - Field QC sampling was completed at a rate of 1:10 for groundwater per sampling event;
 - one (1) intra-laboratory / field duplicate to measure field and laboratory precision;
 - one (1) inter-laboratory / field triplicate to measure laboratory analytical precision;
 - one (1) Trip Spike to assess laboratory recovery rates; and
 - one (1) Trip Blank to assess contamination arising during sampling, transport or handling etc.
- Primary and QAQC samples must be clearly labelled and transported to an independent NATA accredited laboratory under chain of custody (CoC) protocol. Details included on the CoC must include:
 - Project name and number;
 - Project manager details;
 - Field staff details;
 - Turn-around-time required;
 - Analysis required;
 - Special instructions/details for the laboratory;
 - Time and date samples were relinquished;
 - Signature of custodian when relinquishing samples;
 - Time, date and signature upon receipt of samples by the laboratory.
- Reporting is required to be completed by a suitable qualified professional in accordance with the industry guideline.

OEH (2011) Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites. NSW EPA, Sydney.

Field sheets, field notes, calibration certificates, photos, sample custody documentation and laboratory reports must be supplied to the nominated professional undertaking the reporting.

Sample Locations

Nine (9) groundwater wells are known to occur in the vicinity and down-gradient of the DWD and former diesel storage and distribution infrastructure. Sampling locations for the groundwater monitoring associated with this EMP Sampling Schedule are summarised in Table 4 below.

Groundwater sampling locations are shown on Appendix 3 Figure to support this Sampling Program.

Table 4. Sampling Locations

Sample ID	Sample Location
MW01	Down-gradient groundwater monitoring well adjacent to impact area
<i>MW02*</i>	<i>Destroyed / lost</i>
MW03	Background well up gradient to impacted area
MW04	Down gradient of impact area, located on Site boundary
MW05	Located on northern Site boundary, cross gradient of impact area.
MW06	West of primary operational areas and cross gradient of impact area
MW07	Down gradient of impact, and east of DWD pond
MW08	Down gradient of impact, located between DWD and LDP ponds
ESMW01	Down gradient of impact and located on edge of Site boundary
ESMW02	Down gradient of impact and adjacent to DWD pond
<i>PB1*</i>	<i>Destroyed / lost</i>
PB2	Production well adjacent to LDP pond down gradient of impact area

* Wells identified as destroyed and / or unsuitable for monitoring (Arcadis 2017).

Contaminants of Potential Concern

The selected groundwater Contaminants of Potential Concern (CoPC) for this EMP, are based upon NEPM (2013) Table 1C for Fresh Water.

- NEPM (2013) Groundwater Investigation Levels (GILs) Fresh Waters, based on ANZECC /ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh Water.

Table 5 below, lists only the CoPC where NEPM (2013) 'Levels' have been calculated and as applied to the site ESA investigation by Arcadis 2017. Trigger values for further investigation of groundwater are based upon the following;

Environmental Management Plan

- c) Trigger Value defaults to the NEPM Investigation 'Level' where the Arcadis 2017 result reported was Non-Detect; or
- d) Trigger Values are equal to the Arcadis 2017 maximum analysis result + 10%.

Monitoring and laboratory analysis results must be equal to or greater than the 'Trigger Values', as listed below in Table 4, for a period of four (4) consecutive monitoring events in order to trigger a management response. The management response for further investigation may include a formal Environmental Site Assessment (ESA) or development of a RAP.

Table 4. Groundwater Performance Criteria (µg/L)

Group	Contaminant of Potential Concern (CoPC)	NEPM 2013 Table 1C GILs, Fresh Waters	Maximum Analysis Arcadis 2017 (if applicable)	Trigger Value for further investigation refer (a) and (b)
Metals	Cadmium (Filtered)	0.2 ^{#1}	0.1	1
	Copper (Filtered)	1.4 ^{#1}	2	20
	Lead (Filtered)	3.4 ^{#1}	ND	3.4
	Manganese (Filtered)	1,900 ^{#4}	6,150	61,500
	Mercury (Filtered)	0.06 ^{#2}	ND	0.06
	Nickel (Filtered)	11 ^{#1}	20	200
	Zinc (Filtered)	8 ^{#1}	51	510
BTEX	Benzene	950	ND	950
	Xylene (o)	350	ND	350
PAH	Naphthalene	16	ND	16
TPH/TRH	Petroleum hydrocarbons	-	ND	Detection

ND = Non-Detect.

Environmental Standards - Comments

#1: Values calculated using hardness of 30 mg/L CaCO₃. Refer ANZECC & ARMCANZ (2000) for site specific hardness guidance.

#2: Chemical for which possible bioaccumulation and secondary poisoning effects should be considered, refer to ANZECC & ARMCANZ (2000) for further guidance.



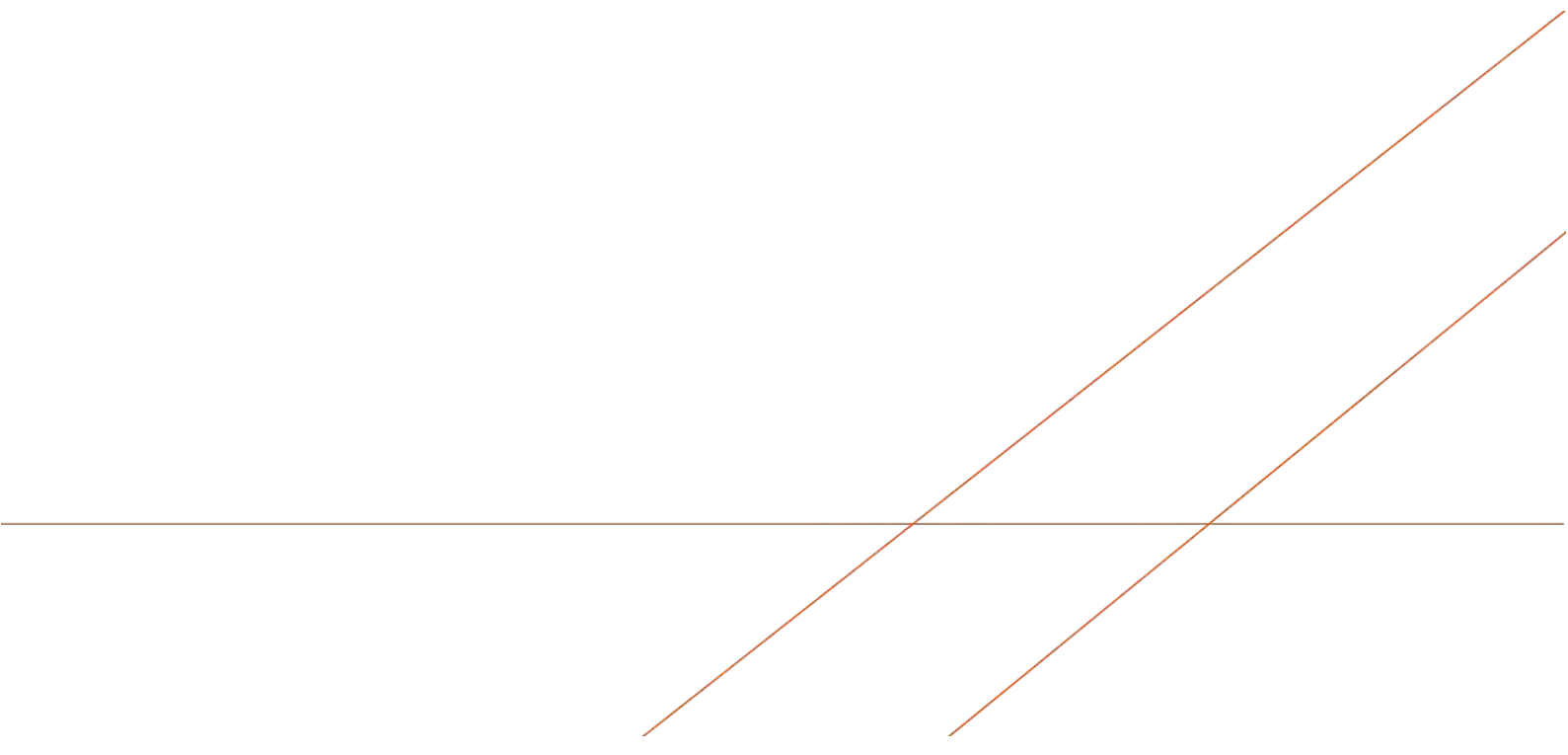
Legend

- ⊗ Monitoring/Production wells
- ⊗ Surface Water samples
- ⊗ Destroyed/lost wells
- Approximate Site boundary
- Inferred groundwater direction

