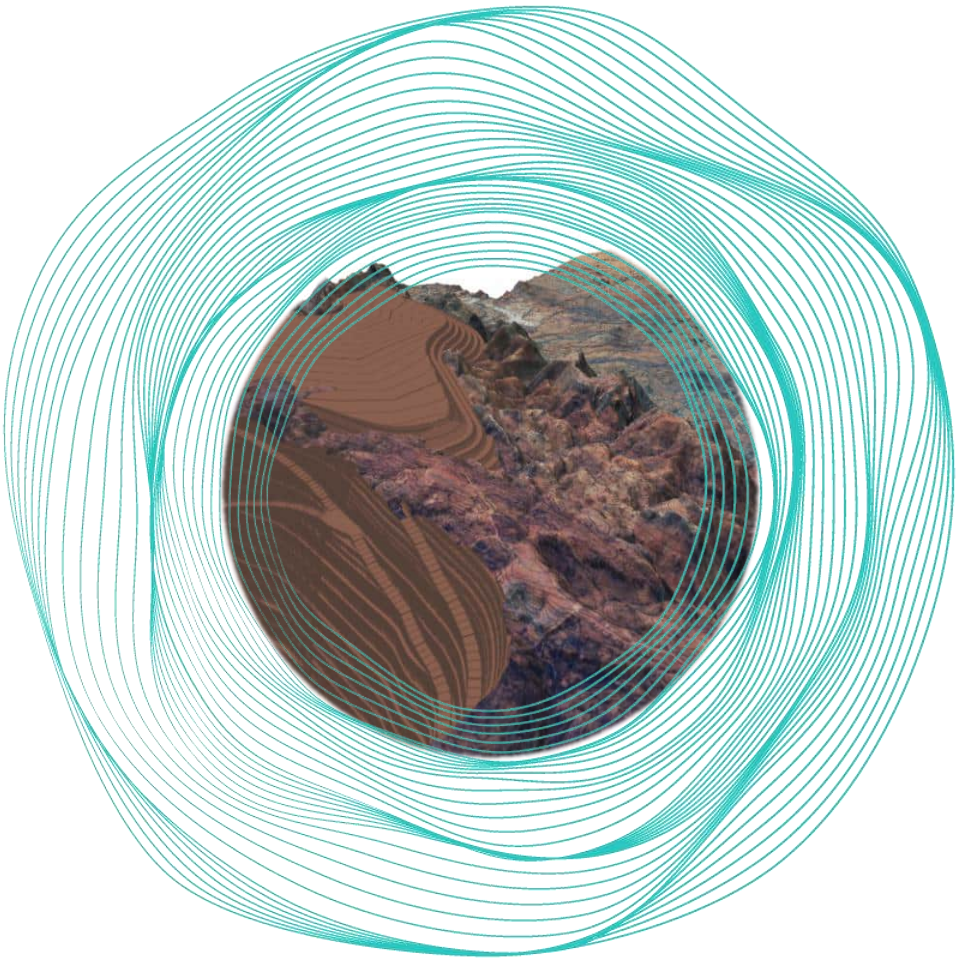
North Star Magnetite Project Extension

Hydrological Impact Assessment Report: Waterways

Document no. Rev 2: HYD-REP-002



28 March 2025

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PROJECT 311012-02196 - HYD-REP-002: North Star Magnetite Project Extension - Hydrological Impact Assessment Report: Waterways

Rev	Description	Originator	Reviewer	Worley Approver	Revision Date	Customer Approver	Approval Date
Rev B	Client review & 3IR	P.Crichton	R.Perrigo	D.Royal	31 July 2024		
Rev 0	Issued for use	P.Crichton	D.Royal	D.Royal	24 September 2024		
Rev 1	Issued for use - minor updates	P.Crichton	D.Royal	D.Royal	12 December 2024		
Rev 2	Issued for use - minor updates	Peter Crichton A.Paudel	Peter Crichton P.Crichton	Digitally signed by Danielle Royal Date: 28/March/2025 D.Royal	28 March 2025		

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Executive summary

Fortescue proposes to construct and operate a mine extension, which includes a waste rock dump, mine pits and associated mine infrastructure, to the existing North Star Magnetite Project, located approximately 110 kilometres (km) southeast of Port Hedland in the Pilbara region of Western Australia.

The North Star Extension (NSE) project will be assessed at the level of a Public Environmental Review (PER), following the referral submission in 2021. As part of the referral submission, a baseline hydrology and surface water impact assessment were undertaken titled *North Star Extension – Hydrological Assessment* (BG&E, 2021) and *North Star Extension – Mundagoora Pool Hydrological Assessment* (BG&E, 2021) which were reviewed by DCCEEW. Per *Guidelines for the content of a draft Public Environment Report – North Star Magnetite Project Extension, Pilbara, WA (EPBC 2023/09466)*(DCCEEW, 2024), the impact assessment required additional works to provide adequate evidence to support the reported impacts.

To satisfy the DCCEEW guideline comments, this impact assessment has been undertaken using a combination of hydrologic and hydraulic modelling as well as desktop assessments to quantify expected changes to the baseline hydrological condition, as detailed in *North Star Magnetite Project Extension – Baseline Hydrology Report* (Worley, 2024). The assessment has been undertaken using the model suite developed for *North Star Magnetite Project Extension – Baseline Hydrology Report* (Worley, 2024) with the methods and data consistent with ARR2019 (Ball et al., 2019), the latest industry guidance on the derivation of hydrological estimates and flood risk.

The assessment of peak flow changes when compared to the baseline condition predicted that the degree of peak flow change was AEP-dependant and influenced by changes in critical design storms at locations downstream of the development. In the Pit catchment, the predicted range of percentage change in peak flows immediately upstream of Mundagoora Pool are estimated to be between -59.5% (20% AEP) and -53.7% (2% AEP) due its location less than 1 km downstream of the pit shells which intercept or constitute a significant portion of the contributing catchment area to the pool. Pool_SW has a lower predicted relative change in peak flow predicted of between -15.7% (20% AEP) and -13.5% (1% AEP) due to smaller amount of catchment area loss when compared to the baseline case at this location. At the Pit catchment outlet (approximately 2.7 km downstream of the NSE development envelope), peak flow change compared to the baseline condition ranges from -15.9% in the 20% AEP to -12.2% in the 1% AEP event, with resulting peak flood level reductions of less than 200 mm in the 1% AEP event (from a maximum peak flood depth of approximately 2.9 m in baseline condition) and less than 100 mm in the 50% AEP event (from a maximum peak flood depth of approximately 1.2 m in baseline condition). Peak velocities are predicted to reduce by approximately 0.1 m/s or less in the 1% AEP and 50% AEP events (from maximum peak flow velocities of approximately 2.8 m/s and 1.6 m/s in baseline conditions) respectively at this location.

Catchment discharge volume change relative to the baseline condition in both catchments is a direct function of catchment area loss differential between the baseline and NSE scenarios, and hence is AEP-independent. Discharge volumes at the Pit catchment outlet (PitVol1) are predicted to decrease by 13.1% due to the catchment area loss associated with the proposed

Glacier Valley North and South pit shells. The relative change in predicted runoff volumes decreases further downstream of the tenement boundary due to the additional catchment area contributing to the waterways, with changes in discharge volumes at Central Pool (approximately 7.1 km downstream of the Pit catchment) reducing to -2.4% when compared to the baseline scenario.

