CHAPTER 9 – HYDROLOGY AND GEOMORPHOLOGY

STANMORE ID EXTENSION PTY LTD

ISAAC DOWNS EXTENSION PROJECT

TABLE OF CONTENTS

Tables

Figures

9. HYDROLOGY AND GEOMORPHOLOGY

9.1 Introduction

This chapter describes the hydrology of the Project area and its surrounding environment, the potential for flooding under different rainfall events in the Project area, and assesses changes to hydrology and geomorphology because of Project infrastructure and landform changes during and post mining. The potential changes to the geomorphic characteristics of the Isaac River, Cherwell Creek and Conrock Gully were assessed for the mining and closure phases of the Project.

This chapter was developed using the Project's hydrologic and geomorphic assessments provided in **Appendix J**.

A diversion of Conrock Gully is proposed to facilitate the safe and efficient mining of the Project's coal resource. A functional design report was developed for the construction and operation of the Conrock Gully diversion and is provided in Appendix D of **Appendix J**.

9.2 Regulatory Framework

9.2.1 Environmental Protection Act 1994

The *Environmental Protection Act 1994* (EP Act) provides for environmental protection policies that establish the environmental values (EVs) which are to be protected, that include quality standards that are relevant to the water environment. The EVs of waterways in Queensland are protected under the EP Act and the subordinate *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (EPP Water).

To allow construction, operation and decommissioning, the Project will require approval of an environmental authority (EA) and a progressive rehabilitation and closure plan (PRCP) schedule, under the EP Act, from the Department of Environment, Tourism, Science and Innovation (DETSI). The EA will authorise the construction and operation of the Project's levees, Conrock Gully diversion and other infrastructure potentially interacting with waters. The PRCP schedule will specify the progressive rehabilitation and closure requirements for the Project's levees, Conrock Gully diversion and other infrastructure.

9.2.2 Environmental Protection Regulation 2019

The *Environmental Protection Regulation 2019* (EP Regulation) elaborates how the principles and objectives of the EP Act are to be implemented and enforced. The EP Regulation also defines the environmental objective and performance outcomes for Queensland's water environment, which are applicable to the Project's assessment and management of potential hydrologic and geomorphologic impacts.

9.2.3 Environmental Protection (Water and Wetland Biodiversity) Policy 2019

The EPP Water is the primary instrument for surface water management under the EP Act. The EPP Water governs discharge to land, surface water and groundwater, aims to protect the EVs, and sets water quality guidelines and objectives.

Under the EPP Water, the EVs and water quality objectives for the Project are specified in the Isaac River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Isaac River Sub-basin (including Connors River) (DEHP, 2011).

9.2.4 Water Act 2000

Under Section 97 and 98 of the *Water Act 2000* (Water Act), diversions associated with an EA (Section 97), or resource activity (Section 98) are approved through the EA process (Section 9.2.1), and therefore, a separate water licence is not required.

Under the Water Act, the defined watercourses in the vicinity of the Project are:

- Isaac River
- Cherwell Creek
- the downstream reach of Conrock Gully (the upstream reach is a defined drainage feature).

The *Water Plan (Fitzroy Basin) 2011* and Fitzroy Basin Resource Operations Plan 2014 (DNRM, 2015) outline the use of water within the basin under the Water Act. The plan defines the availability of water and provides a framework for sustainable management such as targets for environmental flow objectives and regulating the taking of overland flow. The Project falls within the Isaac River sub-basin area of the Fitzroy Basin Resources Operations Plan 2014 (DNRM, 2015).

The Project's activities in watercourses will be conducted in accordance with the riverine protection permit requirements if it cannot meet the Riverine protection permit exemption requirements (DRDMW, 2023).

9.2.5 Fisheries Act 1994

The *Fisheries Act 1994* (Fisheries Act) regulates waterway barrier works within declared watercourses, which may include certain watercourses and drainage features. Mapping for waterway barrier works classifies waterways based on their risk of impact to fish passage.

Conrock Gully (and its tributaries), Cherwell Creek and the Isaac River are mapped within the Queensland waterways for waterway barrier works layer, with classifications ranging between Green (low) and Purple (major). Conrock Gully within the Project disturbance boundary is classified as an Amber (moderate) waterway, and its tributaries classified as Green (low) waterways. Both the Isaac River and Cherwell Creek are classified as Purple (major) waterways. Approval under the Fisheries Act for waterway barrier works within waterways is not required for the Project as mining activities within a mining lease are exempt from the Fisheries Act. Nevertheless, where relevant, the Project's activities in waterways will be conducted in accordance with the Accepted development requirements for operational work that is constructing or raising waterway barrier works (DPI, 2025) (Waterway Barrier Works guideline).

9.2.6 Environmental Objectives and Performance Outcomes

The environmental objectives and performance outcomes, based on the EP Regulation and terms of reference (ToR) for the Project's EIS, that are relevant to the hydrologic and geomorphic assessment, are provided in Table 9-1 and Table 9-2. A corresponding EIS section reference is provided in these tables demonstrating how the Project meets these environmental objectives and performance outcomes.

Table 9-1 Environmental Objectives and Performance Outcomes - Hydrology and Geomorphology

Requirement	Environmental Objectives and Performance Outcomes	EIS Reference
EP Regulations Terms of Reference	The activity will be operated in a way that protects environmental values of waters.	9.3.3, 9.4, 9.5, 9.6, 9.7, 9.8, 9.9, **Chapter 8**
Performance Outcomes		

<table>
<tr><td colspan="2">1 There is no actual or potential discharge to waters of contaminants that may cause an adverse effect on an environmental value from the operation of the activity.</td><td>Chapter 8</td></tr>
<tr><td colspan="2">2 All of the following—
(a) the storage and handling of contaminants will include effective means of secondary containment to prevent or minimise releases to the environment from spillage or leaks;</td><td>Chapter 8</td></tr>
<tr><td colspan="2">(b) contingency measures will prevent or minimise adverse effects on the environment due to unplanned releases or discharges of contaminants to water;</td><td>Chapter 8</td></tr>
<tr><td colspan="2">(c) the activity will be managed so that stormwater contaminated by the activity that may cause an adverse effect on an environmental value will not leave the site without prior treatment;</td><td>Chapter 8</td></tr>
<tr><td colspan="2">(d) the disturbance of any acid sulfate soil, or potential acid sulfate soil, will be managed to prevent or minimise adverse effects on environmental values;</td><td>Section 7.3.21 of Chapter 7</td></tr>
<tr><td colspan="2">(e) acid producing rock will be managed to ensure that the production and release of acidic waste is prevented or minimised, including impacts during operation and after the environmental authority has been surrendered;</td><td>Sections 7.3.12, 7.4.3 and 7.5.3 of Chapter 7</td></tr>
<tr><td colspan="2">(f) any discharge to water or a watercourse or wetland will be managed so that there will be no adverse effects due to the altering of existing flow regimes for water or a watercourse or wetland;</td><td>9.4, 9.5, 9.6
Chapter 8
Chapter 12</td></tr>
<tr><td colspan="2">(g) for a petroleum activity, the activity will be managed in a way that is consistent with the coal seam gas water management policy, including the prioritisation hierarchy for managing and using coal seam gas water and the prioritisation hierarchy for managing saline waste;</td><td>Not applicable</td></tr>
<tr><td colspan="2">(h) the activity will be managed so that adverse effects on environmental values are prevented or minimised.</td><td>9.3.3, 9.4, 9.5, 9.6, 9.7, 9.9
Chapter 8</td></tr>
<tr><td colspan="3">Additional Environmental Objective</td></tr>
<tr><td rowspan="3">Terms of Reference</td><td>Equitable, sustainable and efficient use of water resources.</td><td>Chapter 8</td></tr>
<tr><td>Maintenance of the stability of beds and banks of watercourses.</td><td>9.4, 9.5, 9.6, 9.7, 9.9</td></tr>
<tr><td>Maintenance of environmental flows and water quality to support the long term condition and viability of terrestrial, riverine, wetland and lacustrine ecosystems.</td><td>9.4, 9.5, 9.6
Chapter 8
Section 11.5.3 of Chapter 11
Section 12.4 of Chapter 12
Section 10.6.3 of Chapter 10</td></tr>
</table>

	Maintenance of supply to existing users of surface and groundwater resources.	**Chapter 8** **Chapter 10**
	The construction and operation of the project aims to ensure that the risk and potential adverse impacts from flooding are avoided, minimised or mitigated to protect people, property and the environment.	9.4, 9.5, 9.6, 9.7, 9.8, 9.9

Table 9-2 Environmental Objectives and Performance Outcomes – Regulated Structures

Requirement	Environmental Objectives and Performance Outcomes	EIS Reference
EP Regulations Terms of Reference	The design of the facility permits the operation of the site, at which the activity is to be carried out, in accordance with best practice environmental management.	9.2.9, 9.8, 9.9.6 **Chapter 8**
Performance Outcome		
(b) regulated structures comply with the document called 'Manual for assessing consequence categories and hydraulic performance of structures', published by the department;		9.2.9, 9.8, 9.9.6 **Chapter 8**
Additional Environmental Objective		
Terms of Reference	The potential consequences of the failure of a regulated structure on human life and the environment require that the highest standards are used for their design, construction, operation, modification and decommissioning.	9.2.9, 9.8, 9.9.6 **Chapter 8**

9.2.7 EIS Information Guidelines

The assessment of the Project's impacts on water was undertaken in accordance with the Water—EIS information guideline (ESR/2020/5312) [1]). Table 9-3 outlines the applicable sections of the guideline that apply to hydrology and geomorphology and where they are addressed in this chapter.

Table 9-3 Water – EIS Information Guideline: Hydrology and Geomorphology

Guideline Section	Chapter Section
Surface water resources	9.3, 9.3.2
Alteration to flow of water	9.4, 9.5, 9.6, 9.7
Flooding	9.4, 9.5
Bank Stability and Riparian Vegetation	9.3.3.3, 9.5.4.3, 9.5.4.4, 9.6.2, 9.6.5, 9.9.4.2, 9.9.6.1.1, 9.9.6.2.3, 9.9.6.2.4
Voids	9.4.1, 9.4.8, 9.7.3, 9.9.3
Avoidance and Mitigation Measures	9.8, 9.9

[1] https://www.detsi.qld.gov.au/_global/policy-register/policy-register-pdf?getdoc=5312&name=eis-tm-water-information-guide.pdf

The assessment of the Project's impacts was undertaken in accordance with the last version of the Department of Primary Industries' DAF Environmental impact companion guide, which is currently under review. Table 9-4 outlines the applicable sections of the guideline that apply to hydrology and geomorphology and where they are addressed in this chapter.

Table 9-4 DAF EIS Companion Guide: Hydrology and Geomorphology

Guideline Section	Chapter Section
Planning and approvals	**Chapter 7**
Land Use	**Chapter 7**
Water – surface water	9.4, 9.5, 9.6, 9.9.5, **Chapter 8**
Water – groundwater	**Chapter 10**
Fisheries resources	**Chapter 12**, **Chapter 22**
Climate Change	9.7

The assessment of the Project's regulated structures was undertaken in accordance with the Regulated structures—EIS information guideline (ESR/2020/5307)[2]. Table 9-5 outlines the applicable sections of the guideline that apply to hydrology and geomorphology and where they are addressed in this chapter.

Table 9-5 Regulated structures—EIS Information Guideline: Hydrology and Geomorphology

Guideline Section	Chapter Section
Levees	9.3.3.3, 9.3.3, 9.4, 9.4.4, 9.8, 9.8.2.2, 9.9.6.1
Voids	9.4.1, 9.4.8, 9.7.3, 9.9.3

9.2.8 Diversions – Queensland Technical Guidelines

The 'Guideline: Works that interfere with water in a watercourse for a resource activity—watercourse diversions authorised under the *Water Act 2000* (DNRME, 2019)' (DNRME guideline) and the 'Bowen Basin River Diversions Design and Rehabilitation Criteria, Project C9068 Report for ACARP (Hardie and Lucas, 2002)' (ACARP guideline) provide the requirements for managing, designing, and constructing watercourse diversions for resource activities in Queensland. These guidelines are also designed to ensure diversions maintain geomorphic stability, ecological function, and water quality while minimising environmental harm, and are typically used for mining project approvals.

For the Project, these guidelines were used to develop a detailed functional design report for the Conrock Gully diversion (Appendix D of **Appendix J**) and to guide the hydrologic and geomorphic assessments of the Conrock Gully diversion.

9.2.9 Manual for Assessing Consequence Categories and Hydraulic Performance of Structures

This Manual for assessing hazard consequence and hydraulic performance of structures (DEHP, 2016) (Dam Manual) sets out the requirements of the administering authority, for consequence category assessment and certification of the design of 'regulated structures', constructed as part of environmentally relevant activities under the EP Act. The Dam Manual details the hydraulic design

2 https://www.detsi.qld.gov.au/_global/policy-register/policy-register-pdf?getdoc=5307&name=eis-tm-regulated-structures-information-guide.pdf

requirements for regulated structures and was used as a reference in the design of the levees associated with the Project.

9.3 Surface Water Drainage Network and Infrastructure

9.3.1 Drainage Networks

Section 8.3 of **Chapter 8** describes the regional and local drainage networks relevant for the Project. This includes a description and mapping of the catchments; information on the Isaac River, Cherwell Creek, Conrock Gully and JB Gully; and streamflow data for watercourses and creeks.

9.3.2 Existing Surface Water Infrastructure

9.3.2.1 Overview

The reach of the Isaac River in the vicinity of the Project contains a number of existing and approved mining and transport infrastructure projects. Many of the major infrastructure projects in this reach of the Isaac River maintain surface water infrastructure to manage flows from Isaac River and local creeks. Key major infrastructure projects in the vicinity of the Project, and relevant to the existing or approved surface water drainage network include the following:

- Isaac Downs Mine (IDM) landform and levee
- Poitrel Mine levees
- Winchester South Project levees
- Peak Downs Highway bridge
- Goonyella Railway bridge.

The locality of the relevant surface water infrastructure features in the vicinity of the Project is shown in Figure 9-1, with descriptions provided in the following sections.

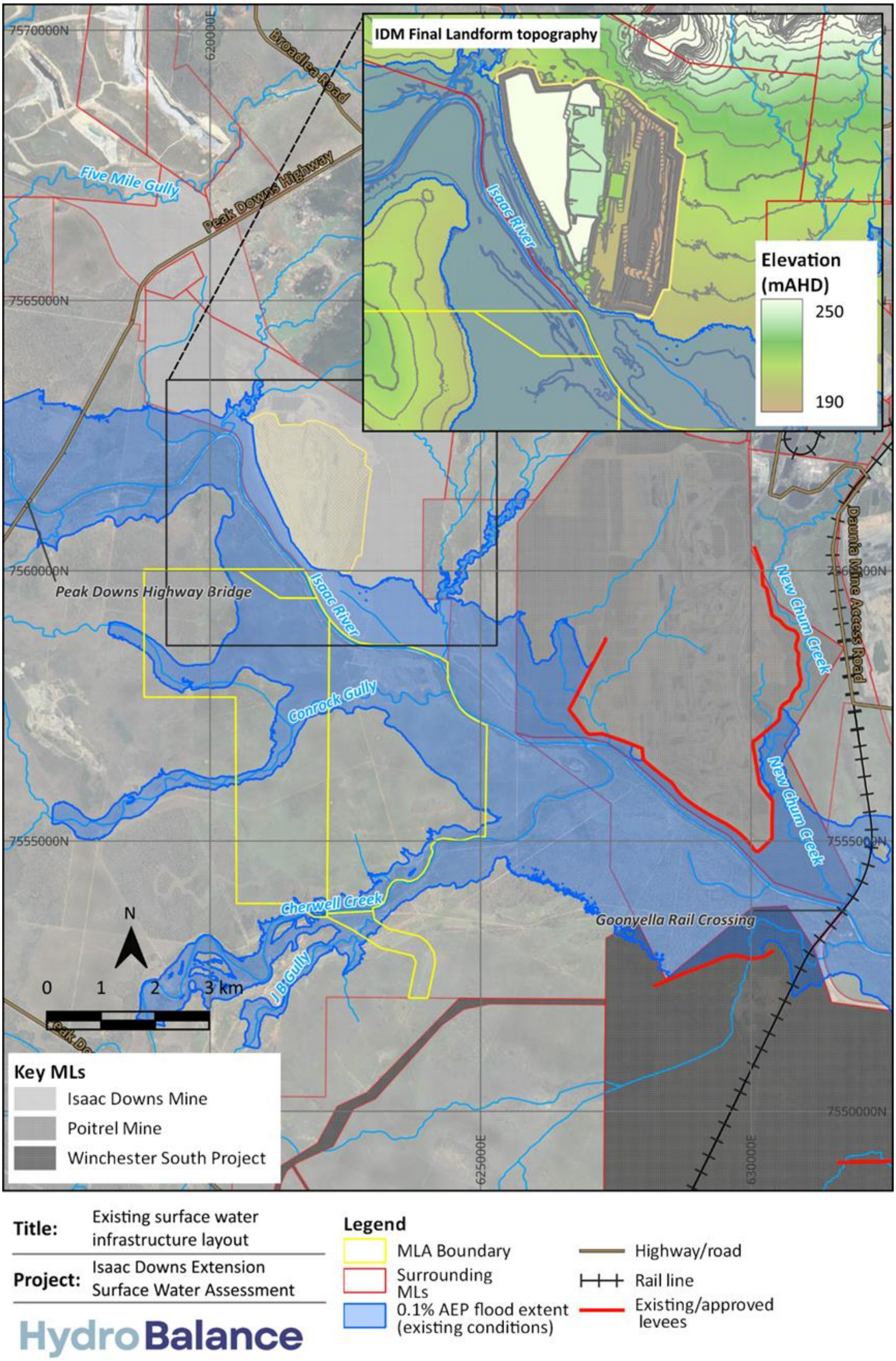


Figure 9-1 Layout of Existing and Approved Surface Water Infrastructure

9.3.2.2 Isaac Downs Mine

IDM adjoins the Project area, with mining operations predominantly north of the Project's planned mining activities.

The IDM flood levee protects the IDM mining pit from Isaac River flood events. The IDM flood levee is located between the Isaac River and the IDM pit on the southwestern side of IDM and spans a distance of about 5 km. The existing levee has a height of up to 8 m from natural surface. The engineered structure designed is situated above the 0.1% annual exceedance probability (AEP) flood event plus 0.7 m of freeboard. The existing levee is planned to be decommissioned following the end of mining at IDM, which is expected to occur prior to the commencement of mining operations within the floodplain at the Project. Therefore, the IDM flood levee is not included in the 'existing conditions' relative to the mining and post-closure phases of the Project.

The approved IDM final landform will be completed prior to the decommissioning of the IDM flood levee. The proposed IDM final landform configuration is shown in Figure 9-1. IDM's final landform comprises a single void and a rehabilitated dump structure bounding the southern and western edges of the void. The dump structure spans about 3.8 km adjacent to the Isaac River and will prevent Isaac River flood waters from entering the IDM final void for at least a 0.1% AEP flood event. The IDM final landform will be in place, with the operational flood levee decommissioned, during the mining and post-closure phases of the Project.

9.3.2.3 Poitrel Mine

Poitrel mine is an open-cut coal mine owned and operated by Stanmore, located approximately 2 km downstream of the Project.

A 3.5 km diversion of New Chum Creek was constructed and is operating in the vicinity of the eastern out-of-pit waste rock dump. A levee bank was constructed along the south-western and southern boundaries of the mine to protect mining operations from flooding up to the 0.1% AEP flood event, plus freeboard. A portion of the levee will run parallel to the New Chum Creek diversion to the east and the remaining portion of the diversion will run parallel to the Isaac River to the south.

The location of the Poitrel Mine levee is shown in Figure 9-1. The Poitrel Mine levees will remain in place during the Project's mining and post-closure phases, and therefore, are included in the Project's flood modelling assessment.

9.3.2.4 Winchester South Project

The Winchester South project is located approximately 8 km downstream of the Project, adjacent to the Isaac River. The Winchester South project involves the future development of an open cut metallurgical coal mine.

Flood levees are proposed for the Winchester South project to prevent flood events from the Isaac River entering the planned open cut pits and negative impacts to the mine's water management system. The location of the Winchester South project's approved levees is shown in Figure 9-1.

The planned levees adjacent the Isaac River will be regulated structures designed with a crest level above the 0.1% AEP flood event plus freeboard. The levees are assumed to be constructed by the start of operations at the Project. The mine life of the Winchester South project is longer than the Project mine life, and therefore, the levees are also expected to be operational during the Project's mining operations and in the early stages of the Project's post-closure period.

A flood model for the Winchester South project was developed as part of that project's surface water and flooding assessment (WRM, 2022). The changes to the flood regime (i.e. levels) due to the Winchester South project are largely limited within that project's mining lease application (MLA) area, with a minor excursion of 360 m to the north of the northern levee, as shown in Figure 9-1.

The Winchester South project levees will remain in place during the Project's mining and post-closure phases, and therefore, are included in the Project's flood modelling assessment.

9.3.2.5 Roads and Rail Bridges

There are two major existing Isaac River crossings in the vicinity of the Project:

- Peak Downs Highway bridge, located 7.3 km upstream of the Project site
- Goonyella Railway bridge, located 7.8 km downstream of the Project site.

The locations of the existing crossings are shown in Figure 9-1. Details of the existing crossing configurations and layouts are provided in Section B.6 within Appendix B of **Appendix J**.

9.3.3 Proposed Surface Water Infrastructure

9.3.3.1 Overview

The proposed Project infrastructure that will interact with flows in local watercourses and drainage features includes:

- a diversion of Conrock Gully with associated levee plug
- a levee along the Isaac River
- a levee plug along a section of backwater flow from Cherwell Creek
- a bridge crossing of the Isaac River for the Project's primary access via IDM
- a bridge crossing of Cherwell Creek for the Project's secondary access to the Eagle Downs project
- a temporary dragline crossing of the Isaac River
- a bed-level crossing of JB Gully along the secondary access road to the Eagle Downs project.

The proposed infrastructure is designed to allow the safe and efficient operation of the Project, while minimising potential impacts on the receiving environment and sensitive ecological receptors.

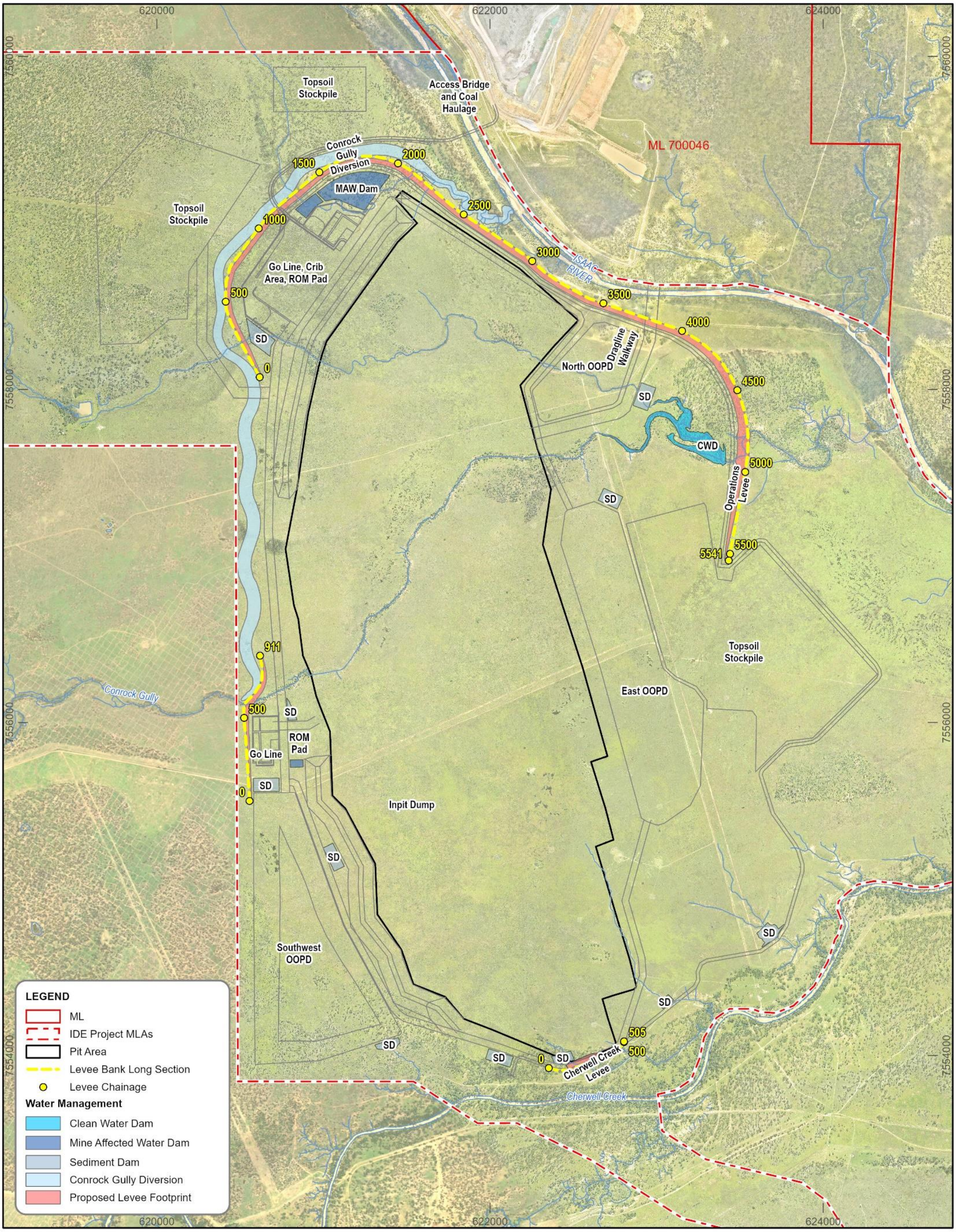
The layout of the Project's key surface water infrastructure elements is presented in Figure 9-2.

9.3.3.2 Conrock Gully Diversion

A diversion of Conrock Gully is proposed to facilitate safe and efficient access to mine the coal resource extending under Conrock Gully within the Project's mining area.

Conrock Gully's planned diversion and diverted reach are approximately 5.2 km long and 5.8 km long, respectively. The channel slope of the planned diversion and the diverted reach is approximately 0.147% to 0.140% in the upstream reaches of the channel. The planned diversion is marginally steeper than the diverted reach in the downstream section where the channel rejoins the Isaac River due to the topography at the proposed diversion outlet/confluence location (i.e. 0.341% compared to 0.330%).

Table 4.1 of **Appendix J** provides a detailed comparison of the geomorphic characteristics of the existing gully and proposed diversion.



0 200 400 600 800 1000

Metres

Datum:	GDA2020 Zone 55
Scale:	See Scale Bar
Date:	22/05/2026 12:57 PM
Drawn:	Minserve
Source:	Minserve/Stanmore
File:	20260414 Proposed Water Infrastructure.aprx

stanmore

ISAAC DOWNS EXTENSION

Proposed Surface Water Infrastructure Layout

Figure | 9-2

The Conrock Gully diversion cross-section includes the following key components:

- 1.7 m deep main channel, which will convey 50% AEP local creek flows.
- 0.5 m deep overbank channel, which will convey 2% AEP local creek flows.
- Variable batter back to natural topography, which may contain local creek events rarer than the 50% AEP local creek flows.

The diversion, particularly in its lower reaches, would not contain regional Isaac River flood flows for the majority of design events, which is typical of local creeks joining the Isaac River in the area. The Isaac River levee will protect flood flows from mining operations.

The proposed diversion channel geometry is shown in Figure 4.1 of **Appendix J**. Section 4.12.3 of **Chapter 4** provides further details on the Conrock Gully diversion.

Conrock Gully's proposed diversion design balances matching the typical cross-section of the existing channel, which has relatively gradual overbank slopes, against minimising the diversion footprint.

A geomorphic assessment of the Conrock Gully diversion is provided in Appendix D of **Appendix J**, with findings summarised in Section 9.9.4.4.

9.3.3.3 Project Levees

The following levees are planned for the Project to protect mining operations from local and regional flooding:

- Isaac River levee: A 5.9 km long levee will provide immunity from regional Isaac River flood events and is located at the northern and eastern edges of the mine disturbance area.
- Cherwell Creek levee plug: A 0.5 km levee will be required along Cherwell Creek to prevent ingress of floodwaters into the southern portion of the mine pit during mining operations.
- Conrock Gully levee plug: A 0.9 km levee will be required at the upstream end of the diversion to prevent flows continuing to traverse the former Conrock Gully channel.

All levees will be designed with sufficient height to provide immunity from the 0.1% AEP (1 in 1,000 average recurrence interval (ARI)) local and regional design flood events. Section 4.12 of **Chapter 4** provides further operational details on the Project's levee and levee plugs. Section 4.3 of **Appendix J** also provides details on the Project's levee and levee plugs.

Detailed levee designs will be undertaken following approval of the Project and may include cut-off trenches beneath the levee and erosion protection, such as rock armouring, clay cut-off and capping of the levee crest, and revegetation of the non-armoured batter slopes with suitable grass species.

Preliminary Consequence Category Assessments were undertaken for the Project's levee and levee plugs in accordance with DEHP (2016), and is provided in Section 9.8.

9.3.3.4 Waterway Crossings

The Project requires waterway crossings in the form of either bridges or bed-level crossings to facilitate primary and secondary site access, the transport of RoM coal to Isaac Plains Mine (IPM) for processing, and the relocation of IDM's dragline to the Project site. Sections 4.14.3, 4.14.4 and 4.14.5 of **Chapter 4** provide greater detail on the Project's planned waterway crossings. Section 4.4 of **Appendix J** also provides details on the Project's waterway crossings.

In summary, the waterway crossings proposed for the Project are as follows:

- Isaac River bridge: Primary access infrastructure that links the Project to IDM, and spans the Isaac River channel.
- Cherwell Creek bridge: Secondary access infrastructure that links the Project to the Eagle Downs project, and spans the Cherwell Creek channel.

- Conrock Gully diversion crossing: Crossing of the Conrock Gully diversion channel is required to facilitate the primary access route from the Project to IDM.
- JB Gully bed-level crossing: A bed-level crossing of the JB Gully channel is required to facilitate the Project's secondary access route.
- Temporary dragline crossing: A temporary bed-level crossing of the Isaac River is required to walk the dragline from IDM to the Project prior to mining, and from the Project to IDM post mining.

9.4 Flood Modelling Assessment

9.4.1 Overview

A TUFLOW hydraulic model was used to assess the impacts of the Project on Isaac River, Cherwell Creek and Conrock Gully flooding for a range of design flood events. The development of the hydrological and hydraulic models is documented in Appendix A and Appendix B, respectively, of **Appendix J**. The following development scenario/event combinations were modelled for the Project:

- Existing (approved) conditions:
    - 50%, 10%, 2%, 1% and 0.1% AEP.
- Developed (operational) conditions:
    - 50%, 10%, 2%, 1% and 0.1% AEP.
- Post-closure (final landform) conditions:
    - 1% AEP, 0.1% AEP and probable maximum flood (PMF).

The existing conditions represent the approved conditions prior to the commencement of construction and operation of the Project, and includes the surface water infrastructure described in Section 9.3.2.

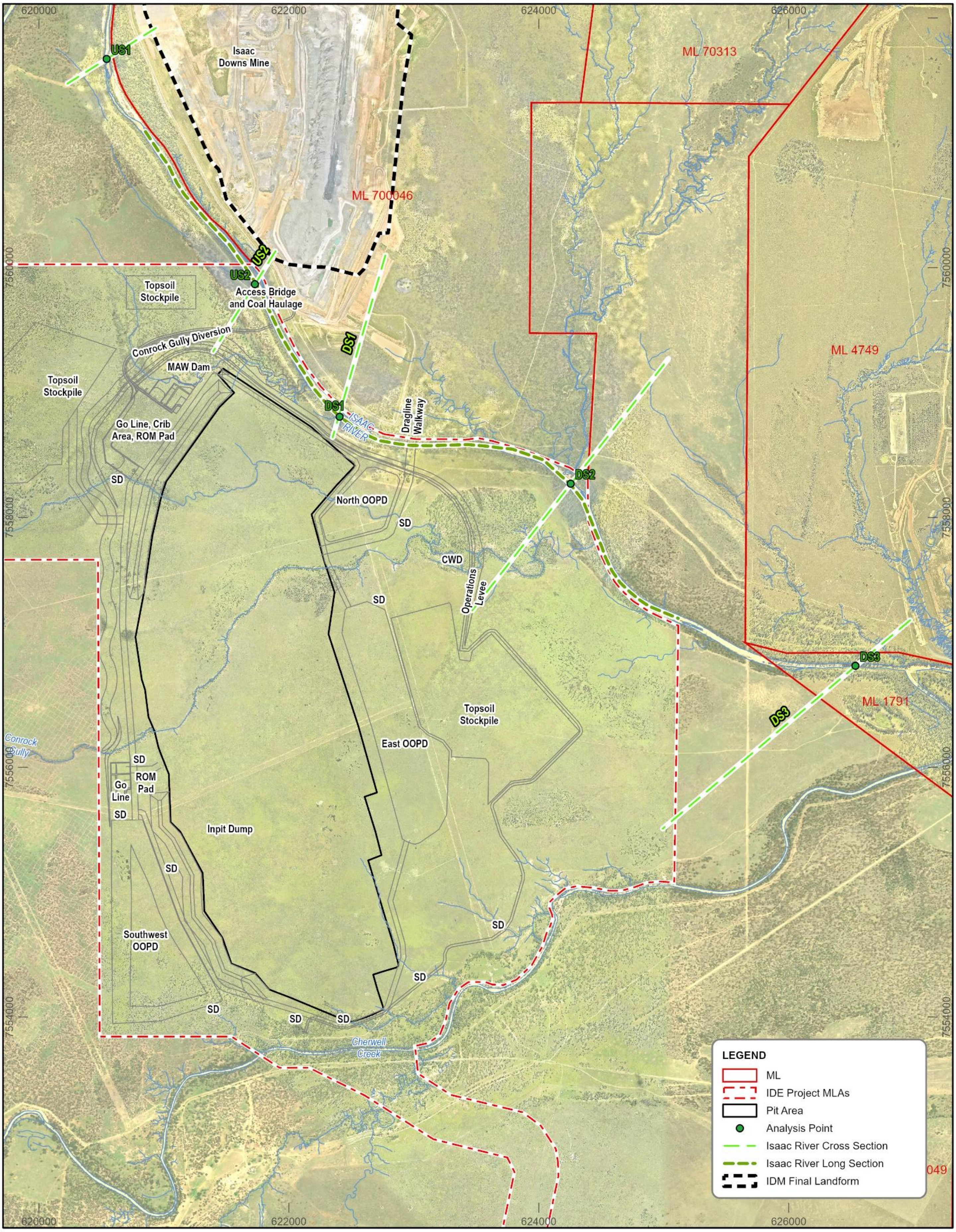
The developed conditions include the proposed water management structures for the Project as described in Section 9.3.3.

The layout of the Project's post-closure landform is shown in **Chapter 5**. The Conrock Gully diversion will remain post-closure. However, the levees will be decommissioned and rehabilitated as they are not required for final void protection because the void is not located within a 0.1% AEP floodplain. The raised haul road located at the upstream end of the Conrock Gully diversion would be rehabilitated, stabilised and incorporated into the final landform dump structure, effectively replacing the functionality of the Conrock Gully levee plug. The Project's final landform includes backfilling of the northern section of the pit to natural topographical levels and rehabilitated overburden dumps.

In the absence of agreement by a third party for retention of infrastructure, bridge and crossing infrastructure will be decommissioned and rehabilitated as part of the final landform.

For the Project's flood impact assessment, the modelled existing conditions flood levels and velocities were subtracted from the flood levels and velocities modelled under the developed and post-closure scenarios. Therefore, a 'positive value' of impact represents an increase in the relevant hydraulic parameter (e.g. level, velocity), and conversely, a 'negative value' of impact represents a reduction in the relevant hydraulic parameter.