Base image sourced from SIX Maps
15/05/2018 Drafted by JV

A
N

Environmental Management Plan



APPENDIX G – Dirty water storage capacity assessment

Design criteria: 5 day 95th percentile rainfall depth for Lithgow

Design rainfall depth: 56.4 mm

Table F-1 Design volume

Water storage	Catchment area (ha)	Design runoff coefficient	Design settling volume (ML)	Design sediment volume (ML)
Dirty water dam	11.7	0.5	3.3	1.6
Triangle pond	5.0	0.5	1.4	0.7

Table F-2 Design compliance

Water storage	Total required water storage capacity (ML)	Existing water storage capacity (ML)	Compliant
Dirty water dam	4.9	6.1	Yes
Triangle pond	2.1	5.1 (planned to increase to 8.1 ML in 2021)	Yes

Table F-3 Dirty water dam – stage storage (surveyed August 2016)

Stage (m AHD)	Storage (ML)	Note
874.50	0.000	
875.00	0.040	
875.50	0.264	
876.00	0.861	
876.50	1.915	
877.00	3.375	
877.50	5.206	
877.75	6.096	Spill level

Table F-4 Triangle pond – stage storage (surveyed August 2016)

Stage (m AHD)	Storage (ML)	Note
874.00	0.005	
874.50	0.072	
875.00	0.619	
875.50	1.753	
876.00	3.904	
876.20	5.150	Spill level

Table F-5 Triangle pond – stage storage (design for upgrade planned for 2021)

Stage (m AHD)	Storage (ML)	Note
875.0	0.00	
875.5	1.50	
876.0	5.27	
876.5	8.47	Spill level

APPENDIX H – Operational checklist

SCSO-

TITLE: Appendix B – Environmental Inspection Checklist: Water Management

Prepared by:	Date:	Time:
Reviewed by:	Date:	
Approved by:	Review Frequency:	

LEGEND – INSPECTION RATING OF SYSTEM ELEMENT (AREA, INFRASTRUCTURE, ASSET OR TASK)

- A. **No issues identified.** All in accordance with management plan. Inspection of system element complete
- B. **Issue identified and rectified.** System element restored to operational in accordance with management plan. Inspection complete. Review of issue required to avoid recurrence.
- C. **Issue identified but not rectified.** System element is still suitable for ongoing operation, with rectification to be scheduled at earliest opportunity. Reinspection required after rectification complete. Review of issue required.
- D. **Issue identified but not rectified.** System element is unsuitable for continued operation. System element to be removed from service immediately and works to make safe to be undertaken. Incident report required if impacts have occurred to human health and/or the environment. Reinspection required after rectification. Review of issue required to prevent recurrence.
- E. **Not inspected.** System element not inspected. State reasoning. Inspect item as soon as reasonably practicable.

System Element to be Inspected	Inspection Description	Inspection Rating A B C D	*Action Required Yes / No	Inspection Close Out Initials / Date
	<i>*Actions for identified issues to be carried out as per:</i> <i>Western Coal Services: Water Management Plan (Feb 2019); Appendix J – Trigger action response plan</i> <i>or</i> <i>Lidsdale Siding: Water Management Plan (Jan 2019); Appendix E – Trigger action response plan</i>			
1. Surface water storage volume	Per Rainfall Event – storage captures events up to and including design criteria.			
2. Clean water diversion	Regular – clean water is diverted around dirty water areas			
3. Dirty water diversion	Regular – Dirty water channels are maintained with no route blockages			
4. Erosion and sediment controls	Per event – all controls are appropriately in place and well maintained. No unstable disturbance or migration of sediment away from designated development area. <i>As per WCS Water Management Plan (Feb 2019); Appendix E - Erosion & Sediment Control Plan</i>			

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System Element to be Inspected	Inspection Description <i>*Actions for identified issues to be carried out as per: Western Coal Services: Water Management Plan (Feb 2019); Appendix J – Trigger action response plan or Lidsdale Siding: Water Management Plan (Jan 2019); Appendix E – Trigger action response plan</i>	Inspection Rating A B C D	*Action Required Yes / No	Inspection Close Out Initials / Date
5. Hydrocarbon management	Regular – all hydrocarbon materials are stored appropriately <i>As per SCSO Hazardous Substances Management System (April 2019)</i>			
6. Water quality	Regular – Water quality at monitoring site is within the SSGVs specified within the relevant Water Management Plan <i>(see above references for WCS and Lidsdale Siding)</i>			
7. LDP discharge quality	Regular – Discharge quality is within limits defined by EPL. <i>(see above references for WCS and Lidsdale Siding)</i>			
8. LDP discharge volume	Per rainfall event – Discharge volume is within predictions of the site water balance. <i>(see above references for WCS and Lidsdale Siding)</i>			
9. Unlicensed emergency discharges	Per rainfall event or incident – No discharges from unlicensed locations			
10. Groundwater level	Regular – Groundwater level below triggers specified <i>(see above references for WCS and Lidsdale Siding, cite water trigger memo)</i>			
11. Groundwater quality	Regular – Groundwater quality within or below triggers specified <i>(see above references for WCS and Lidsdale Siding, cite water trigger memo)</i>			
12. Watercourse instabilities	Regular – Watercourse monitoring indicates no areas of instability <i>(Cite Aquatic Ecology Monitoring Reports)</i>			
13. Instream Vegetation	Regular – No significant variation in vegetation extent or quality when compared with reference sites and previous monitoring results <i>(see above references for WCS and Lidsdale Siding)</i>			
14. Macroinvertebrate community condition	Regular – Assessment of macroinvertebrate metrics indicates no impairment attributable to licensed discharges from the site <i>(see above references for WCS and Lidsdale Siding, Cite Aquatic Ecology Monitoring Reports)</i>			
15. Erosion or scour of material within REA	Regular – Visual monitoring indicates no areas of instability <i>(see above references for WCS only)</i>			

System Element to be Inspected	Inspection Description <i>*Actions for identified issues to be carried out as per: Western Coal Services: Water Management Plan (Feb 2019); Appendix J – Trigger action response plan or Lidsdale Siding: Water Management Plan (Jan 2019); Appendix E – Trigger action response plan</i>	Inspection Rating A B C D	*Action Required Yes / No	Inspection Close Out Initials / Date
16. Water volume within REA	Regular – Water level is maintained below the maximum operating level (see above references for WCS only)			
17. Surface water quality of decant water from REA	Regular – Decant water quality is within or below the values specified (see above references for WCS only)			
18. WCS – Main Sediment Dam	Regular (record water quality readings on following table) - Are there defects on the dam crest, batters or spillway? - Is water treatment required?			
19. WCS – Washery Sediment Pond	Regular (record water quality readings on following table) - Are there defects on the dam crest, batters or spillway? - Is water treatment required?			
20. WCS – Stockpile Sediment Pond	Regular (record water quality readings on following table) - Are there defects on the dam crest, batters or spillway? - Is water treatment required?			
21. WCS – Retention Pond	Regular (record water quality readings on following table) - Are there defects on the dam crest, batters or spillway? - Is water treatment required?			
22. WCS – Cooks Dam	Regular (record water quality readings on following table) - Are there defects on the dam crest, batters or spillway? - Is water treatment required? Note: Level monitored by ALS			
23. WCS – DML Dam	Regular (record water quality readings on following table) - Are there defects on the dam crest, batters or spillway? - Is water level within normal trends?			
24. WCS – LDP001 (formerly LDP006)	Regular (record water quality readings on following table) - Are there defects on the dam crest, batters or spillway? - Does the sediment control require replacement?			
25. WCS LDP002 (formerly LDP007)	Regular - Are there defects on the dam crest, batters or spillway? - Does the sediment control require replacement?			