In the WRD catchment, the largest peak flow change relative to the baseline condition are mostly restricted to the northern tributary arm downstream of the WRD, as is to be expected, due to the effective elimination of this catchment area. Changes in peak flow relative to the baseline condition reduce to between -36.6% (20% AEP) and -32.2% (1% AEP) further downstream at Pool_NJA21-006_US and reduce further to between -16.3% (50% AEP) and -11.6% (2% AEP) at Pool_NJA21-006_DS. Smaller changes in peak flows are predicted at Pool NJA19 of between -5% (10% AEP) and -2.8% (20% AEP).

At the WRD catchment outlet, peak flow reductions range from -14.4% in the 50% AEP to -9.7% in the 1% AEP event, with corresponding peak flood level reductions of approximately -150 mm in the 1% AEP event (from a maximum peak flood depth of approximately 2.7 m in the baseline condition) and -100 mm in the 50% AEP event (from a maximum peak flood depth of approximately 1.3 m in the baseline condition). Peak velocity change at this location is limited to less than approximately -0.1 m/s in both the 1% AEP and 50% AEP events, from maximum peak flow velocities of approximately 1.7 m/s and 1.3 m/s respectively in the baseline condition.

Discharge volumes near the WRD catchment outlet at the previously reported major confluence location (BG&E, 2021), and reported as WRDVol1 in this study, are predicted to decrease by 9.3% due to the catchment area loss associated with the WRD landform. The reduction in discharge volume decreases further downstream as additional catchment area reduces the overall relative catchment area loss associated with the WRD landform, with a change in discharge volume of -1.9% predicted at the WRDVol4 reporting location, approximately 8.4 km downstream of the WRD catchment outlet.

This report primarily presents the predicted hydrological changes for waterways within the catchments associated with the proposed NSE development. The peak flow reduction for the pools along the waterways within flood model boundary have been presented in this report. Detailed hydrological assessment of the pools will be covered in a separate study report.

Detailed responses and links to relevant report sections which address comments pertaining to this baseline hydrology assessment in *Guidelines for the content of a draft Public Environment Report – North Star Magnetite Project Extension, Pilbara, WA (EPBC 2023/09466)* (DCCEEW, 2024) are included in Section 6 (Table 6-1) of this report.

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Acronyms and abbreviations

Acronym/ abbreviation	Definition
AEP	Annual Exceedance Probability
ARR2019	Australian Rainfall and Runoff 2019 (Ball et al., 2019)
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DRL	Dry Reject Landform
EPBC	Environment Protection and Biodiversity Conservation
FMG	Fortescue Metals Group (now Fortescue)
GDA94	Geocentric Datum of Australia 1994
GIS	Geographic Information System
MDE	Mining Development Envelope
MGA	Map Grid of Australia
MNES	Matters of National Environmental Significance
NSE	North Star Extension
PER	Public Environmental Review
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
PMPF	Probable Maximum Precipitation Flood
PO	Plot Output
ROM	Run of Mine
WRD	Waste Rock Dump

1. Introduction

1.1 Background

Fortescue proposes to construct and operate a mine extension, which includes a waste rock dump, mine pits and associated mine infrastructure, to the existing North Star Magnetite Project, located approximately 110 kilometres (km) southeast of Port Hedland in the Pilbara region of Western Australia.

The North Star Extension (NSE) project will be assessed at the level of a Public Environmental Review (PER), following the referral submission in 2021. As part of the referral submission, a baseline hydrology and surface water impact assessment were undertaken titled *North Star Extension – Hydrological Assessment* (BG&E, 2021) and *North Star Extension – Mundagoora Pool Hydrological Assessment* (BG&E, 2021) which were reviewed by DCCEEW. Per *Guidelines for the content of a draft Public Environment Report – North Star Magnetite Project Extension, Pilbara, WA (EPBC 2023/09466)* (DCCEEW, 2024), the baseline hydrologic characterisation of the proposed mine extension area needed to be updated to provide additional justifications on key hydrological parameters and various other hydrologic-related inputs and approaches. Worley Services Pty Ltd (Worley) have recently detailed the baseline hydrologic setting of the Study Area in *North Star Magnetite Project Extension Baseline Hydrology Report* (2024).

This study builds on the baseline hydrology assessment and represents an updated hydrological impact assessment of the waterways in the indicative area of interest to quantify any hydrologic and hydraulic changes as a result of the proposed mine extension and addresses all relevant comments in *Guidelines for the content of a draft Public Environment Report – North Star Magnetite Project Extension, Pilbara, WA (EPBC 2023/09466)* (DCCEEW, 2024).

The indicative area of interest is presented in Figure 1-1. This represents the same area of interest as used in *North Star Magnetite Project Extension Baseline Hydrology Report* (Worley, 2024). Details regarding hydrologic and hydraulic modelling extents are presented in Section 4.

1.2 Scope of work

The scope of work for this assessment as agreed with Fortescue is summarised below:

Update the hydrology impact assessment to:

1. Report on the hydrological changes in downstream waterways including afflux mapping to present changes in peak flood depth within study area, tabulating changes in peak flows and catchment area at selected reporting points between baseline and mine extension scenarios, for a range of AEPs.
2. Develop a hydrological impact assessment report summarising the findings of the assessment.

This report primarily presents the hydrological changes for waterways downstream of the NSE development. The peak flow reduction for the pools along the waterways within the modelled

extents have been presented in this report. A hydrological assessment specific to pools will be covered in a separate study report.

It is noted that the proposed Waste Rock Dump (WRD) landform is situated within the WRD catchment and the adjacent Site 12 Pool catchment. The catchment area associated with the northern extents of the WRD and Site 12 Pool forms part of the Six Mile Creek catchment (a tributary of the East Strelley River). No assessment of the Site 12 Pool catchment is included in this study, as directed by Fortescue (being undertaken as a separate scope).

NORTH STAR EXTENSION HYDROLOGICAL IMPACT ASSESSMENT: WATERWAYS

FIGURE 1-1

STUDY AREA

SULPHUR SPRINGS CREEK

MINNIERITCHIE CREEK

SIX MILE CREEK

COCKATOO CREEK

Iron Bridge/
North Star Mine

HONEYEATER CREEK

LEILIRA CREEK

RED CREEK

UPPER RED CREEK

LAPILLISTONE CREEK

PADDY MARKET CREEK

Legend

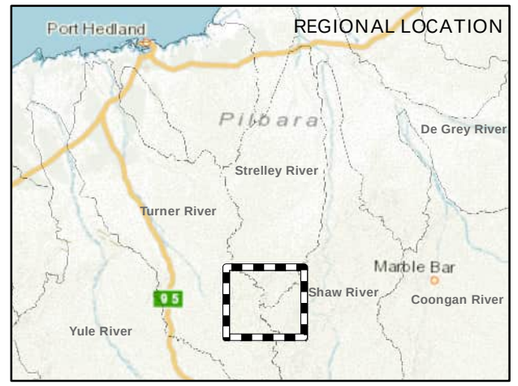
- Indicative Area of Interest
- Mining Tenements
- North Star Extension - Development Envelope
- North Star Extension - Indicative Disturbance Footprint
- North Star - Approved Mine Area Development Envelope
- North Star - Approved Indicative Disturbance Footprint (Key Mining Activities)
- Watercourse

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994
False Easting: 500,000.0000

Scale at A3 - 1:100,000

0 1 2 3 4 5

Kilometres



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19/09/2024 Rev: 0 ISSUED FOR INFORMATION Org: PC Chk: MH

2. Supplied information and data

The mine design information summarised in Table 2-1 was provided by Fortescue for use in the hydrologic impact assessment study. For all data used to inform the derivation of the baseline hydrologic characteristics of the Study Area (and associated model suites), refer to *North Star Magnetite Project Extension Baseline Hydrology Report* (Worley, 2024).