The key reporting locations for the Project's flood modelling assessment are presented in Figure 9-3, which includes a long section along the Isaac River (6,000 m) and five cross sections through the Isaac River and surrounding floodplain upstream (US1 and US2), and adjacent and downstream (DS1, DS2, DS3) from the Project.



0 200 400 600 800 1000

Metres

Datum:	GDA2020 Zone 55
Scale:	See Scale Bar
Date:	22/05/2026 12:52 PM
Drawn:	Minserve
Source:	Minserve/Stanmore
File:	20260522 Reporting Locations.aprx

DISCLAIMER: Third party data sources are used in this map compilation. Minserve makes no warranty regarding this data's accuracy or currency.

stanmore

ISAAC DOWNS EXTENSION

Key Reporting Locations for Flood Modelling Assessment

Figure | 9-3

9.4.2 Existing Conditions

Modelled 1% AEP and 0.1% AEP flood depths and extents for the existing conditions scenario are shown in Figure 9-4 and Figure 9-5, respectively. Modelled flood velocities for the existing conditions for the 1% AEP and 0.1% AEP flood events are shown in Figure 9-6 and Figure 9-7, respectively.

In summary, the modelled existing Isaac River flood depths and velocities show the following characteristics:

- A perched overbank channel runs along the west bank of the Isaac River from upstream of US1 to immediately upstream of DS1.
- The width of the Isaac River floodplain ranges been 700 m at US1 upstream of the Project to 2,500 m at DS2 downstream of the Project.
- For the 1% AEP depths and velocities:
    - The maximum flood depths in the Isaac River channel adjacent to the Project typically ranges between 11 m to 12 m.
    - The western floodplain depths vary in the vicinity of the Project, with the perched overbank channel experiencing depths up to 4 m to 5 m and the depths in the flatter regions of the floodplain ranging from 1.0 m to 1.5 m.
    - The depths in the eastern floodplain adjacent to the Project range between 1.8 m to 2.2 m.
    - The maximum flood velocities in the Isaac River main channel in the vicinity of Project range between 2 m/s to 2.5 m/s. The floodplain velocities generally remain below 1 m/s, aside from the western perched overbank channel, where velocities may reach up to 2 m/s.
- For the 0.1% AEP depths and velocities:
    - The maximum flood depths in Isaac River channel adjacent to the Project typically ranges between 13 m to 14 m.
    - The western floodplain depths vary in the vicinity of the Project, with the perched overbank channel experiencing depths up to 5 m to 6 m and the depths in the flatter regions of the floodplain ranging from 1.5 m to 2.5 m.
    - The depths in the eastern floodplain adjacent to the Project range between 3 m to 4 m.
    - The maximum flood velocities in the Isaac River main channel in the vicinity of Project range between 2.5 m/s to 3.0 m/s. The floodplain velocities generally remain below 1.5 m/s, aside from the western perched overbank channel, where velocities may reach up to 2.4 m/s.
    - The IDM final void will not be encroached by the 0.1% AEP Isaac River flood.

In summary, the modelled existing Cherwell Creek flood depths and velocities show the following characteristics:

- A number of minor breakout channels occur along Cherwell Creek, particularly along the southern bank and in the reach downstream of the JB Gully confluence. The number of breakout channels increases during the 0.1% AEP flood event and rarer, suggesting that the Cherwell Creek main channel generally has a conveyance capacity of equivalent to the 1% AEP flood event.
- Cherwell Creek is generally well confined during the 1% AEP flood event. The Cherwell Creek floodplain width during the 0.1% AEP flood event ranges between 600 m to 1,000 m.
- Cherwell Creek is impacted by the Isaac River flood, with river backwater flowing 3.0 km into Cherwell Creek during major flood events (1% AEP and 0.1% AEP).
- The JB Gully channel is poorly defined in comparison to Cherwell Creek. JB Gully is impacted by Cherwell Creek flood backwater.
- For the 1% AEP depths and velocities:

  - The non-backwater affected reaches of Cherwell Creek in the vicinity of the Project generally range between 6 m to 8 m.
  - The non-backwater affected reaches of Cherwell Creek in the vicinity of the Project generally range between 2.0 m/s and 3.0 m/s.
- For the 0.1% AEP depths and velocities:
  - The non-backwater affected reaches of Cherwell Creek in the vicinity of the Project generally range between 8 m to 12 m deep.
  - The non-backwater affected reaches of Cherwell Creek in the vicinity of the Project generally range between 2.5 m/s and 4.0 m/s.

In summary, the modelled existing Conrock Gully flood depths and velocities show the following characteristics:

- The Conrock Gully floodplain width ranges between 150 m and 300 m in the vicinity of the Project.
- Conrock Gully is impacted by the Isaac River flood, with river backwater flowing 2.5 km to 3.5 km into Conrock Gully during major flood events (1% AEP and 0.1% AEP).
- The flood behaviour in Conrock Gully does not change significantly between the 1% AEP and 0.1% AEP flood events.
- The depth in non-backwater affected reaches of Conrock Gully in the vicinity of the Project generally range between 1.0 m to 2.0 m in the upstream reach and 2.0 m to 3.5 m in the downstream reach.
- The velocity in non-backwater affected reaches of Conrock Gully in the vicinity of the Project generally ranges between 1.0 m/s and 3.0 m/s.

In addition, mapping of 50% AEP, 10% AEP, 2% AEP and PMF results of the flood modelling for existing conditions are presented in Appendix C of **Appendix J**.

9.4.3 Developed Conditions

Modelled 1% AEP and 0.1% AEP flood depths and extents for the developed conditions scenario are shown in Figure 5.7 and Figure 5.8, respectively, of **Appendix J**. Modelled flood velocities for the developed conditions for the 1% AEP and 0.1% AEP flood events are shown in Figure 5.9 and Figure 5.10, respectively, of **Appendix J**.

In summary, the modelled developed Isaac River flood depths and velocities show the following characteristics:

- The Isaac River floodplain is partially reduced around US2, between the proposed Project Isaac River levee and the IDM final landform. The width of the Isaac River floodplain in this location is less than 900 m. The proposed levee, along the western bank of the Isaac River interacts with Isaac River floodwaters to around DS2.
- The proposed Isaac River levee has sufficient height to provide flood immunity to the Project's operational pit area and other mine infrastructure for a 0.1% AEP flood event.
- Infrastructure associated with the haul road bridge crossing of the Isaac River will interact with flood waters. The topsoil stockpiles have been located so that they are almost entirely outside the 1% AEP flood event, with flexibility to modify the locations of these stockpiles during operations and as topsoil is recycled for use in rehabilitation.
- For the 1% AEP depths and velocities:
  - The maximum flood depths in the Isaac River channel adjacent to the Project are typically greater than 12 m.
  - The depths in the western perched overbank channel range between 4 m to 5 m and the depths in the flatter regions of the western floodplain upstream of the proposed levee range between 1 m to 2 m.
  - The eastern floodplain depths range between 2.0 m to 2.6 m.

    - The maximum flood velocities in the Isaac River main channel in the vicinity of Project range between 1.8 m/s to 2.4 m/s. The western floodplain velocities upstream of the proposed levee generally remain below 1.0 m/s, aside from the perched overbank channel, where velocities may reach up to 1.8 m/s. The velocities in the eastern floodplain generally remain below 1.0 m/s.
- For the 0.1% AEP depths and velocities:
    - The maximum flood depths in Isaac River adjacent to the Project are typically greater than 13 m.
    - The depths in western perched overbank channel range between 5 m to 7 m and the depths in the flatter regions of the western floodplain upstream of the proposed levee range between 2.5 m to 3.5 m.
    - The eastern floodplain depths range between 3 m to 4 m.
    - The maximum flood velocities in the Isaac River main channel in the vicinity of Project range between 2.2 m/s to 3.0 m/s. The western floodplain velocities upstream of the proposed levee generally remain below 1.3 m/s, aside from the perched overbank channel, where velocities may reach up to 2 m/s. The velocities in the eastern floodplain generally remain below 1.8 m/s.

In summary, the modelled developed Cherwell Creek flood depths and velocities show the following characteristics:

- There is no interaction between the Project operations and infrastructure, other than the secondary access road and bridge crossing, for the 1% AEP flood event, and only minor interaction between the northern floodplain and the proposed Cherwell Creek levee plug during a 0.1% AEP flood event.
- The Cherwell Creek flood depths and velocities for the developed conditions are generally similar to the existing conditions levels.

In summary, the modelled developed Conrock Gully flood depths and velocities show the following characteristics:

- The proposed drainage infrastructure, including the Conrock Gully diversion and levee plug, and Isaac River levee, have sufficient capacity to convey the 0.1% AEP flood event.
- For the 1% AEP depths and velocities:
    - The depths in Conrock Gully upstream of the diversion generally range between 1 m in the upper reaches to 4 m as it meets the diversion.
    - The depths in the Conrock Gully diversion generally range between 4 m and 6 m.
    - The velocities in Conrock Gully upstream of the diversion generally range between 0.6 m/s and 2.2 m/s.
    - The velocities in the Conrock Gully diversion generally range between 1.0 m/s and 2.0 m/s.
- For the 0.1% AEP depths and velocities:
    - The depths in the Conrock Gully upstream of the diversion generally range between 1 m in the upper reaches to 5 m as it meets the diversion.
    - The depths in the Conrock Gully diversion generally range between 4 m and 8 m.
    - The velocities in the Conrock Gully upstream of the diversion generally range between 1.0 m/s and 2.5 m/s.
    - The velocities in the Conrock Gully diversion generally range between 1.3 m/s and 2.5 m/s.

In addition, mapping of 50% AEP, 10% AEP and 2% AEP results of the Project's flood modelling for developed conditions are presented in Appendix C of **Appendix J**.

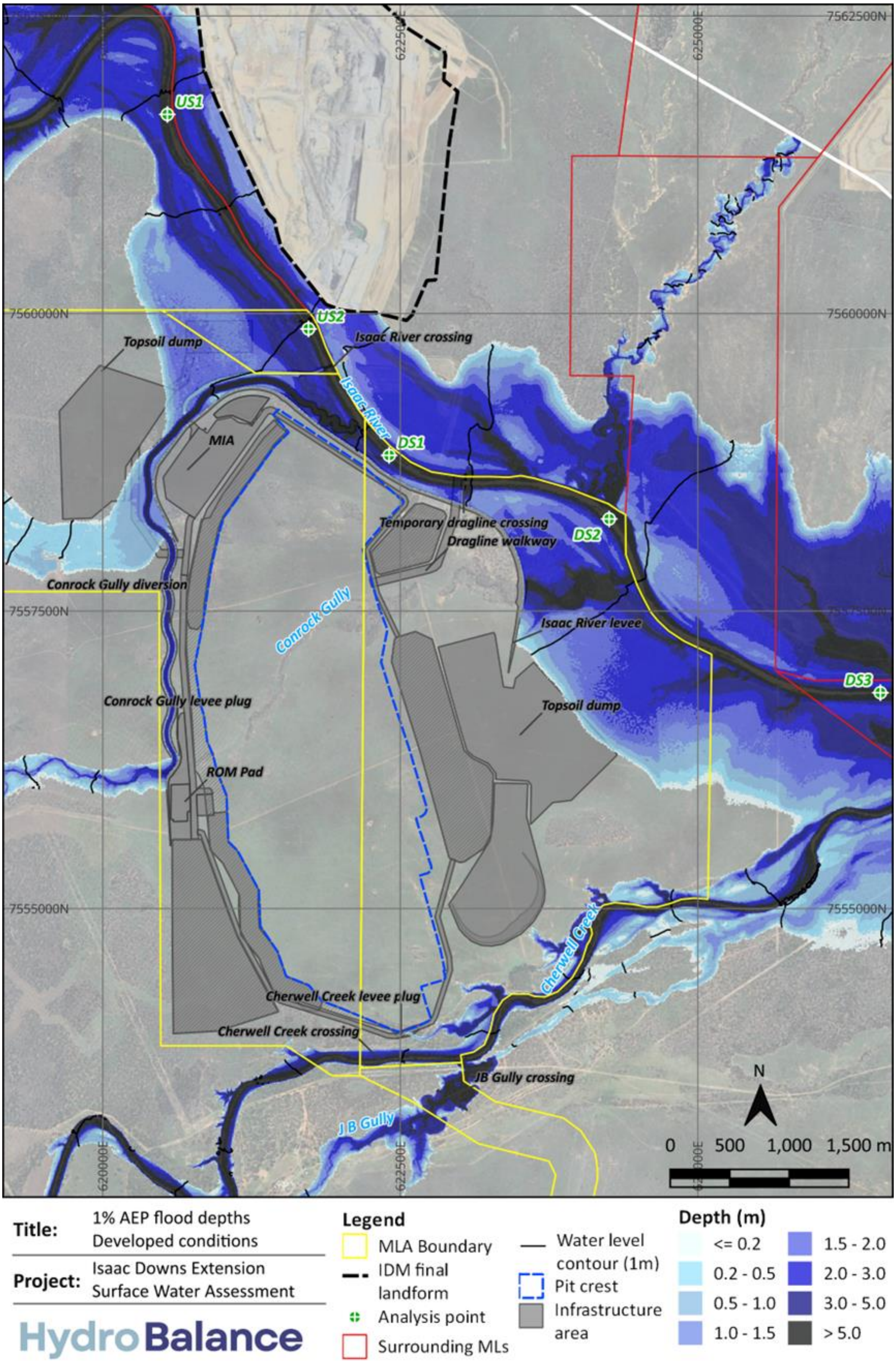


Figure 9-4 Developed Conditions – 1% AEP Flood Depths and Heights

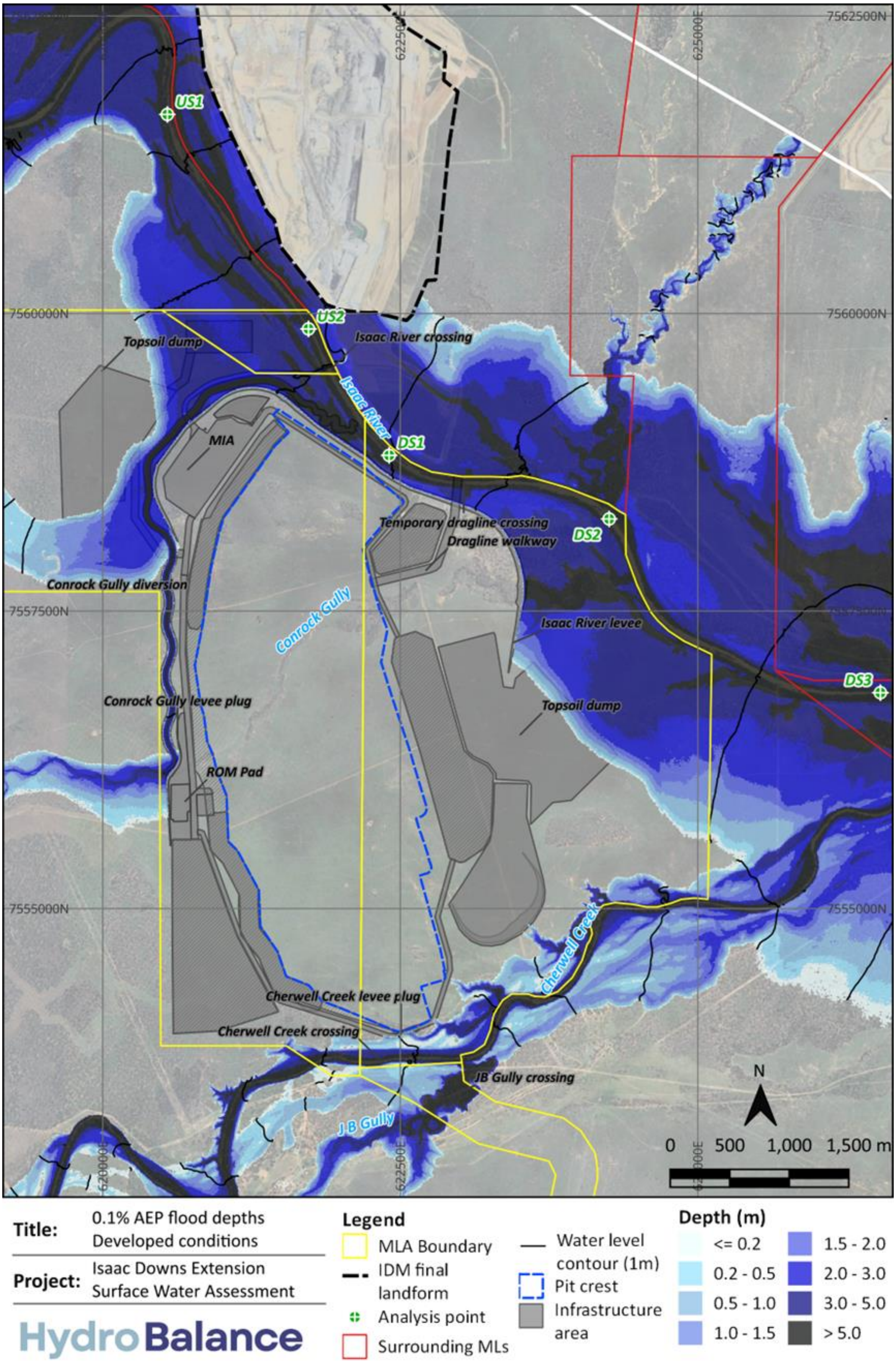


Figure 9-5 Developed Conditions – 0.1% AEP Flood Depths and Heights

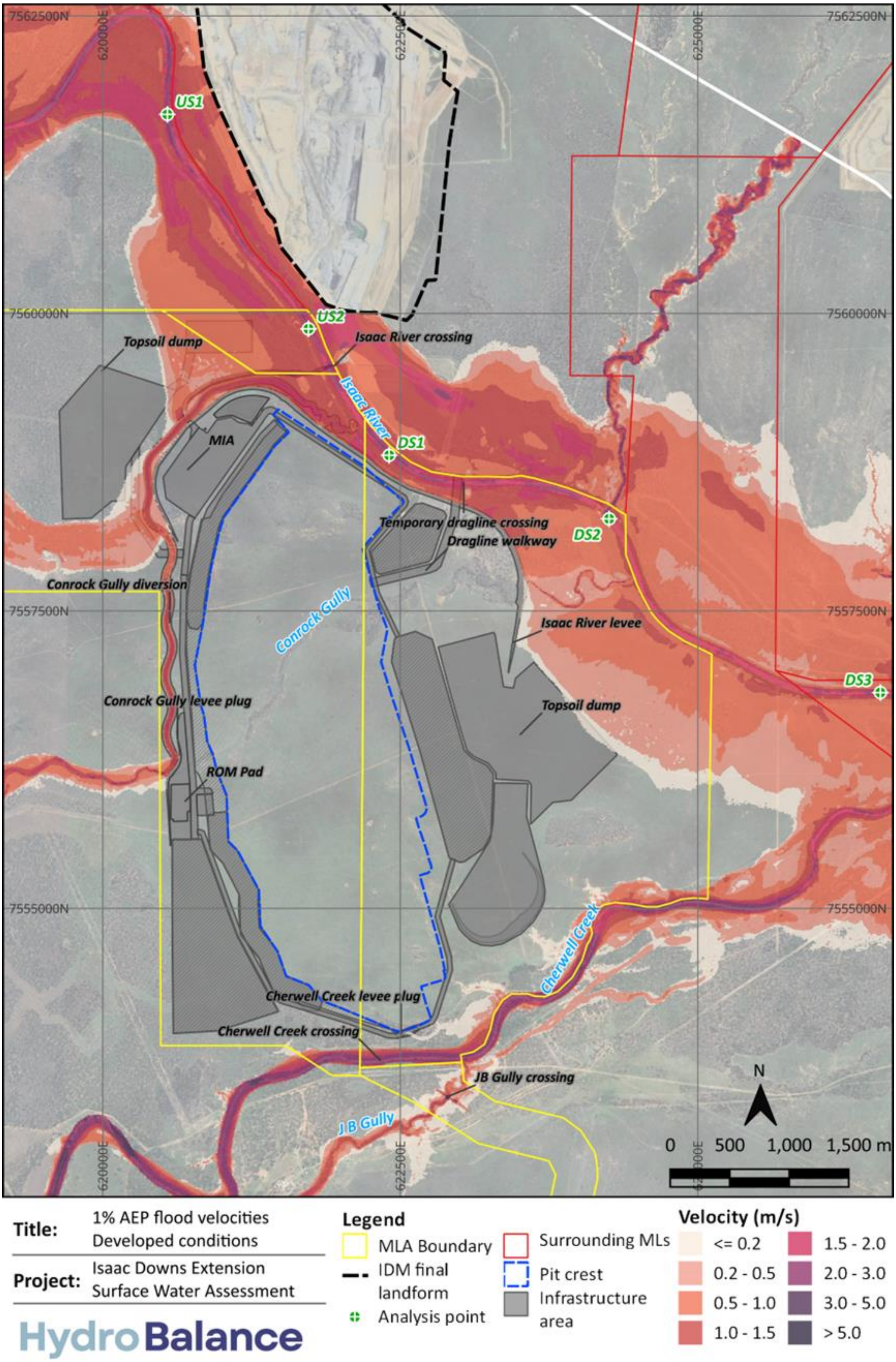


Figure 9-6 Developed Conditions – 1% AEP Flood Velocity

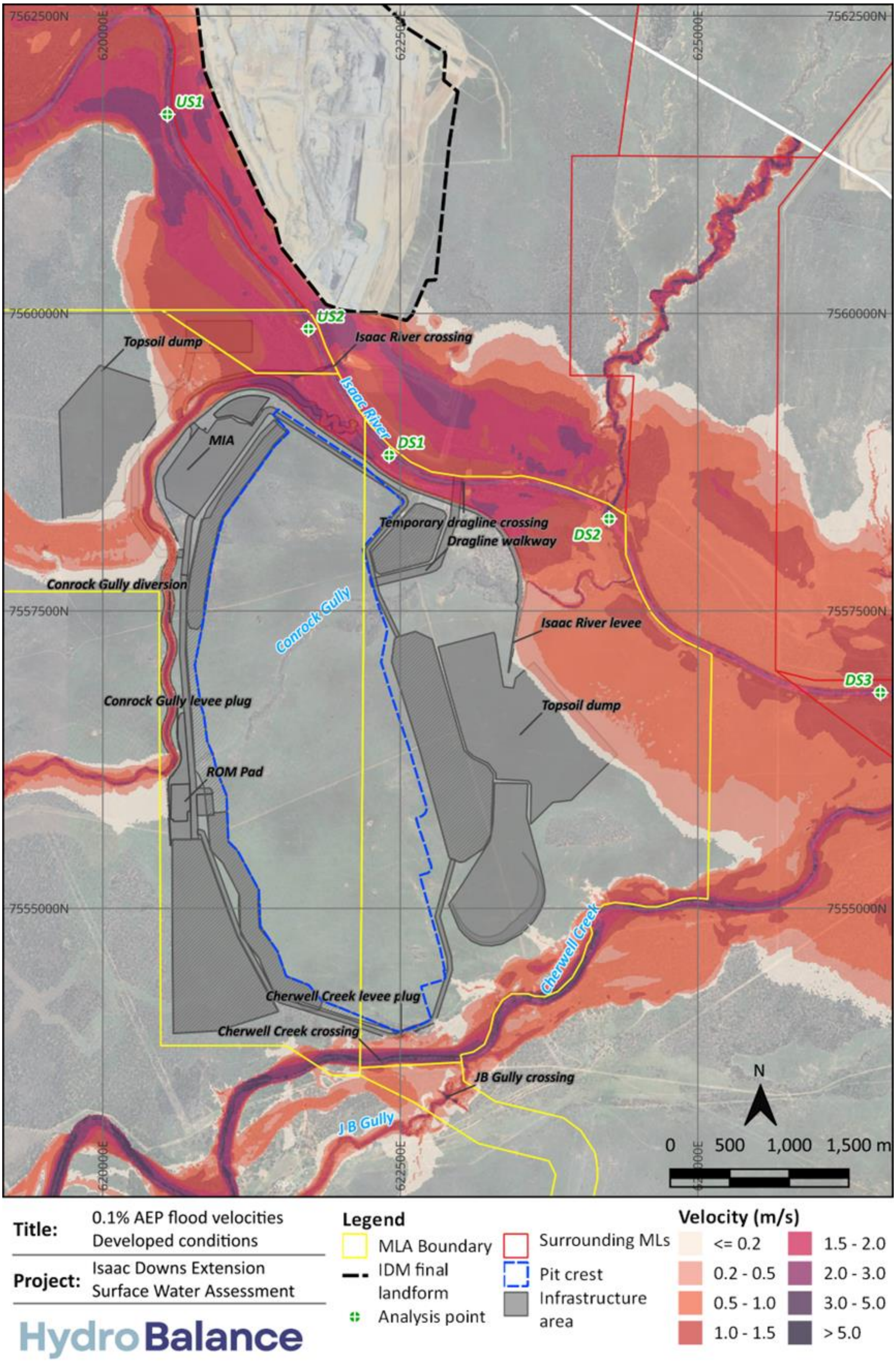


Figure 9-7 Developed Conditions – 0.1% AEP Flood Velocity

9.4.4 Developed Conditions – Levee Water Levels and Velocities Impact Assessment

The locations and chainages along the following proposed levees are presented in Figure 9-2:

- Isaac River levee
- Cherwell Creek levee plug
- Conrock Gully levee plug.

Figure 9-8, Figure 9-9 and Figure 9-10 show proposed levee heights and 0.1% AEP water levels for the Isaac River levee, Cherwell Creek levee plug and the Conrock Gully levee plug, respectively. These figures shows that the 0.1% AEP water levels along the proposed levees do not overtop the levee crests and will maintain a freeboard of at least 300 mm along the length of all levees and plugs. Consequently, the Project's mining operations, including dams, will be protected from a 0.1% AEP flood event by the Project's planned levee and levee plugs.

Figure 9-8, Figure 9-9 and Figure 9-10 also show the modelled 0.1% AEP, 1% AEP and 10% AEP velocities for the respective levees / plugs.

In terms of potential impacts, the following results are described:

- In relation to the Isaac River levee:
  - The 1% AEP and 10% AEP velocities are consistently less than 1.7 m/s, and therefore, are unlikely to cause scour if the levee is fully vegetated.
  - For the 0.1% AEP, the highest risk of scour occurs in the centre of the levee, which is closest to the Isaac River. Rock protection could be implemented between chainage 1,700 m and 4,200 m, if required, equating to a 2.5 km rock protected section. However, the occurrence of the 0.1% AEP flood event, by definition, is highly infrequent and scour is not expected to occur for a vegetated levee for events more frequent than the 0.1% AEP. The remaining sections of the levee would experience velocities less than 1.7 m/s during the 0.1% AEP, and therefore, are unlikely to cause scour if these sections are fully vegetated.
- In relation to the Cherwell Creek levee plug:
  - The 0.1% AEP, 1% AEP and 10% AEP velocities are consistently less than 1.7 m/s, and therefore, are unlikely to cause scour if the levee is fully vegetated.
- In relation to the Conrock Gully levee plug
  - The 0.1% AEP, 1% AEP and 10% AEP velocities are consistently less than 1.7 m/s, with the exception of a small section at chainage 590 m for the 0.1% AEP flood event, where velocities may reach up to 2.1 m/s. Rock protection may be applied in this section if required. Velocities along the remainder of the levee are unlikely to cause scour if the levee plug is fully vegetated.

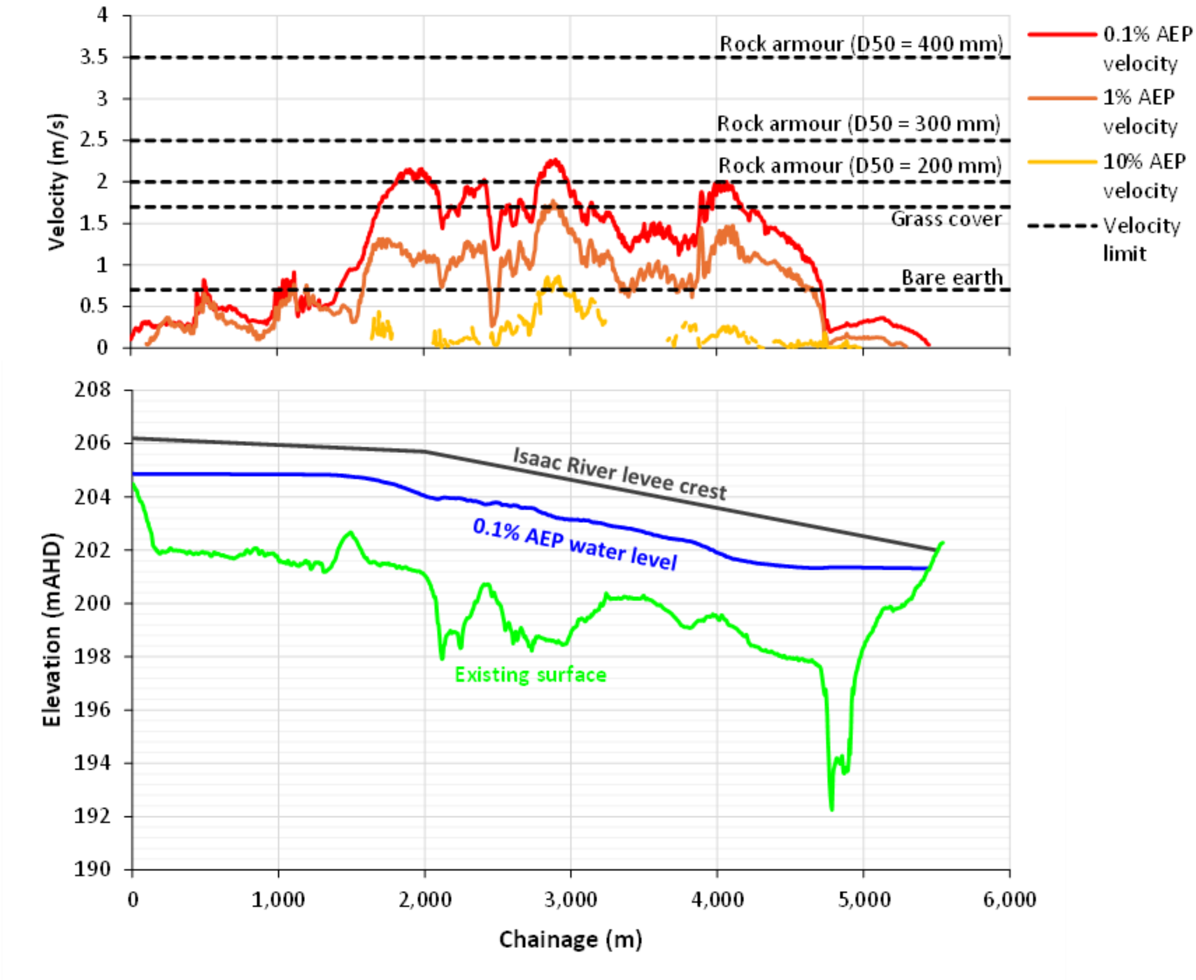


Figure 9-8 Isaac River Levee - Long Section - 0.1% AEP Water Levels and Velocities

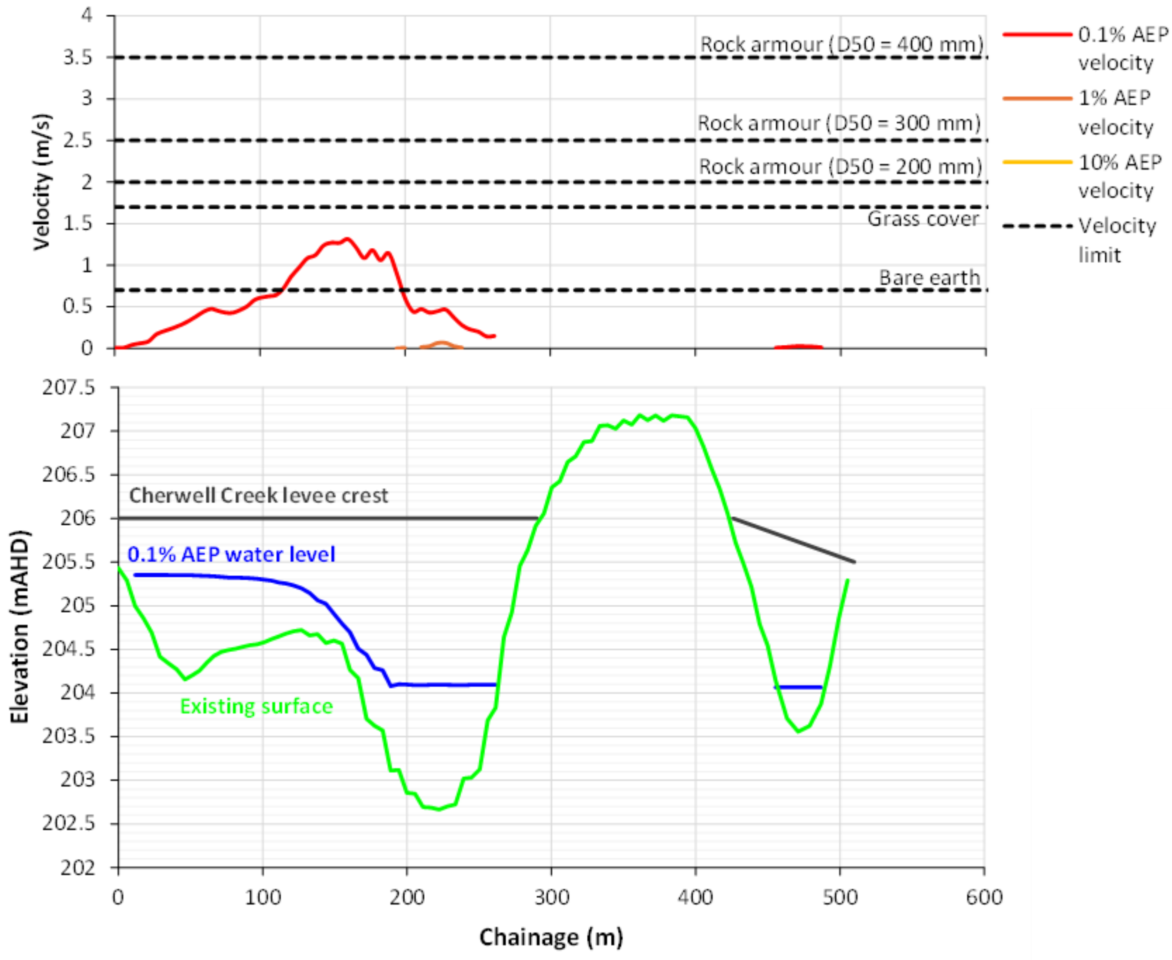


Figure 9-9 Cherwell Creek Levee Plug - Long Section - 0.1% AEP Water Levels and Velocities

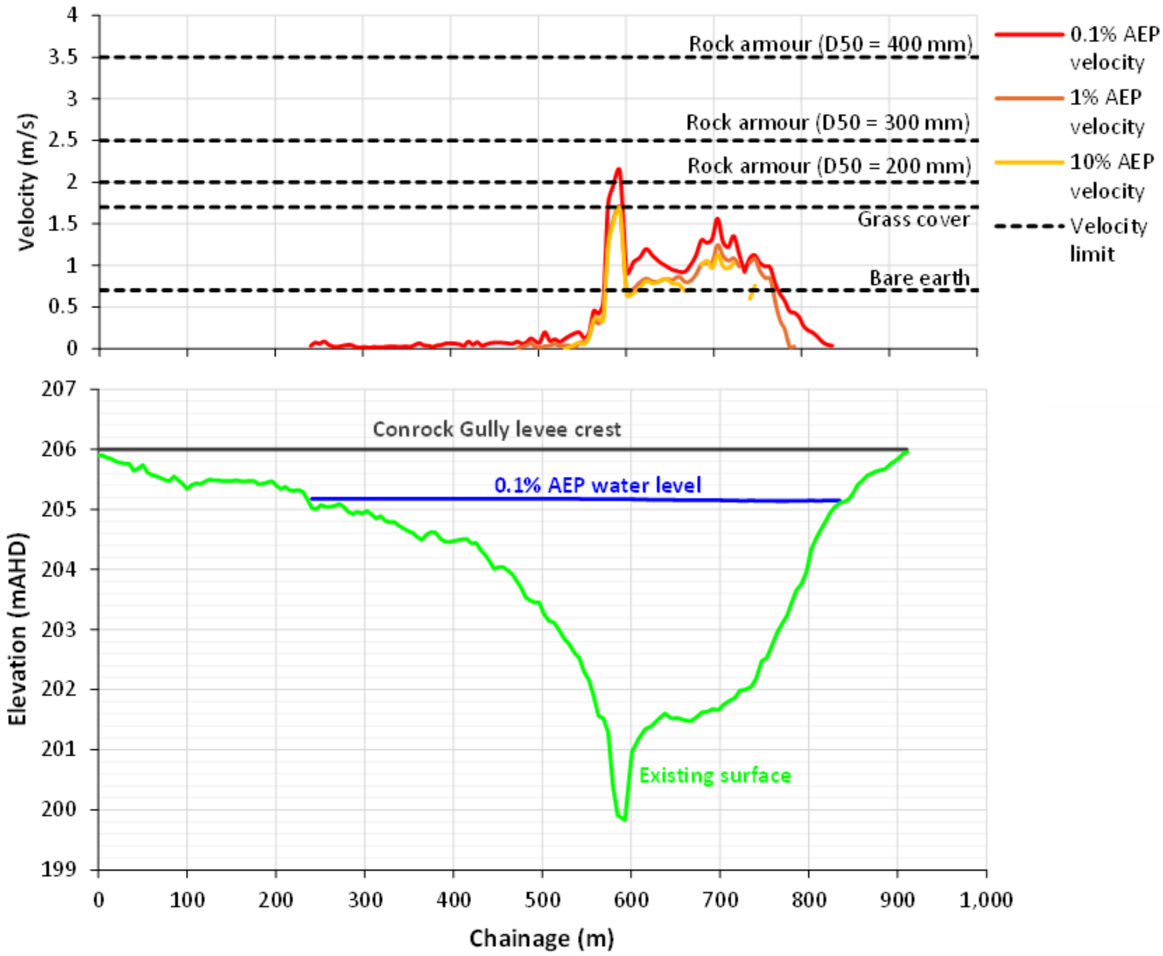


Figure 9-10 Conrock Gully Levee Plug - Long Section - 0.1% AEP Water Levels and Velocities

9.4.5 Developed Conditions – Flood Level Change Assessment

The modelled Isaac River and local creek flood level changes or afflux for developed conditions for the 1% AEP and 0.1% AEP flood events are shown in Figure 9-11 and Figure 9-12, respectively. This section summarises the impacts across all modelled events. In addition, flood level change (afflux) mapping of the 50% AEP, 10% AEP, and 2% AEP flood events is presented in Appendix C of **Appendix J**.