System Element to be Inspected	Inspection Description	Inspection Rating A B C D	*Action Required Yes / No	Inspection Close Out Initials / Date
	<i>*Actions for identified issues to be carried out as per:</i> <i>Western Coal Services: Water Management Plan (Feb 2019); Appendix J – Trigger action response plan</i> <i>or</i> <i>Lidsdale Siding: Water Management Plan (Jan 2019); Appendix E – Trigger action response plan</i>			
26. Lidsdale Siding - Triangle Pond	Regular (record water quality readings on following table) - Are there defects on the dam crest, batters or spillway? - Is water treatment required?			
27. Lidsdale Siding – Dirty Water Dam	Regular (record water quality readings on following table) - Are there defects on the dam crest, batters or spillway? - Is water treatment required?			

WATER QUALITY READINGS

Parameter	WCS Main Sediment Dam	WCS Washery Sediment Pond	WCS Stockpile Sediment Pond	WCS Retention Pond	WCS Cooks Dam	WCS DML Dam	WCS LDP01 (former LDP06)	Lidsdale Siding Triangle Pond	Lidsdale Siding Dirty Water Dam
pH									
EC (µS/Cm)									
TSS (mg/L)									
Temp (°C)									
Turbidity (NTU)									

Lidsdale Siding Bore Pump Reading_006012:

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ACTIONS REQUIRED TO RECTIFY ISSUES

No. of Element Inspected	Issue Identified	Action Required	By Who	When

No. of Element Inspected	Issue Identified	Action Required	By Who	When

REFERENCES

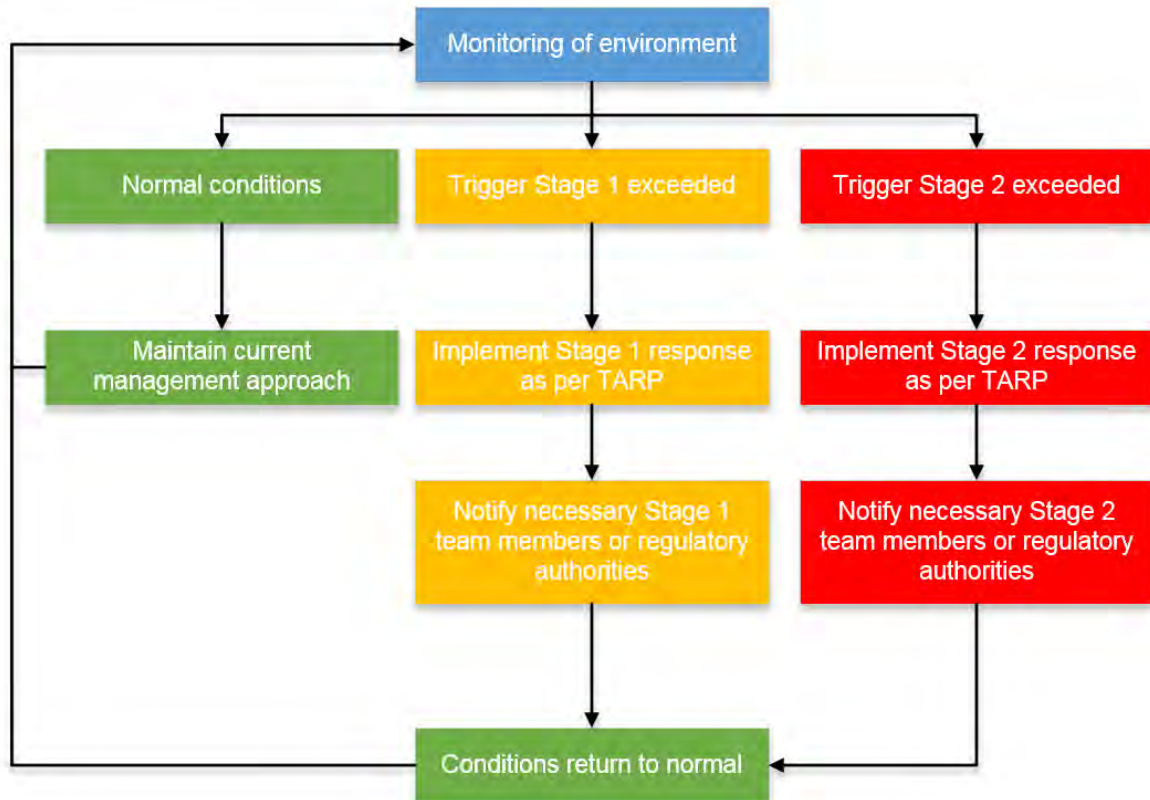
Lidsdale Siding: Water Management Plan (Jan 2019)

Western Coal Services: Water Management Plan (Feb 2019)

Water Trigger Memos

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APPENDIX I – Trigger action response plans



Site surface operations

Aspect	Normal	Stage 1	Stage 2	Notifications
Surface water storage volume	Storages (including Triangle Pond) captures events up to and including the design criteria.	Trigger: Storage is not dewatered appropriately following storm event in accordance with design criteria. Action: Investigate storage operation and dewatering options. Increase inspection frequency as required. Education for staff.	Trigger: Storage is discharging as a result of a storm event less than design criteria. Action: Investigate storage operation and dewatering options. Increase inspection frequency as required. Undertake water quality sampling of discharge and flocculate if necessary. Undertake water quality sampling of downstream sites if necessary.	Stage 1: Notify Environment and Community Coordinator and Operations Manager immediately. Stage 2: Notify relevant agencies in accordance with Pollution Incident Response Management Plan (PIRMP) requirements immediately if material harm to the environment has occurred.

Aspect	Normal	Stage 1	Stage 2	Notifications
Clean water diversions	Clean water diverted around dirty water areas.	Trigger: Clean water bypass through dirty water areas. Action: Review catchment plan. Review design capacity of clean water system. Appropriately treat and manage from dirty water.	Trigger: Clean water creates flooding problems through site. Action: Evacuate site if danger exists. Establish temporary bunding around clean water source. Utilise earthworks machinery to cut appropriate channel to manage clean water. Protect equipment and infrastructure. Utilise portable pumps to dewater flooded areas into storages.	Stage 1: Notify Environment and Community Coordinator and Operations Manager immediately. Stage 2: Notify relevant agencies in accordance with PIRMP requirements immediately if material harm to the environment has occurred.

Aspect	Normal	Stage 1	Stage 2	Notifications
Erosion and sediment control	All controls are appropriately in place and well maintained. No unstable disturbance areas or migration of sediment away from designated development areas.	Trigger: One or more areas of surface erosion in the form of rilling, bank erosion or other movement of sediment from an area of disturbance. Controls are not maintained or inappropriately installed. Action: Seek to stabilise the area to stop the erosion process. This can include the use of groundcover, or other temporary measures. Investigate works undertaken prior to the disturbance activities.	Trigger: Rainfall event leads to sediment migrating off-site. Controls are not in place. Action: Isolate the area through diverting contributing surface flows to another appropriate control structure.	Stage 1: Notify Environment and Community Coordinator and Operations Manager immediately. Stage 2: Notify relevant agencies in accordance with PIRMP requirements immediately if material harm to the environment has occurred.
Hydrocarbon management	All hydrocarbon materials are stored appropriately.	Trigger: Minor spill occurs on site with limited risk of off-site migration. Action: Implement procedures in the PIRMP. Utilise spill kit.	Trigger: Major spill occurs on site with risk of off-site migration. Action: Isolate area and divert contributing surface flows. Engage waste contractor to clean up spill. Review potential for contamination of waterways.	Stage 1: Notify Environment and Community Coordinator and Operations Manager immediately. Stage 2: Notify relevant agencies in accordance with PIRMP requirements immediately if material harm to the environment has occurred.