Table 2-1: Fortescue-supplied data

Data / Information	Description	File / Format
Mine design surfaces (NSE proposed key landforms)	Glacier Valley North Pit	pit_gvn_s01_rev01_201905_cut.tif
	Glacier Valley South Pit	gvs03_pitd_r02.2_sur_cut.tif
	Waste Rock Dump (WRD)	nts99_00_dump_cut_r001_csur.tif

3. Existing studies and guidelines

3.1 North Star Extension - Hydrological Assessment Report (BG&E, 2021)

BG&E Pty Limited (BG&E) were engaged by Fortescue Metals Group Ltd (FMG) (now Fortescue) to develop the baseline hydrology and surface water impact assessment for the North Star Extension (NSE).

The assessment used rainfall-runoff modelling (RORB) and 2D hydraulic modelling (TUFLOW) to assess the baseline hydrologic characteristics of the proposed extension area for the 20%, 10%, 5% and 1% Annual Exceedance Probability (AEP) events. The study also assessed potential impacts from mining landforms such as proposed pits and the waste rock dump.

The model results suggested that the difference in peak flows at Central Creek Pool for the 63.2% to 1% AEP events was less than 10% for the combined North Star Mine and NSE developed scenario whilst peak flows at SWGVPool would remain within 20% of the baseline condition.

In the WRD catchment, there was approximately 10% reduction in 10% to 1% AEP peak flows at the major confluence 7.8 km downstream of the NSE WRD compared to the baseline scenario. Larger reductions of approximately 90% were shown to occur at the mine tenement boundary, which is located immediately downstream of the NSE WRD.

3.2 North Star Magnetite Project Extension, Pilbara, WA (EPBC 2023/09466) (DCCEEW, 2024)

As part of the proposed NSE extension, the proposed action was referred under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) to the Minister for the Environment (the Minister) on 30 January 2023. On 9 November 2023 a delegate to the Minister determined the action to be a controlled action due to potential significant impacts on matters of national environmental significance (MNES). On 9 November 2023, a delegate to the Minister determined the proposed action would be assessed by a Public Environment Report (PER).

The DCCEEW noted that information about the proposed action and its relevant impacts, as detailed in the document (2023/09466), are to be provided in the PER. Previous works undertaken as part of the *North Star Magnetite Project Extension – Baseline Hydrology Report* (Worley, 2024) have detailed the technical works which address the DCCEEW statements on the previous (BG&E, 2021) baseline hydrologic derivation works. Therefore, only the information requested pertaining to the hydrologic impact assessment works only are presented in Table 3-1 for direct reference to this impact assessment report. Relevant sections of this report addressing the DCCEEW statement are also included for reference.

Table 3-1: Relevant DCCEEW statements on previous BG&E study and applicable sections in this study

Item	DCCEEW statement	Relevant section in this report
63f	The testing used to identify the parameter values for initial and continuing loss for the waste rock dump footprint should be provided (BG&E 2021, p. 15).	Section 4.2.2
66	In order for potential impacts associated with catchment reduction from the project to be adequately assessed evidence to support the assertion that flows will return to within 10% of pre-development flows downstream of the major confluence (FMGIB 2023, p. 90) is required. Currently this does not appear to be explored within modelling results and is not investigated within the provided documentation.	Section 5.1 & 6

4. Impact assessment methodology

4.1 General approach

The key objective of this study is to quantify any hydrologic changes to the hydrological regime along the downstream waterways resulting from the proposed mining operations and landforms.

Peak flows and hence peak flood hydraulic behaviours can be influenced by changes in catchment runoff response resulting from catchment changes due to the proposed mining landforms. Accordingly, changes associated with peak flows have been explicitly modelled using the TUFLOW hydrodynamic model suite developed as part of the *North Star Magnetite Project Extension Baseline Hydrology Report* (Worley, 2024).

As runoff volumes are a mass balance function of catchment area, comparative design event rainfall and empirical losses, this has been calculated in a desktop environment considering changes in catchment area due to the proposed pits and landform development.

The adopted approaches and background data and assumptions used to determine the relative change for each hydrologic result are detailed in the following sub sections.

The same Study Area catchment identifiers developed for the *North Star Magnetite Project Extension Baseline Hydrology Report* (Worley, 2024) have been adopted for this study (i.e., Pit and WRD catchments).

The catchment extents and mining landforms which represent the baseline and NSE scenarios are presented in Figure 4-1 and discussed in the following sections.

4.2 Mining landforms and design philosophy

4.2.1 Baseline condition landforms

As detailed in *North Star Magnetite Project Extension – Baseline Hydrology Report* (Worley, 2024), the following mining landforms were adopted as part of the baseline condition in the Pit catchment based on these landforms being previously approved under North Star Stage 2 Mining Proposal Revision 4 (Registration ID: 118381):

- Dry Reject Landform (DRL)
- Run of Mine landform (ROM)

The influence of these landforms and their design philosophies on the adopted model boundary for the baseline condition have been detailed in *North Star Magnetite Project Extension Baseline Hydrology Report* (Worley, 2024).

NORTH STAR EXTENSION HYDROLOGICAL IMPACT ASSESSMENT: WATERWAYS

FIGURE 4-1
STUDY AREA CATCHMENTS

Iron Bridge/
North Star Mine

Run of Mine
Landform

Dry Rejects Landform

Glacier Valley
North
Pit Shell

Waste Rock
Dump Landform

Figure 4-4
extent

Glacier Valley
South
Pit Shell

Figure 4-3
extent

SIX MILE CREEK

HONEYEATER
CREEK

Legend

- Pit Catchment - NSE Scenario
- WRD Catchment - NSE Scenario
- Mining Tenements
- Pit Catchment - Baseline Scenario
- WRD Catchment - Baseline Scenario
- Site 12 Pool Catchment (N.B. separate study)
- North Star Extension - Development Envelope
- North Star Extension - Indicative Disturbance Footprint
- North Star - Approved Mine Area Development Envelope
- North Star - Approved Indicative Disturbance Footprint (Key Mining Activities)
- Watercourse
- 10 m Interval Topographic Contour

Approved Mine Landforms [North Star Stage 2 Mining Proposal Revision 4 (Registration ID: 118381)]

- High elevation
- Low elevation

Mine Extension Scenario Landforms

- High elevation
- Low elevation

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994
False Easting: 500,000.0000

N

Scale at A3 - 1:50,000

0 0.5 1 1.5 2 2.5

Kilometres

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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13/12/2024 Rev: 0 ISSUED FOR INFORMATION Org: PC Chk: MH

4.2.2 NSE landforms

Additional landforms have been supplied by Fortescue for inclusion in the NSE impact assessment. These include:

- Proposed Glacier Valley North pit shell design (Pit catchment)
- Proposed Glacier Valley South pit shell design (Pit catchment)
- Waste Rock Dump closure landform design including the proposed extension of the WRD as part of the NSE development (WRD catchment)

The following sections detail the landforms in their respective catchment settings and design philosophies, which inform the assessment approach.