Changes in flood levels are considered in the context of the regional landscape in which the change occurs, notable a pastoral landscape with surrounding mining activity, and without residences or infrastructure.

In summary, the findings of the modelled Isaac River flood level changes for developed conditions are as follows:

- The flood levels in Isaac River channel and floodplain increase up to:
  - 1 m (generally less than 0.5 m) along a 4 km reach for the 1% AEP flood event.
  - 1.2 m (generally less than 1 m) along a 5.4 km reach for the 0.1% AEP flood event.
- Changes in flood level adjacent the IDM final landform are generally around 0.5 m.
- The flood level impacts do not extend downstream beyond the Project footprint and changes in flood levels are considered to be minor.
- The greatest increase in the Isaac River flood levels occur near US2, where the floodplain width is reduced by both the approved IDM levee and the Project’s proposed Isaac River levee. The flood

levels may be increased by up to 0.5 m for the 1% AEP flood event and 1.2 m for the 0.1% AEP flood event.

- There are minor decreases in flood levels on the downstream face of the Project's proposed Isaac River levee for the 0.1% AEP flood event, due to reduced conveyance past this location.
- The magnitude of changes in flood levels reduces for more frequent flood events.
- Reducing the extent of the floodplain behind the Project's proposed Isaac River levee has negligible to minor impact on the expansion of the floodplain into areas that were previously not flooded.
- The proposed Isaac River bridge and the temporary dragline crossing have negligible impacts on the 1% and 0.1% AEP flood events, as the structures are inundated by these flood flows. Minor water level changes of up to 0.5 m at the Isaac River bridge and 0.25 m at the temporary dragline crossing can be observed for smaller events (e.g. the 10% AEP). The minor water level increases at the temporary dragline crossing are primarily a result of the bed level crossing. The bed level crossing will be removed and stabilised once the dragline walk is completed. Therefore, the water level impacts in this area are highly unlikely to occur.
- The IDM final void will not be encroached by the 0.1% AEP flood during the Project's developed conditions, because the IDM final landform is sufficient to hold back 0.1% AEP Isaac River flood water, with the Project's Isaac River levee in place.
- There are no material water level impacts to the Peak Downs Highway bridge or the Goonyella Railway bridge for any of the modelled events.

In summary, the findings of the modelled Cherwell Creek flood level changes for developed conditions are as follows:

- The proposed Cherwell Creek bridge may increase water levels upstream of the bridge by up to 0.1 m for the 1% AEP flood event and 0.2 m for the 0.1% AEP flood event.
- During the 0.1% AEP flood event, flows are pushed towards the proposed Cherwell Creek levee plug by the bridge, causing a localised increase of up to 0.6 m at the proposed levee plug. The 0.1% AEP flows do not overtop the Cherwell Creek levee plug. Flows do not interact with the Cherwell Creek levee plug for any events more frequent than a 0.1% AEP flood event.
- The JB Gully bed-level crossing has a negligible impact on all modelled flood events, because the structure is inundated by flood flows.

In summary, the potential impacts from the modelled Conrock Gully flood level changes for developed conditions are as follows:

- The flood levels immediately upstream of the diversion will be increased by up to 1.2 m for the 1% AEP flood event and 2.2 m for the 0.1% AEP flood event. Water level increases up to 0.1 m would propagate 800 m upstream for the 1% AEP flood event and 1,200 m upstream for the 0.1% AEP flood event. The magnitude of changes in flood levels reduces for more frequent flood events. Changes in flood levels are considered to be minor and localised.
- The remainder of the existing Conrock Gully channel will be excised by the Project. However, downstream of the Project area, in the remnant Conrock Gully channel, there is no change in flood levels for the 1% AEP and 0.1% AEP flood events, and up to the 10% AEP flood event, because these areas continue to be flooded by backwater flow from the Isaac River.

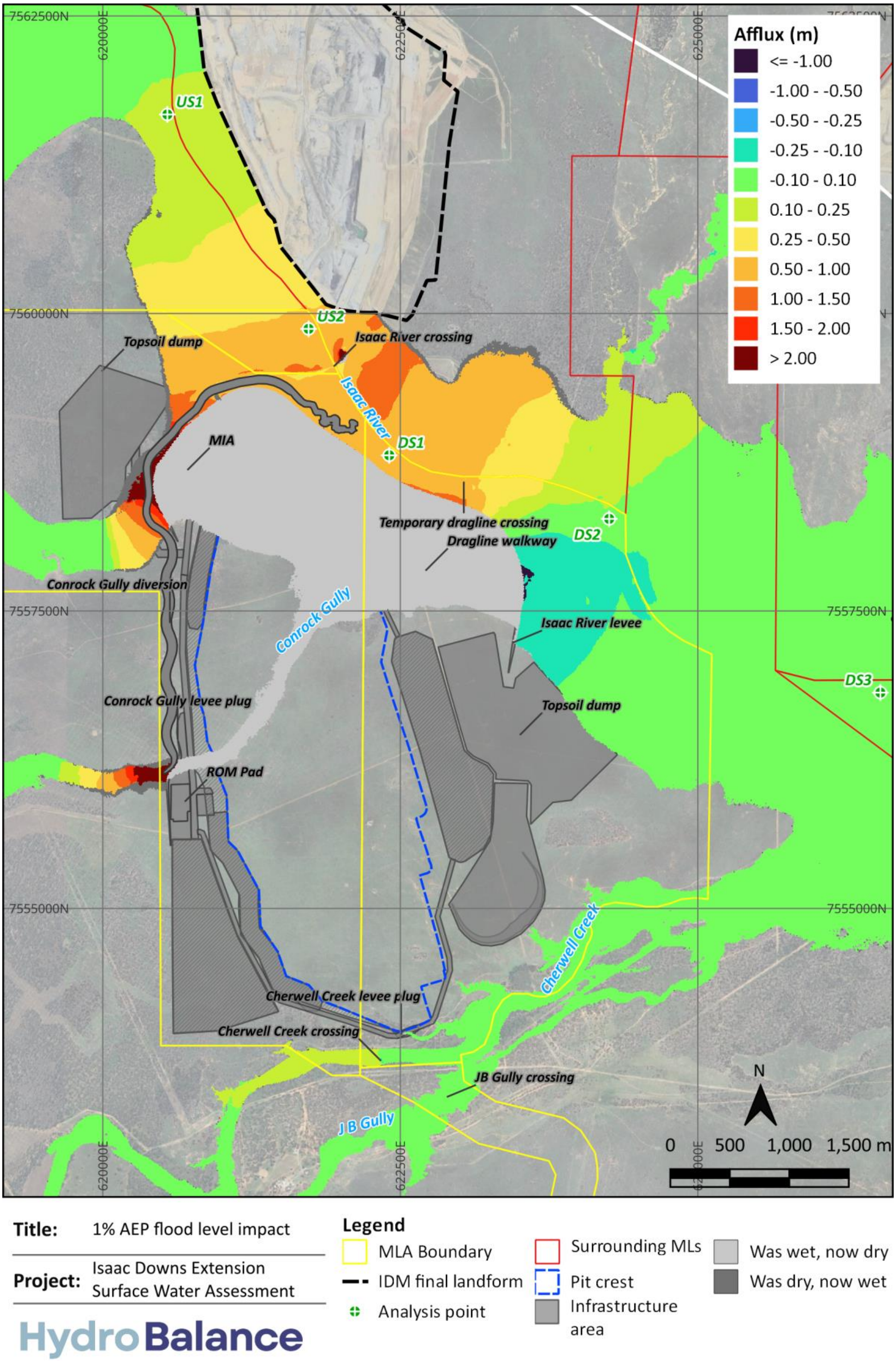


Figure 9-11 1% AEP Flood Level Impacts

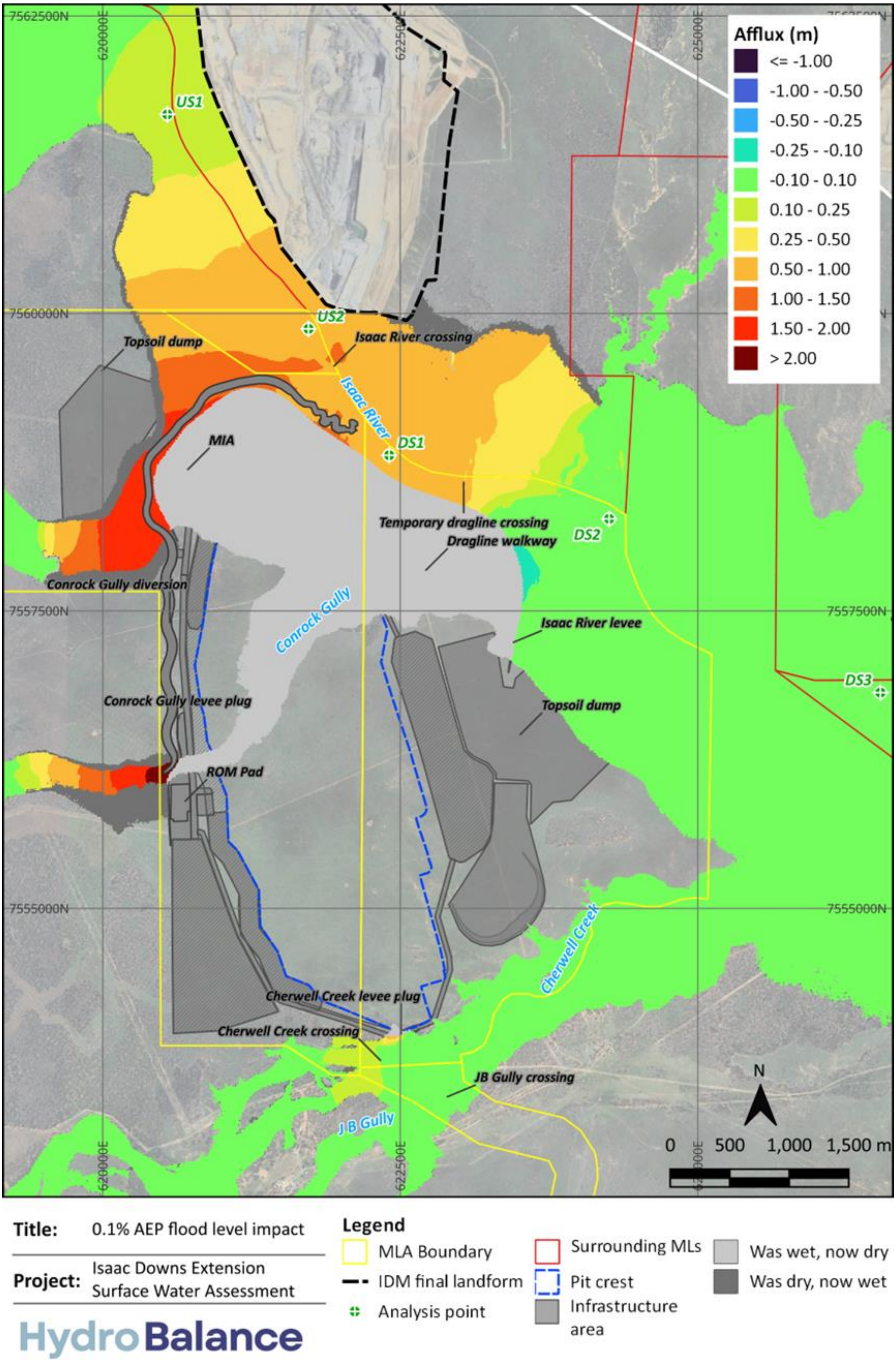


Figure 9-12 0.1% AEP Flood Level Impacts

9.4.6 Developed Conditions – Flood Duration Impact Assessment

Table 9-6 presents an assessment of the potential impacts on the duration of floodplain inundation along the Isaac River. The developed conditions were compared to the existing conditions to represent the potential impact on floodplain residence times, because the developed conditions represent the greatest potential change to the Isaac River floodplain. The locations of the assessment points are shown in the flood maps (Figure 9-3, and Figure 5.3 to Figure 5.22 of **Appendix J**). The rationale applied to select the assessment points is as follows:

- US1: upstream location in the vicinity of mapped regional ecosystems (REs) and groundwater dependent ecosystems (GDEs).
- US2: upstream of the proposed Isaac River bridge crossing and mapped REs located upstream of the proposed Conrock Gully diversion.
- DS1: downstream of proposed Conrock Gully diversion and located in the vicinity of mapped GDEs.
- DS2: downstream of old Conrock Gully channel and in the vicinity of mapped GDEs and Poplar Box threatened ecological communities (TECs).
- DS3: located at the wetland near the confluence of Isaac River and Cherwell Creek.

Cross sections of the Isaac River floodplain and main channel at each of the assessment points are shown in Figure 9-13 to Figure 9-17. These figures also show the modelled flood water levels at each of the assessment points. The locations of the Isaac River floodplain cross sections are shown on Figure 9-3. These cross sections show that the impact to water level is greatest at the US2 and DS1 locations, with water level differences of up to 1 m for the 0.1% AEP flood event. For more frequent flood events (e.g. 10% AEP) at US2 and DS1 flood level changes are negligible. However, at other locations upstream and downstream (US1, DS2, DS3) water level changes are negligible for all modelled flood events.

The duration of floodplain inundation was derived from the TUFLOW hydraulic model. The Isaac River floodplain is considered inundated when the water level increases above the Isaac River main channel top of bank. In summary, the findings regarding the floodplain inundation are as follows:

- Under existing conditions, the Isaac River floodplain may be inundated by between 5 to 22 hours for the 10% AEP flood event, and between 40 and 50 hours for the 0.1% AEP flood event.
- The floodplain inundation duration is generally the greatest at US2 and DS1, both of which are adjacent to IDM.
- The Project results in negligible change to the duration of floodplain inundation, with less than 1 hour change in duration for all AEP flood events, and generally less than 0.5 hours.

Overall, the Project has a negligible impact on the Isaac River floodplain residence times.

Table 9-6 Floodplain Inundation Time Impact Assessment

Design event AEP	Condition	Duration of floodplain inundation (hrs)				
		US1	**US2**	**DS1**	**DS2**	**DS3**
10% AEP	Existing	5.0	15.1	21.2	8.4	5.0
	Developed	5.6	15.4	21.4	8.5	5.2
	Difference	**0.6 (13%)**	**0.3 (2%)**	**0.2 (1%)**	**0.1 (1%)**	**0.2 (2%)**
1% AEP	Existing	28.9	35.8	40.4	31.1	28.8
	Developed	29.2	36.1	40.8	31.2	28.7
	Difference	**0.3 (1%)**	**0.3 (1%)**	**0.4 (1%)**	**0.1 (<1%)**	**-0.1 (<1%)**
0.1% AEP	Existing	39.6	45.3	49.1	41.6	39.6
	Developed	39.9	45.6	49.4	41.7	39.5
	Difference	**0.3 (1%)**	**0.3 (1%)**	**0.3 (<1%)**	**0.1 (<1%)**	**-0.1 (<1%)**

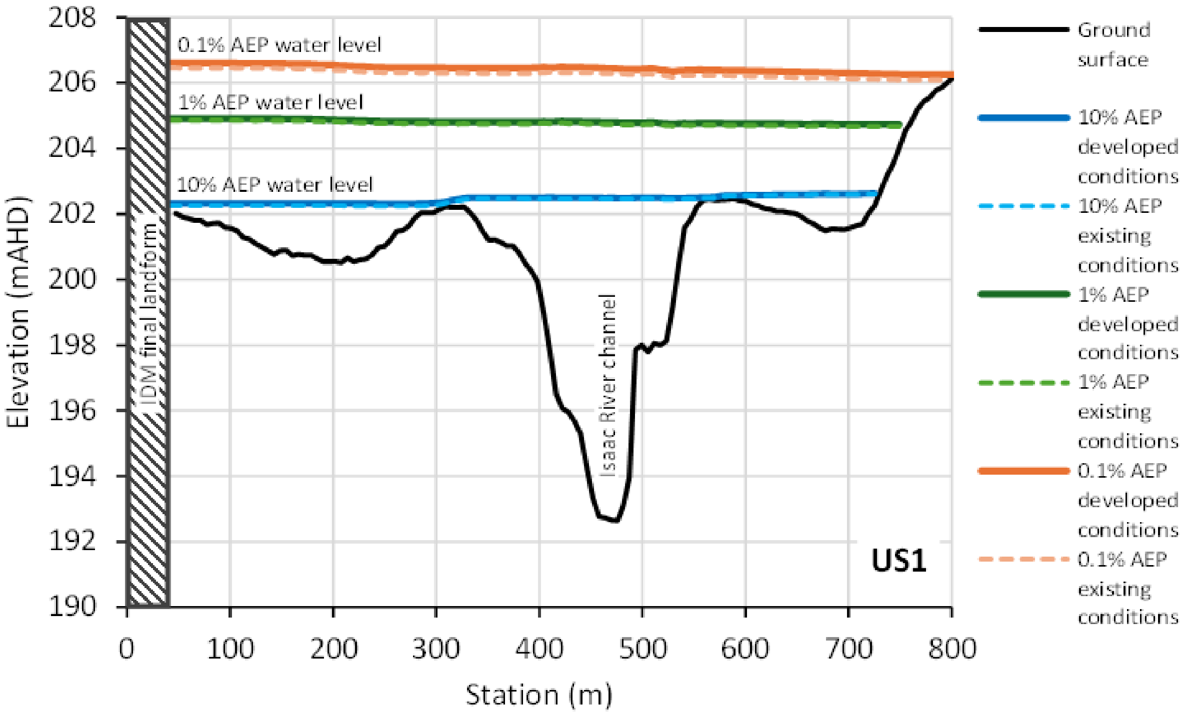


Figure 9-13 Assessment Point Cross-sections in the Isaac River, US1

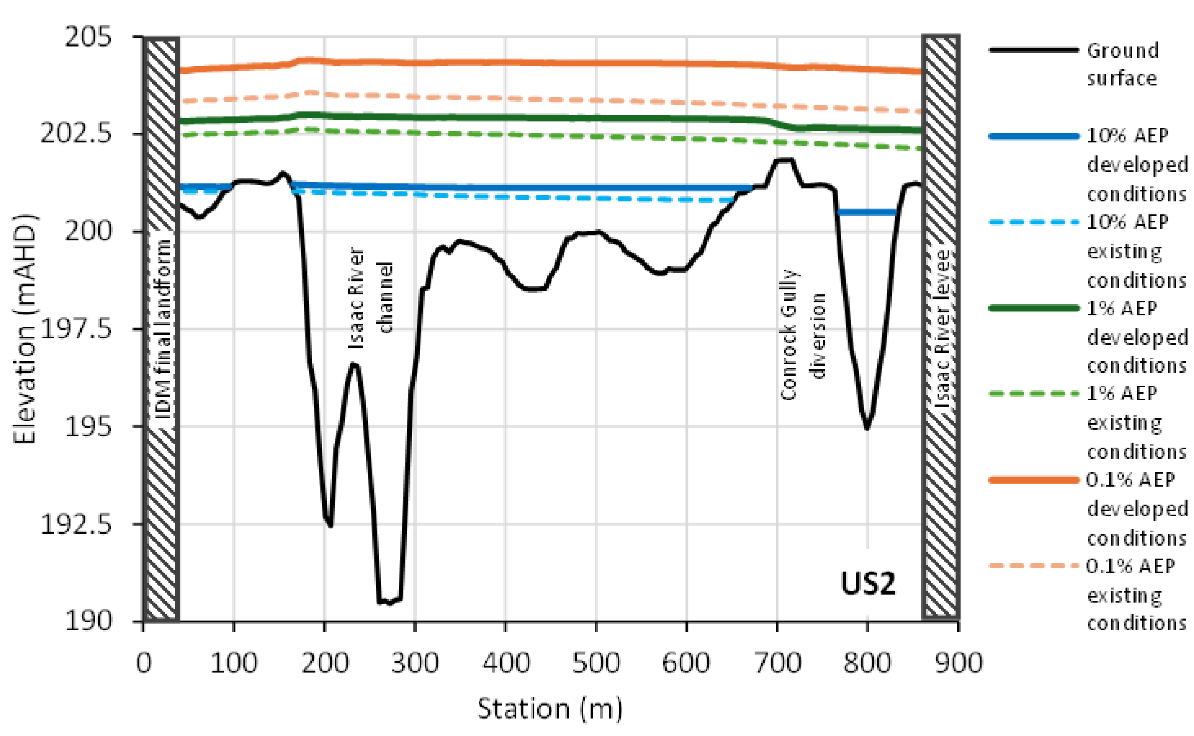


Figure 9-14 Assessment Point Cross-sections in the Isaac River, US2

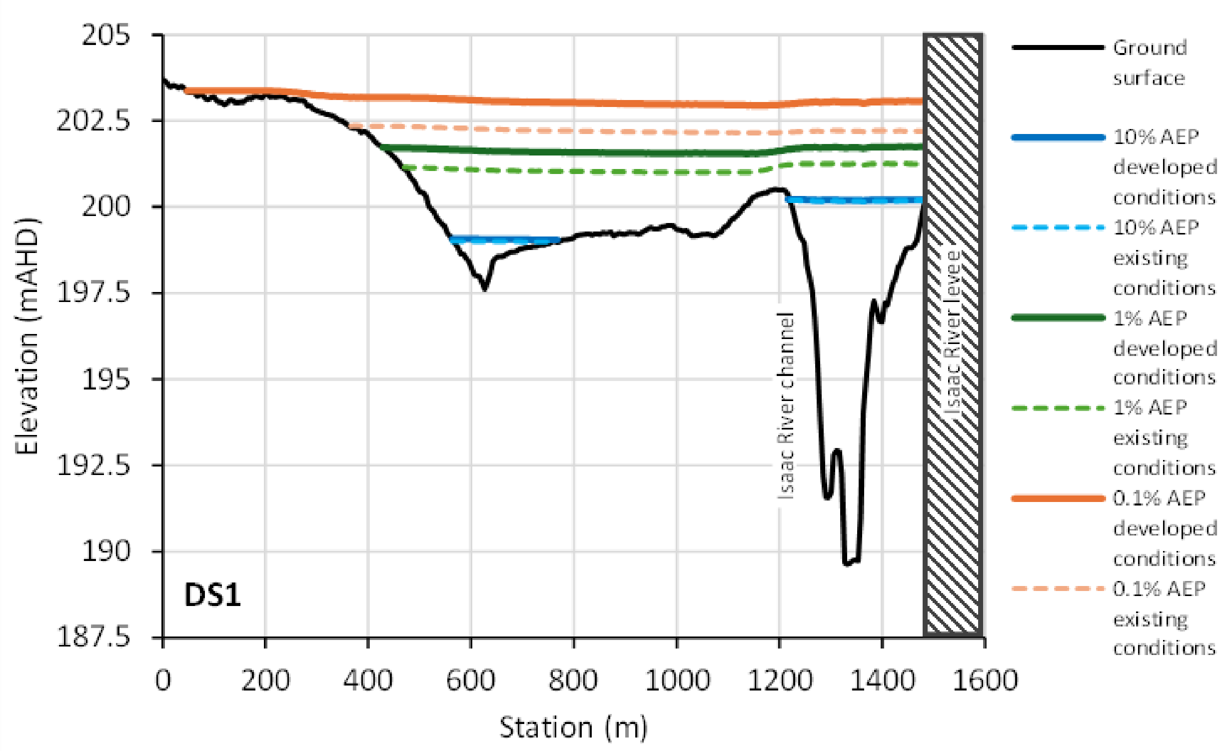


Figure 9-15 Assessment Point Cross-sections in the Isaac River, DS1

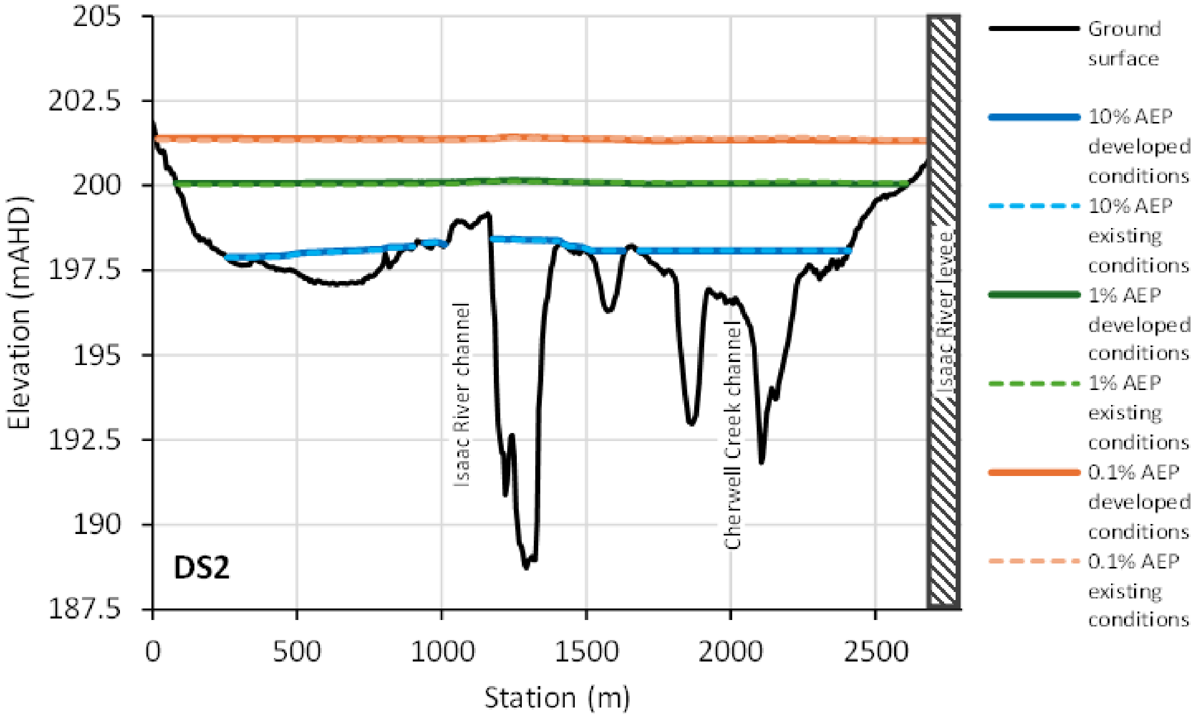


Figure 9-16 Assessment Point Cross-sections in the Isaac River, DS2

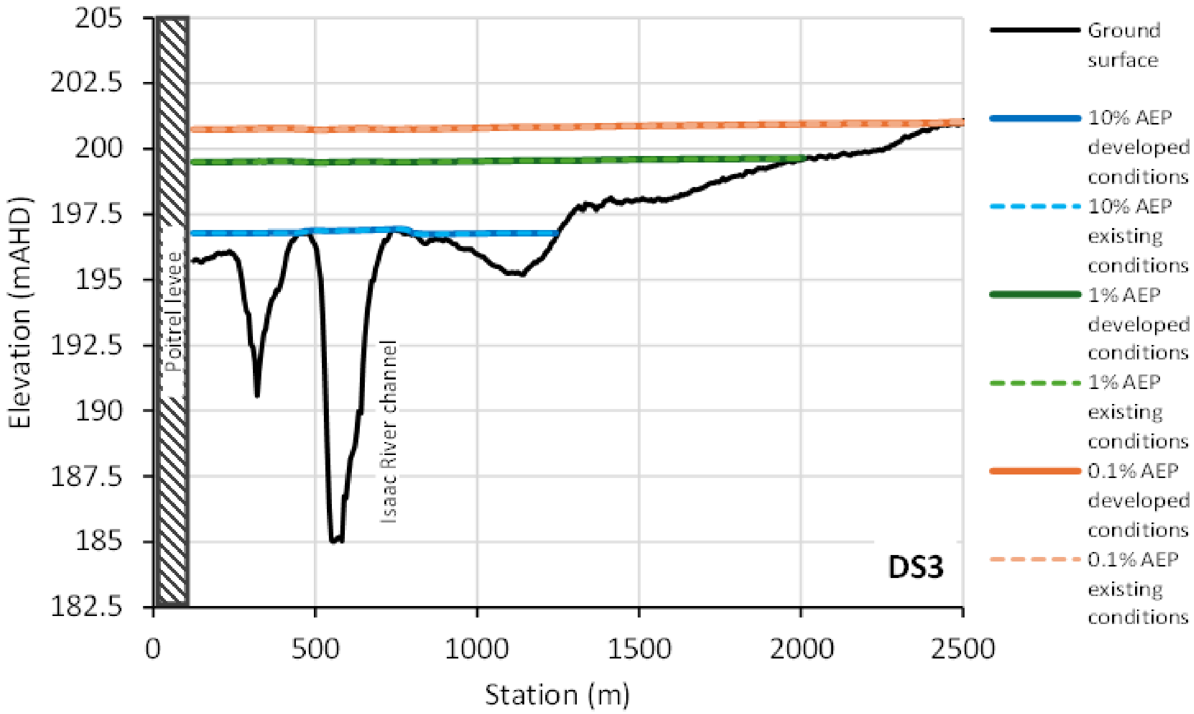


Figure 9-17 Assessment Point Cross-sections in the Isaac River, DS3

9.4.7 Developed Conditions – Velocity Change Assessment

The modelled Isaac River and local creek flood velocity changes for developed conditions for the 1% AEP and 0.1% AEP flood events are shown in Figure 9-18 and Figure 9-19, respectively. In addition, the flood velocity change mapping of the 50% AEP, 10% AEP, and 2% AEP flood events is presented in Appendix C of **Appendix J**.

Changes in flood velocities are considered in the context of the regional landscape in which the change occurs, notable a pastoral landscape with surrounding mining activity, and without residences or infrastructure.

In summary, the findings of the modelled Isaac River flood velocity changes for developed conditions are as follows:

- The flood velocities are generally decreased upstream of the Project, including adjacent the IDM final landform. The greatest decreases are located around the proposed Isaac River bridge, with modelled decreases reaching up to 0.9 m/s for the 1% AEP flood event and 1.1 m/s for the 0.1% AEP flood event. Velocity decreases also occur in the Isaac River floodplain adjacent to the Conrock Gully diversion, due to reduced conveyance in this location.
- The flood velocities in the eastern floodplain adjacent to the Project and the floodplain downstream of IDM, between DS1 and DS2, would be increased. This increase occurs due to the increased conveyance through this section and the upstream reduction of the floodplain width due to the proposed Isaac River levee. The velocity increases in these sections may reach up to 0.7 m/s for the 1% AEP flood event and 1.0 m/s for the 0.1% AEP flood event. The potential geomorphic impacts of the velocity increases on the Isaac River floodplain are discussed in Section 9.5.4.
- There are decreases in flood velocities on the downstream face of the Isaac River levee, due to reduced conveyance past this location. The velocity reduction in this location is up to 1.0 m/s for the 1% AEP flood event and 1.2 m/s for the 0.1% AEP flood event.
- The flood velocity changes do not extend downstream beyond the proposed levee.
- There are no material velocity impacts to the Peak Downs Highway bridge or the Goonyella Railway bridge for any of the modelled events.
- The magnitude of change in velocity reduces for more frequent flood events.

In summary, the findings of the modelled Cherwell Creek flood velocity changes for developed conditions are as follows:

- There are minor localised changes in velocities for the 1% AEP and 0.1% AEP flood events downstream of the proposed Cherwell Creek bridge and JB Gully bed-level crossing. The velocity impacts do not propagate downstream.
- Velocity impacts in Cherwell Creek in the vicinity of the Project are more apparent for flood events more frequent than the 1% AEP flood event. For example, for the 10% AEP flood event, velocities may be impacted for up to 660 m downstream of the Cherwell Creek bridge and 400 mm downstream of the JB Gully bed-level crossing. The velocities downstream of the Cherwell Creek bridge are generally increased and the velocities downstream of the JB Gully bed-level crossing are generally decreased. The velocities for the developed conditions are within the range of the expected existing condition velocities for this reach of Cherwell Creek.

In summary, the findings of the modelled Conrock Gully flood velocity changes for developed conditions are as follows:

- The flood velocities upstream of the diversion would be decreased by up to 0.4 m/s for the 1% AEP flood event and 0.5 m/s for the 0.1% AEP flood event. The velocity reduction would propagate 700 m upstream for the 1% AEP flood event and 900 m upstream for the 0.1% AEP flood event. The magnitude of change would reduce for more frequent flood events.

- The remainder of the existing Conrock Gully channel will be excised by the Project. However, the remnant Conrock Gully channel will continue to be flooded by the Isaac River backwaters, with lower velocities than pre-mining.