Watercourses

Aspect	Normal	Stage 1	Stage 2	Notifications
Water quality	Water quality at monitoring locations within or below the values specified in Table 6-1.	Trigger: Water quality is outside or above the values specified in Table 6-1 for at least one parameter for two consecutive sampling events. Action: Review recent monitoring results for adjacent sites and any relevant operational data (e.g. operational activities, clearing activities, meteorological data). Investigate the source of the exceedance and develop preventative/corrective actions based on outcomes.	Trigger: Investigation into Stage 1 trigger identifies that trigger exceedance is due to an operational activity. Community complaint to Centennial regarding surface water quality. Action: Determine if an incident has potentially occurred and investigate the source of the exceedance. Increase monitoring frequency and undertake additional monitoring (e.g. water quality, aquatic ecology) where relevant. Implement corrective/preventative actions, in consultation with relevant agencies, based on the outcomes of the investigation and/or additional monitoring. Prioritise actions based on the risk to the environment and likelihood of further impact. Review the WMP and related procedures to prevent reoccurrence. Loss of water supply to any adjacent landholders due to operational activities will need to be replaced by Centennial.	Stage 1: Notify Environment and Community Coordinator and Operations Manager immediately. Stage 2: Notify relevant agencies in accordance with PIRMP requirements immediately if material harm to the environment has occurred. Notify DPIE Water as soon as practicable.

Flooding

Aspect	Normal	Stage 1	Stage 2	Notifications
Flooding	Water levels within Pipers Flat Creek and Coss River below minor flood level.	Trigger: Flooding occurs less than a 20 year ARI event. Action: Construct temporary bunding and mobilise portable pumps to manage flood waters away from assets and potential contamination sources. Continue water monitoring program with additional monitoring as required.	Trigger: Flooding occurs greater than a 20 year ARI event. Action: Consult with emergency services. Construct temporary bunding and mobilise portable pumps to manage flood waters away from assets and potential contamination sources. Additional water monitoring to be undertaken as required to support mitigation of offsite contamination risks.	Stage 1: Notify emergency services immediately if required. Notify Environment and Community Coordinator and Operations Manager immediately. Stage 2: Notify emergency services immediately if required. Notify relevant agencies in accordance with PIRMP requirements immediately if material harm to the environment has occurred. Notify DPIE Water as soon as practicable.

Discharge management

Aspect	Normal	Stage 1	Stage 2	Notifications
LDP discharge volume	Discharge volume is within predictions of the site water balance.	Trigger: Discharge volume exceeds predictions for no more than one day. Action: Undertake review of water management on site. Review monitoring equipment on discharge volume.	Trigger: Discharge volume exceeds predictions for more than one day. Action: Undertake review of water management on site. Review site transfers and predictions of site water balance model. Update model as required.	Stage 1: Notify Environment and Community Coordinator and Operations Manager immediately. Stage 2: Notify relevant agencies in accordance with PIRMP requirements immediately if material harm to the environment has occurred.
LDP discharge quality	Discharge quality is within limits defined by EPL, provided in Table 1-3.	Trigger: Water quality parameters exceed discharge limits for one parameter for one discharge event. Action: Undertake review of water management on site. Repeat sampling.	Trigger: Water quality parameters exceed discharge limits for more than one parameter. Action: Undertake review of water management on site. Increase monitoring frequency and undertake additional monitoring (e.g. water quality, aquatic ecology) where relevant.	Stage 1: Notify Environment and Community Coordinator and Operations Manager immediately. Stage 2: Notify relevant agencies in accordance with PIRMP requirements immediately if material harm to the environment has occurred. Notify WaterNSW and DPIE as soon as practicable.

Aspect	Normal	Stage 1	Stage 2	Notifications
Unlicensed emergency discharges	No discharges from unlicensed/emergency locations.	Trigger: Discharge from a non-EPL defined, emergency discharge location. Action: Undertake review of water management on site. Increase monitoring frequency and undertake additional monitoring (e.g. water quality, aquatic ecology) where relevant.	Trigger: Continued discharge from a non-EPL defined, emergency discharge location. Action: Undertake review of water management on site. Undertake incident investigation, including ecotoxicology and aquatic ecology monitoring where relevant.	Stage 1: Notify Environment and Community Coordinator and Operations Manager immediately. Stage 2: Notify relevant agencies in accordance with PIRMP requirements immediately if material harm to the environment has occurred. Notify WaterNSW and DPIE as soon as practicable.

Groundwater environment

Aspect	Normal	Stage 1	Stage 2	Notifications
Groundwater level	Groundwater level is greater than the values specified in Table 6-6.	Trigger: Groundwater level falls below values specified in Table 6-6 at one or more monitoring locations. Action: Review recent monitoring results for adjacent sites and any relevant operational data (e.g. operational activities, meteorological data). Undertake investigation to determine if the change in groundwater level is due to operational activities.	Trigger: Investigation into Stage 1 trigger identifies that trigger exceedance was due to operational activities. Community complaint to Centennial regarding groundwater levels. Action: Review recent monitoring results for adjacent sites and any relevant operational data (e.g. operational activities, meteorological data). Undertake investigation to determine if the change in groundwater level is due to operational activities. If environmental impacts are unacceptable and/or if the beneficial use of the groundwater changes, remediation options will be considered. Loss of water supply to any adjacent landholder due to operational activities will need to be replaced by Centennial.	Stage 1: Notify Environment and Community Coordinator and Operations Manager immediately. Stage 2: Notify relevant agencies in accordance with PIRMP requirements immediately if material harm to the environment has occurred.

Aspect	Normal	Stage 1	Stage 2	Notifications
Groundwater quality	Groundwater quality within or below values specified in Table 6-6.	Trigger: Groundwater quality is outside or above values specified in Table 6-6 at for at least one parameter for two consecutive sampling events. Action: Review recent monitoring results for adjacent sites and any relevant operational data (e.g. operational activities, meteorological data). Undertake investigation to determine if the change in groundwater quality is due to operational activities.	Trigger: Investigation into Stage 1 trigger identifies that trigger exceedance was due to operational activities. Community complaint to Centennial regarding groundwater quality. Action: Review recent monitoring results for adjacent sites and any relevant operational data (e.g. operational activities, meteorological data). Undertake investigation to determine if the change in groundwater quality is due to operational activities. If environmental impacts are unacceptable and/or if the beneficial use of the groundwater changes, remediation options will be considered. Loss of water supply to any adjacent landholder due to operational activities will need to be replaced by Centennial.	Stage 1: Notify Environment and Community Coordinator and Operations Manager immediately. Stage 2: Notify relevant agencies in accordance with PIRMP requirements immediately if material harm to the environment has occurred.

Aspect	Normal	Stage 1	Stage 2	Notifications
Hydrocarbon contamination	Hydrocarbon levels below values specified in Table 6-6.	Trigger: Positive result for TRHs at down gradient monitoring well MW4, MW7, MW8 or MW10. Action: Resample and analyse for full suite of BTEX and TRHs.	Trigger: Positive result for hydrocarbon contamination (BTEX or TRHs) and potential for migration off-site. Action: Implement more detailed contamination investigation and assess remediation measures if required. Continue water monitoring program, with additional monitoring as required. Report exceedance in Annual Review.	Stage 1: Notify Environment and Community Coordinator and Operations Manager immediately. Stage 2: Notify relevant agencies in accordance with PIRMP requirements immediately if material harm to the environment has occurred. Notify EPA on confirmation of hydrocarbon contamination following detailed investigation.