A summary of the baseline condition and mine extension landforms are presented in Figure 4-1.

4.2.2.1 Glacier Valley Pits

The Glacier Valley North and Glacier Valley South pits are located in the upper headwater areas of the Pit catchment.

Due to the proposed pit shell extents with respect to the existing waterway alignments, the steep headwater setting and relatively small catchment upstream of the pit shells, for the purpose of the hydrological impact assessment, it was conservatively assumed that all drainage lines and gullies which are intercepted by the pit shell designs are considered captured by the pits.

The location of the pits in the Pit catchment model area is presented in Figure 4-1, with detailed representation of the proposed Glacier Valley pit shell locations presented in Figure 4-2.

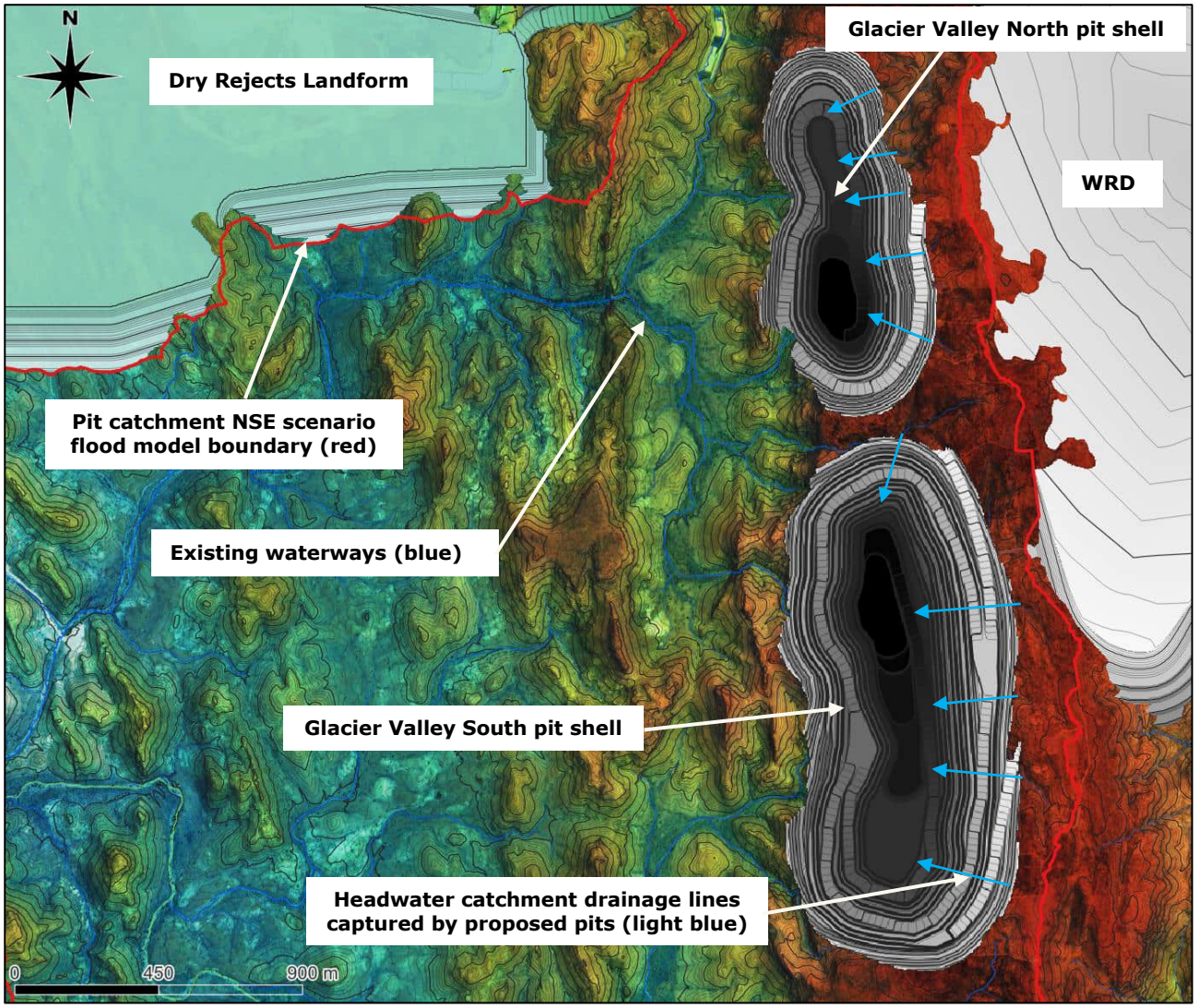

Figure 4-2: Proposed Glacier Valley North and South pit shell extents and headwater capture

4.2.2.2 Waste Rock Dump landform

The Waste Rock Dump (WRD) landform is located in the upper northwestern extents of the WRD catchment. Some discrete areas of batter slope intrusion occur into the upper limits of the Pit catchment, although these are noted as being minor, with the small, affected catchment area captured by the proposed Glacier Valley pit shells.

The WRD landform design intent mimics that of the DRL landform, in that the landform is proposed to be internally draining. The exception being that the top surface of the WRD closure landform is designed to drain into the adjacent northern catchment reporting to Site 12 Pool, upstream of Six Mile Creek.

The WRD landform location in the indicative area of interest is presented in Figure 4-1, with more detailed representation of the WRD presented in Figure 4-3 and Figure 4-4, which also conceptualises the dump surface top lift runoff direction and internal drainage of berms and batters that have been designed to a 1 in 2000 AEP standard.

It is noted that the proposed Waste Rock Dump (WRD) landform is situated within the WRD catchment and the adjacent Site 12 Pool catchment. The catchment area associated with the northern extents of the WRD and Site 12 Pool forms part of the Six Mile Creek catchment (a tributary of the East Strelley River). No assessment of the Site 12 Pool catchment is included in this study, as directed by Fortescue (being undertaken as a separate scope).