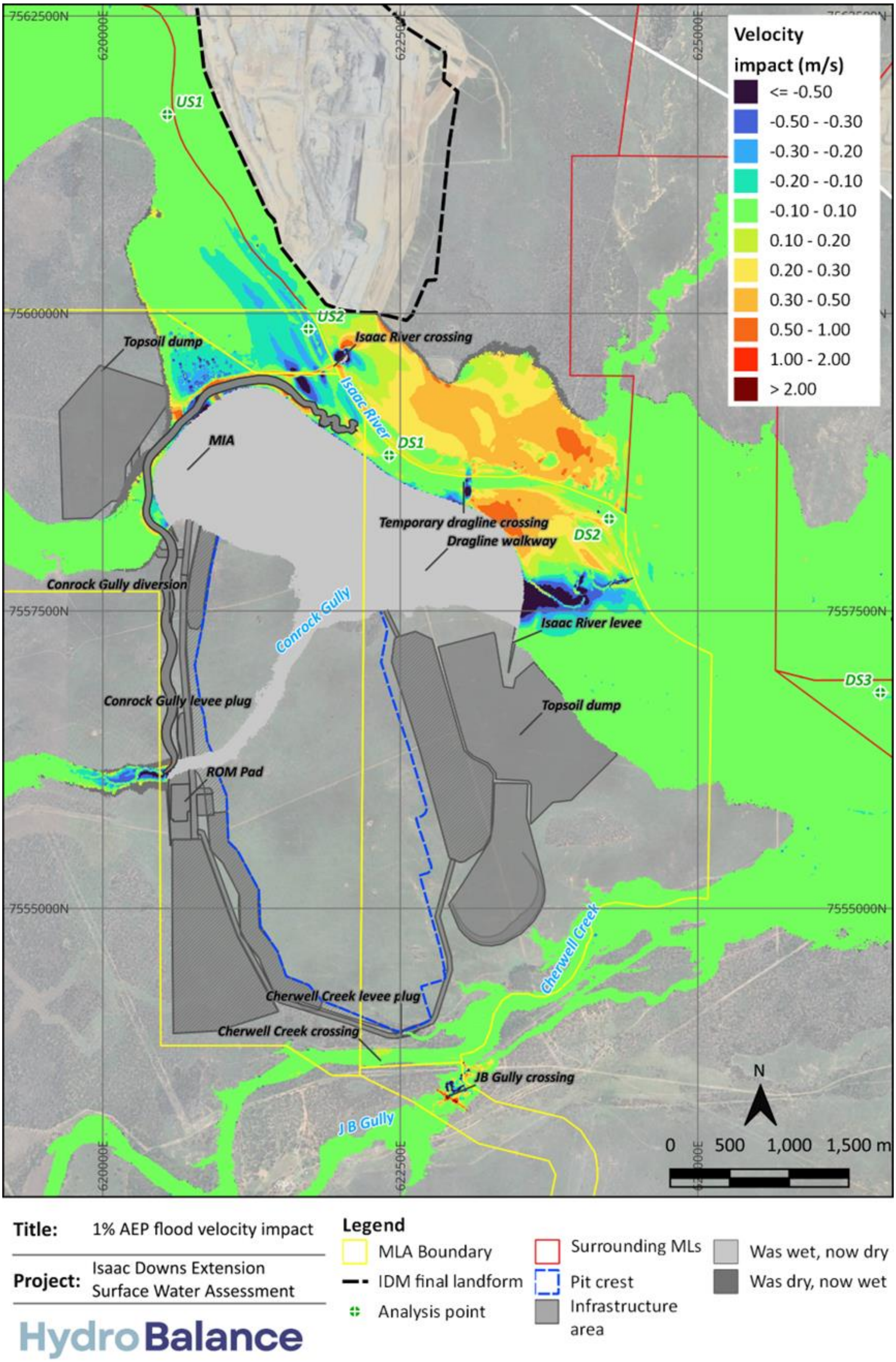


Figure 9-18 1% AEP Flood Velocity Impacts

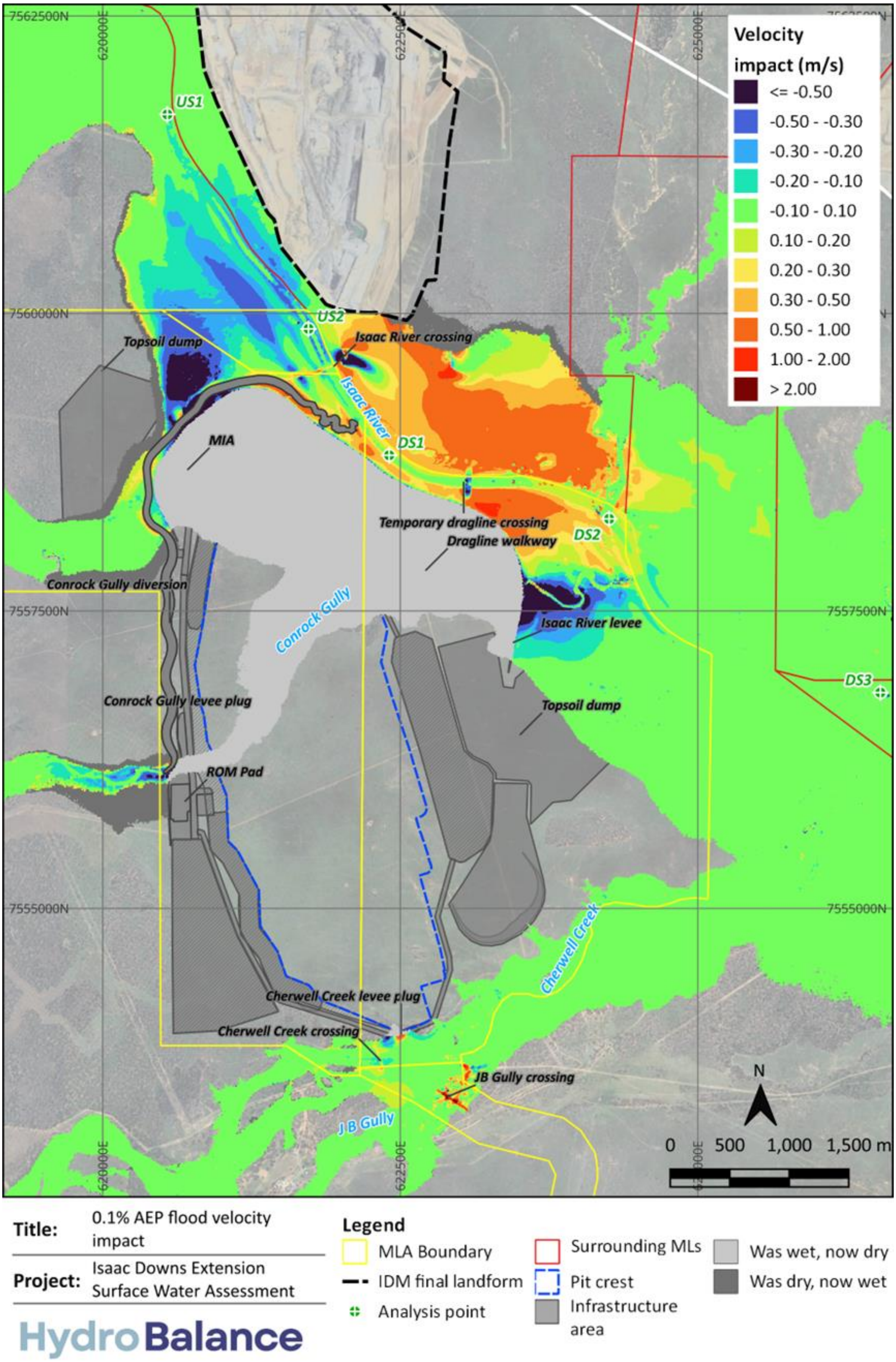


Figure 9-19 0.1% AEP Flood Velocity Impacts

9.4.8 Final Landform Conditions

Modelled 0.1% AEP flood depths and velocities for the final landform scenario are shown in Figure 9-20 and Figure 9-21, respectively. There would be insignificant interactions between floodwaters and the final landform for an event more frequent than the 2% AEP.

In summary, the findings of the modelled 0.1% AEP final landform flood depths and velocities are as follows:

- The flood does not interact with the proposed final void. The final void crest has a freeboard of at least 1.1 m above the flood level.
- The Isaac River floodwaters interact with the main spoil dump. The flood does not interact with either the eastern or southwestern out-of-pit dumps. Conrock Gully floodwaters will be directed to the diversion by a stabilised final landform design, incorporating the rehabilitated raised haul road and adjacent spoil dump.
- The Isaac River floodwaters may reach up to 3.3 m against the main spoil dump. Conrock Gully may reach up to 3.6 m against the final landform.
- Velocities range between 0.5 and 2.0 m/s may occur along the northern face of the main spoil dump within the Isaac River floodplain. Velocities do not exceed 0.8 m/s for the 1% AEP along this face and there is minimal interaction for the 2% AEP flood event and more frequent events. Therefore, potentially erosive flows will be very infrequent and only occur for short durations. For the vast majority of Isaac River flood events, interaction between floodwaters and the final landform will be either minimal or non-existent. The final landform will be revegetated, with vegetation cover providing sufficient protection against interaction with infrequent flood events.
- Velocities up to 1.1 m/s may occur in an approximate 25 m wide section of the stabilised final landform where the existing Conrock Gully channel is redirected to the diversion. The velocities within the remainder of the Conrock Gully where it interacts with the stabilised final landform are typically 0.1 m/s or lower (i.e. minor). The vegetation cover on the final landform is expected provide sufficient scour protection in this section for the flood events up to and including the 0.1% AEP.

Modelled PMF flood depths for the final landform scenario are shown in Figure 9-22. The PMF event is a hypothetical extreme and unlikely event that is larger than the 0.1% AEP flood event, with the Isaac River floodwaters being 3 m to 5 m higher during the PMF. It should be noted that assessment of a PMF event is normally used as a design safety standard for infrastructure where there is a threat to human life (e.g. a dam), which is not the case for the Project. The larger PMF event may cause floodwater to encroach on the northern end of the final void. However, the final void will possess a safety bund as a component of its closure requirements, which will also provide immunity to a PMF flood event.

Modelled 1% AEP flood depths and velocities for the final landform scenario are shown in Appendix C of **Appendix J**. The final void will not be inundated by a 0.1% AEP flood event.

9.4.9 Final Landform – Flood Level and Velocity Change Assessment

The modelled Isaac River and local creek 0.1% AEP flood level changes (afflux) and flood velocity changes for the final landform are shown in Figure 9-23 and Figure 9-24, respectively.

In summary, the findings of the modelled 0.1% AEP flood level changes for the final landform are as follows:

- The final landform results in negligible change to flood levels in the Isaac River. There are minor increases in water levels, up to 0.2 m, in the reach where the Conrock Gully diversion meets the floodplain.
- The flood levels upstream of the diversion will be increased by up to 1.9 m, with changes up to 0.1 m localised and propagating up to 1.1 km upstream.

- There are no water level changes in Cherwell Creek in the vicinity of the final landform.
- The magnitude of change in flood level is reduced compared to the developed conditions scenario, as the final landform allows for the expansion of the floodplain into areas previously protected by the Isaac River levee.
- There are no changes in flood levels in the downstream remnant section of Conrock Gully as this area is subject to backwater flooding from the Isaac River.

In summary, the findings of the modelled 0.1% AEP flood velocity changes for the final landform are as follows:

- The final landform results in negligible change to velocity in the Isaac River channel.
- Velocities within the Conrock Gully diversion are increased compared to the pre-mining/existing scenario without a diversion. Section 9.9 and Appendix D of Appendix J provide an assessment of the Conrock Gully diversion hydrology and geomorphology which demonstrates that the planned design meets accepted operational standards.
- There are decreased velocities in the existing Conrock Gully channel downstream of the Project, noting that these areas will continue to receive flood flows from Isaac River backwater flooding, but at reduced velocities.
- The flood velocities upstream of the diversion will be decreased by up to 0.8 m/s, propagating up to 1.1 km upstream.
- There are no flood velocity changes in Cherwell Creek in the vicinity of the final landform.
- The magnitude of velocity change is generally reduced compared to the developed conditions scenario.

The magnitude of flood level and velocity change reduces for more frequent flood events.

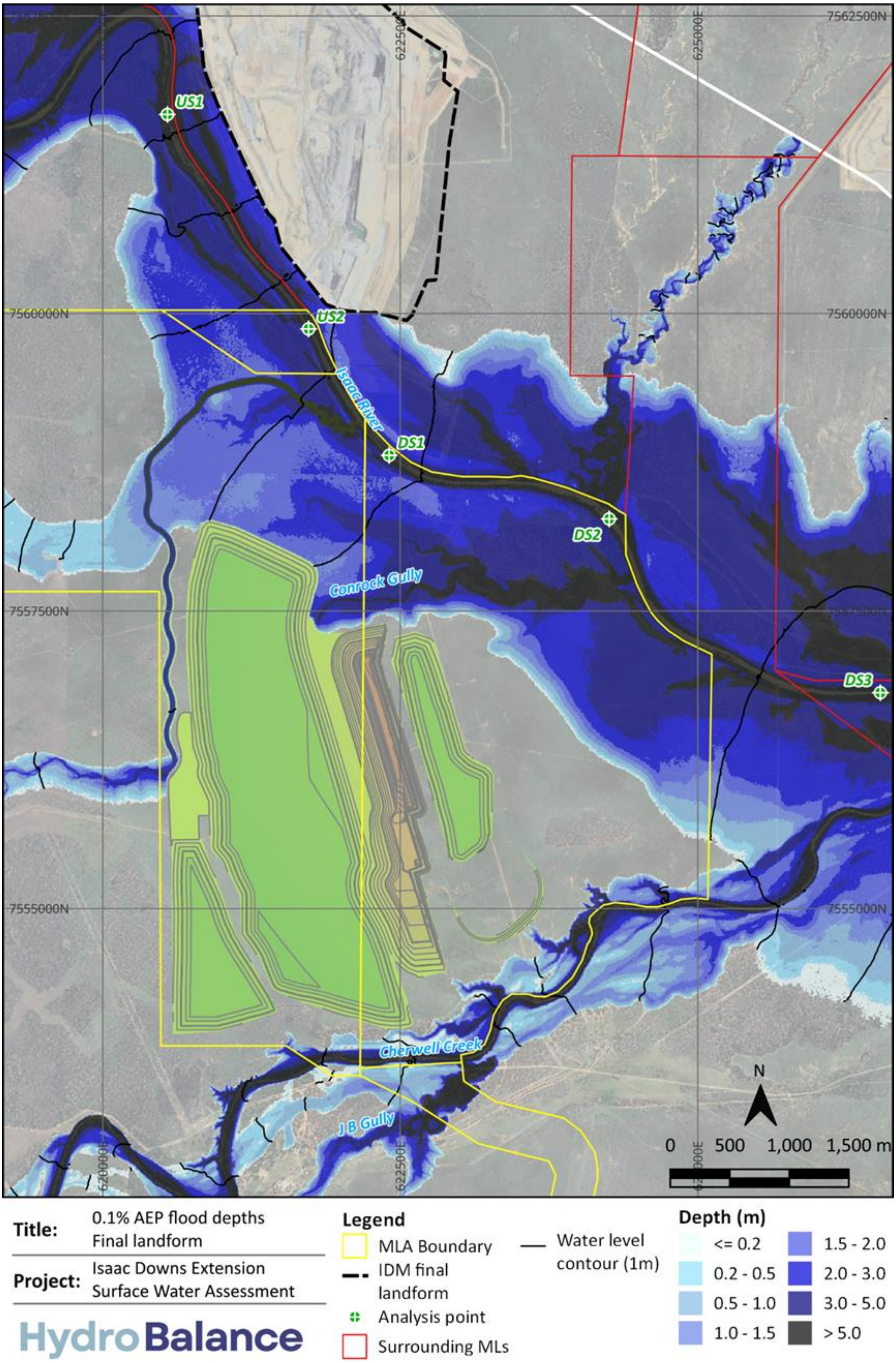


Figure 9-20 Final Landform – 0.1% AEP Flood Depths and Heights

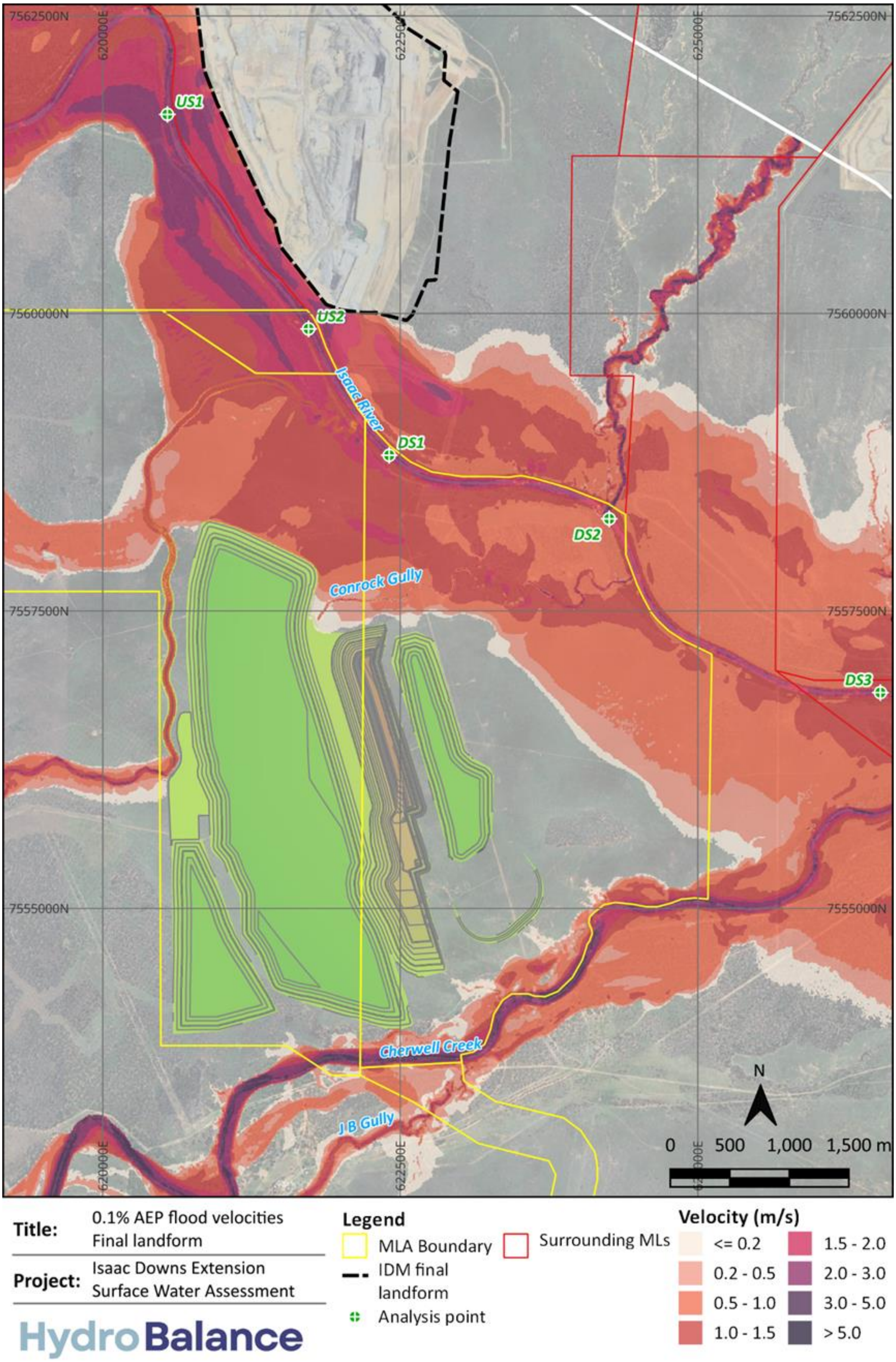


Figure 9-21 Final Landform – 0.1% AEP Flood Velocities

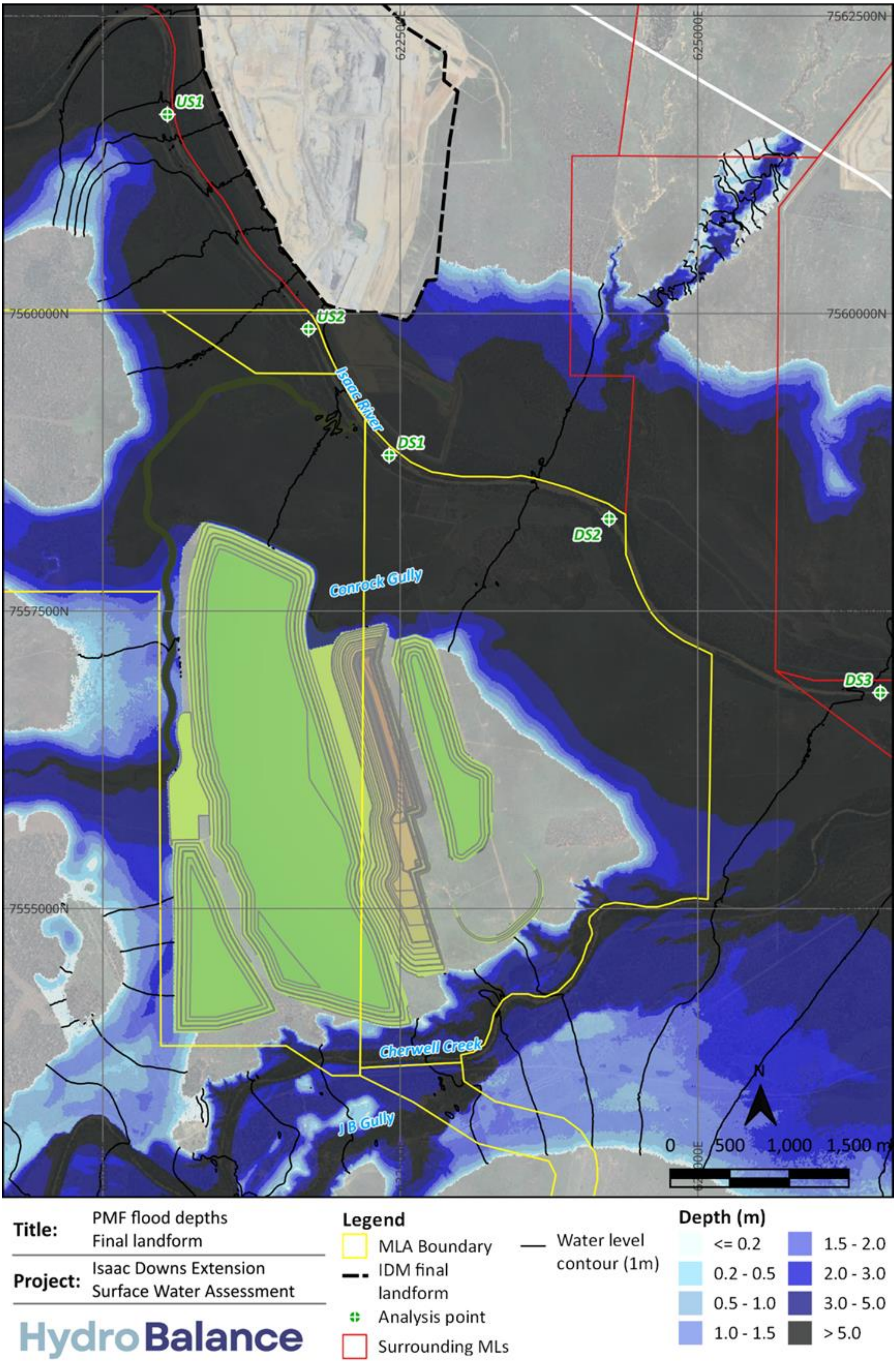


Figure 9-22 Final landform – PMF Flood Depths and Heights

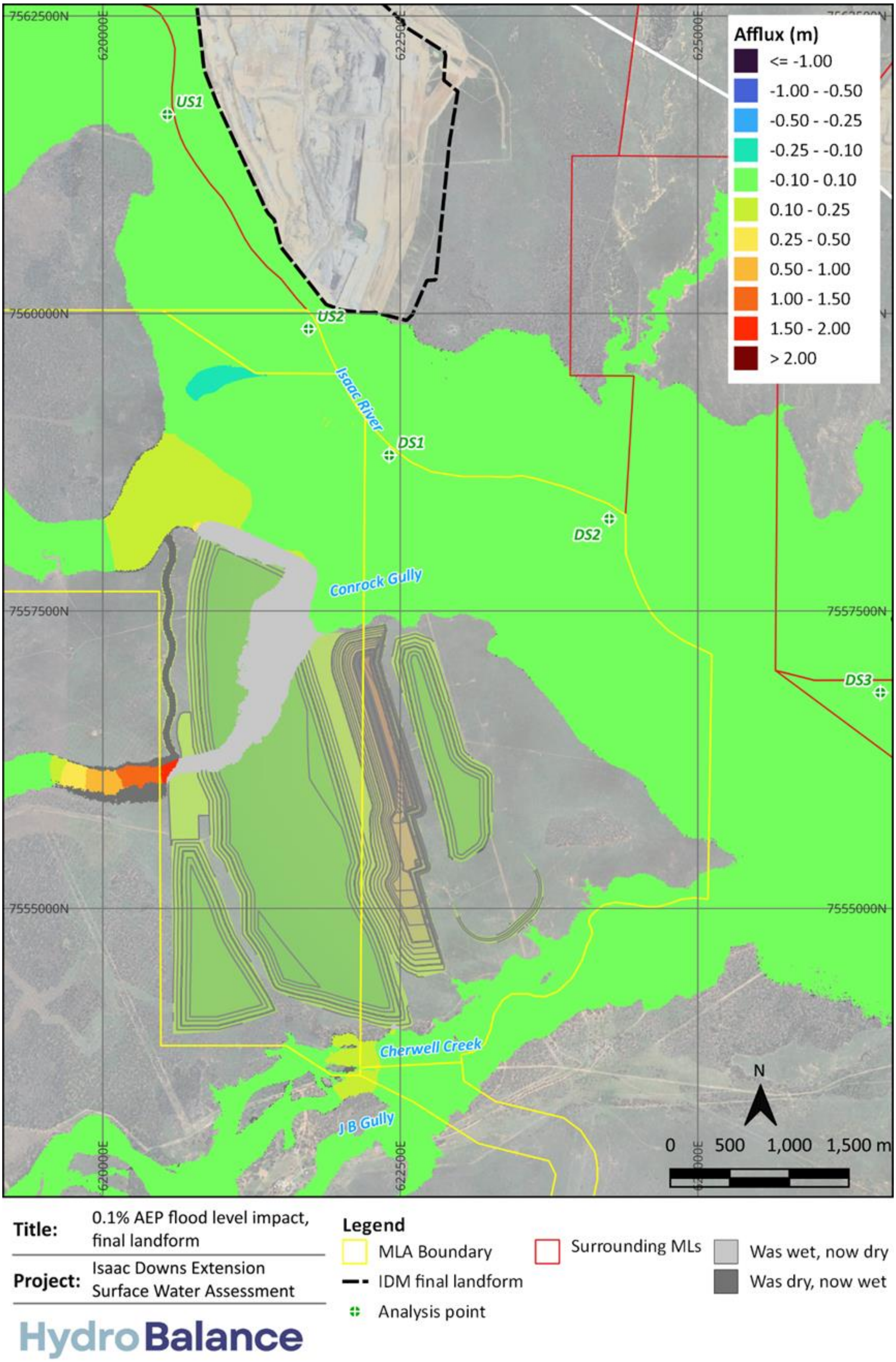


Figure 9-23 Final Landform – 0.1% AEP Flood Level Impacts

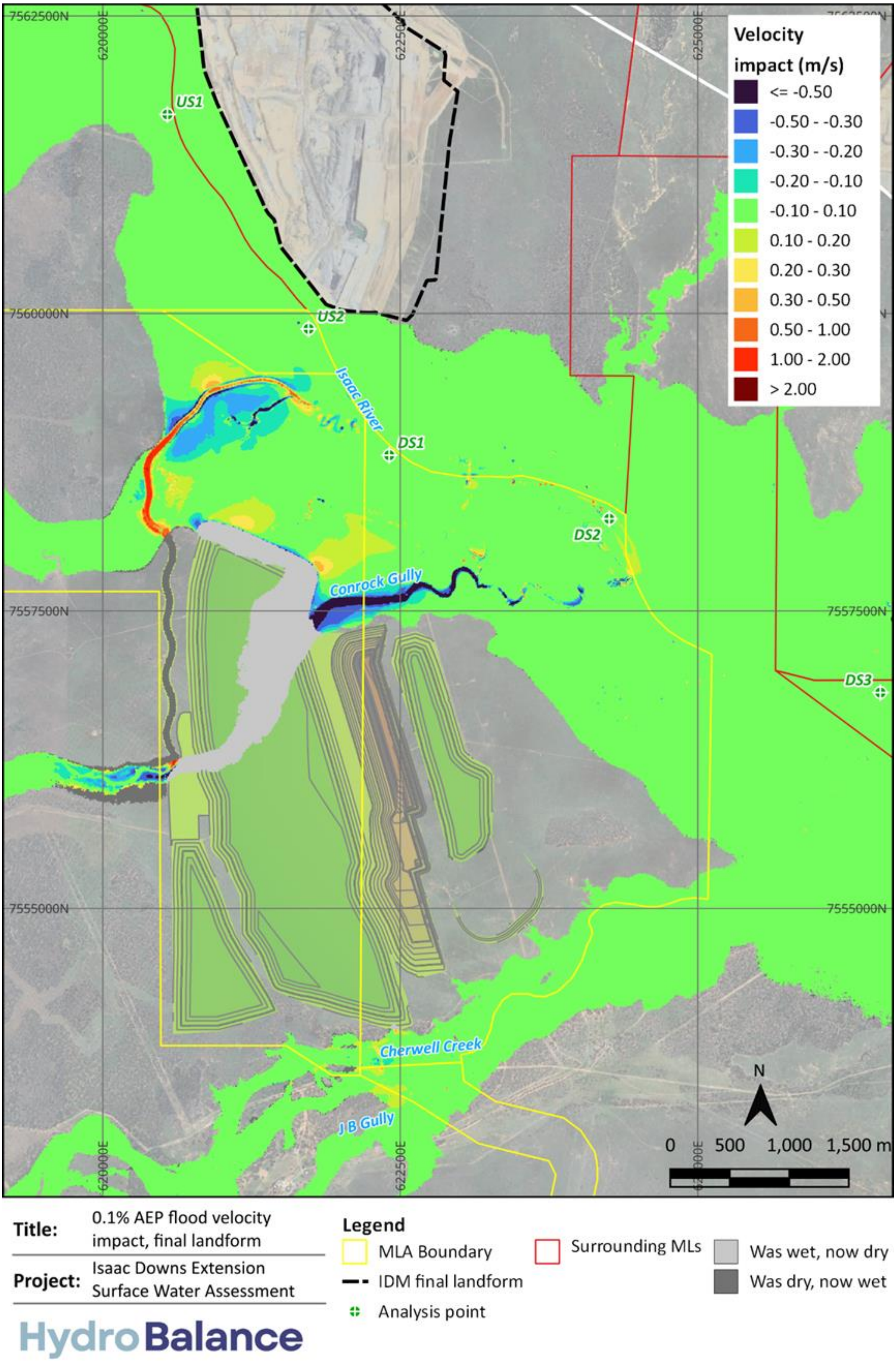


Figure 9-24 Final Landform – 0.1% AEP Flood Velocity Impacts

9.5 Isaac River Geomorphic Impact Assessment

9.5.1 Overview

The hydraulic model results were used to assess the potential impacts of the Project's mining and post-closure phases on the geomorphic behaviour of the Isaac River, including the potential to increase erosion and/or sedimentation, and impact on the morphology of the adjacent floodplains. The geomorphic impacts were assessed through comparative analysis of the peak velocity, bed shear stress and stream power for existing conditions (current environment), developed conditions (mining), and the post-mining final landform.

The hydraulic criteria to assess the impacts on geomorphology were adopted from the ACARP guideline. It should be noted that changes in channel geomorphology are generally controlled by regular flows, not extreme low-probability events.

An assessment of floodplain geomorphology was undertaken for out-of-channel 2% and 0.1% AEP flood events. The 50% AEP flood event was excluded because Isaac River flows are generally within the channel for this event.

The geomorphological impacts on the Cherwell Creek and JB Gully main channels and floodplains due to the Project are negligible, apart from highly localised changes near the proposed crossings. Figure 5.33 to Figure 5.40 of **Appendix J** support this finding. Therefore, the Project's impacts on the geomorphology of Cherwell Creek and JB Gully are not further discussed due to the negligible geomorphic impacts.

A geomorphic assessment of Conrock Gully and the proposed Conrock Gully diversion is provided in Appendix D of **Appendix J**.

9.5.2 Hydraulic Criteria

Shear stress provides a measure of the tractive force acting on sediment particles at the boundary of the stream and is used to determine the threshold of motion for bed material. It provides an indication of the potential for erosion of cohesive sediments or movement of non-cohesive sediments at the channel boundary.

The DNRME guideline provides guidance on design parameters for watercourse diversions and constrictions of watercourses due to levee banks. The DNRME guideline states that the hydraulic criteria of a watercourse should be used as first preference to develop design parameters for a watercourse diversion. Additionally, DNRME guideline provides some nominal hydraulic threshold values to compare against for floodplain geomorphology.

Table 9-7 summarises Bowen Basin watercourse diversion design values for velocity, stream power and shear stress levels, from the ACARP guideline. The minimum requirement when undertaking a hydraulic analysis is to review the watercourse and diversion energy conditions for 2% and 50% AEP flood events.

The ACARP guideline does not include relevant guideline values for events rarer than a 2% AEP flood event with respect to assessing floodplain morphology. For the Project's geomorphic assessment, 2% and 0.1% AEP flood events were used. Conclusions for the 0.1% AEP flood event were drawn from the impacts caused to the hydraulic criteria on the Isaac River floodplain as a result of the Project's proposed infrastructure compared to existing conditions.

Table 9-7 ACARP Design Criteria for Bowen Basin Stream Diversions

Scenario	Stream Power (W/m^2)	Velocity (m/s)	Bed Shear (N/m^2)
50% AEP (no vegetation)	<35	<1.0	<40

Scenario	Stream Power (W/m^2)	Velocity (m/s)	Bed Shear (N/m^2)
50% AEP (vegetated)	<60	<1.5	<40
2% AEP	<150	<2.5	<50

9.5.3 Impacts on Channel Morphology

The reach of the Isaac River assessed for the Project's impacts on channel morphology is presented in Figure 9-3.

9.5.3.1 Existing Conditions – Hydraulic Characteristics

The Project's existing conditions model results show the following properties:

- In relation to a 50% AEP flood event (Figure 9-25):
  - Velocities are highest within the main channel banks and are generally under 2.0 m/s, with peak velocities occurring along the centre of the Isaac River channel up to 2.4 m/s.
  - The bed shear stress levels along the centre of the Isaac River channel are generally less than 30 Newton per square metre (N/m^2), with some localised areas exceeding 40 N/m^2.
  - The stream power levels along the centre of the Isaac River channel are generally less than 50 Watts per square metre (W/m^2), with some localised areas exceeding 60 W/m^2.
  - The highest hydraulic parameters occur at around chainage 4,000 m where the Isaac River main channel is constricted to a base width of about 20 m, due to an instream island. The main channel width in the vicinity of the Project is generally around 45 m. Bed shear stress reaches up to 57 N/m^2 in this location, and stream power reaches up to 120 W/m^2.
  - Compared to the ACARP guideline values, the Isaac River channel velocities are higher than the guideline value of 1.5 m/s. Whilst this guideline value is for frequent flood events, 50% AEP, it indicates that stream velocities generally exceed the guideline value for existing conditions.
  - Bed shear stress and stream power levels are generally within the ACARP guideline values except for localised areas.
- In relation to a 2% AEP flood event (Figure 9-26):
  - Velocities are highest within the main channel banks and are consistently less than 2.5 m/s.
  - The bed shear stress levels along the centre of the Isaac River channel are generally less than 40 N/m^2, with some localised areas exceeding 50 N/m^2.
  - The stream power levels along the centre of the Isaac River channel are generally less than 100 W/m^2, with some localised areas reaching up to 150 W/m^2.
  - Compared to the ACARP guideline's hydraulic criteria, under existing conditions, Isaac River channel velocities are lower than the guideline value of 2.5 m/s.
  - Velocity and stream power levels are below the ACARP guideline values.
  - Bed shear stress levels are generally within the ACARP guideline values except for localised areas.
- In relation to a 0.1% AEP event (Figure 9-27):
  - Velocities are highest within the main channel banks and are generally under 2.5 m/s. However, where there are major bends in the Isaac River channel, velocities can reach up to 3.3 m/s.
  - The bed shear stress levels along the centre of the Isaac River channel are generally less than 60 N/m^2.