Stream health

Aspect	Normal	Stage 1	Stage 2	Notifications
Instream/riparian vegetation	No significant variation in vegetation extent or quality when compared with reference sites and previous monitoring results.	Trigger: Visual inspections show change in extent and density of vegetation not specific to season. Introduction or increase number of exotic species. Action: Review activities likely to influence instream vegetation. Review flow monitoring and rainfall data.	Trigger: Visual inspections show significant change in extent and density of instream vegetation as a result of clearing or impact. Action: Increase monitoring frequency and undertake additional monitoring (e.g. water quality, watercourse stability) where relevant. Undertake water quality monitoring to determine potential impact on in situ conditions. Stabilise watercourse banks as necessary.	Stage 1: Notify Environment and Community Coordinator and Operations Manager immediately. Stage 2: Notify DPIE Water immediately if the change was caused by site operations.
Macroinvertebrate metrics	Assessment of macroinvertebrate metrics (taxa richness, EPT richness and SIGNAL-2) and multivariate analyses of macroinvertebrate data (including MDS, Cluster analysis, ANOSIM and SIMPER) indicates no impairment attributable to licensed discharges from the site.	Trigger: Assessment indicates community impairment directly attributable to licensed discharges at one of the downstream sites. Action: Investigate possible causes for the macroinvertebrate community impairment. Report on findings in the annual aquatic ecology monitoring report.	Trigger: Assessment indicates community impairment directly attributable to licensed discharges at Pipers Flat Creek site downstream of LDP004. Action: Investigate possible causes for the macroinvertebrate community impairment. Report on findings in the annual aquatic ecology monitoring report. Undertake follow up monitoring for the full suite of water quality parameters.	Stage 1: Notify Environment and Community Coordinator and Operations Manager immediately. Stage 2: Notify DPIE Water immediately if the change was caused by site operations.

APPENDIX J – Erosion and sediment control plan

J.1 Requirements and guidelines

All erosion and sediment control measures are to be designed and implemented according to the requirements and guidelines provided in:

- Managing Urban Stormwater: Soils and Construction, Volume 1 (Landcom 2004).
- Managing Urban Stormwater: Soils and Construction, Mines and Quarries Volume 2E (DECC 2008).
- Best Practice Erosion and Sediment Control (IECA 2008).

J.2 Disturbance and sediment generating activities

Disturbance and sediment generating activities that are likely to require erosion or sediment controls may include:

- Rehabilitation activities.
- Site reshaping.
- Temporary stockpiles.
- Dewatering activities.
- Temporary open channel diversions.
- Instream watercourse works.

J.3 Erosion risk

Disturbance activities are a function of the daily operations, with the resulting erosion risk varying throughout the year in response to changes in rainfall. The initial erosion risk has been estimated based on the:

- Average monthly rainfall.
- Area of disturbance (considered as the total water management system catchment).
- Soil loss classes (refer to Table 4.2; Landcom 2004).

Typical erosion risk ratings for the western region are provided in Table J-1. The average monthly rainfall is given by IECA (2008) based on rainfall recorded in Bathurst. The initial erosion risk is principally affected by the average rainfall, with *high* erosion risk identified for summer months (i.e. December to February), with the initial erosion risk reducing to *low* during the winter months (i.e. June to August).

When disturbance activities are undertaken within higher risk months, it is recommended that additional management measures be undertaken to ensure that the erosion and sediment controls are capable of operating effectively.

Table J-1 Typical erosion risk

Month	Average rainfall (mm)	Erosion risk rating
January	85.1	High
February	79.1	High
March	65.0	Moderate
April	44.6	Low to moderate

Month	Average rainfall (mm)	Erosion risk rating
May	49.4	Low to moderate
June	49.0	Low
July	50.9	Low
August	64.2	Low
September	52.4	Low to moderate
October	67.1	Moderate
November	72.5	Moderate
December	73.6	High

J.4 Soil landscapes

Table J-2 summarises the various soil landscapes and associated erosion hazard for LS. The erosion hazard associated with the soil landscapes at LS varies from a moderate to high erosion hazard.

Table J-2 Applicable soil landscapes for erosion risk

Soil landscape	Typical terrain	Erosion hazard
Cullen Bullen	Hill crests	High
Lithgow	Lower slopes and poorly drained areas	Moderate

J.5 Environmental constraints

Environmental constraints that should be considered when estimating the potential sediment loads associated with a proposed activity are presented in Table J-3.

Table J-3 Environmental constraints and characteristics

Component	Range of parameters
Works period and site sensitivity (DECC 2008)	Greater than three years Downstream environment defined as sensitive
Rainfall factor – R	1,360 to 1,800
Soil erodibility factor – K	0.05 to 0.075
Slope and flow length	Maximum flow length should not exceed 80 m Typical slopes are between 0.5% to 3%
Sediment basin requirement threshold	Predicted soil loss > 150 m ³ /year (based on RUSLE equation results)
Sediment basin type for construction	‘Wet Basin’ – Type D, 5 day 95th percentile

Component	Range of parameters
Sediment volume allowance for sediment basins	Dependent upon operations and clean out frequency – two to six months
Soil hydrologic type	Type D
Volumetric coefficient of runoff	0.39 to 0.79 (DECC 2008 recommends 0.9 for hardstand areas)

J.6 Typical controls

Prior to any construction activity, temporary erosion and sediment controls shall be installed. The following are temporary erosion and sediment control that are currently being utilised at Centennial's western sites. The installation of these controls should be in accordance with the specification detailed in the *Managing Urban Stormwater, Soils and Construction* (Landcom 2004) standard drawings.

J.6.1 Sediment fence

Sediment fences trap sediment that is mobilised by runoff across a disturbed area. Sediment fences should only be temporary and require regular maintenance to remain effective.

Sediment fences are to be installed along the contour downslope of disturbed areas. Sediment fences are not to be located within (or adjacent to) concentrated flow paths, but in positions that provide adequate vegetative filtering of sheet flows downslope of the disturbed area. Sediment fences shall be installed in accordance with the Sediment Fence Standard Drawing (SD6-8: Landcom 2004).

J.6.2 Inlet pit protection

Where disturbance activities are to be carried out within the vicinity of an existing stormwater drainage network (i.e. a pit and pipe system), it is recommended that inlet pit protection measures are used. Pit protection measures provide a filter for sediment-laden runoff, reducing the risk of stormwater pipes being blocked with accumulated sediment. Inlet pit protection shall be installed in accordance with the Inlet Pit Protection Standard Drawing (SD6-11: Landcom 2004).

J.6.3 Sediment traps and basins

Where disturbance activities exceed the manageable capacity of sediment fences, with respect to duration or extent, it is recommended that sediment traps and/or basins be installed. Sediment traps and basins can be constructed from available construction materials or by shaping an earth embankment. It is expected that sediment traps and basins would be installed and operated similar to a Type D Sediment Basin (SD6-4: Landcom 2004).

J.6.4 Flow breaks (low flow channels)

The use of flow breaks decreases flow velocities within low flow channels, reducing the potential for the low flow channels to erode and scour and reduce the migration of sediment from disturbed areas. Flow breaks can be constructed from earth, natural materials (logs, mulch and so on) or from proprietary products. Breaks should be used in a similar manner to a sediment fence, however flow breaks are typically more porous than sediment fences, allowing water to flow through faster.

J.6.5 Rolled erosion control products

Rolled erosion control products (RECPs) reduce erosion by completely covering the disturbed area. RECPs are easily applied to disturbed areas in an emergency or where the area requires temporary stabilisation for an extended period of time. RECPs typically require little maintenance. RECPs may consist of processed natural or synthetic fibres bound together to form a continuous mat. They may also be used to facilitate vegetation establishment by temporarily or permanently reinforcing the soil surface during and after vegetation maturation.