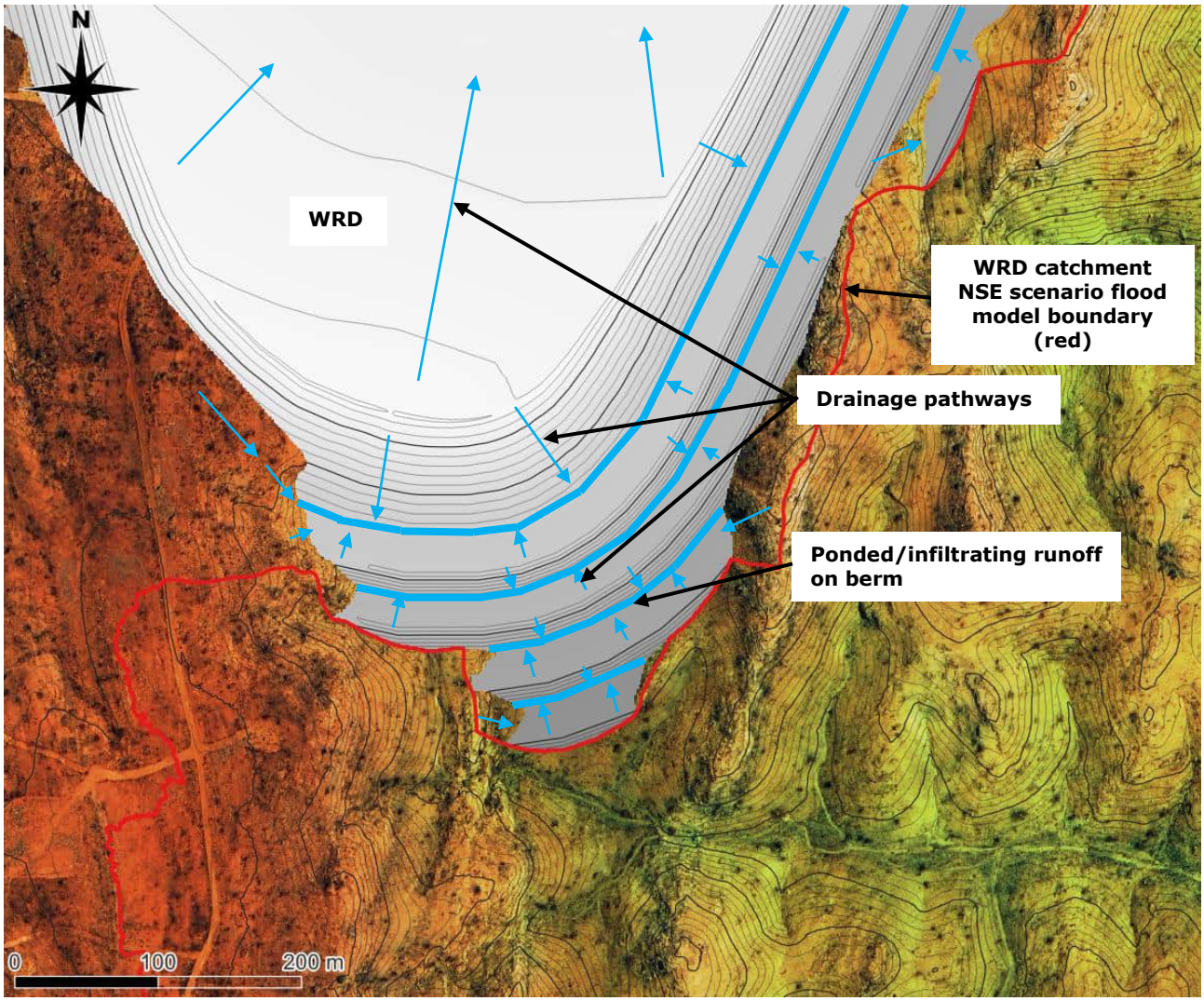

Figure 4-3: WRD landform internally draining berms and batters for operations and closure – drainage conceptualisation (indicative only)

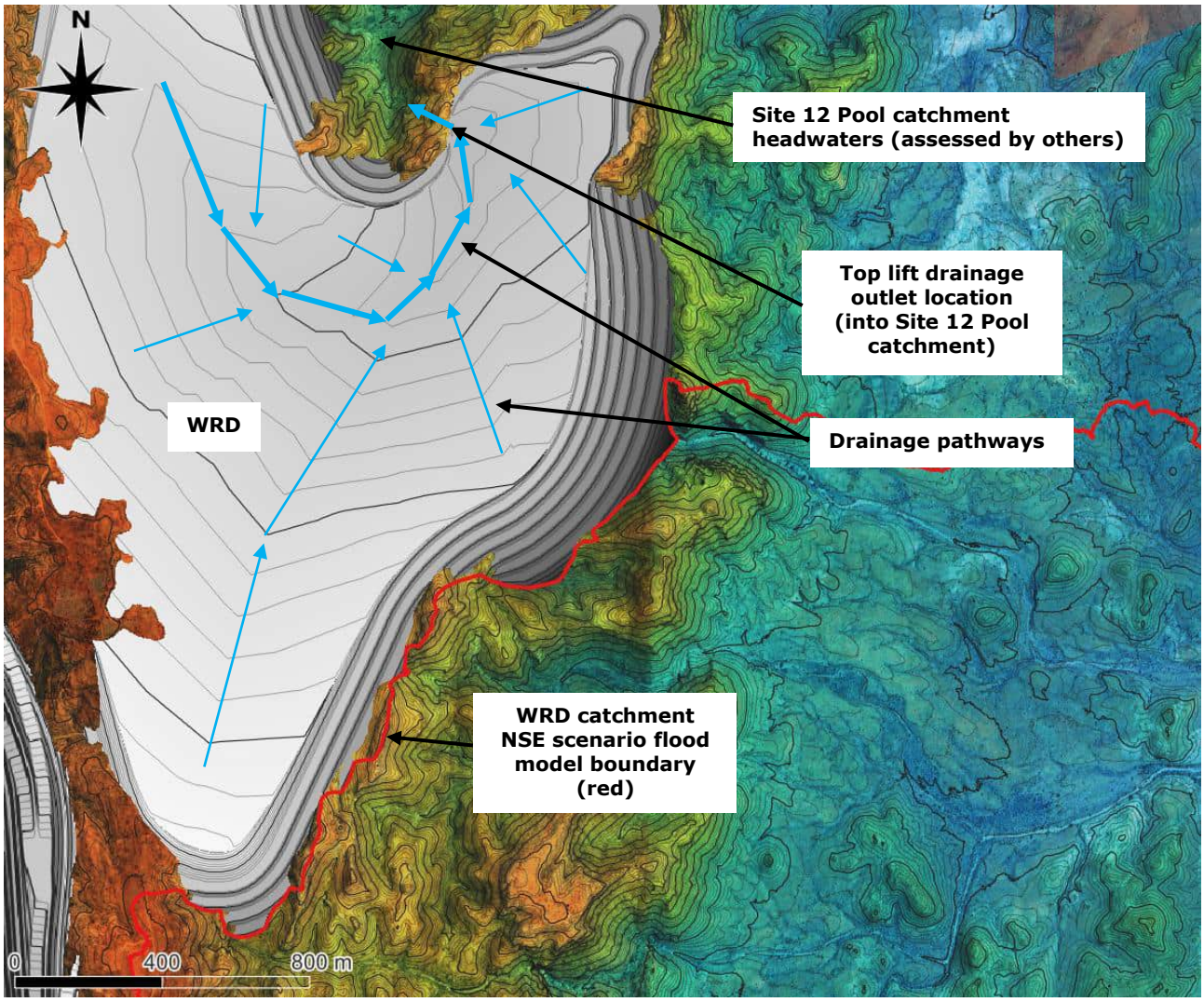

Figure 4-4: WRD closure design top lift drainage conceptualisation (indicative only)

4.3 Peak flow and hydraulic change assessment approach

To assess the potential changes to peak flows and hydraulic behaviours downstream of the NSE development, the TUFLOW hydraulic model suite developed as part of *North Star Magnetite Project Extension – Baseline Hydrology Report* (Worley, 2024) was updated with the proposed mine extension landforms.