- The stream power levels along the centre of the Isaac River channel are generally less than 150 W/m^2, with some localised areas reaching up to 240 W/m^2.

9.5.3.2 Developed Conditions – Channel Impact Assessment

A longitudinal section along the centre of the Isaac River channel was taken to compare the velocities, bed shear stress and stream power under developed conditions to those under existing conditions. The results are provided in Figure 9-25, Figure 9-26 and Figure 9-27, with chainage starting from approximately 1.3 km upstream of the Isaac River levee and finishing 1.7 km downstream of the Isaac River levee.

In summary, the channel impact assessment of the developed conditions presented the following findings:

- In relation to a 50% AEP flood event (Figure 9-25):
  - Velocities are increased by up to 0.2 m/s at the downstream end of the levee. However, the velocities in this area are lower than the peak velocities along the channel under existing conditions.
  - Bed shear stress levels increase by up to 5 N/m^2 at the downstream end of the levee. However, levels are still generally within the ACARP guideline values to a similar degree as the existing conditions.
  - Stream power levels increase by up to 20 W/m^2 at the downstream end of the levee. However, levels remain below the ACARP guideline values to a similar degree as the existing conditions.
  - Overall, there is negligible to minor change in velocities, bed shear stress and stream power.
- In relation to a 2% AEP flood event (Figure 9-26):
  - Velocities are increased by up to 0.4 m/s at the downstream end of the levee. However, levels are still below the ACARP guideline values.
  - Bed shear stress levels increase by up to 5 N/m^2 at the downstream end of the levee. However, levels are still generally within the ACARP guideline values to a similar degree as the existing conditions.
  - Stream power levels increase by up to 21 W/m^2 at the downstream end of the levee. However, levels remain below the ACARP guideline values to a similar degree as the existing conditions.
  - Overall, there is negligible to minor change in velocities, bed shear stress and stream power.
- In relation to a 0.1% AEP flood event (Figure 9-27):
  - Velocities are increased by up to 0.2 m/s at the downstream end of the levee, with velocities peaking at 3.3 m/s.
  - Bed shear stress levels increase by up to 4 N/m^2 at the downstream end of the levee. However, bed shear stresses in this area are lower than peak bed shear stresses in the channel under existing conditions.
  - Stream power levels increase by up to 15 W/m^2 at the downstream end of the levee, peaking at to 210 W/m^2. However, stream power levels in this area are lower than peak stream power levels in the channel under existing conditions.
  - Overall, there are minor changes in velocities, bed shear stress and stream power.

The impact assessment demonstrates that under the Project's developed conditions the proposed Isaac River levee causes negligible to minor impacts to flood velocities, bed shear stress and stream power along the centre of the Isaac River channel compared to existing conditions, and are appropriate when compared to the ACARP guideline values for 50% and 2% AEP flood events.

In addition, under developed conditions, during a 0.1% AEP flood event, the proposed Isaac River levee causes minor impacts to peak velocities at the downstream end of the levee. However, these velocities are well within the range of velocities normally experienced in the Isaac River's main channel in this reach of the river.

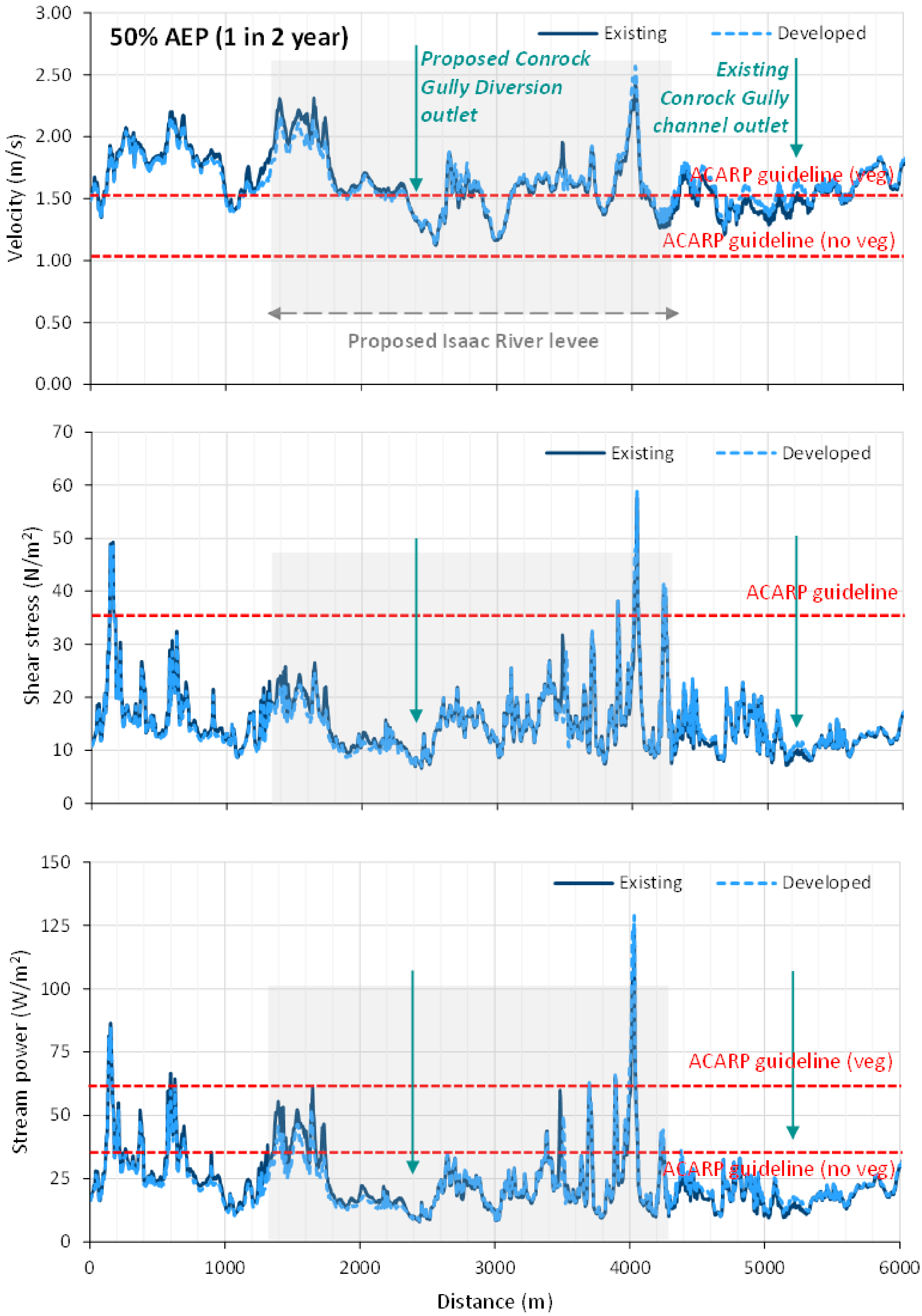


Figure 9-25 ***50% AEP Flood Event – Developed Conditions vs Existing Conditions – Peak Velocities, Stream Power and Bed Shear Stress (centre of the Isaac River channel)***

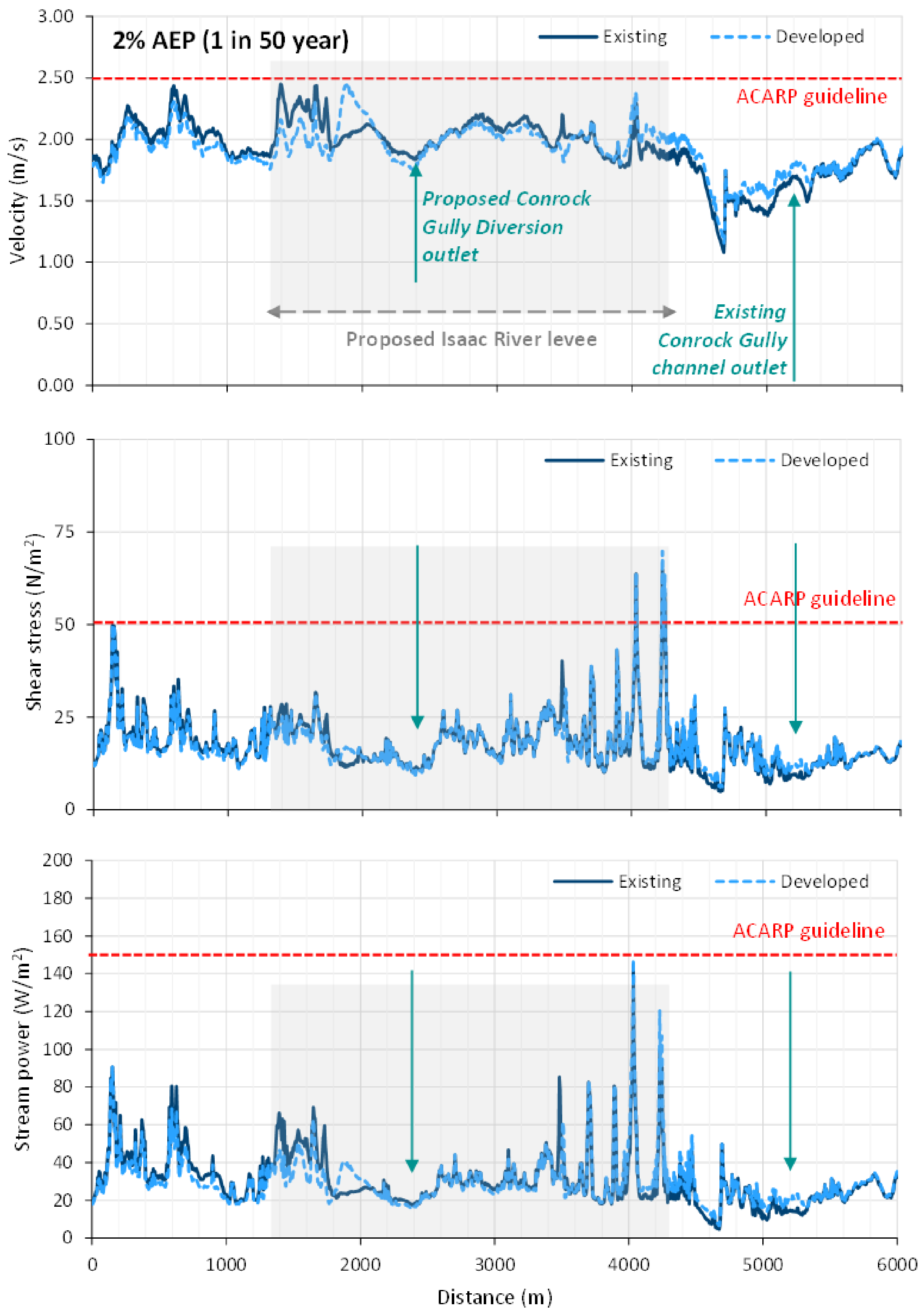


Figure 9-26 ***2% AEP Flood Event – Developed Conditions vs Existing Conditions – Peak Velocities, Stream Power and Bed Shear Stress (centre of the Isaac River channel)***

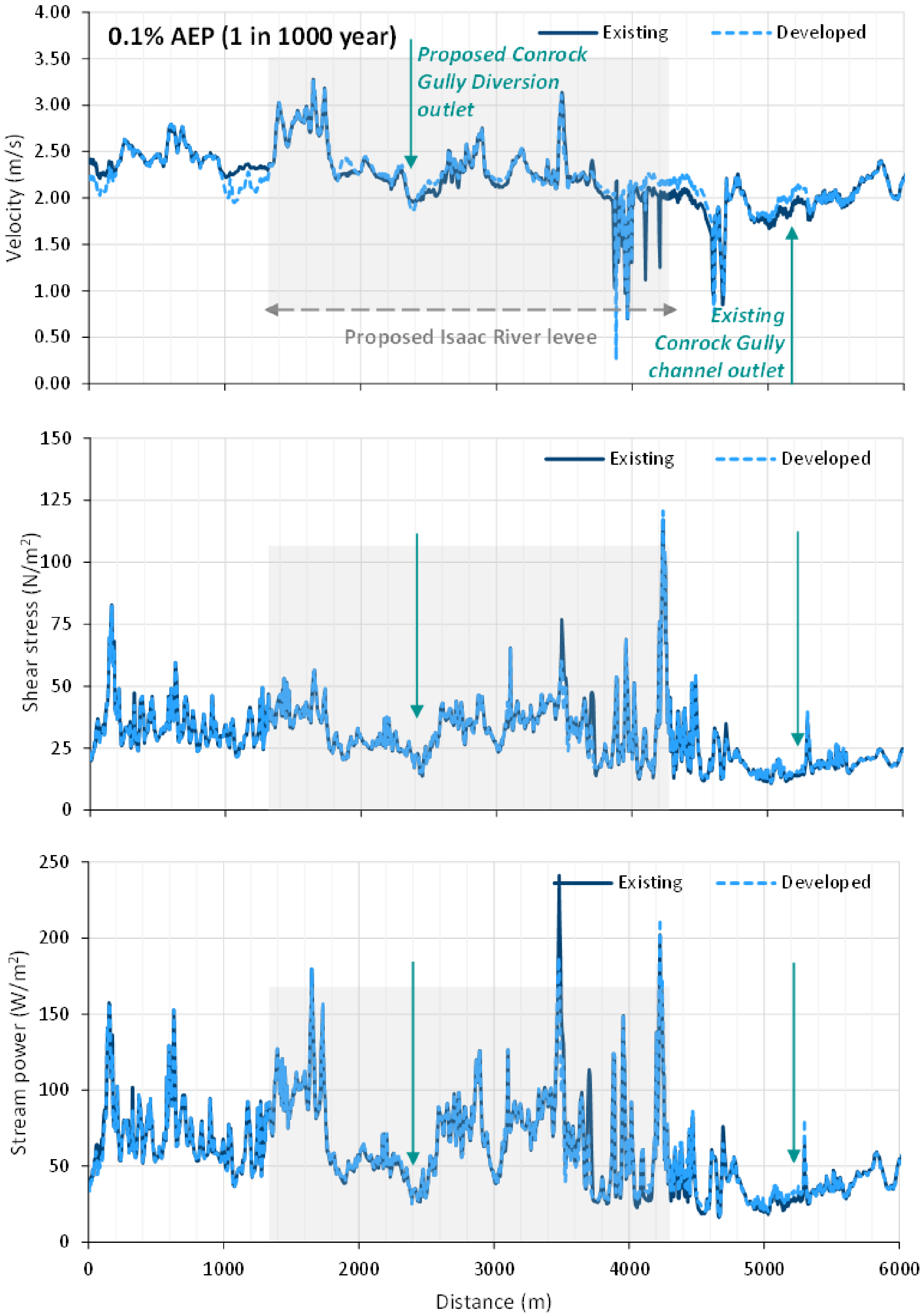


Figure 9-27 0.1% AEP Flood Event – Developed Conditions vs Existing Conditions – Peak Velocities, Stream Power and Bed Shear Stress (centre of the Isaac River channel)

9.5.3.3 Final Landform Conditions – Channel Impact Assessment

A longitudinal section along the centre of the Isaac River channel was taken to compare the velocities, bed shear stress and stream power under final landform conditions to those under existing conditions. The results are provided in Figure 9-28, Figure 9-29 and Figure 9-30.

In summary, the channel impact assessment of the final landform conditions presented the following findings:

- In relation to a 50% AEP flood event (Figure 9-28):
  - Velocities are increased by up to 0.1 m/s downstream of the final landform. However, the velocities in this area are lower than the peak velocities along the channel under existing conditions.
  - Bed shear stress levels increase by up to 1 N/m^2 downstream of the final landform. However, levels are still generally within the ACARP guideline values to a similar degree as the existing conditions.
  - Stream power levels increase by up to 3 W/m^2 downstream of the final landform. However, levels remain below the ACARP guideline values to a similar degree as the existing conditions.
  - Overall, there is negligible change in velocities, bed shear stress and stream power.
- In relation to a 2% AEP flood event (Figure 9-29):
  - Velocities are increased by up to 0.2 m/s downstream of the final landform. However, the velocities consistently remain below the ACARP guideline values.
  - Bed shear stress levels increase by up to 3 N/m^2 downstream of the final landform. However, levels are still generally within the ACARP guideline values to a similar degree as the existing conditions.
  - Stream power levels increase by up to 7 W/m^2 downstream of the final landform. However, levels consistently remain below the ACARP guideline values.
  - Overall, there is negligible change in velocities, bed shear stress and stream power.
- In relation to a 0.1% AEP flood event (Figure 9-30):
  - Velocities are increased by up to 0.15 m/s downstream of the final landform.
  - There are negligible impacts on bed shear stress or stream power levels under final landform conditions.
  - Overall, there is negligible change in velocities, bed shear stress and stream power.

The impact assessment demonstrates that the Project's final landform conditions will have even less impact on velocities, bed shear stress and stream power than developed conditions, because the Isaac River levee is decommissioned and rehabilitated.

The proposed final landform causes negligible impacts to flood velocities, bed shear stress and stream power along the centre of the Isaac River channel compared to existing conditions, and are appropriate when compared to the ACARP guideline values for 50% and 2% AEP flood events.

The impacts of the proposed final landform during a 0.1% AEP flood event are also negligible.

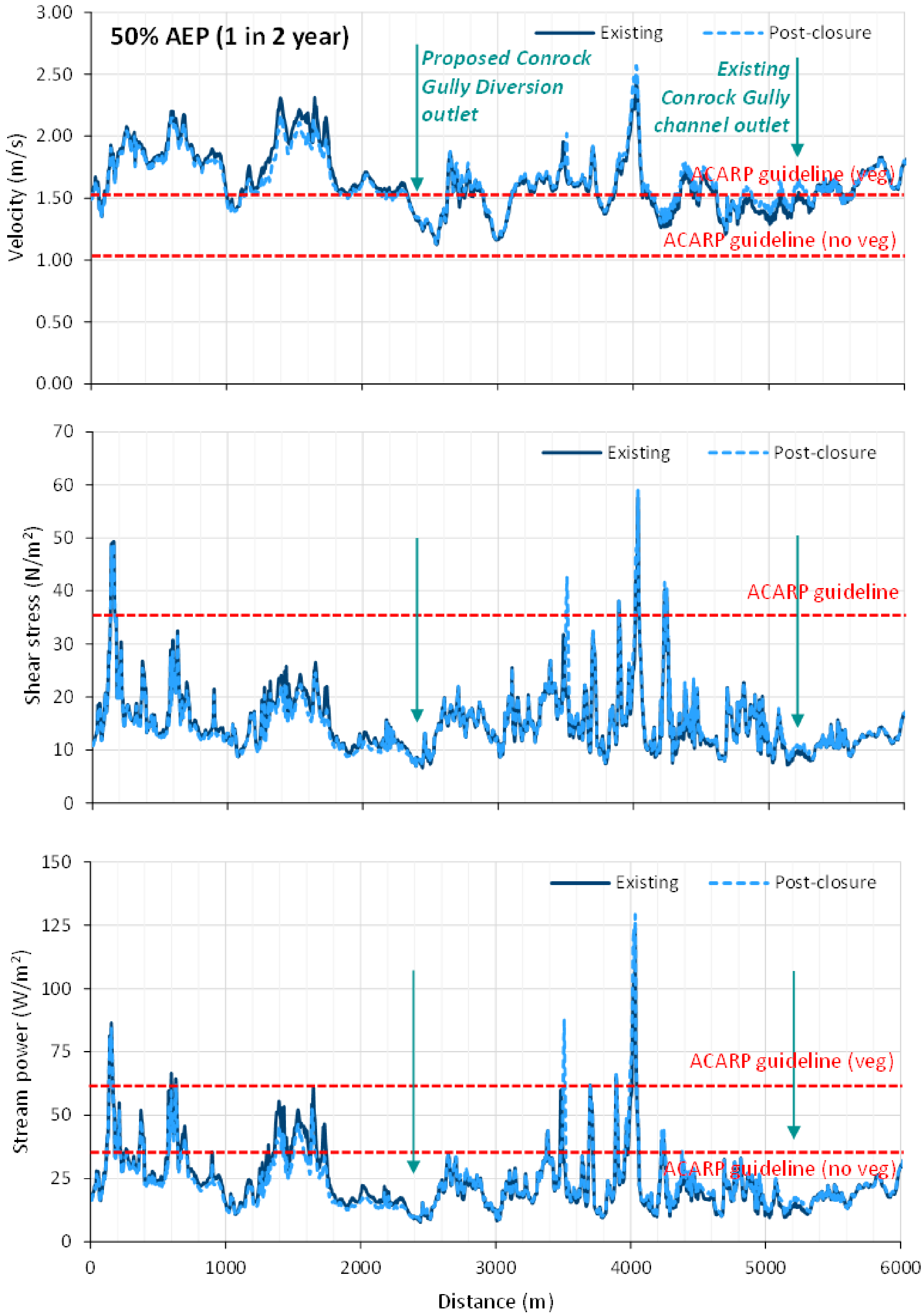


Figure 9-28 50% AEP Flood Event – Final Landform Conditions vs Existing Conditions – Peak Velocities, Stream Power and Bed Shear Stress (centre of the Isaac River channel)

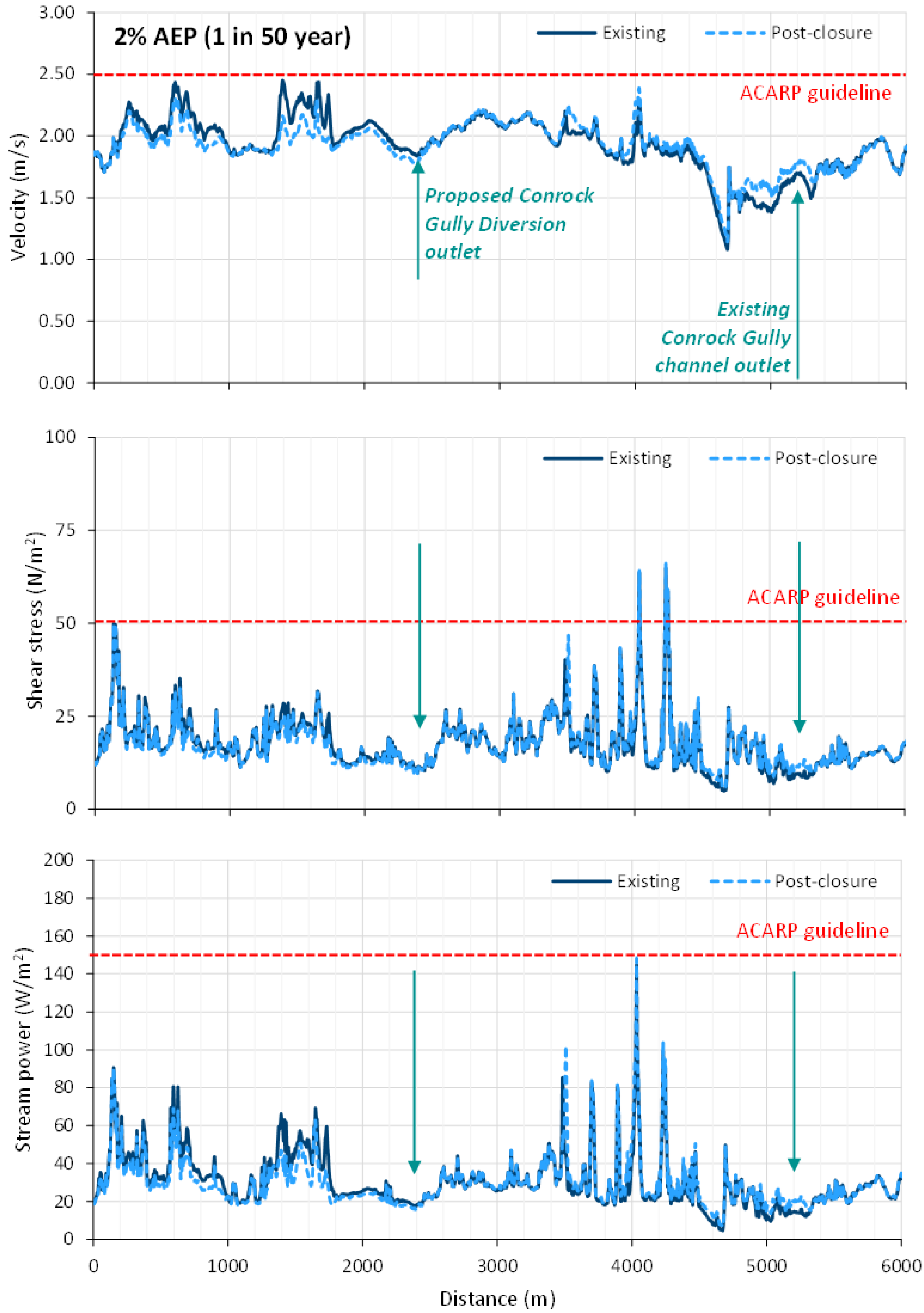


Figure 9-29 ***2% AEP Flood Event – Final Landform Conditions vs Existing Conditions – Peak Velocities, Stream Power and Bed Shear Stress (centre of the Isaac River channel)***

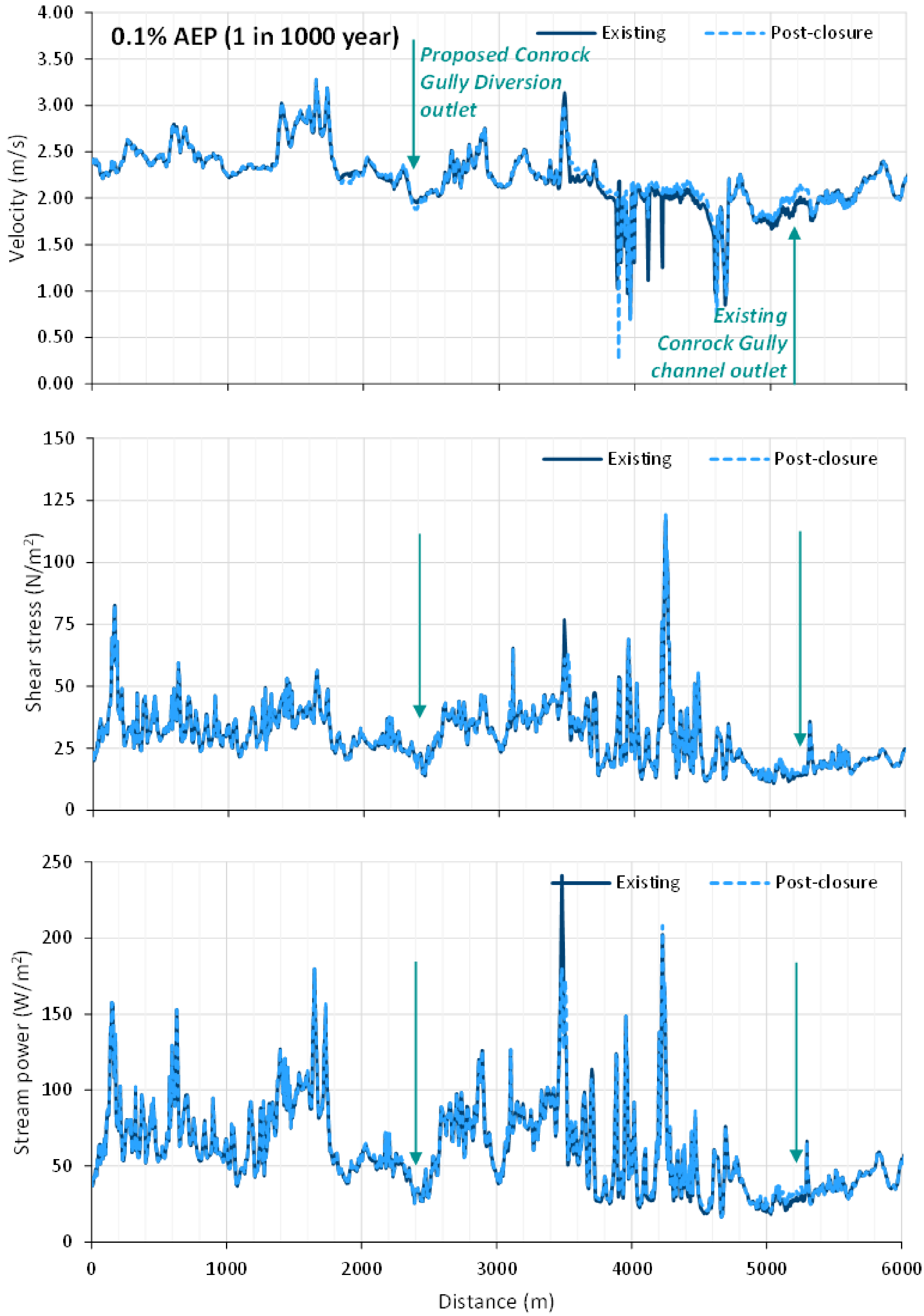


Figure 9-30 0.1% AEP Flood Event – Final Landform Conditions vs Existing Conditions – Peak Velocities, Stream Power and Bed Shear Stress (centre of the Isaac River channel)

9.5.4 Impacts on Floodplain Morphology

The hydraulic characteristics of velocity, shear stress and stream power for the Isaac River floodplain for the existing, developed and final landform conditions were assessed for 2% AEP and 0.1% AEP flood events. The 50% AEP flood event was excluded as the Isaac River flow is generally contained within the river channel for this event, and therefore, does not interact with the floodplain.

9.5.4.1 Existing Conditions – Hydraulic Characteristics

The Project's existing conditions model results show the following properties:

- In relation to a 2% AEP flood event (Appendix C.2 of **Appendix J**):
  - Floodplain velocities are generally less than 2 m/s and peak along floodplains adjacent to the major bends in the Isaac River channel.
  - Floodplain bed shear stresses are generally less than 35 N/m^2, with some localised areas adjacent to the channel reaching 60 N/m^2.
  - Floodplain stream power levels are generally less than 60 W/m^2, with some localised areas peaking to values greater than 100 W/m^2.
  - Velocities, bed shear stresses and stream power levels are generally below the ACARP guideline values, with the exception of small localised areas along the floodplain directly adjacent to the Isaac River channel where previous scour is evident and levels can exceed guideline values.
- In relation to a 0.1% AEP flood event (Appendix C.2 of **Appendix J**):
  - Floodplain velocities are generally less than 2.6 m/s and peak along floodplains adjacent to the major bends in the Isaac River channel.
  - Floodplain bed shear stresses are generally less than 60 N/m^2, with some localised areas reaching 80 N/m^2.
  - Floodplain stream power levels are generally less than 150 W/m^2, with some localised areas exceeding 200 W/m^2.

9.5.4.2 Developed Conditions – Floodplain Impact Assessment

In summary, the floodplain impact assessment of the developed conditions presented the following findings:

- In relation to a 2% AEP event (Figure 9-31, Figure 9-33 and Appendix C.2 of **Appendix J**):
  - Velocities are increased by up to 0.5 m/s along the floodplain to the south of IDM and by up to 0.8 m/s along the downstream reach of the Isaac River levee. However, the floodplain velocities in these areas are generally lower than 2 m/s and below the ACARP guideline values.
  - Bed shear stresses are increased by up to 15 N/m^2 along the floodplain to the south of IDM and by up to 30 N/m^2 along the downstream reach of the Isaac River levee. However, levels are generally similar to existing conditions along the floodplain adjacent to the Isaac River levee.
  - Stream power levels are increased by up to 35 W/m^2 along the floodplain to the south of IDM and by up to 50 W/m^2 along the downstream reach of the Isaac River levee. Levels are generally unchanged from existing conditions along the floodplain adjacent to the Isaac River levee and below the ACARP guideline values.
  - Overall, bed shear stress and stream power experience negligible change across the majority of the floodplain, with some minor localised changes.
- In relation to a 0.1% AEP flood event (Figure 9-32, Figure 9-34 and Appendix C.2 of **Appendix J**):
  - Velocities are generally increased by around 0.7 m/s in the floodplain adjacent to the Project, with some areas increasing by up to 1.1 m/s downstream of IDM and adjacent to

the downstream reach of the Isaac River levee. However, the velocities in this area are lower than the peak velocities along the floodplain under existing conditions.
- Bed shear stresses increase by up to 25 N/m^2 along the floodplain adjacent to the Project. However, increases in shear stress of up to 35 W/m^2 are observed in the floodplain downstream of IDM and adjacent to the downstream reach of the Isaac River levee.
- Stream power levels are generally increased by less than 60 W/m^2 in the floodplain adjacent to the Project. However, increases in stream power of up to 100 W/m^2 are observed in the floodplain downstream of IDM and adjacent to the downstream reach of the Isaac River levee.
- The bed shear stress and stream power levels in the Isaac River floodplain are higher than the levels typically experienced during the 0.1% AEP flood event for existing conditions with potential localised floodplain changes downstream of IDM, and adjacent to the downstream reach of the Isaac River levee, which will have rock protection to prevent scour.

The impact assessment demonstrates that under the Project's developed conditions, the peak velocities, bed shear stresses and stream power levels along the floodplain adjacent to Isaac River are generally similar to the peak levels under existing conditions and are appropriate compared to the ACARP guideline values during a 2% AEP flood event.

For the extremely rare 0.1% AEP flood event, it is possible that some impacts to the Isaac River floodplain geomorphology may occur in localised areas: the sections downstream of IDM and in the downstream section of the Isaac River levee. Geomorphological changes are most likely to occur due to frequent and repeated flood flows, rather than a 0.1% AEP flood event. Therefore, it is considered unlikely that these changes will occur within the Project's 15-year mine life when the Isaac River levee is in place. The proposed Isaac River levee will be decommissioned and rehabilitated following mining operations.