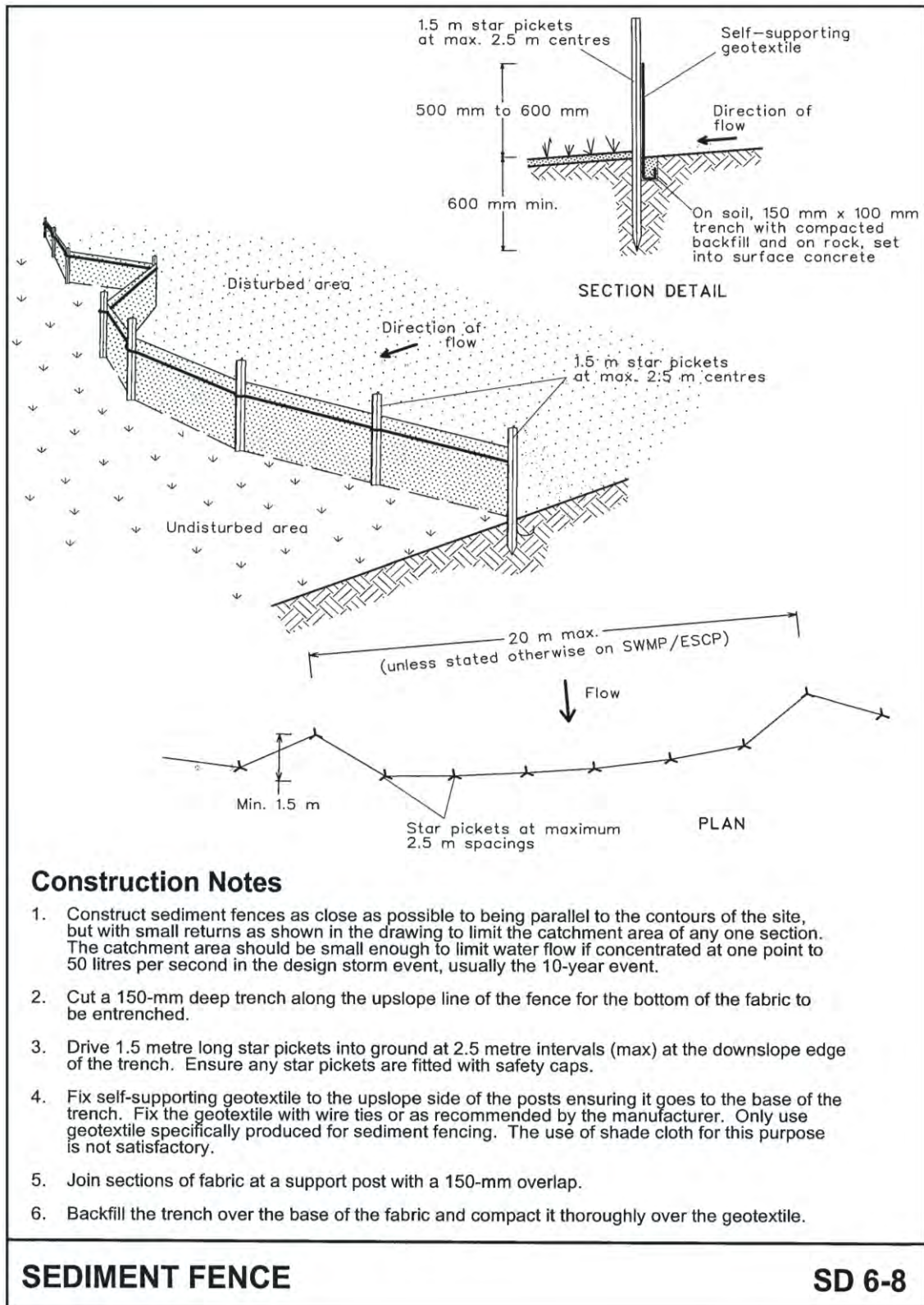
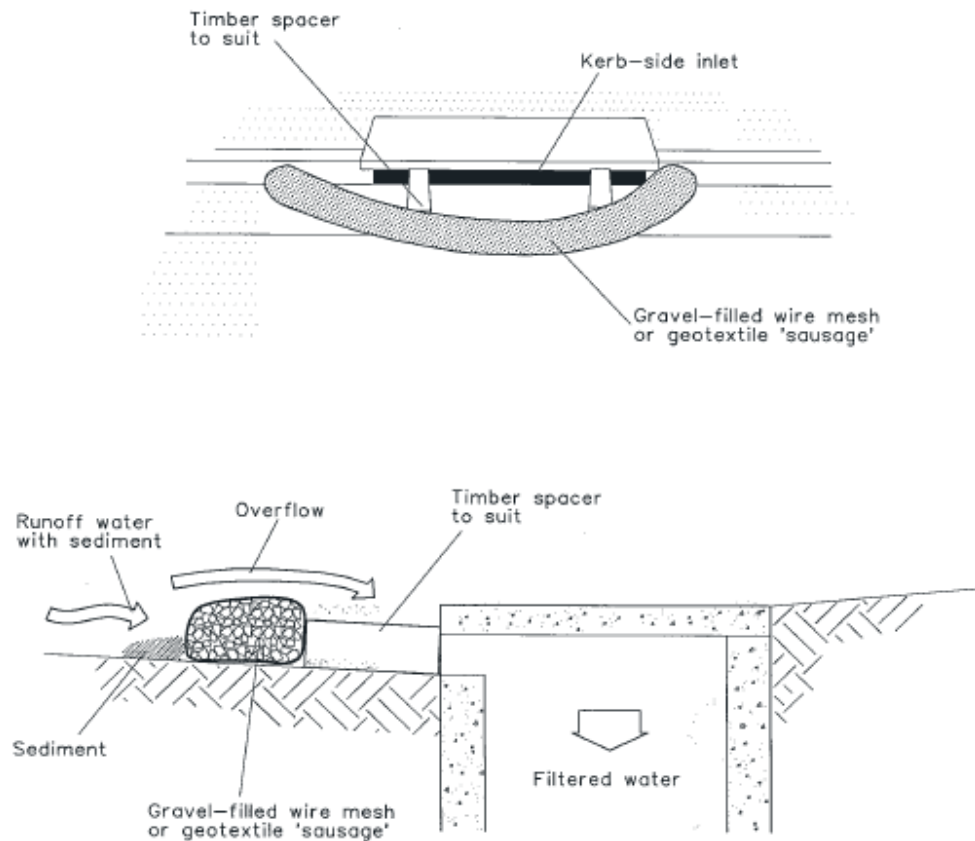


Figure J-1 Typical sediment fence (Landcom 2008)



NOTE: This practice only to be used where specified in an approved SWMP/ESCP.

Construction Notes

1. Install filters to kerb inlets only at sag points.
2. Fabricate a sleeve made from geotextile or wire mesh longer than the length of the inlet pit and fill it with 25 mm to 50 mm gravel.
3. Form an elliptical cross-section about 150 mm high x 400 mm wide.
4. Place the filter at the opening leaving at least a 100-mm space between it and the kerb inlet. Maintain the opening with spacer blocks.
5. Form a seal with the kerb to prevent sediment bypassing the filter.
6. Sandbags filled with gravel can substitute for the mesh or geotextile providing they are placed so that they firmly abut each other and sediment-laden waters cannot pass between.

MESH AND GRAVEL INLET FILTER

SD 6-11

Figure J-2 Typical inlet protection measure (Landcom 2008)