Catchment and model boundaries were also updated to reflect the influence of the proposed WRD landform due to its internally draining philosophy and minor embankment incursion into the Pit catchment as discussed in Section 4.2.

A comparison of the Pit catchment and WRD catchment boundaries between the baseline and mine extension (impact assessment) scenarios because of the internally draining WRD landform have been previously presented in Figure 4-1.

The influence of the Glacier Valley pit shells on direct rainfall and headwater capture are explicitly assessed through inclusion of the pit shells and associated storage within the hydraulic model topography.

As the WRD landform and upslope areas have been excluded from the TUFLOW model for the WRD catchment (due to its internally draining design philosophy and the top surface of the WRD closure landform draining into the adjacent Site 12 Pool catchment), no consideration of landform-specific infiltration parameters or hydraulic roughness is required.

All other model parameters remain as previously detailed in *North Star Magnetite Project Extension Baseline Hydrology Report* (Worley, 2024).

4.4 Runoff volume impact assessment approach

As noted in *North Star Magnetite Project Extension Baseline Hydrology Report* (Worley, 2024), estimates of catchment volumetric runoff have been undertaken in a desktop environment. This is because volumetric runoff is a mass balance consideration, with catchment area, design rainfall and empirical losses being the key drivers. Whilst physical processes such as micro storage capture of runoff within the catchment landform is acknowledged, the impacts of these features will be mostly common between both baseline and mine extension scenarios.

The use of the TUFLOW hydraulic model to assess volumetric changes requires the model suite to be simulated for a significant simulation period, until the model reaches a state of mass equilibrium. This would result in unmanageable runtimes in the context of deriving impact estimates due to both baseline and mine extension cases having to be simulated for extended periods.

To determine runoff volume estimates, catchment areas for each scenario were then multiplied by areal-reduced design rainfall, with the adopted empirical losses removed from the rainfall event total (including representations of pre-burst rainfall) to derive an estimated runoff volume for each catchment and design rainfall event. Discharge volume impacts at the model outlets and reporting locations further downstream are therefore a rainfall excess and catchment area reduction product differential for the respective critical storm durations (for both the reported peak flow critical duration and discharge volume critical duration). As such, the respective catchment area change (due to the proposed landforms associated with NSE) also represents the change in runoff volume.

The results of the volumetric impact assessment are presented in Section 5.1.2 with reporting locations presented in Figure 5-1 and Figure 5-2.

5. Impact assessment results

5.1 Hydrological change estimates

5.1.1 Peak flow

The TUFLOW models developed for the *North Star Magnetite Project Extension Baseline Hydrology Report* (Worley, 2024) included the placement of flow reporting lines [Plot Output (PO) lines] in the models to obtain design flows at the model outlets and general hydrologic locations of interest throughout the catchments (such as stream confluences) and pools.

The same reporting locations have been used in the impact assessment to allow direct assessment of peak flow changes throughout the Study Area, with the reporting locations presented in Figure 5-1 and Figure 5-2. Tabulated peak flow results for both the baseline and mine extension scenarios are included in Appendix A.

In order to maintain AEP-neutrality, comparison of critical storm peak flows from the baseline condition have been compared with the same assessment approach for the NSE condition. This approach results in some minor fluctuations in peak flow changes due to differences in critical storms (temporal pattern and/or duration) as a result of the impacts of the NSE proposed landforms on the catchment's hydrologic response, with the results presented in Table 5-1 and Table 5-3.

A comparison of design storm results informed by the baseline condition critical design storm (i.e., a like-for-like comparison) has also been undertaken, with these results presented in Table 5-2 and Table 5-4.

NORTH STAR EXTENSION HYDROLOGICAL IMPACT ASSESSMENT: WATERWAYS

FIGURE 5-1

PIT CATCHMENT PEAK FLOW AND VOLUME REPORTING LOCATIONS

PitVol4 (Central Pool)
PitVol3
PitVol2
PitVol1
Run of Mine Landform
Dry Rejects Landform
Pit 1 (Mundagoora Pool)
Pit 2
Pit 3 (Pool_SW)
Pit 4
Pit 5
Pit 6

Legend

- Indicative Area of
- # Runoff Volume Reporting Location
- Peak Flow Reporting Location
- Mining Tenements
- Pit Catchment
- North Star Extension - Development Envelope
- North Star Extension - Indicative Disturbance Footprint
- North Star - Approved Mine Area Development Envelope
- North Star - Approved Indicative Disturbance Footprint (Key Mining Activities)
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- 10 m Interval Topographic Contour

Approved Mine Landforms [North Star Stage 2 Mining Proposal Revision 4 (Registration ID: 118381)]

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Coordinate System: GDA 1994 MGA Zone 50
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False Easting: 500,000.0000

Scale at A3 - 1:40,000

0 0.4 0.8 1.2 1.6 2

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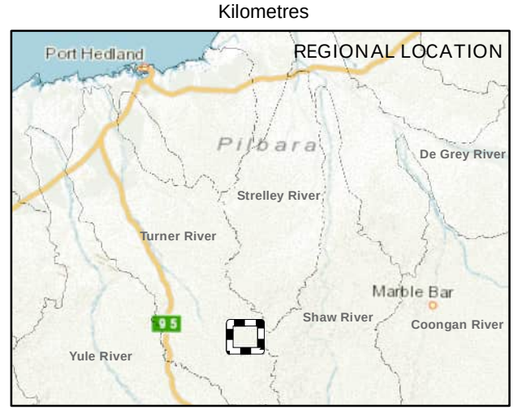