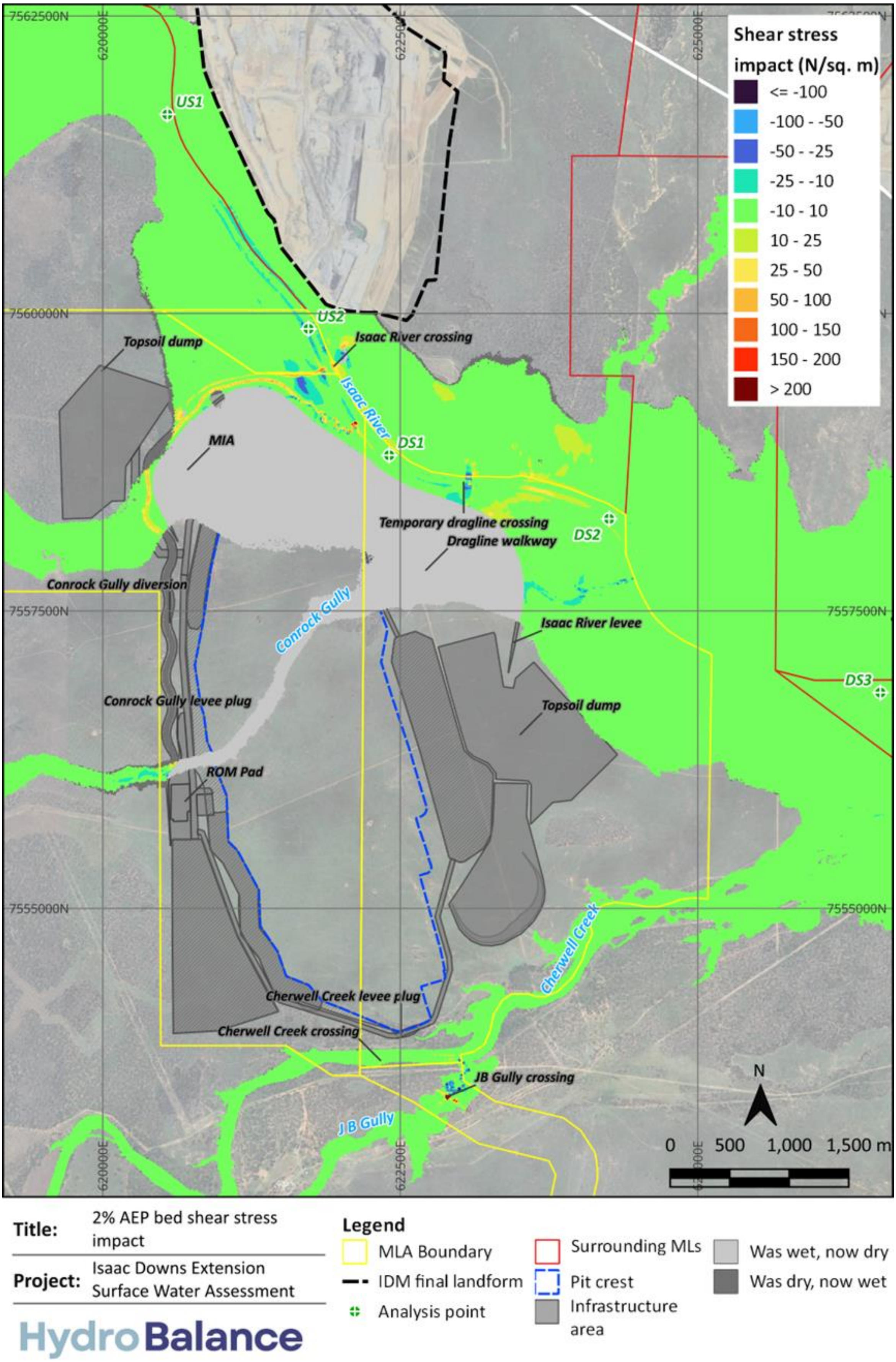


Figure 9-31 2% AEP Flood Event – Bed Shear Stress Impacts (Developed minus Existing Conditions)

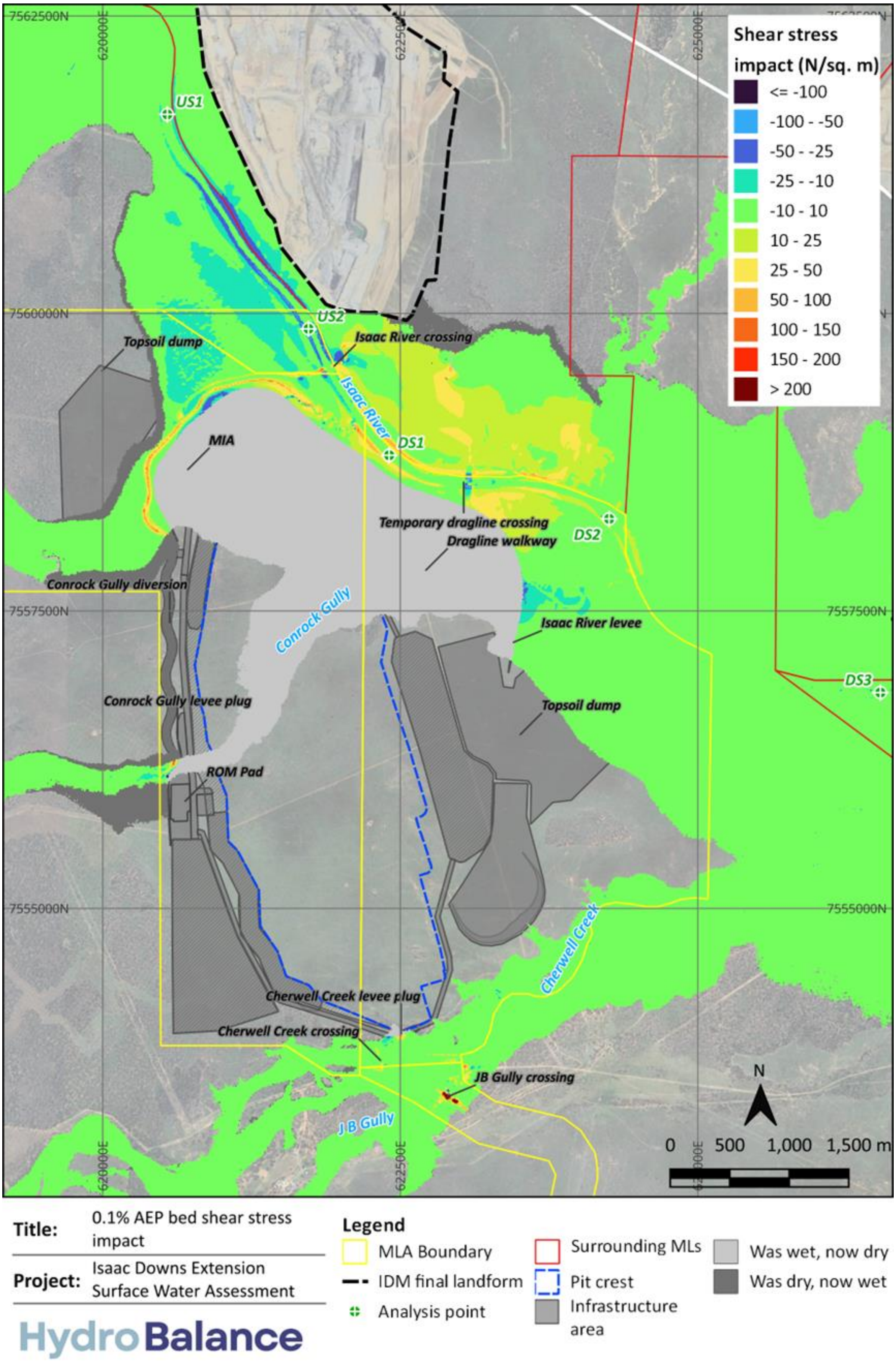


Figure 9-32 0.1% AEP Flood Event – Bed Shear Stress Impacts (Developed minus Existing Conditions)

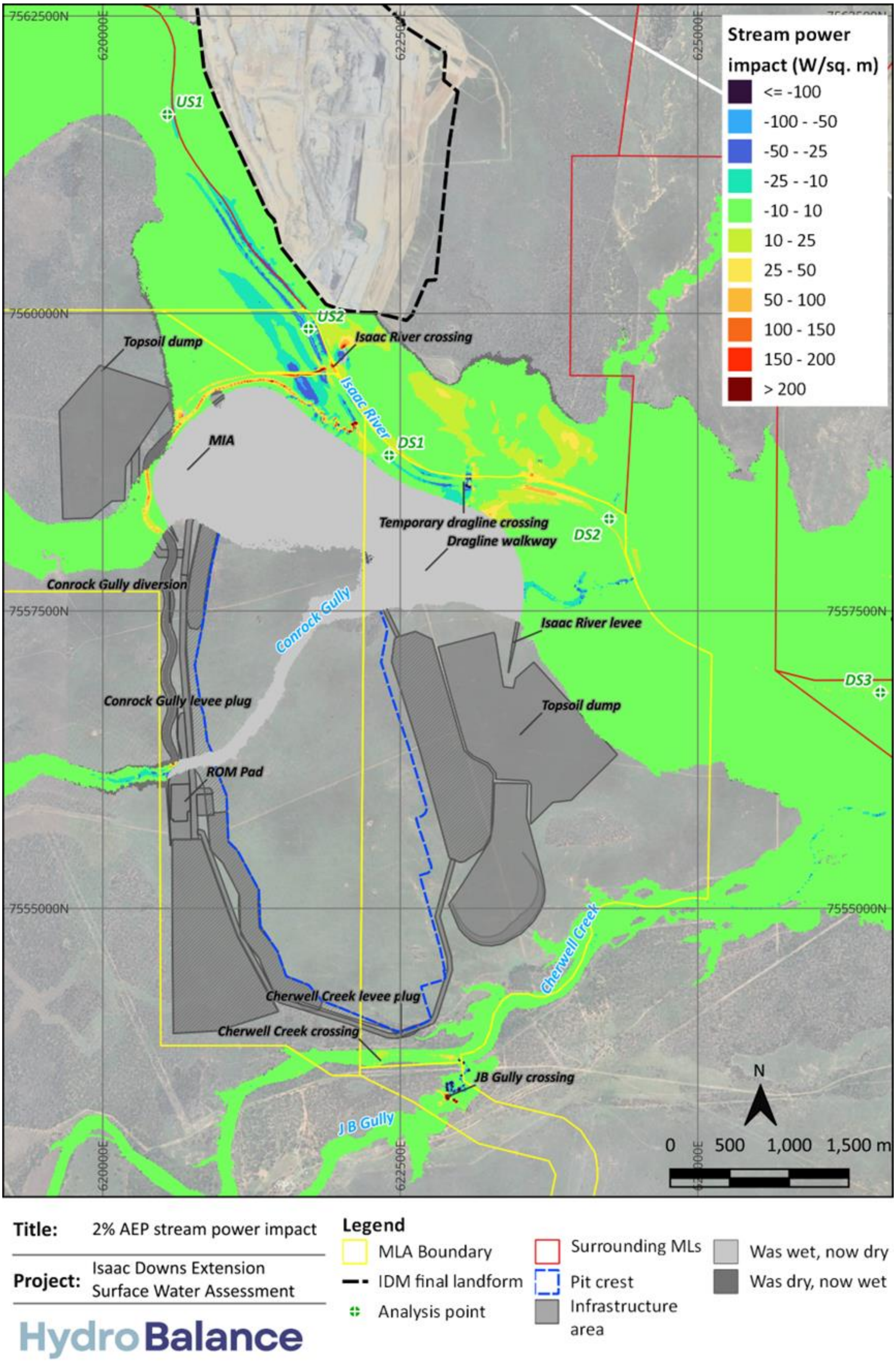


Figure 9-33 2% AEP Flood Event – Stream Power Impacts (Developed minus Existing Conditions)

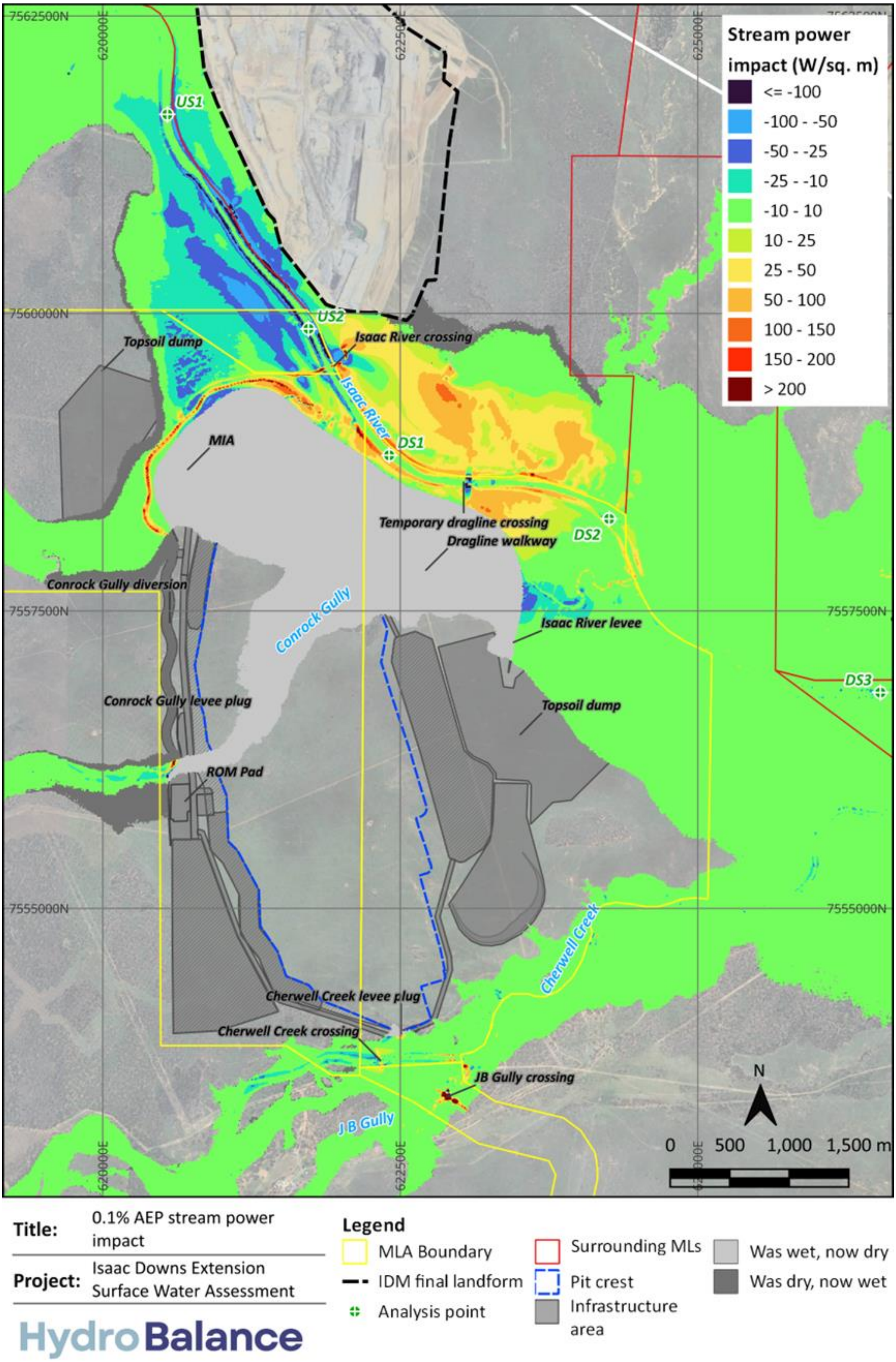


Figure 9-34 0.1% AEP Flood Event – Stream Power Impacts (Developed minus Existing Conditions)

9.5.4.3 Final Landform Conditions – Floodplain Impact Assessment

The Isaac River levee will be decommissioned and rehabilitated following mining operations, and therefore, any impacts on the floodplain morphology under final landform conditions would be even less than during mining operations. An assessment of the floodplain morphology for the Project's final landform conditions under rare and extreme flood events was undertaken for 2% and 0.1% AEP flood events.

In summary, the floodplain impact assessment of the Project's final landform conditions presented the following findings:

- In relation to a 2% AEP flood event (Figure 9-35, Figure 9-37 and Appendix C.2 of **Appendix J**):
    - There are negligible impacts to velocity, bed shear stress and stream power levels in the Isaac River floodplain due to the proposed final landform.
- In relation to a 0.1% AEP flood event (Figure 9-36, Figure 9-38 and Appendix C.2 of **Appendix J**):
    - Velocities may increase by up to 0.4 m/s along the floodplain adjacent to the out-of-pit dump emplacement. However, the velocities in this area are generally consistent with peak velocities along the floodplain under existing conditions.
    - Bed shear stress impacts along the western floodplain are generally less than 10 N/m^2. There are no material impacts along the eastern floodplain.
    - Stream power level impacts along the western floodplain are generally less than 20 W/m^2. There are no material impacts along the eastern floodplain.
    - Overall, there are negligible changes in bed shear stress and stream power across the entire floodplain.

The impact assessment demonstrates that there are negligible to minor increases in velocity, and negligible changes in shear stress and stream power within floodplain of the Isaac River, as a result of the Project's proposed final landform. Therefore, the geomorphic impact on the Isaac River floodplain due to the Project's proposed final landform is expected to be negligible.

As part of final landform preparation required under the Project's PRCP, floodplain surfaces will be stabilised and rehabilitated to achieve a self-sustaining vegetation cover. This vegetation cover will increase erosion resistance and enhance landform stability.

The hydraulic characteristics of flow within the Project's backfilled pit area are similar to or lower than under existing conditions, and therefore, the Project's backfilled pit area is expected to remain a stable landform with revegetation of the floodplain surface.

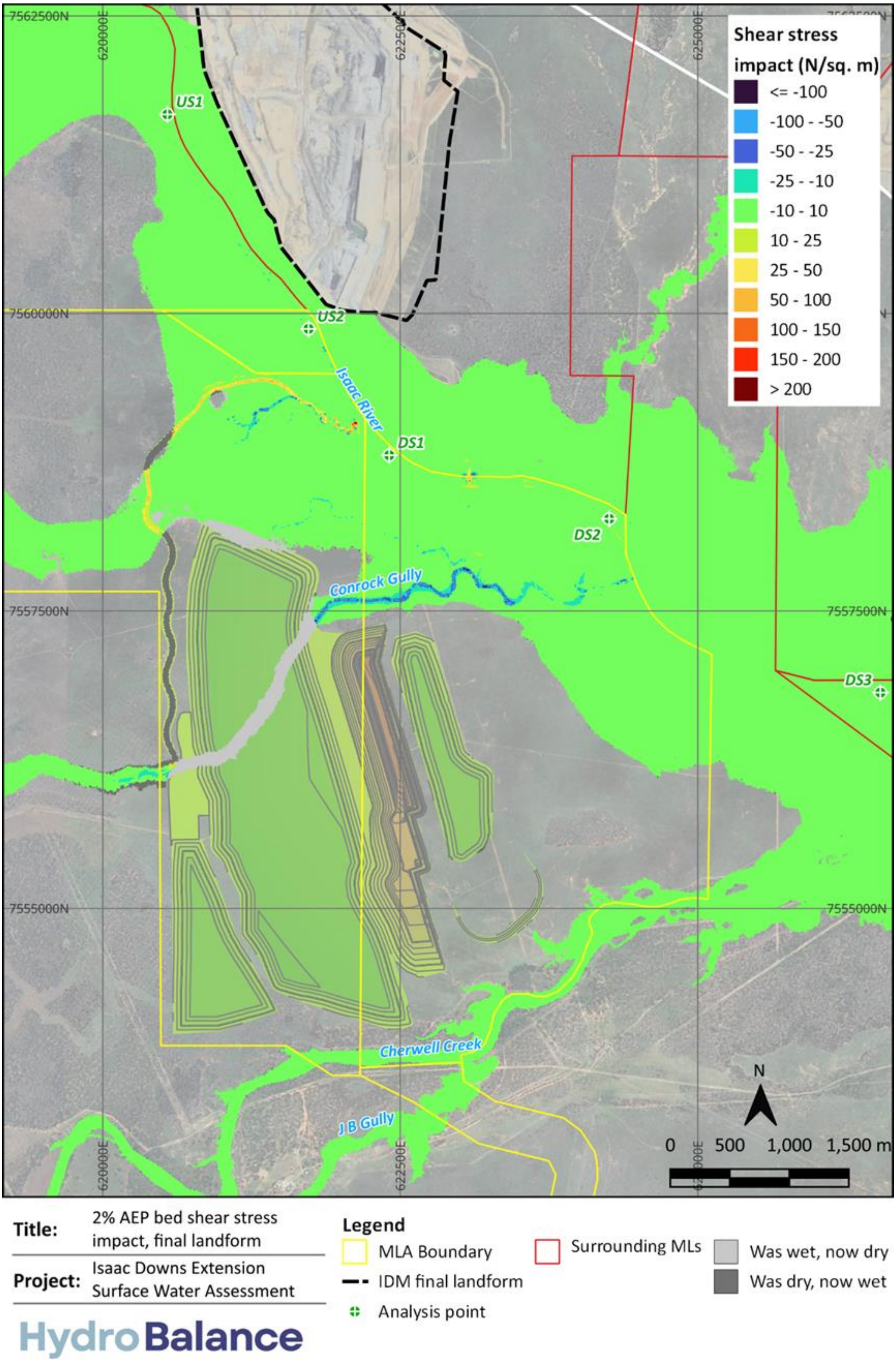


Figure 9-35 Final Landform – 2% AEP Flood (Minus Existing Conditions) – Bed Shear Stress Impacts

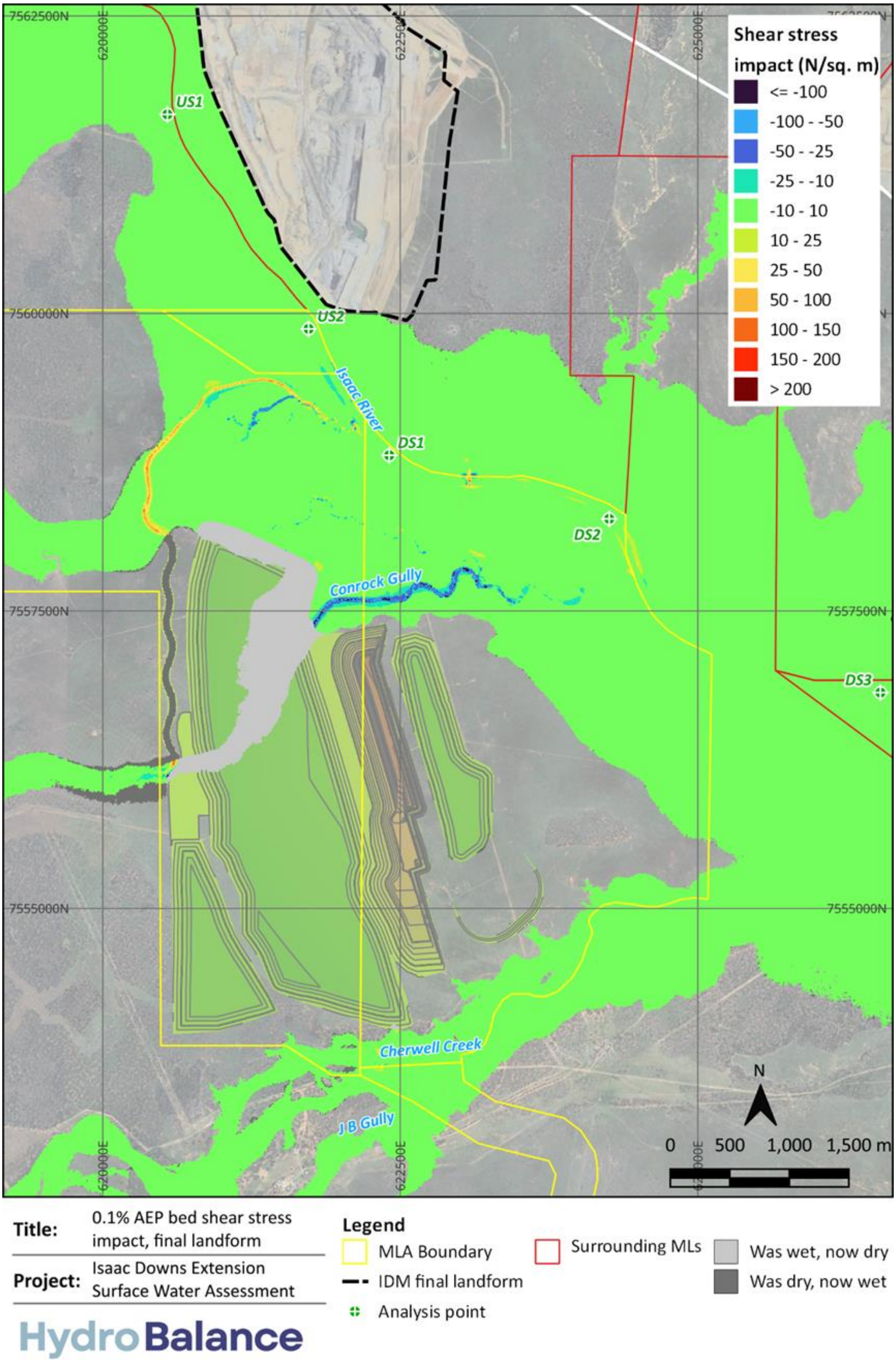


Figure 9-36 Final Landform – 0.1% AEP Flood (Minus Existing Conditions) – Bed Shear Stress Impacts

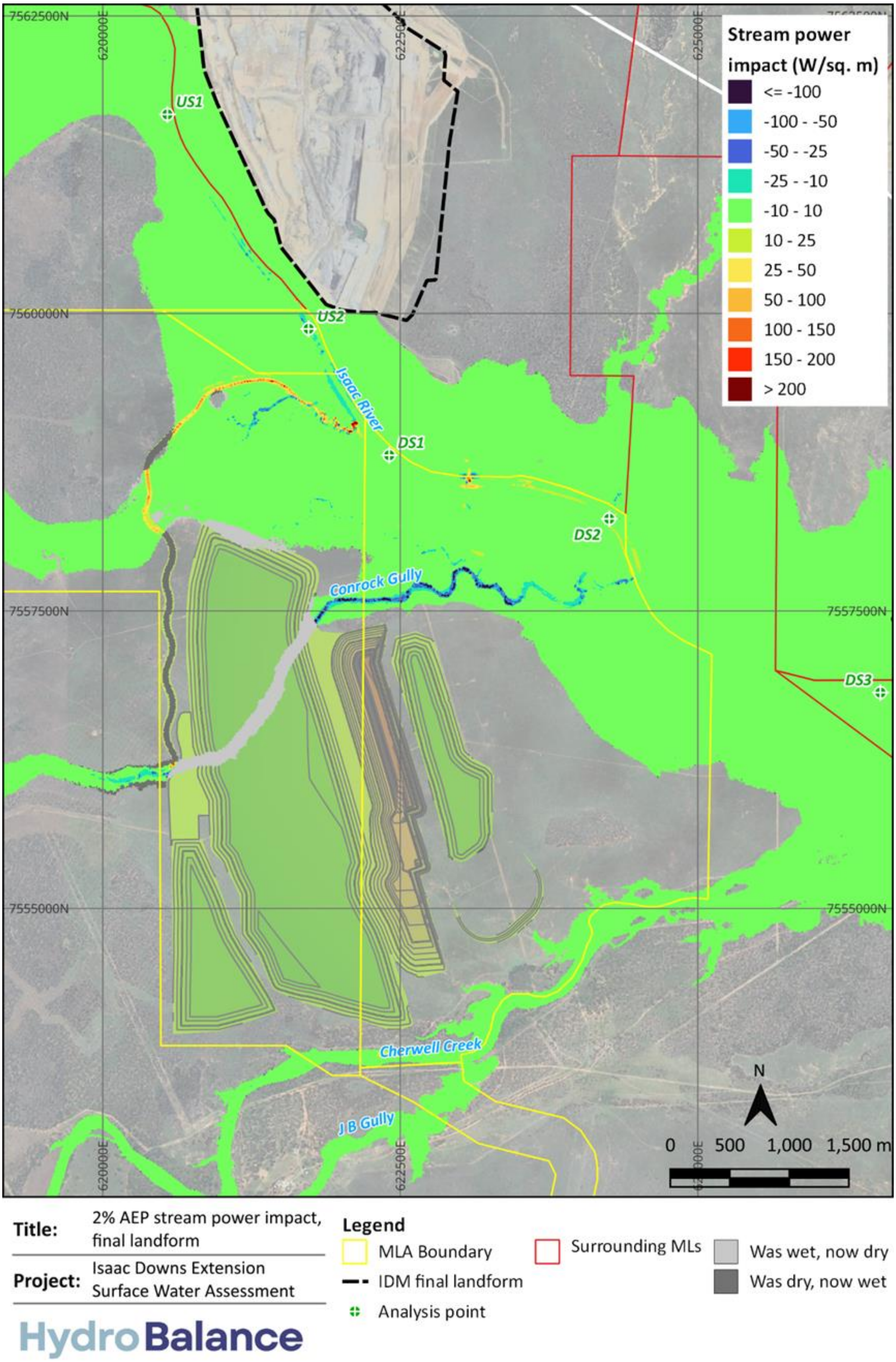


Figure 9-37 Final Landform – 2% AEP Flood (Minus Existing Conditions) – Stream Power Impacts

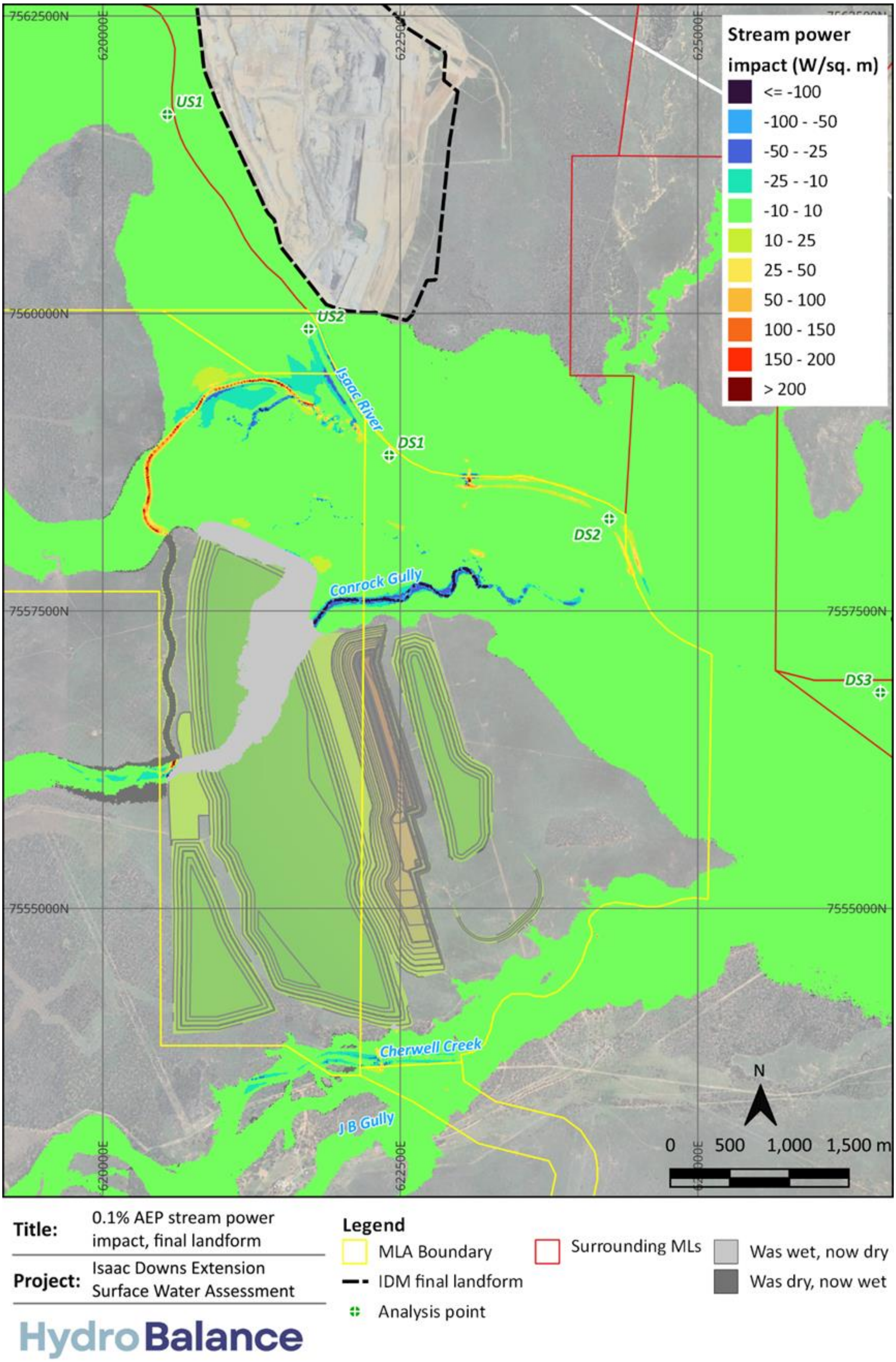


Figure 9-38 Final Landform – 0.1% AEP Flood (Minus Existing Conditions) – Stream Power Impacts

9.5.4.4 Geomorphic Impact Assessment Summary

The Project's geomorphic impact assessment of channel morphology identified the following conclusions:

- In relation to existing conditions:
  - Velocities within the main channel are generally higher than the ACARP guideline values for a 50% AEP flood event. The 2% AEP flood velocities are consistently less than the ACARP guideline values.
  - Bed shear stress and stream power are generally within the ACARP guideline values, except for small, localised areas.
- In relation to developed conditions:
  - The Isaac River levee causes negligible to minor impacts to flood velocities, bed shear stress and stream power along the Isaac River channel.
  - The proposed Project infrastructure is unlikely to materially impact on the geomorphology of the Isaac River channel in the vicinity of the Project.
- In relation to final landform conditions:
  - Following the decommissioning and rehabilitation of the Isaac River levee, the proposed final landform causes negligible impacts to flood velocities, bed shear stress and stream power along the Isaac River channel.
  - The proposed final landform is unlikely to impact on the geomorphology of the Isaac River channel in the vicinity of the Project.

The Project's geomorphic impact assessment of floodplain morphology identified the following conclusions:

- In relation to existing conditions:
  - Velocities along the Isaac River floodplain are generally within the ACARP guideline values for a 2% AEP flood event.
  - Shear stress and stream power are generally within the ACARP guideline values, except for small, localised areas.
- In relation to developed conditions:
  - The peak velocities, bed shear stresses and stream power levels along the floodplain adjacent to Isaac River are generally similar to the peak levels under existing conditions and are appropriate compared to the ACARP guideline values during a 2% AEP flood event.
  - For the extremely rare 0.1% AEP flood event, it is possible that some localised impacts to the Isaac River floodplain geomorphology may occur in the sections downstream of IDM and downstream of the Isaac River levee. However, it is considered unlikely that these localised impacts will occur within the relatively short 15-year period of mining operations. The Isaac River levee will be decommissioned and rehabilitated prior to closure.
- In relation to final landform conditions:
  - There are negligible to minor changes in the hydraulic characteristics within the floodplain of the Isaac River as a result of the proposed final landform.

As part of final landform preparation required under the Project's PRCP, floodplain surfaces will be stabilised and rehabilitated to achieve a self-sustaining vegetation cover. This vegetation cover will increase erosion resistance and enhance landform stability.

9.6 Conrock Gully Assessment

9.6.1 Functional Design Report

The existing Conrock Gully main channel flows into the Isaac River from the west. To provide safe and efficient access to the Project's underlying coal resource, the gully channel will be diverted to the northwest. The Isaac River levee will be constructed along the southern edge of the diversion to protect the Project's mining operations from Isaac River flood events, which results in Isaac River backwater entering the diversion similar to current circumstances where the Isaac River backwater enters the existing Conrock Gully channel. The Project's functional design report for the Conrock Gully diversion is provided in Appendix D of **Appendix J**. The Project's functional design report comprises the following sections:

- Section 1: Introduction
- Section 2: Design Approach
- Section 3: Existing Geomorphic and Vegetation Conditions
- Section 4: Existing Hydrologic and Hydraulic Conditions
- Section 5: Design Details
- Section 6: Hydraulic Assessment
- Section 7: Monitoring
- Section 8: Conclusions

The hydraulic assessment was used to assess the potential hydraulic impacts and demonstrate the suitability of Conrock Gully diversion's functional design.

Cross sections of Conrock Gully in the reach to be diverted are provided in Section 3 of Appendix D of **Appendix J.** The typical channel is described as having a base width of approximately 4 m, a side slope of 1V in 6H for the channel and a side slope of 1V in 30H on the channel overbank. The diversion geometry, designed to be similar to the existing gully geometry is provided in Section 5 of Appendix D of **Appendix J**.

9.6.2 Design Approach

A functional design for the Conrock Gully diversion was prepared to address the objectives and design criteria of the DNRME guideline and achieve the following required outcomes:

- Outcome 1 - The design incorporates natural features present in the local watercourses, and it replicates the channel length, slope and cross-sectional shape. It incorporates meanders with radii, amplitude and magnitude similar to existing meanders in the adjacent reaches and the reach to be diverted. A revegetation plan will be established which will incorporate local vegetation to achieve bank stability.
- Outcome 2 - As the diversion is located on the edge of the floodplain, and it incorporates the above features, it maintains the existing hydrologic characteristics of surface water systems.
- Outcome 3 - The hydraulic characteristics of the design are comparable with those in the existing watercourse, and it is therefore suitable for the region in which the diversion is located.
- Outcome 4 - As the hydraulic characteristics are largely unchanged, the sediment transport will allow the watercourse diversion to be self-sustaining and is unlikely to result in material or serious environmental harm on upstream and downstream reaches.
- Outcome 5 - The watercourse diversion and associated structures maintain stability and functionality and are appropriate for all substrate conditions they encounter. This will be confirmed in later design phases.