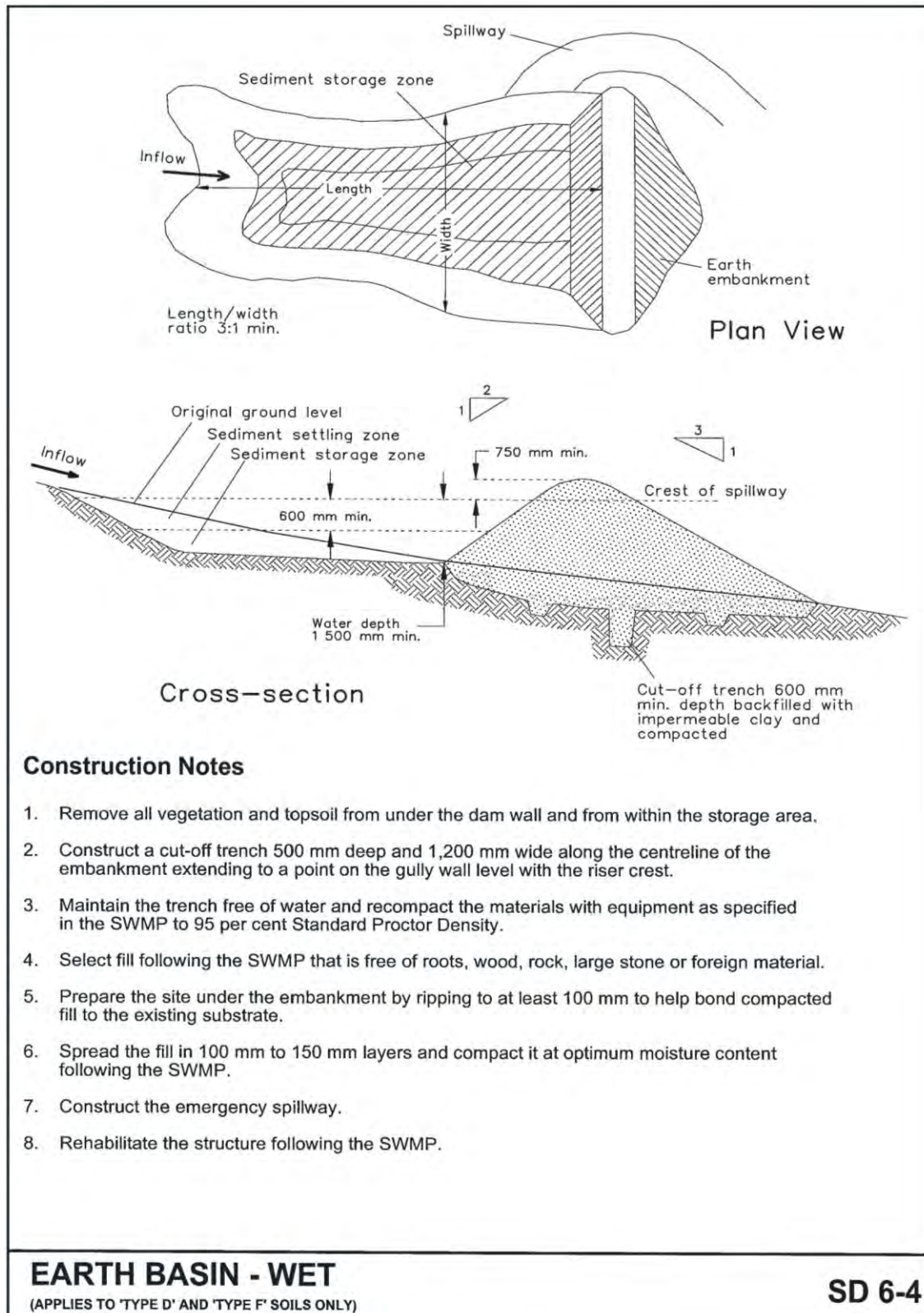


Figure J-3 Typical sediment basin (Landcom 2008)

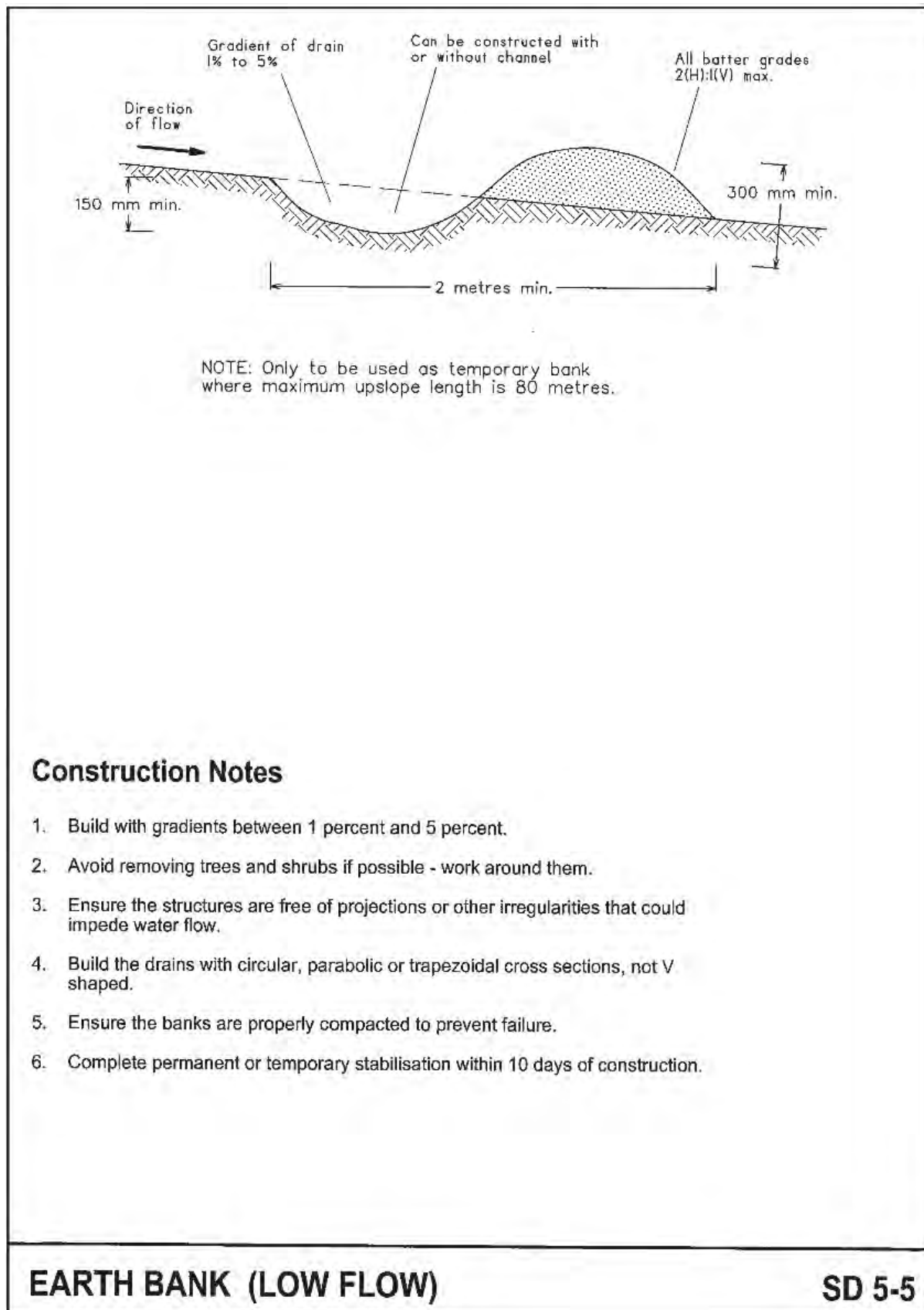


Figure J-4 Typical diversion channel (Landcom 2008)