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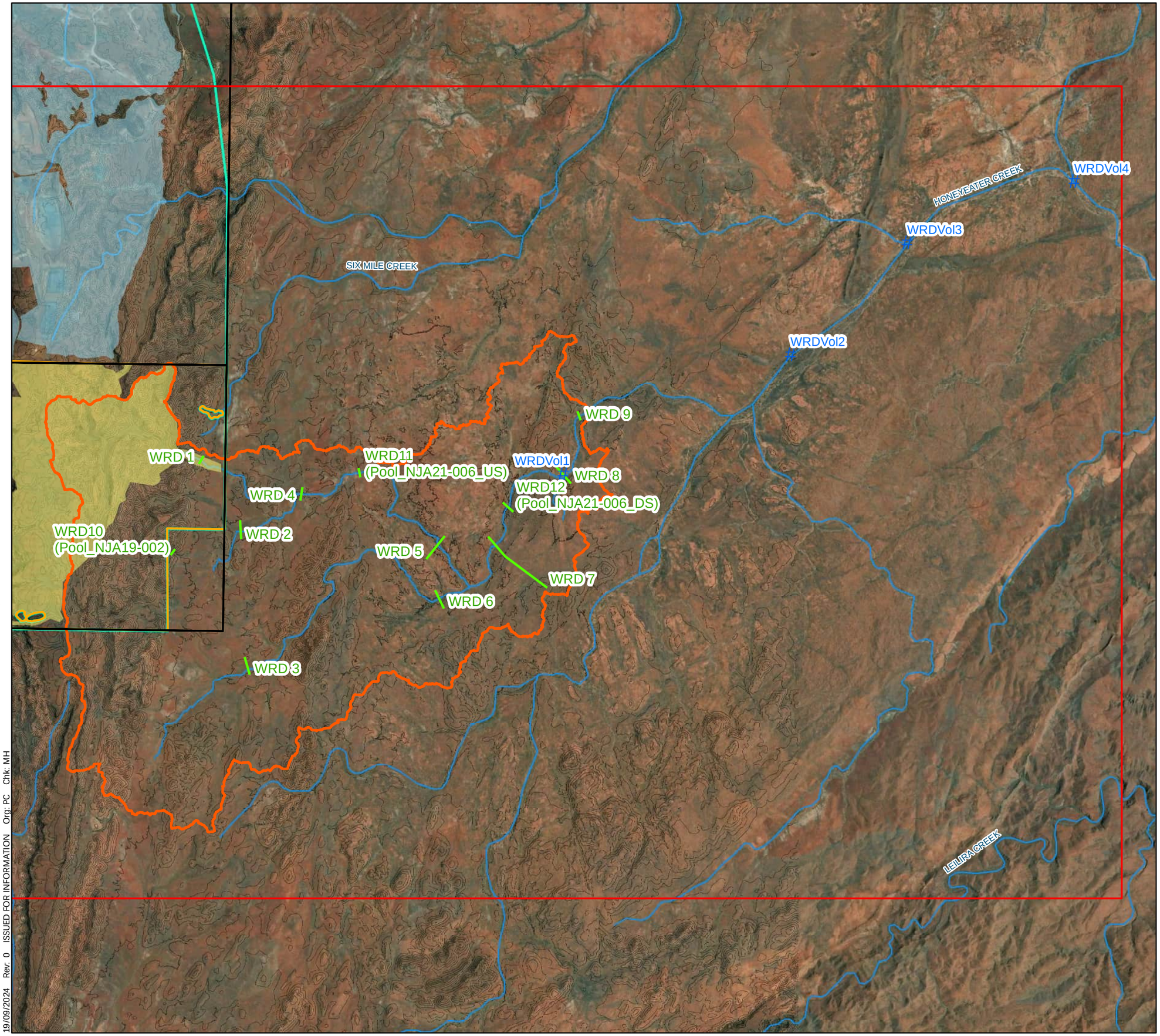
19/09/2024 Rev: A ISSUED FOR INFORMATION Org: PC Chk: PC

NORTH STAR EXTENSION HYDROLOGICAL IMPACT ASSESSMENT: WATERWAYS

FIGURE 5-2

WRD CATCHMENT PEAK FLOW AND VOLUME REPORTING LOCATIONS



Legend

- Indicative Area of Interest
- # Runoff Volume Reporting Location
- Peak Flow Reporting Location
- Mining Tenements
- WRD Catchment
- North Star Extension - Development Envelope
- North Star Extension - Indicative Disturbance Footprint
- North Star - Approved Mine Area Development Envelope
- North Star - Approved Indicative Disturbance Footprint (Key Mining Activities)
- Watercourse
- 10 m Interval Topographic Contour

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994
False Easting: 500,000.0000

Scale at A3 - 1:50,000

0 0.5 1 1.5 2 2.5

Kilometres

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19/09/2024 Rev: 0 ISSUED FOR INFORMATION Org: PC Chk: MH

Table 5-1: Peak flow change estimates (critical design storm comparison from each scenario) – frequent to rare events

Cat. ID	Reporting Location ID	AEP event					
		50% (% change)	20% (% change)	10% (% change)	5% (% change)	2% (% change)	1% (% change)
PIT	Pit 1 (Mundagoora Pool)	-57.6%	-59.5%	-54.7%	-54.9%	-53.7%	-54.5%
	Pit 2	-38.0%	-44.3%	-38.7%	-38.0%	-38.0%	-36.6%
	Pit 3 (Pool_SW)	-13.8%	-15.7%	-14.3%	-14.8%	-14.3%	-13.5%
	Pit 4	-8.7%	-9.5%	-6.9%	-7.1%	-8.4%	-7.6%
	Pit 5	-15.0%	-17.2%	-15.8%	-14.4%	-13.3%	-12.5%
	Pit 6	-14.2%	-15.9%	-14.4%	-14.3%	-13.9%	-12.2%
WRD	WRD 1	-95.7%	-95.5%	-95.1%	-94.8%	-94.7%	-95.1%
	WRD 2	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	WRD 3	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	WRD 4	-39.3%	-39.2%	-39.4%	-39.7%	-39.6%	-41.1%
	WRD 5	-30.4%	-25.8%	-24.0%	-23.3%	-22.9%	-22.0%
	WRD 6	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	WRD 7	-16.6%	-15.5%	-13.8%	-15.8%	-11.1%	-12.5%
	WRD 8	-14.9%	-12.3%	-12.0%	-13.2%	-10.5%	-10.7%
	WRD 9	-14.4%	-13.2%	-11.8%	-12.7%	-10.1%	-9.7%
	WRD10 (Pool_NJA19-002)	-1.5%	-2.8%	-5.0%	-3.6%	-4.2%	-3.8%
	WRD11 (Pool_NJA21-006_US)	-36.5%	-36.6%	-32.6%	-36.1%	-34.2%	-32.2%
	WRD12 (Pool_NJA21-006_DS)	-16.3%	-15.5%	-13.1%	-14.5%	-11.6%	-12.6%

Table 5-2: Peak flow change estimates (Baseline condition critical design storm comparison) – frequent to rare events

Cat. ID	Reporting Location ID	AEP event					
		50% (% change)	20% (% change)	10% (% change)	5% (% change)	2% (% change)	1% (% change)
PIT	Pit 1 (Mundagoora Pool)	-56%	-55%	-55%	-58%	-56%	-56%
	Pit 2	-42%	-44%	-39%	-39%	-38%	-36%
	Pit 3 (Pool_SW)	-14%	-16%	-14%	-15%	-14%	-14%
	Pit 4	-9%	-10%	-7%	-7%	-8%	-7%
	Pit 5	-15%	-17%	-16%	-14%	-14%	-13%
	Pit 6	-14%	-16%	-15%	-14%	-14%	-12%
WRD	WRD 1	-95%	-96%	-96%	-94%	-95%	-95%
	WRD 2	0%	0%	0%	0%	0%	0%
	WRD 3	0%	0%	0%	0%	0%	0%
	WRD 4	-39%	-40%	-39%	-39%	-41%	-41%
	WRD 5	-35%	-26%	-24%	-22%	-22%	-22%
	WRD 6	0%	0%	0%	0%	0%	0%
	WRD 7	-17%	-12%	-14%	-13%	-11%	-10%
	WRD 8	-15%	-14%	-12%	-13%	-12%	-10%
	WRD 9	-14%	-13%	-12%	-13%	-11%	-10%
	WRD10 (Pool_NJA19-002)	-1%	-3%	-5%	-4%	-3%	-4%
	WRD11 (Pool_NJA21-006_US)	-36%	-35%	-32%	-36%	-34%	-32%
	WRD12 (Pool_NJA21-006_DS)	-16%	-12%	-13%	-13%	-10%	-12%