The ACARP guideline design criteria recommended for Bowen Basin stream diversions are provided in Table 9-7. The terms 'ACARP guideline' and 'DNRME guideline' are used interchangeably when comparing hydraulic performance to design criteria.

9.6.3 Hydraulic Assessment Methodology

For Conrock Gully diversion's hydraulic assessment, the existing conditions TUFLOW hydraulic model was amended to include the Conrock Gully diversion and the proposed levees required to protect the Project's mining area from local gully and Isaac River flooding. Further details of the hydraulic assessment's methodology are provided in Section 6.1 within Appendix D of **Appendix J**.

9.6.4 Diversion Depths and Velocities

9.6.4.1 Summary – Depths and Velocities

The developed conditions flood depths for the 50% and 2% AEP design local flood events, with no regional flood event within the Isaac River, are shown in Figure 6.1 and Figure 6.2, respectively, within Appendix D of **Appendix J**. The 0.1% AEP design regional flood extent for developed conditions is shown in Figure 6.3 within Appendix D of **Appendix J**. The flood depths are relatively uniform throughout the 4.0 km upstream reach of the diversion. The depths fluctuate slightly (± 1 m) within the downstream 1.2 km reach due to the changes to the diversion base slope and meander radii. The flood depth within the diversion is generally around 2.2 m and 3.9 m for the 50% AEP and 2% AEP local flood events, respectively.

The modelled flood velocity for the 50% and 2% AEP design local flood events and the 0.1% AEP design regional flood events are shown in Figure 6.4, Figure 6.5 and Figure 6.6, respectively, within Appendix D of **Appendix J**. Overall, the velocities are relatively uniform throughout the Conrock Gully diversion, increasing slightly as the Conrock Gully diversion joins the Isaac River. Velocities within the Conrock Gully diversion are generally around 2 m/s or lower.

The flood modelling presented in Section 9.4 includes the diversion and hence this shows any changes in flood depth and velocity attributable to the diversion.

9.6.4.2 Outlet Velocities

The Conrock Gully diversion outlet is located at the Isaac River bank, at an existing confluence between a minor drainage line and the Isaac River. At the outlet, the diversion may experience higher than average diversion velocities when there are low or no flows in the Isaac River. The modelled velocities at the outlet are shown in Figure 6.7 within Appendix D of **Appendix J**. The peak velocities at this location range between 3.2 m/s (50% AEP flood event) and 4.6 m/s (2% AEP flood event). The peak velocities at the outlet would be far lower during Isaac River flow events due to tailwater effects, generally below 2 m/s. Isaac River flows would submerge the diversion outlet during flood events greater than or equal to the 10% AEP regional flood event. Conrock Gully flow events are expected to occur independently of Isaac River flow events infrequently.

The velocities during local creek flow events at the diversion outlet are similar to those experienced in the existing waterways and drainage lines at their respective confluences with the Isaac River. Table 6.1 within Appendix D of **Appendix J** shows a comparison between the post-development and existing velocities. The results show that the velocities at the diversion outlet would be close to or within the range of those experienced at the existing Conrock Gully confluence locations.

In summary, the velocities at the proposed Conrock Gully diversion outlet are considered acceptable, given the following considerations:

- High velocities are only expected to occur when Conrock Gully flows independently of the Isaac River, which is unlikely to occur frequently.

- The velocities at the diversion outlet during local flows with no regional flooding are within the range of the velocities at the existing Isaac River confluences.

9.6.5 Comparison to DNRME Guideline Hydraulic Criteria

The main channel section-averaged results of the hydraulic modelling of the Conrock Gully diversion in a 50% AEP flood event is shown in Figure 9-39. Generally, due to the uniform diversion channel shape, the values within the diversion channel vary more uniformly than in the existing channel.

In summary, the following results were identified for a vegetated diversion channel:

- In relation to velocity:
  - At most locations, the existing Conrock Gully velocity is below the DNRME guideline value of 1.5 m/s, with atypical range of 0.75 m/s to 1.5 m/s.
  - The velocity in the Conrock Gully diversion channel is lower than the existing Conrock Gully channel and consistently below the guideline value of 1.5 m/s, with a typical range of 0.7 m/s to 1.2 m/s.
  - In the downstream section of the Conrock Gully diversion, there is a slight increase in velocity as flows traverse down the Isaac River bank, although this is still below the DNRME guideline value. Vegetation, including trees and shrubs, will be established in this location, to manage the potential scour risk and to be consistent with the existing Isaac River banks in this location.
- In relation to shear stress and stream power:
  - The values in the existing Conrock Gully channel fluctuate and periodically exceed the DNRME Guideline values throughout the length of Conrock Gully.
  - The values in the Conrock Gully diversion are relatively uniform and are below the existing gully channel and well within the envelope of naturally occurring values. There is an exceedance of the DNRME guideline values at the confluence with the Isaac River, which also occurs in the existing channel. The confluence shear stress and stream power is improved in the Conrock Gully diversion compared to the existing channel.
  - The shear stress and stream power levels are improved in comparison to the existing Conrock Gully channel.

For a non-vegetated diversion channel, the DNRME guideline includes hydraulic criteria for un-vegetated conditions, which would be representative of potential conditions immediately post-construction of the Conrock Gully diversion for a 50% AEP flood event.

The modelled velocities and stream power in the Conrock Gully diversion may exceed the DNRME Guideline value for un-vegetated conditions in some local areas, similar to, although less frequent than, the existing Conrock Gully channel.

The results indicate that post-construction there will be an elevated erosion risk, which will be managed through revegetation planning. Stabilisation works may need to be considered to manage the potential for damage during early flows. However, this potential for damage is likely to be mitigated by the relatively cohesive nature of the local soils. The proposed rehabilitation and revegetation for the diversion is included the PRCP schedule. Initial vegetation cover will be established before accepting overland flow from the Conrock Gully catchment.

The main channel section-averaged results of the hydraulic modelling of the Conrock Gully diversion in a 2% AEP flood event is shown in Figure 9-40. In summary, the following results were identified:

- In relation to velocity:
  - The existing Conrock Gully velocity is less than the DNRME guideline value of 2.5 m/s, with a typical range of 1.0 m/s to 1.5 m/s.

  - In the Conrock Gully diversion, the velocity is well below the DNRME guideline values and are consistently within or better than the typical range of the existing Conrock Gully channel.
- In relation to shear stress and stream power:
  - The existing Conrock Gully channel shear stress and stream power level are generally below the DNRME guideline values aside from some exceedances, particularly as the existing channel meets the Isaac River.
  - The shear stress and stream power in the Conrock Gully diversion is generally similar to the existing Conrock Gully condition, and below the DNRME guideline values. At the confluence with the Isaac River the Conrock Gully diversion has lower shear stress and stream power than the existing Conrock Gully confluence, although with minor exceedances of the DNRME guideline values.
  - Overall, the shear stress and stream power levels for the Conrock Gully diversion are improved in comparison to the existing Conrock Gully channel.

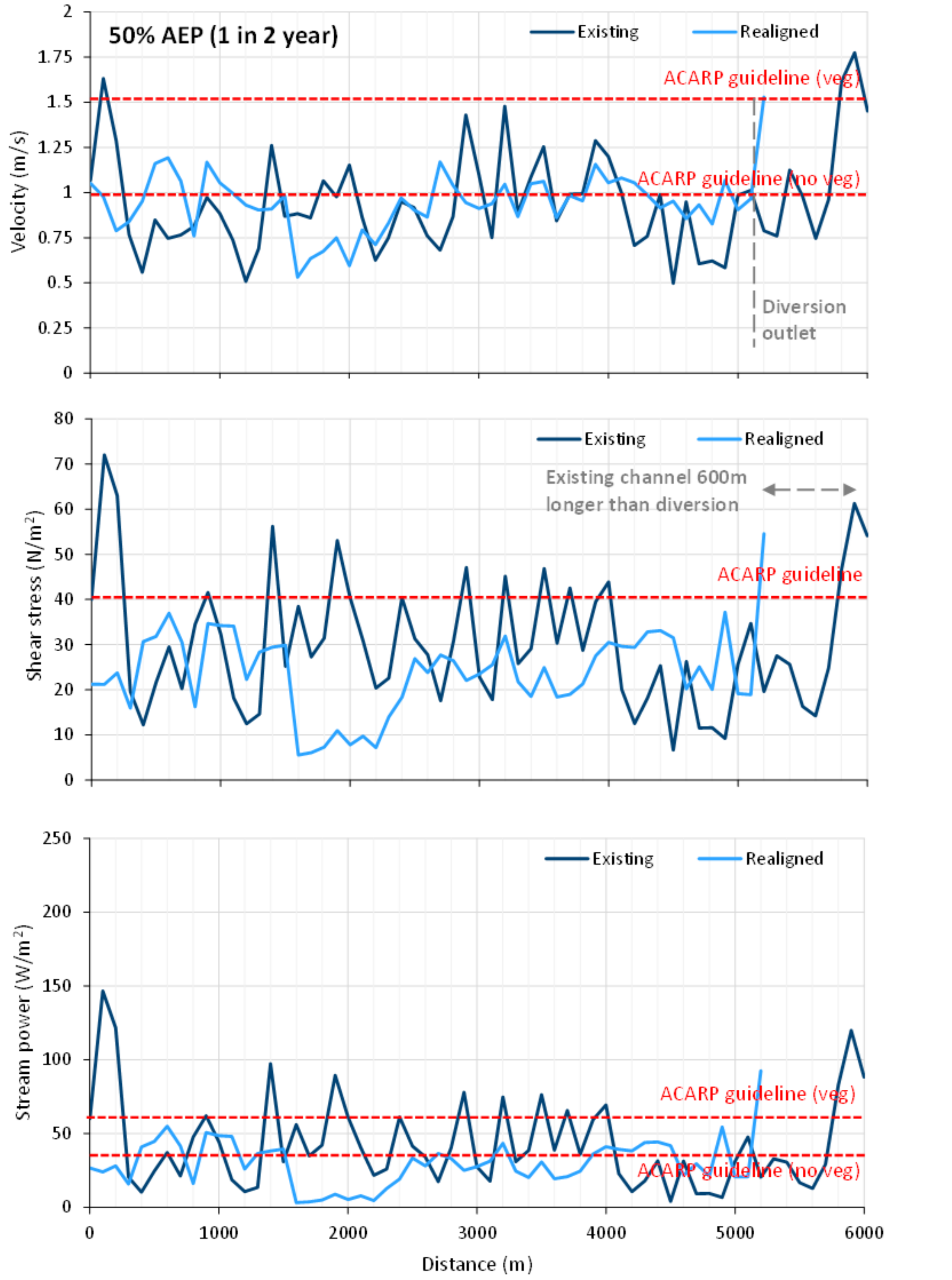


Figure 9-39 Longitudinal Profiles: 50% AEP Section-averaged Velocity, Stream Power and Bed Shear Stress

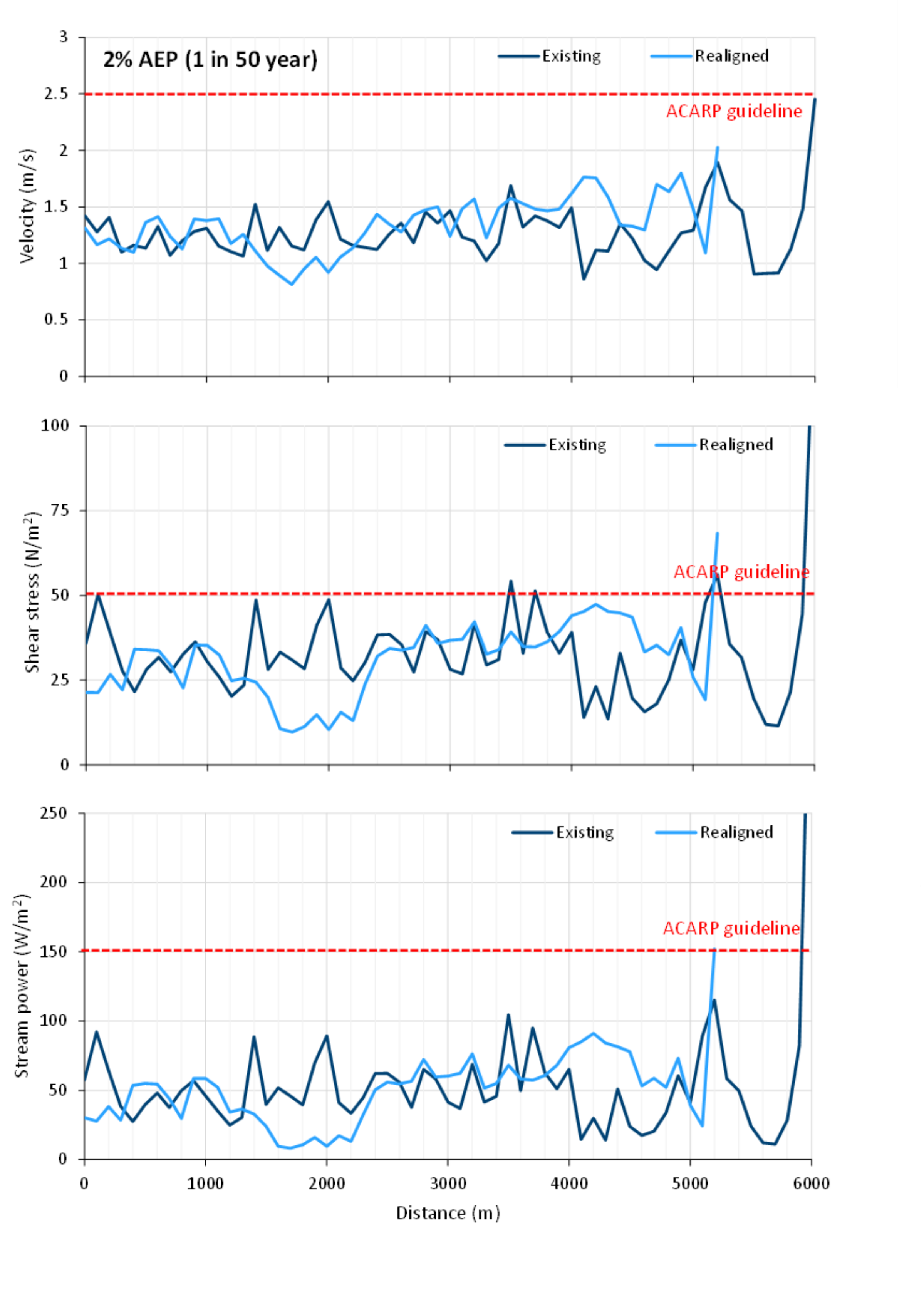


Figure 9-40 Longitudinal Profiles: 2% AEP Section-averaged Velocity, Stream Power and Bed Shear Stress

9.6.6 Project Site Access Road Assessment

A one-dimensional HEC-RAS (USACE, 2024) model was developed to assess the proposed crossing that would allow the Project's site access / haul road to traverse the Conrock Gully diversion. The crossing has been designed to have immunity from the 10% AEP local Conrock Gully flows. The road would be overtopped by design events rarer than the 10% AEP local Conrock Gully event. The location of the proposed road crossing is shown in Figure 9-2.

The HEC-RAS model was used to determine a conceptual crossing configuration to convey the 10% AEP local Conrock Gully flows, utilising the conceptual culvert crossing design.

The culvert hydraulic assessment demonstrates that during frequent 50% AEP local flood events within the immunity of the structure, the velocities upstream of the crossing may be increased by a negligible to minor change of 3%, due to the efficient flow regime through the culverts. During rarer 2% AEP local flood events outside of the immunity of the crossing, velocities upstream of the crossing may be reduce by a negligible to minor change of 3%, due to the reduced conveyance. The velocity downstream of the crossing is not impacted by the culverts.

Longitudinal sections of the modelled maximum channel velocity and channel water level in the Conrock Gully diversion are provided in Section 6.7 of Appendix D of **Appendix J**, with and without the Project's site access road crossing in place. These figures show that the impact on velocities and water levels in the Conrock Gully diversion due to the crossing is negligible to minor for the 50% AEP and 2% AEP local flow events. The minor impacts propagate for a short distance upstream or downstream of the crossing. The Project's site access crossing would be fully drowned by 10% AEP regional Isaac River flood flows.

9.6.7 Monitoring

The Conrock Gully diversion will be monitored regularly to collect data for use in evaluating the performance of the diversion during construction and operations. Collection of monitoring data will help identify any issues with the construction of the diversion and assist with achieving rehabilitation milestones for a stable landform in accordance with the Project's PRCP schedule. The monitoring program will be conducted using the process documented in the DNRME guideline.

Further details on the planned monitoring of the Conrock Gully diversion, including monitoring parameters and schedule, are provided in Section 7 of Appendix D of **Appendix J**.

9.6.8 Assessment Summary

To achieve the design outcomes, the following criteria were considered when developing the Conrock Gully diversion design:

- The diversion ties in with the existing watercourse within the Project area. The proposed diversion alignment has been selected to minimise interference with mining infrastructure, whilst being within the Project MLAs.
- The stability and performance of the diversion will be assisted by vegetation within the watercourse diversion and adjoining floodplain and will not include artificial structures for grade control.
- The proposed diversion channel has similar dimensions to the existing channel and thus has similar design capacity (Table 9-8).
- The existing channel includes a large meander which contributes significantly to the length of channel being diverted. A number of meanders have been introduced at the upstream end of the diversion which results in a length of channel and bed slope similar to the existing channel. The meanders have similar amplitude, wavelength, sinuosity, and bend radius to bends found in the existing creek channel (Table 9-8).

- The main channel has a similar geometry to the existing channel, but with slightly steeper side slopes to reduce the extent of disturbance required. The hydraulic conditions within the existing Conrock Gully channel and proposed diversion channel have been compared for conditions before and after the proposed development, and to the guideline conditions within the DNRME guideline (Table 9-9).

Table 9-8 compares the average geomorphic characteristics of the existing and proposed channels of Conrock Gully. In summary, the diversion design reasonably matches the existing Conrock Gully geometry.

Table 9-8 Conrock Gully Diversion – Channel Geomorphic Characteristics Comparison

Parameter		Existing Gully	Proposed Diversion
Length (km)		5.8	5.2
Bed Grade (%) – floodplain reach		0.140	0.147
Bed Grade (%) – downstream reach		0.330	0.341
Bed Width (m)		4	4
Top Width (m)		26	28
Depth to floodplain (m)		7	5
Meander Radius (m)		240 (median)	240 (median)
Meander Sinuosity Index		1.2-1.7	1.1
Meander Wavelength (m)		250-1,200	140-350
Meander Amplitude (m)		150-330	75-170
50% AEP	Mean Velocity (m/s)	0.95	0.93
	Mean Bed Shear Stress (N/m^2)	30.1	23.66
	Mean Stream Power (W/m^2)	42.7	29.3
	Hydraulic Gradient (%)	0.17	0.14
2% AEP	Mean Velocity (m/s)	1.28	1.33
	Mean Bed Shear Stress (N/m^2)	33.5	30.9
	Mean Stream Power (W/m^2)	55.7	49.6
	Hydraulic Gradient (%)	0.16	0.15

Within the Conrock Gully diversion, the design hydraulic conditions are similar, and generally improved, to those in the existing Conrock Gully channel, and are consistent with the ACARP guideline for channel-averaged shear stress, stream power and velocity. The assessment results are summarised in more detail in Table 9-9.

Table 9-9 Conrock Gully Diversion – Modelled Guideline Hydraulic Conditions Comparison

Shear stress	Stream power	Velocity
50% (1 in 2 year) AEP Flood Event		
Upstream		

Shear stress	Stream power	Velocity
Decreased, due to ponding upstream.	Decreased, due to ponding upstream.	Decreased, due to ponding upstream.
Diversion Reach Generally similar to the existing channel. Isolated locations above ACARP guideline in both the existing channel and proposed diversion, although improved for the proposed diversion.	Slight decrease mid diversion. Isolated locations above ACARP guideline in both the existing channel and proposed diversion, although improved for proposed diversion.	Slight decrease mid diversion. Isolated locations above ACARP guideline in both the existing channel and proposed diversion, although improved for proposed diversion.
Downstream Overall decrease and within range of existing values.	Overall decrease and within range of existing values.	Overall decrease and within range of existing values.
2% (1 in 50 year) AEP Flood Event		
Upstream Decreased, due to ponding upstream.	Decreased, due to ponding upstream.	Decreased, due to ponding upstream.
Diversion Reach Generally similar to the existing channel. Isolated locations above ACARP guideline in both the existing channel and proposed diversion, although improved for the proposed diversion.	Slight decrease mid diversion. Isolated locations above ACARP guideline in both the existing channel and proposed diversion, although improved for proposed diversion.	Generally similar to the existing channel. Isolated locations above ACARP guideline in both the existing channel and proposed diversion, although improved for the proposed diversion.
Downstream Overall decrease and within range of existing values.	Overall decrease and within range of existing values.	Overall decrease and within range of existing values.

Under close to bank-full conditions, there are small reductions in shear stress, stream power and velocity predicted for the Conrock Gully diversion channel itself compared to the existing Conrock Gully channel. In the downstream diversion reaches shear stress, stream power and velocity will increase, compared to the rest of the diversion, as flows enter Isaac River, but they will be similar to or lower than those occurring in the existing Conrock Gully.

Revegetation of the Conrock Gully diversion will occur to achieve the ACARP guideline criteria. Rehabilitation of the Conrock Gully diversion will be scheduled to align with the Project's operational requirements for the Conrock Gully diversion and to achieve a long term stable landform in accordance with the PRCP schedule.

9.7 Climate Change Assessment

9.7.1 Overview

To assess the potential impacts of climate change on the flood behaviour, the 0.1% AEP design rainfall intensities were increased by a climate change factor, which is presented in Table A.14 of Appendix A of **Appendix J**.

Year 2050 climatic conditions were used to assess the impact of climate change on the Project's developed conditions. The year 2050 was selected as the representative year, being the period within 5 – 10 years of the end of the Project's mining operations. This is a conservative approach as it represents changes in climate greater than what is likely to be experienced during mining operations when the levee or levee plugs are operational.

Year 2100 climatic conditions were used to assess flooding of the final landform conditions. The year 2100 was selected as it is the furthest time horizon for which climate change factors are available from Australian Rainfall and Runoff: A Guide to Flood Estimation (Ball et al., 2019).

9.7.2 Developed Conditions – Climate Change Flood Assessment

Figure 9-41, Figure 9-42 and Figure 9-43 display the impact the year 2050 climate conditions have on the predicted peak flood levels along the Isaac River levee, Cherwell Creek levee plug and Conrock Gully levee plug, respectively. The climate change flood assessment indicates that the predicted peak flood levels along the Isaac River levee and Conrock Gully levee plug will increase by up to 0.5 m, and the predicted peak flood levels along the Cherwell Creek levee plug will increase by up to 0.8 m. However, the levee crests are not overtopped by the predicted flood levels.

In summary, the climate change flood assessment results demonstrate that the proposed flood protection levee and levee plugs for the Project's developed conditions adequately protects the mining operations from flooding during the 0.1% AEP climate change flood event, even under conservative assumptions about changes in climate during the operational life of the Project. Therefore, no specific mitigation strategies are required to manage climate change impacts during mining operations.

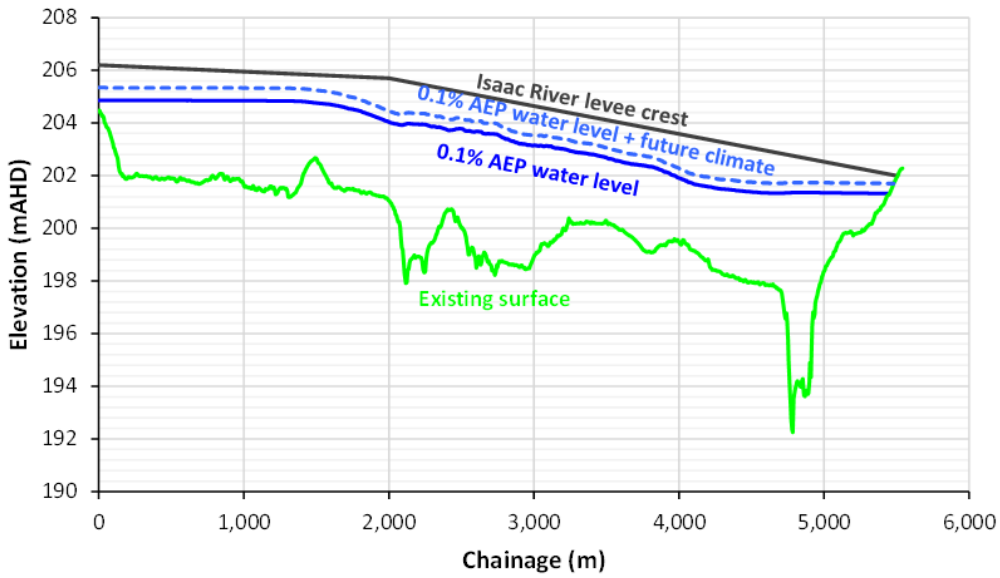


Figure 9-41 Isaac River Levee – Long Section – 0.1% AEP Water Levels plus Year 2050 Climatic Conditions

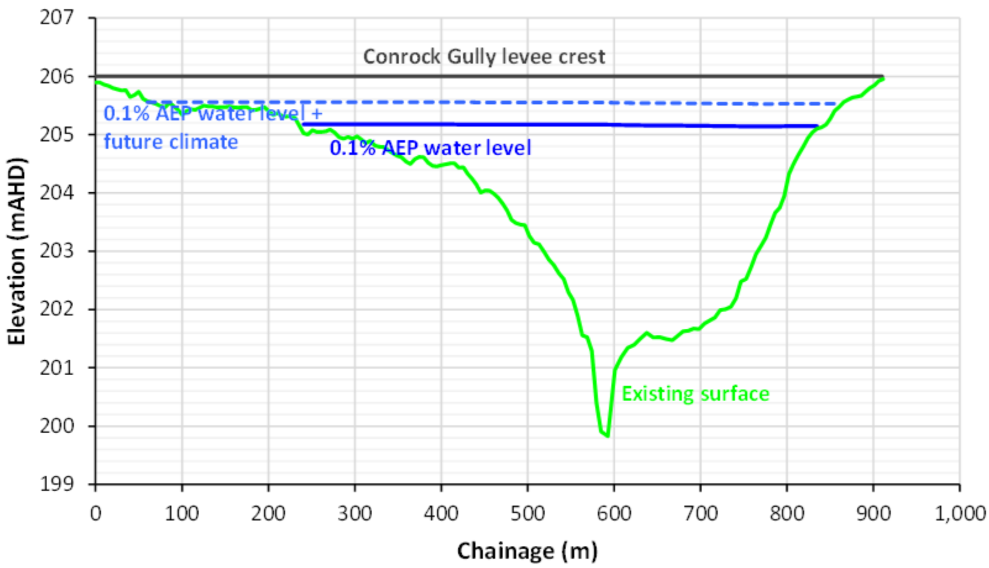


Figure 9-42 Cherwell Creek Levee Plug – Long Section – 0.1% AEP Water Levels plus Year 2050 Climatic Conditions

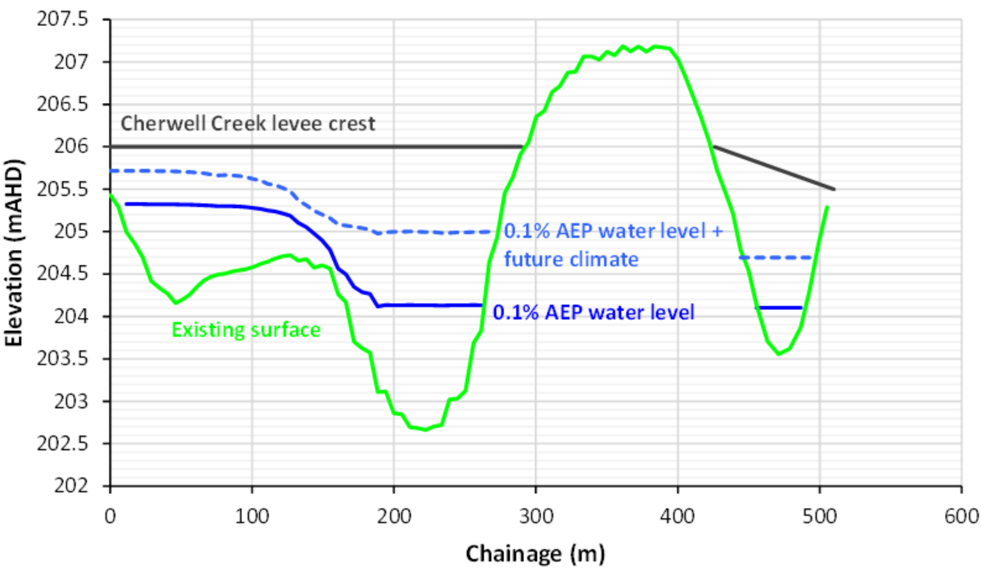


Figure 9-43 Conrock Gully Levee Plug – Long Section – 0.1% AEP Water Levels plus Year 2050 Climatic Conditions

9.7.3 Final Landform Conditions – Climate Change Flood Assessment

Figure 5.46 shows for final landform conditions the extent of the year 2100 0.1% AEP climate change flood event and Figure 5.47 shows for final landform conditions the peak year 2100 0.1% AEP climate change velocities.

The modelling results indicate that the Project's final void will not be inundated following mine closure during a year 2100 0.1% AEP climate change flood event. The predicted velocities under this future climatic change condition are similar to the predicted velocities under the climatic conditions described in Section 9.4.8.

In addition, the modelled final landform will include at least a 0.5 m high safety bund adjacent to the final void that will be part of the normal void safety requirements for mine closure under the Project's PRCP. The safety bund will provide additional protection from a year 2100 0.1% AEP climate change flood event. Therefore, no specific mitigation strategies are required for the final landform to manage possible future climate change impacts.

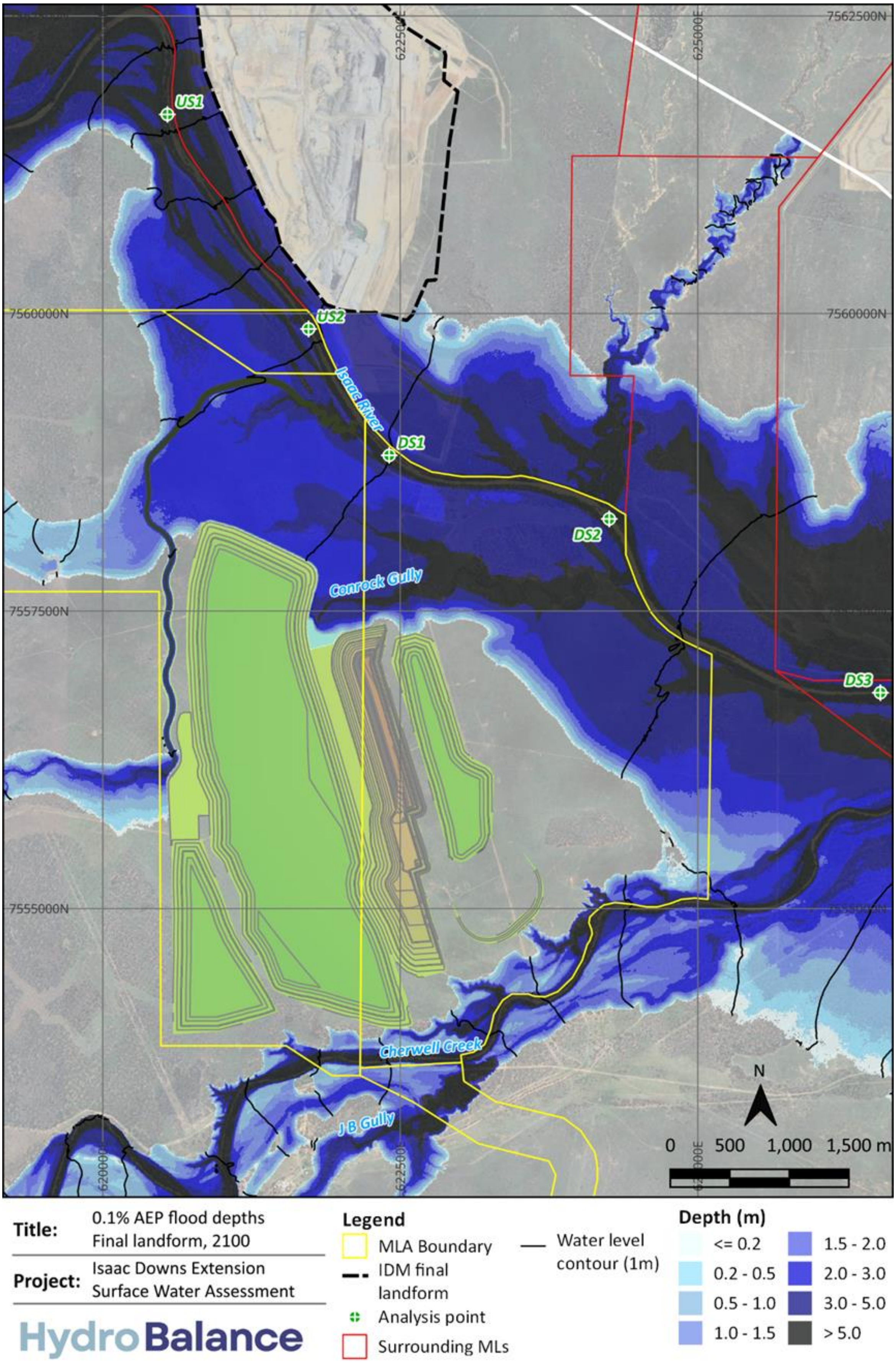


Figure 9-44 Final Landform Conditions – 0.1% AEP Climate Change Flood Event – Flood Depths

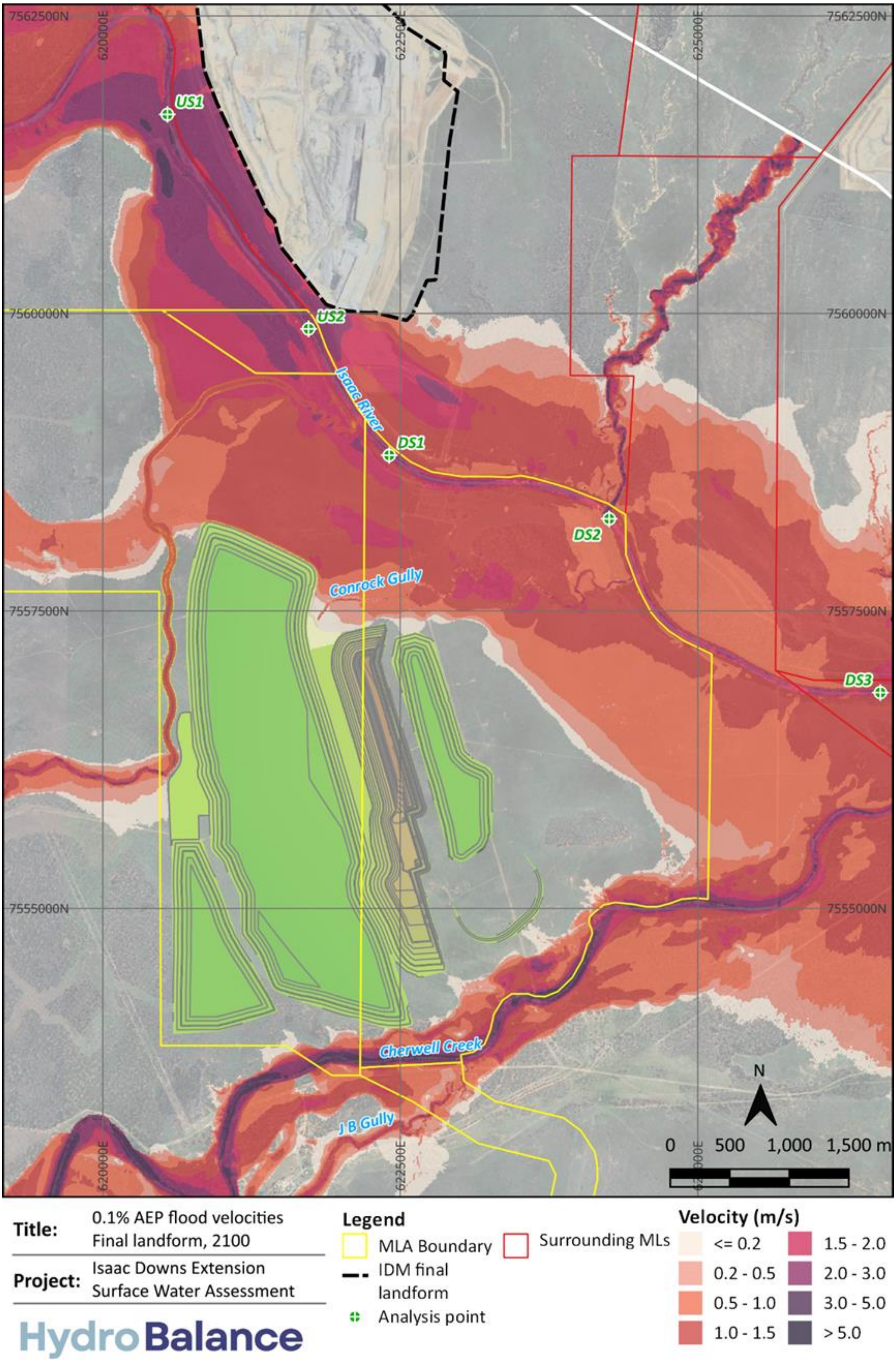


Figure 9-45 Final Landform Conditions – 0.1% AEP Climate Change Flood Event – Flood Velocities

9.8 Preliminary Consequence Category Assessment

9.8.1 Overview

A preliminary consequence category assessment (CCA) for the Project's levees and levee plugs was undertaken in accordance with the Dams Manual.