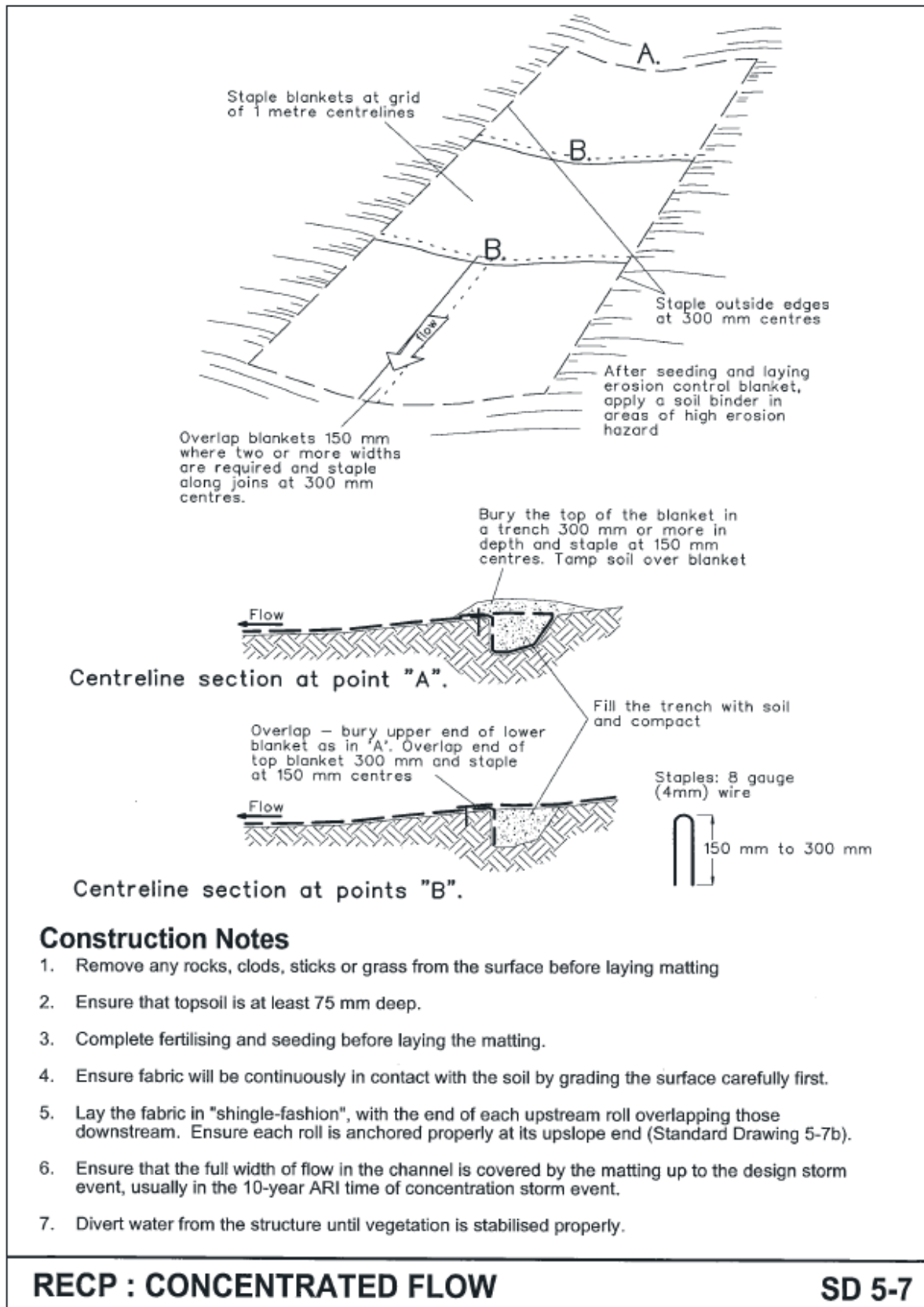


Figure J-5 Typical application of rolled erosion control products in channels (Landcom 2004)

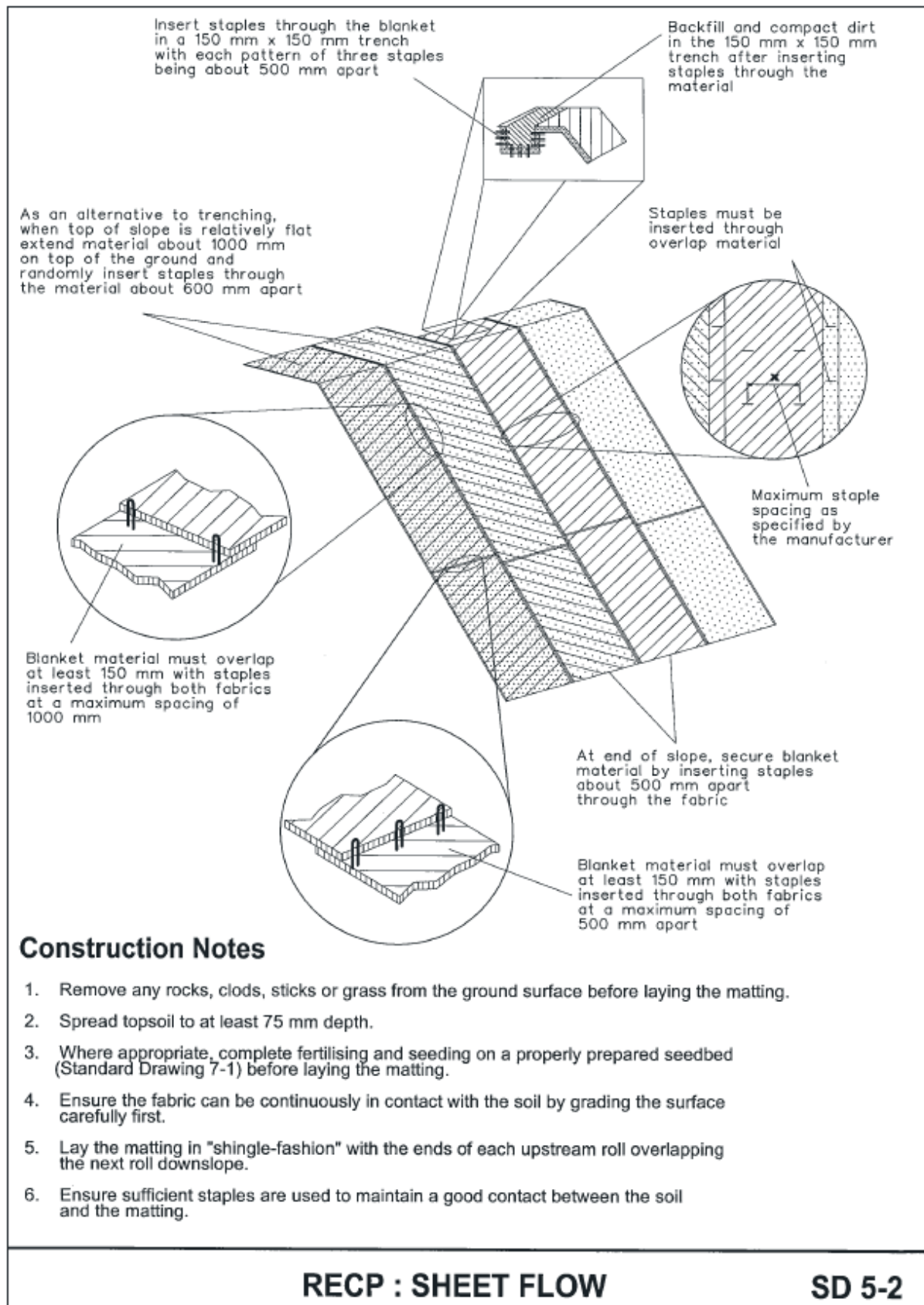


Figure J-6 Typical application of rolled erosion control products on disturbed areas (Landcom 2004)

J.7 Implementation

The typical implementation strategy for managing erosion and sediment controls includes:

- Sediment controls are to be implemented in the area of any ground disturbance, prior to the disturbance activity occurring. A sediment fence or appropriately designed sediment control structure must be erected downslope of the area of disturbance.
- Dirty runoff water should be directed to the sediment controls. Small areas of ground disturbance may be managed in situ by using appropriate sediment source controls.
- Dirty runoff that may be exposed to hydrocarbons must be treated with an oil/water separator, where practicable. The collected hydrocarbon wastes must be disposed off-site by a licensed waste operator. Remote site facilities should be managed on a site by site basis within the confines of the facility.
- Areas where contamination of water by hydrocarbons must be minimised. Servicing of vehicles must be conducted within appropriate areas designed to treat potential hydrocarbon spills.
- Equipment and materials should be cleaned in the designated washdown areas.
- All emergency discharge sites are to include flow dissipaters to reduce scouring directly downstream of the discharge point.
- All erosion and sediment controls are to remain in place until the area of disturbance can be satisfactorily rehabilitated and stabilised.

Table J-4 summarises the acceptable water quality objectives for disturbance activities when works may occur outside the catchment of an LDP.

Table J-4 Water quality objectives

Parameter	Units	Concentration limit
pH	pH units	6.5–8.5
Oil and grease	mg/L	10
Total suspended solids	mg/L	50



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