This assessment is based on preliminary design information, and therefore, relies on a number of assumptions. This assessment will be updated during detailed design.

Certified copies of the consequence category determination for each of the proposed structures will be provided following detailed design.

9.8.2 Assessable Infrastructure

9.8.2.1 Water Storages

A preliminary consequence category assessment of the Project's water storages is summarised in Section 8.4.4 of **Chapter 8** and provided in a surface water impact assessment report (**Appendix I**).

9.8.2.2 Levee and Levee Plugs

The Dams Manual specifies the following requirement with respect to levees:

- Where a levee is designed to prevent ingress of non-mine affected floodwater into an operational area, or catchment of a containment system, the suitably qualified and experienced person conducting and certifying the assessment and construction would declare that the levee is a regulated structure where the flood modelling shows that the pit would be encroached by a flood event with a probability more likely than or equal to 1:1000 AEP.

The Isaac River, Cherwell Creek and the downstream 3.2 km reach of Conrock Gully are the only defined watercourses that flow immediately past the Project mining activities, and therefore, were assessed as part of the Project's preliminary CCA.

9.8.3 Assessment Outcomes

The Isaac River flows past the eastern side of the Project, from northwest to southeast. Cherwell Creek flows past the southern boundary of the Project, from west to east. The alignments of these watercourses have not been modified as part of the Project's mining activities.

Conrock Gully currently flows through the Project's proposed mining area towards the Isaac River. A diversion of Conrock Gully is proposed to divert the local creek flows around the Project's proposed mining area and into the Isaac River.

The Project's flood modelling assessment shows that under pre-mining conditions, the Isaac River's, Cherwell Creek's and Conrock Gully's 0.1% AEP flood extents (1:1000 AEP) will interact with the Project's operational mining pit (Section 9.4). Based on this outcome, the Isaac River flood protection levee, the Cherwell Creek levee plug and the Conrock Gully levee plug are classified as 'regulated structures' in accordance with the Dams Manual.

The Project's flood modelling results for developed conditions with the levee and levee plugs in place demonstrate that the levee and levee plug designs protect the Project's mining operations from a 0.1% AEP flood event (plus freeboard), and therefore, are compliant with the hydraulic performance requirements for regulated levees outlined in the Dams Manual.

9.9 Potential Impacts, and Mitigation and Management Measures

9.9.1 Potential Impacts

The potential impacts from the Project on surface water resources include:

- Alterations to the flooding regime of the Isaac River, Cherwell Creek, JB Gully and Conrock Gully, due to the Project's infrastructure (operational phase) and final landform (post-closure phase).
- Impact on stream flows due to ingress of floodwater into the final void, which is not modelled to occur.
- Changes to creek and floodplain geomorphology, due to the construction of the Conrock Gully diversion and Project levees and levee plugs.
- Cumulative impacts of all projects in the region on the environmental values of the receiving waters.

The assessment of surface water impacts was undertaken based on commonly applied methodologies for the simulation of hydrologic and hydraulic processes using currently available data. The adopted approach was considered suitable for quantifying impacts to a level of accuracy consistent with current industry best practice. Certain aspects of the Project, such as changes to landforms due to construction of overburden dumps, will create permanent changes. However, these topographical changes will be designed and managed to protect the environmental values of receiving waters through rehabilitation stable landforms in accordance with PRCP schedule requirements.

9.9.2 Flood Impacts

Potential impacts of the Project on flood levels and velocities of the Isaac River, Cherwell Creek, JB Gully and Conrock Gully were assessed using a two-dimensional TUFLOW hydraulic model. The modelling included a range of design flood events from 50% AEP to the PMF, and considered for the Project's existing, developed and final landform conditions. Potential impacts of the Project on flood levels and velocities are fully described in Section 9.4 and Section 5 of **Appendix J**.

9.9.2.1 Mining Operations – Flood Regime Summary

The modelled potential impacts to the flood regimes of the Isaac River, Cherwell Creek, JB Gully and Conrock Gully during the Project's mining phase are summarised for potential water level impacts and potential water velocity impacts in Table 9-10 and Table 9-11, respectively.

Table 9-10 Summary of Modelled Potential Water Level Impacts – Project's Mining Operations

Location	Water Level Impacts
Isaac River	The flood levels in the Isaac River channel and floodplain increase up to 1 m (generally less than 0.5 m) along a 4 km reach for the 1% AEP flood event and up to 1.2 m (generally less than 1 m) along a 5.4 km reach for a 0.1% AEP flood event. The magnitude of changes in flood levels reduces for more frequent flood events. The flood level impacts do not extend downstream beyond the Project area. In the context of the regional landscape setting for the Project, flood level impacts are considered to be minor. Reducing the extent of the floodplain behind the Project's proposed Isaac River levee has negligible to minor impact on the expansion of the floodplain into areas that were previously not flooded. The proposed Isaac River bridge and the temporary dragline crossing have negligible impacts on the 1% and 0.1% AEP flood events, as the structures are inundated by these flood flows. Minor water level changes of up to 0.5 m at the Isaac River bridge and 0.25 m at the temporary dragline crossing can be observed for smaller events (e.g. the 10% AEP). The minor water level increases at the temporary dragline crossing are primarily a result of the bed level crossing. The bed level crossing will be removed and stabilised once the dragline walk is completed, which is proposed for the dry season. Therefore, the water level impacts in this area are highly unlikely to occur. A floodplain residence time impact assessment found negligible change to the duration of Isaac River flood events for all flood events. There are no material water level impacts to upstream and downstream flood management infrastructure at other mines, or at the Peak Downs Highway bridge or the Goonyella Railway bridge for any of the modelled events.
Cherwell Creek and JB Gully	The proposed Cherwell Creek bridge may increase water levels upstream of the bridge by up to 0.1 m for the 1% AEP flood event and 0.2 m for the 0.1% AEP flood event. During the 0.1% AEP flood event, flows are pushed towards the proposed Cherwell Creek levee plug by the bridge, causing a localised increase of up to 0.6 m at the proposed levee plug. The 0.1% AEP flows do not overtop the Cherwell Creek levee plug. Flows do not interact with the Cherwell Creek levee plug for any events more frequent than a 0.1% AEP flood event. The Cherwell Creek bridge and levee plug have negligible to localised minor impact on flood levels. The JB Gully bed-level crossing has a negligible impact on all modelled flood events, as the structure is inundated by flood flows.

Location	Water Level Impacts
Conrock Gully (other than diversion)	The flood levels immediately upstream of the diversion will be increased by up to 1.2 m for the 1% AEP flood event and 2.2 m for the 0.1% AEP flood event. Water level increases up to 0.1 m would propagate 800 m upstream for the 1% AEP flood event and 1,200 m upstream for the 0.1% AEP flood event. The magnitude of changes in flood levels reduces for more frequent flood events. Changes in flood levels are considered to be minor and localised. The remainder of the existing Conrock Gully channel will be excised by the Project. However, downstream of the Project area, in the remnant Conrock Gully channel, there is no change in flood levels for the 1% AEP and 0.1% AEP flood events, and up to the 10% AEP flood event, because these areas continue to be flooded by backwater flow from the Isaac River.

Table 9-11 Summary of Modelled Potential Velocity Impacts – Project's Mining Operations

Location	Velocity Impacts
Isaac River	The flood velocities are generally decreased upstream of the Project. The greatest decreases are located around the proposed Isaac River bridge, with modelled decreases reaching up to 0.9 m/s for the 1% AEP flood event and 1.1 m/s for the 0.1% AEP flood event. Velocity decreases also occur in the Isaac River floodplain adjacent to the Conrock Gully diversion, due to reduced conveyance in this location. The flood velocities in the eastern floodplain adjacent to the Project and the floodplain downstream of IDM would be increased. This increase occurs due to the increased conveyance through this section and the upstream reduction of the floodplain width due to the proposed Isaac River levee. The velocity increases in these sections may reach up to 0.7 m/s for the 1% AEP flood event and 1.0 m/s for the 0.1% AEP flood event. Rock protection is propsoed along a 2.5 km section of the Isaac River levee to mitigate potential scour risk. There are decreases in flood velocities on the downstream face of the Isaac River levee, due to reduced conveyance past this location. The velocity reduction in this location is up to 1.0 m/s for the 1% AEP flood event and 1.2 m/s for the 0.1% AEP flood event. The magnitude of change in velocity reduces for more frequent flood events. There are negligible changes in velocity at the Isaac River bridge and temporary dragline crossing for more frequent flood events. The flood velocity changes do not extend downstream beyond the Isaac River levee. There are no material velocity impacts upstream and downstream flood management infrastructure at other mines, or to the Peak Downs Highway bridge or the Goonyella Railway bridge for any of the modelled events. In the context of the regional landscape setting for the Project, flood velocity changes are considered negligible to minor.

Location	Velocity Impacts
Cherwell Creek and JB Gully	There are minor localised changes in velocities for the 1% AEP and 0.1% AEP flood events downstream of the proposed Cherwell Creek bridge and JB Gully bed-level crossing. The velocity impacts do not propagate downstream.
Conrock Gully (other than diversion)	The flood velocities upstream of the diversion would be decreased by up to 0.4 m/s for the 1% AEP flood event and 0.5 m/s for the 0.1% AEP flood event. The velocity reduction would propagate 700 m upstream for the 1% AEP flood event and 900 m upstream for the 0.1% AEP flood event. The magnitude of change would reduce for more frequent flood events. The remainder of the existing Conrock Gully channel will be excised by the Project. However, the remnant Conrock Gully channel will continue to be flooded by the Isaac River backwaters, with lower velocities than pre-mining.

9.9.2.2 Final Landform – Flood Regime Summary

The modelled impacts of the Project's final landform flood regime in the Isaac River, Cherwell Creek, JB Gully and Conrock Gully are summarised as follows:

- In relation to water levels:
  - The final landform results in negligible change to flood levels in the Isaac River. There are minor increases in water levels, up to 0.2 m, in the reach where the Conrock Gully diversion meets the floodplain.
  - The flood levels upstream of the Conrock Gully diversion are impacted to a similar level as the operational conditions scenario (Table 9-10).
  - There are no water level changes in Cherwell Creek in the vicinity of the final landform.
  - The magnitude of change in flood level is reduced compared to during mining operations, as the final landform allows for the expansion of the floodplain into areas previously protected by the Isaac River levee.
  - There are no changes in flood levels in the downstream remnant section of Conrock Gully as this area is subject to backwater flooding from the Isaac River
- In relation to velocities:
  - The final landform results in negligible change to velocity in the Isaac River channel.
  - There are decreased velocities in the existing Conrock Gully channel downstream of the mine, noting that these areas will continue to receive flood flows from Isaac River backwater flooding, but at reduced velocities.
  - The flood velocities upstream of the Conrock Gully diversion are impacted to a similar level as the operational conditions scenario (Table 9-11).
  - There are no flood velocity changes in Cherwell Creek in the vicinity of the final landform.
  - The magnitude of velocity change is generally reduced compared to during mining operations.

Overall the final landform, which incorporates the hydraulically stable diversion of Conrock Gully, and decommissioning and rehabilitation of the Isaac River levee, Cherwell Creek levee plug, the bridge crossings, and the dragline crossing, results in negligible changes to water levels and velocities.

9.9.3 Final Void – Flood Ingress Summary

The Project's flood modelling assessment in Section 9.4 shows that the final void lies outside of the 0.1% AEP flood extent for the Isaac River. Therefore, the Project will have no impact on Isaac River flows as there will be no ingress of water into the final void up to a 0.1% AEP flood event.

9.9.4 Geomorphic Impacts

9.9.4.1 Isaac River Channel Geomorphology

The Project's geomorphic impact assessment indicated that the Project's infrastructure and final landform are likely to have negligible to minor impacts on velocity, bed shear stress and stream power, and therefore, are unlikely to have a material impact on the geomorphology of the Isaac River channel in the vicinity of the Project.

9.9.4.2 Isaac River Floodplain Geomorphology

The Project's geomorphic impact assessment indicated that the Project's infrastructure and final landform are likely to have negligible to minor impacts on velocity, bed shear stress and stream power, and therefore, are unlikely to have a material impact on the geomorphology of the Isaac River floodplain in the vicinity of the Project.

During operations and for extremely rare 0.1% AEP flood events it is possible that some localised impacts to the Isaac River floodplain's geomorphology may occur in the sections downstream of IDM and the Isaac River levee. However, it is considered unlikely that these changes would occur within the Project's relatively short 15-year mine life. The proposed Isaac River levee will be decommissioned and rehabilitated prior to closure.

As part of the final landform preparation, floodplain surfaces will be stabilised and rehabilitated to achieve a self-sustaining vegetation cover. This vegetation cover will increase erosion resistance and stability. The hydraulic characteristics of flow within the Project's backfilled pit area are similar to or lower than under existing conditions, and therefore, the Project's backfilled pit area is expected to remain a stable landform with revegetation of the floodplain surface.

9.9.4.3 Chewrell Creek and JB Gully Geomorphology

The geomorphological impacts on the Cherwell Creek and JB Gully main channels and floodplains due to the Project are negligible, as evidenced by negligible changes in velocity, bed shears trees and stream power for all modelled flood events (see, for example, Figure 9-18and Figure 9-19).

9.9.4.4 Conrock Gully Diversion Geomorphology

As described in Section 9.6.8, Conrock Gully diversion's functional design was developed to address the objectives, design criteria and required outcomes of the DNRME guideline. Table 9-8 demonstrates that the diversion design reasonably matches the existing Conrock Gully geometry. Table 9-9 demonstrates that within the Conrock Gully diversion, the design hydraulic conditions are similar, and generally improved, to those in the existing Conrock Gully channel, and are consistent with the ACARP guideline for channel-averaged shear stress, stream power and velocity.

Under close to bank-full conditions, there are small reductions in shear stress, stream power and velocity predicted for the Conrock Gully diversion channel itself compared to the existing Conrock Gully channel. In the downstream diversion reaches shear stress, stream power and velocity will increase, compared to the rest of the diversion, as flows enter Isaac River, but they will be similar to or lower than those occurring in the existing Conrock Gully.

Revegetation of the Conrock Gully diversion will occur to achieve the ACARP guideline criteria. Rehabilitation of the Conrock Gully diversion will be scheduled to align with the Project's PRCP schedule requirements for the Conrock Gully diversion and to achieve a long term stable landform.

The Conrock Gully diversion will be monitored regularly to collect data for use in evaluating the performance of the diversion during construction and operation. Collection of monitoring data will help identify any issues with the construction of the diversion and assist with achieving rehabilitation milestones for a stable landform in accordance with the Project's PRCP schedule.

9.9.5 Cumulative Impact Assessment

The Project's flood assessment includes flood infrastructure from existing and proposed neighbouring mines, including IDM, Poitrel Mine and the Winchester South project. As a result, there is potential for cumulative hydrological impacts.

The Project flood model assesses the Isaac River flood regime with the existing and proposed flood infrastructure, including levees and final landforms, with and without the Project's proposed infrastructure in place.

The Project flood model considers the impact of the existing and proposed infrastructure on the flooding in the vicinity on the Project and determines the potential flood impact to the neighbouring mines. The potential flood impacts to the neighbouring mines due to the Project, as determined through the flood modelling, is summarised as follows:

- In relation to IDM:
    - Isaac River flood water levels adjacent to IDM increase by up to 0.6 m to 0.9 m for 1% AEP and 0.1% AEP flood events due to the Project. The IDM final landform will not be overtopped by the 0.1% AEP Isaac River flood, with the Project's proposed infrastructure in place.
    - Isaac River flood velocities decrease adjacent to the western face of IDM final landform by 0.1 m/s to 0.2 m/s for 1% AEP and 0.1% AEP flood events, with the Project's proposed infrastructure in place.
    - Isaac River flood velocities increase immediately downstream of the southern face of IDM final landform by 0.1 m/s to 0.3 m/s for 1% AEP and 0.1% AEP flood events, with the Project's proposed infrastructure in place. However, velocities were low in this location during existing conditions, and generally less than 1.5 m/s during a 0.1% AEP flood event, as the southern face of the IDM landform is located in a low-conveyance area of the Isaac River floodplain. Therefore, the change in velocity will not alter the proposed final landform design.
- In relation to Poitrel Mine:
    - There are no material water level or velocity impacts to the Poitrel Mine levee due to the Project's proposed infrastructure.
- In relation to the Winchester South project:
    - There are no material water level or velocity impacts to the approved Winchester South project's planned levee due to the Project's proposed infrastructure.

9.9.6 Proposed Mitigation and Management Measures

9.9.6.1 Proposed Mitigation and Management Measures – Mining Operations

9.9.6.1.1 Levee and Levee Plugs

The following mitigation and management measures will be applied to the Project's levees:

- As required by the Dams Manual, a detailed CCA will be conducted by a suitably qualified person prior to the Project's construction phase, which will ensure flood immunity up to and including a 0.1% AEP flood event to Protect the Project's mining operations, including dams.
- Prior to the Project's construction phase, detailed designs of the Project's planned levee and levee plugs will be developed by a suitably qualified person to ensure compliance with the Dams Manual.
- Construction of the Project's levee and levee plugs will be supervised and certified by a suitably qualified person to ensure compliance with the Dams Manual.
- The Project's levee and levee plugs will be constructed prior to the Project's operational phase where activities occur in a floodplain.

- Rock protection is proposed on approximately 2.5 km of the central section of the levee between chainages 1700 m and 4200 m to prevent scour during the 0.1% AEP flood conditions.
- The non-armoured sections of the Project's levee and levee plugs will be revegetated with suitable grass species to increase erosion resistance and stability.
- Detailed designs of the levee and levee plugs may include cut-off trenches beneath the levee, and clay cut-off and capping of the levee crest.
- The Project's levee and levee plugs have been aligned to minimise impacts to riparian vegetation.
- The construction footprint of the Project's levee and levee plugs will be kept to a minimum that allows safe and efficient construction techniques.
- During the Project's mining phase, the levee and levee plugs will be monitored following regional flood events, and if required, flood damage will be rectified in a timely manner to ensure operational efficiency is reinstated.
- As regulated structures, the Project's levee and levee plugs will be subject to an annual inspection and reporting regime under the EP Act.
- The levee's and levee plugs' construction and operation will be in accordance with the DNRME guideline and the Dam Manual.
- During the Project's life of operations, the Project's levee and levee plugs will be managed under the Isaac Plains Complex (IPC) Safety and Health Management System (SHMS) and in accordance with the Project's EA.

9.9.6.1.2 Conrock Gully Diversion

The following mitigation and management measures will be applied to the Conrock Gully diversion:

- Prior to the commencement of mining in the Conrock Gully floodplain, the Conrock Gully diversion will be constructed as specified by its Functional Design Report to achieve a hydraulically and geomorphically stable structure.
- Construction of the Conrock Gully diversion will be supervised and certified by a suitably qualified person to ensure it complies with the Functional Design Report.
- If possible, the Conrock Gully diversion will be constructed during the dry season.
- To ensure safe and efficient operations, weather conditions will be monitored prior to and during the construction of the Conrock Gully diversion.
- The Conrock Gully diversion will be monitored as specified by its Functional Design Report, and if identified by monitoring, damaged areas will receive appropriate remedial actions in a timely manner to restore functional efficiency.
- During the Project's life of operations, the Conrock Gully diversion will be managed under the IPC SHMS and in accordance with the Project's EA.

9.9.6.1.3 Isaac River Bridge and Cherwell Creek Bridge

The following mitigation and management measures will be applied to the Isaac River and Cherwell Creek bridges:

- Prior to the Project's construction phase, a detailed design of the Project's planned bridges will be developed by a suitably qualified person.
- Construction of the bridges will be supervised and certified by a suitably qualified person to ensure it complies with its detailed design plans.
- The bridges' construction and operation will be designed to prevent permanent barriers to the flow of water.
- If construction will not occur in accordance with the riverine protection exemption requirements (DRDMW, 2023), a riverine protection permit will be obtained.
- If possible, the bridges will be constructed during the dry season.

- To ensure safe and efficient operations, weather conditions will be monitored prior to and during the construction of the bridges.
- During the Project's life of operations, the bridges will be managed under the IPC SHMS and in accordance with the Project's EA.

9.9.6.1.4 Temporary Isaac River Dragline Crossing

The following mitigation and management measures will be applied to the temporary Isaac River dragline crossing, which apply to both during construction phase walk and the closure / rehabilitation period walk (see **Chapter 4**):

- Prior to the Project's construction phase, a detailed design of the Project's planned temporary Isaac River dragline crossing will be developed by a suitably qualified person.
- Construction of the temporary Isaac River dragline crossing will be supervised and certified by a suitably qualified person to ensure it complies with its detailed design plans.
- The proposed location for the dragline walk route crossing of the Isaac River has been selected based on relatively shallow and low river banks and minimising areas of remnant vegetation clearing.
- The walk route construction, use and removal of material on the bed of the river would occur for less than 180 days (i.e. 6 months). The dragline walk route would not result in a permanent barrier to the flow of waters.
- The dragline walk route will be preferentially constructed and utilised in the dry season when flows in the Isaac River are unlikely.
- Following utilisation of the crossing, and within 180 days of construction commencement, the temporary gravel base will be removed, and any sand that has been removed will be replaced to restore the natural bed of the Isaac River.
- Bank cuttings and the walk route itself will be stabilised and rehabilitated through topsoiling, seeding and vegetation establishment. Rock protection installed during construction will remain in place. These rehabilitation and stabilisation activities will remain in place during the life of operations between the period when the initial dragline walk during construction and the later dragline walk during closure.
- To ensure safe and efficient operations, weather conditions will be monitored prior to and during the construction of the temporary Isaac River dragline crossing.
- The temporary Isaac River dragline crossing will be constructed, operate and rehabilitated in accordance with the Waterway Barrier Works guideline for temporary waterway crossings.
- If construction will not occur in accordance with the riverine protection exemption requirements (DRDMW, 2023), a permit will be obtained.
- During its period of operation, the temporary Isaac River dragline crossing will be managed under the IPC SHMS and in accordance with the Project's EA.

9.9.6.1.5 JB Gully Bed-level Crossing and Conrock Gully Diversion Crossing

The following mitigation and management measures will be applied to the JB Gully bed-level crossing and the access / haul road crossing of Conrock Gully diversion:

- Following Project approval and prior to the Project's construction phase, a detailed design of the Project's planned crossings will be developed by a suitably qualified person.
- Construction of the crossings will be supervised and certified by a suitably qualified person to ensure it complies with its detailed design plans.
- The crossings' construction and operation will be based on the principles of the Waterway Barrier Works guideline.
- If construction will not occur in accordance with the riverine protection exemption requirements (DRDMW (2023)), a permit will be obtained.

- If possible, the crossings will be constructed during the dry season.
- To ensure safe and efficient operations, weather conditions will be monitored prior to and during the construction of the crossings.
- During the Project's mining phase, the crossings will be monitored following regional and local flood events, and if required, flood damage will be rectified in a timely manner to ensure operational efficiency is reinstated.
- During the Project's life of operations, the crossings will be managed under the IPC SHMS and in accordance with the Project's EA.

9.9.6.2 Proposed Mitigation and Management Measures – Final Landform

9.9.6.2.1 Levee and Levee Plugs

The following mitigation and management measures will be applied to the Project's levees:

- At the completion of mining and all other major rehabilitation works, the Project's levee and levee plugs will be decommissioned and rehabilitated as specified by the Project's PRCP schedule.
- If possible, the Project's levee and levee plugs will be decommissioned and rehabilitated during the dry season.
- To ensure safe and efficient operations, weather conditions will be monitored prior to and during the decommissioning and rehabilitation of the Project's levee and levee plugs.
- Monitoring of the rehabilitated area of the levee and levee plugs will continue as specified by the Project's PRCP schedule to demonstrate rehabilitation success for surrender of the Project's mining leases (MLs) and EA.

9.9.6.2.2 Conrock Gully Diversion

The following mitigation and management measures will be applied to the Conrock Gully diversion:

- Monitoring of the rehabilitated levee area will continue as specified by the Project's PRCP schedule to demonstrate long term establishment success of a hydraulically and geomorphically stable structure for surrender of the Project's MLs and EA.

9.9.6.2.3 Isaac River Bridge and Cherwell Creek Bridge

The following mitigation and management measures will be applied to the Isaac River and Cherwell Creek bridge:

- At the completion of mining and all other major rehabilitation and post-mining land use works, the bridges will be decommissioned and rehabilitated as specified by the Project's PRCP schedule (unless a third party agreement is reached for its retention).
- The proposed post mining land use for the rehabilitation bridge area is riparian vegetation.
- If possible, the bridges will be decommissioned and rehabilitated during the dry season.
- To ensure safe and efficient operations, weather conditions will be monitored prior to and during the decommissioning and rehabilitation of the bridges.
- Monitoring of the rehabilitated bridge areas will continue as specified by the Project's PRCP schedule to demonstrate rehabilitation success for surrender of the Project's MLs and EA.

9.9.6.2.4 Temporary Isaac River Dragline Crossing

The following mitigation and management measures will be applied to the temporary Isaac River dragline crossing following the return of the dragline to IDM:

- Once the dragline has returned to IDM, the crossing will be fully rehabilitated with the gravel base removed, sandy bed reestablished, bank cuttings filled to resemble pre-mining topography and landforms rehabilitated through topsoiling, seeding and revegetation in accordance with the PRCP schedule requirements.

- The proposed post mining land use for the rehabilitation bridge area is riparian vegetation.
- Monitoring of the rehabilitated temporary Isaac River dragline crossing area will continue as specified by the Project's PRCP schedule to demonstrate rehabilitation success for surrender of the Project's MLs and EA.

9.9.6.2.5 JB Gully Bed-level Crossing and Conrock Gully Diversion Crossing

The following mitigation and management measures will be applied to the JB Gully bed-level crossing and the access / haul road crossing of Conrock Gully diversion:

- At the completion of mining, the crossings will be decommissioned and rehabilitated as specified by the Project's PRCP schedule.
- If possible, the crossings will be decommissioned and rehabilitated during the dry season.
- To ensure safe and efficient operations, weather conditions will be monitored prior to and during the decommissioning and rehabilitation of the crossings.
- Monitoring of the rehabilitated crossing areas will continue as specified by the Project's PRCP schedule to demonstrate rehabilitation success for surrender of the Project's MLs and EA.

9.10 Conclusion

To understand the potential impacts to the hydrologic and geomorphic environments within the Project area and in the vicinity of the Project, a detailed flood modelling assessment was conducted using a hydraulic model for a range of design flood events from 50% AEP to the PMF for the Project's existing, developed (mining), and final landform (post closure) conditions.

The hydraulic model results were used to assess the potential impacts of the Project's mining and post-closure phases on flood levels and velocities, and the geomorphic behaviour of the Isaac River, including the potential to increase erosion and/or sedimentation, and impact on the morphology of the adjacent floodplains.

Infrastructure interacting with waterways during operations has been designed to minimise hydrological impacts, including minimising barriers to flows during all flood events. Following operations, infrastructure will be decommissioned and rehabilitated, further reducing any hydrological impacts.

The Project's flood modelling identified the following outcomes during mining operations in relation to water levels and velocities:

- The flood level changes do not extend downstream beyond the Project area and are considered to be minor in the context of the regional landscape of the Project.
- Reducing the extent of the floodplain behind the proposed Isaac River levee has negligible to minor impact on the expansion of the floodplain into areas that were previously not flooded.
- The proposed Isaac River bridge and the temporary dragline crossing have negligible to localised minor impacts on flood events.
- The dragline crossing will be temporary and occur during the dry season, hence any modelled changes water levels or velocities are highly unlikely to occur.
- A floodplain residence time impact assessment found negligible change to the duration of Isaac River flood events.
- In the context of the regional landscape setting for the Project, flood velocity changes (decreases and increases) are considered negligible to minor. Rock protection is proposed along a 2.5 km section of the Isaac River levee to mitigate potential scour risk.

- There are no material water level or velocity impacts to upstream and downstream flood management infrastructure at other mines, or at the Peak Downs Highway bridge or the Goonyella Railway bridge, for any of the modelled events.
- Flows do not interact with the Cherwell Creek levee plug for any events more frequent than a 0.1% AEP flood event.
- The JB Gully bed-level crossing has a negligible impact on all modelled flood levels.
- There are minor localised changes in velocities for the 1% AEP and 0.1% AEP flood events downstream of the proposed Cherwell Creek bridge and JB Gully bed-level crossing. The velocity impacts do not propagate downstream.
- For the Conrock Gully diversion, changes in flood levels are considered to be minor and localised. The magnitude of change would reduce for more frequent flood events.
- The remainder of the existing Conrock Gully channel will be excised by the Project. However, the remnant Conrock Gully channel will continue to be flooded by the Isaac River backwaters, with lower velocities than pre-mining.

The Project's flood modelling identified the following outcomes for post closure in relation to water levels and velocities:

- The final landform results in negligible change to flood levels and velocities in the Isaac River and Cherwell Creek. The magnitude of change in flood level and velocities is reduced compared to during mining operations, as the final landform allows for the expansion of the floodplain into areas previously protected by the Isaac River levee.
- Conrock Gully diversion results in localised minor changes to flood levels and velocities in the closure landform, in accordance with the acceptable functional design for the diversion. There are no changes in flood levels in the downstream remnant section of Conrock Gully as this area is subject to backwater flooding from the Isaac River.

In summary, the modelled potential impacts to the flood regimes (flood levels and velocities) of the Isaac River, Cherwell Creek, JB Gully and Conrock Gully, during the Project's mining phase and post closure from the final landform, were both determined to be negligible to minor.

The Project's geomorphic impact assessment identified during mining operations that peak velocities, bed shear stresses and stream power levels along the floodplain adjacent to Isaac River are generally similar to the peak levels under existing conditions and are appropriate compared to the ACARP guideline values.

The Project's geomorphic impact assessment identified in relation to final landform conditions that there are negligible to minor changes in the hydraulic characteristics within the floodplain of the Isaac River as a result of the proposed final landform. As part of final landform preparation required under the Project's PRCP, floodplain surfaces will be stabilised and rehabilitated to achieve a self-sustaining vegetation cover. This vegetation cover will increase erosion resistance and enhance landform stability.

In summary, the Project's geomorphic impact assessment indicates that the Project's operational infrastructure and final landform are likely to have negligible to minor impacts on velocity, bed shear stress and stream power, and therefore, are unlikely to have a material impact on the geomorphology of the Isaac River's channel and floodplain in the vicinity of the Project. The Project will have negligible impact on the geomorphology or Cherwell Creek and JB Gully.

A functional design report was developed for the Conrock Gully diversion to address the objectives, design criteria and required outcomes of the DNRME guideline. A hydraulic assessment of the Conrock Gully diversion demonstrates that the diversion design reasonably matches the existing Conrock Gully geometry and the design hydraulic conditions are similar, and generally improved, to those in the existing Conrock Gully channel, and are consistent with the ACARP guideline for channel-averaged shear stress, stream power and velocity.

The Project's flood modelling assessment shows that the final void lies outside of the 0.1% AEP flood extent for the Isaac River and other watercourses. Therefore, the Project will have no impact on Isaac River or other watercourse flows as there will be no ingress of water into the final void up to a 0.1% AEP flood event.

A climate change flood assessment was undertaken and demonstrated that the proposed flood protection levee and levee plugs for the Project's developed conditions adequately protects the mining operations from flooding during the 0.1% AEP climate change flood event, even under conservative assumptions about changes in climate during the operational life of the Project. The climate change assessment also determined that the Project's final void will not be inundated following mine closure during a year 2100 0.1% AEP climate change flood event.

A preliminary consequence category assessment of the Project's flood protection infrastructure was completed, which included the Isaac River flood protection levee, Cherwell Creek levee plug and Conrock Gully levee plug. All the Project's flood protection infrastructure were classified as 'regulated structures' in accordance with the Dams Manual. The Project's flood modelling results for mining with the levee and levee plugs in place demonstrate that the levee and levee plug designs protect the Project's mining operations from a 0.1% AEP flood event (plus freeboard), and therefore, are compliant with the hydraulic performance requirements for regulated levees outlined in the Dams Manual.

A cumulative impact assessment was completed using the flood model to incorporate all infrastructure from surrounding existing and proposed mines The cumulative impact assessment demonstrated that there were no material water level or velocity on surrounding mines or projects.

In conclusion, the impact assessments of the hydrologic and geomorphic environments within the Project area and in the vicinity of the Project, during the Project's mining and post closure phases, have demonstrated that there will be no negligible to minor impacts. Therefore, the Project's mining operations and final landform will be able to satisfy the environmental objectives and performance outcomes for hydrology and geomorphology.

9.11 References

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Ball et al.) 2019, 'Australian Rainfall and Runoff: A Guide to Flood Estimation', Geoscience Australia, Canberra.

Department of Environment and Heritage Protection (DEHP) 2011, 'Isaac River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Isaac River Sub-basin (including Connors River)', Queensland Government, Brisbane.

Department of Environment and Heritage Protection (DEHP) 2016, 'Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (ESR/2016/1933) Version 5.05', Queensland Government, Brisbane.

Department of Natural Resources and Mines (DNRM) 2015, 'Fitzroy Basin Resource Operations Plan', Queensland Government, Brisbane.

Department of Natural Resources, Mines and Energy (DNRME) 2019, 'Guideline: Works that interfere with water in a watercourse for a resource activity—watercourse diversions authorised under the *Water Act 2000* (OSW/2019/4599), Version 2.00 (05/02/2019)', Queensland Government, Brisbane.

Department of Primary Industries (DPI) 2025, 'Accepted development requirements for operational work that is constructing or raising waterway barrier works', Queensland Government, Brisbane.

Department of Regional Development, Manufacturing and Water (DRDMW) 2023, 'Riverine protection permit exemption requirements (WSS/2013/726 Version 2.03 2/06/2023)', Queensland Government, Brisbane.

Hardie, R and Lucas, R. (Hardie and Lucas) 2002, 'Bowen Basin River Diversions Design and Rehabilitation Criteria', Project C9068 Report for ACARP from Fisher Stewart Ltd.

US Army Corps of Engineers (USACE) 2024, 'HEC-RAS version 6.6'.

WRM Water and Environment (WRM) 2022, 'Winchester South Project: Surface Water and Flooding Assessment', Brisbane.