Table 5-3: Peak flow change estimates (critical design storm comparison from each scenario) – very rare and extreme events

Cat. ID	Reporting Location ID	AEP event					
		1 in 200 (% change)	1 in 500 (% change)	1 in 1000 (% change)	1 in 2000 (% change)	PMPF (% change)	PMF (% change)
PIT	Pit 1 (Mundagoora Pool)	-53.3%	-51.0%	-52.0%	-53.3%	-52.5%	-52.2%
	Pit 2	-37.8%	-35.2%	-33.7%	-30.9%	-32.2%	-31.5%
	Pit 3 (Pool_SW)	-14.5%	-13.7%	-14.4%	-14.7%	-13.5%	-13.2%
	Pit 4	-7.6%	-2.6%	-6.0%	-3.3%	-4.6%	-4.8%
	Pit 5	-7.0%	-14.3%	-12.0%	-12.3%	-9.9%	-8.6%
	Pit 6	-13.0%	-13.4%	-10.0%	-7.7%	-7.4%	-7.9%
WRD	WRD 1	-94.5%	-94.2%	-94.2%	-94.1%	-93.3%	-92.4%
	WRD 2	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	WRD 3	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	WRD 4	-40.8%	-41.5%	-41.6%	-39.5%	-38.8%	-39.7%
	WRD 5	-19.5%	-21.1%	-17.8%	-20.8%	-17.5%	-14.6%
	WRD 6	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	WRD 7	-11.7%	-11.6%	-11.1%	-10.9%	-10.5%	-11.8%
	WRD 8	-10.8%	-10.3%	-9.9%	-10.0%	-6.9%	-6.5%
	WRD 9	-9.2%	-8.9%	-8.2%	-8.2%	-4.9%	-4.7%
	WRD10 (Pool_NJA19-002)	-4.1%	-3.5%	-2.5%	-3.0%	-2.2%	-2.3%
	WRD11 (Pool_NJA21-006_US)	-34.6%	-36.2%	-32.7%	-36.6%	-30.4%	-31.9%
	WRD12 (Pool_NJA21-006_DS)	-11.9%	-11.7%	-11.4%	-5.9%	-5.4%	-4.8%

Table 5-4: Peak flow change estimates (Baseline condition critical design storm comparison) – very rare and extreme events

Cat. ID	Reporting Location ID	AEP event					
		1 in 200 (% change)	1 in 500 (% change)	1 in 1000 (% change)	1 in 2000 (% change)	PMPF (% change)	PMF (% change)
PIT	Pit 1 (Mundagoora Pool)	-56%	-50%	-55%	-49%	-50%	-54%
	Pit 2	-41%	-43%	-33%	-33%	-34%	-32%
	Pit 3 (Pool_SW)	-14%	-14%	-14%	-14%	-13%	-13%
	Pit 4	-7%	-6%	-5%	-6%	-5%	-5%
	Pit 5	-13%	-13%	-13%	-13%	-10%	-9%
	Pit 6	-13%	-11%	-10%	-10%	-8%	-9%
WRD	WRD 1	-94%	-95%	-94%	-94%	-95%	-93%
	WRD 2	0%	0%	0%	0%	0%	0%
	WRD 3	0%	0%	0%	0%	0%	0%
	WRD 4	-41%	-41%	-44%	-44%	-40%	-40%
	WRD 5	-20%	-21%	-20%	-21%	-17%	-17%
	WRD 6	0%	0%	0%	0%	0%	0%
	WRD 7	-11%	-10%	-9%	-9%	-11%	-12%
	WRD 8	-11%	-10%	-10%	-11%	-6%	-7%
	WRD 9	-9%	-9%	-8%	-8%	-5%	-5%
	WRD10 (Pool_NJA19-002)	-4%	-4%	-2%	-4%	-2%	-2%
	WRD11 (Pool_NJA21-006_US)	-34%	-35%	-36%	-37%	-30%	-32%
	WRD12 (Pool_NJA21-006_DS)	-12%	-12%	-11%	-11%	-5%	-5%

When reviewing the predicted changes in peak flow between the assessment approaches, it is evident that the chosen assessment approach can influence the relative change estimate to the baseline condition. Maintaining AEP-neutrality (Table 5-1 and Table 5-3) can result in associated changes in critical design storms (median temporal patterns and critical durations) at the comparison locations, which accordingly can result in minor variance in predicted peak flow change through the AEP range.

The use of like-for-like design storms from the baseline condition (Table 5-2 and Table 5-4), results in generally similar relative difference estimates, but exhibits less variance in relative change through the AEP range.

For alignment with the procedures outlined in ARR2019 (Bell et al. 2019) for the derivation of design flood estimates, the comparison of design flows calculated independently for each scenario (i.e., baseline and NSE) maintains an AEP-neutral approach and hence has been used for comparative purposes in the following sections.

5.1.2 Catchment discharge volumes

The baseline and mine extension catchment areas and respective differences between scenarios are detailed in Table 5-5. The differences in catchment area are a result of either pit capture of upslope runoff (Pit catchment) or the influence of the proposed WRD landform catchment area loss (WRD catchment).

As previously noted, the respective catchment area change (due to the proposed landforms associated with NSE) also represents the change in runoff volume at each comparison location for each AEP event. These locations represent the same previously reported runoff volumes in *North Star Magnetite Project Extension – Baseline Hydrology Report* (Worley, 2024) and are presented in Figure 5-1 and Figure 5-2. All baseline and mine extension volumetric estimates are tabulated in Appendix B.

Table 5-5: Catchment area change – baseline to mine extension scenarios

Catchment ID	Baseline catchment area (km^2)	Mine extension catchment area (km^2)	Approximate distance downstream of model boundary (km)	Catchment area change from mine extension (%)
PitVol1	15.29	13.28	-	-13.1%
PitVol2	34.49	32.48	2.5	-5.8%
PitVol3	54.13	52.12	4.5	-3.7%
PitVol4 (Central Pool)	83.81	81.80	7.1	-2.4%
WRDVol1	28.24	25.61	-	-9.3%
WRDVol2	100.52	97.89	3.4	-2.6%
WRDVol3	117.20	114.57	5.7	-2.2%
WRDVol4	142.10	139.47	8.4	-1.9%

All baseline and mine extension volumetric estimates are tabulated in Appendix B for the reporting locations previously presented in *North Star Magnetite Project Extension Baseline Hydrology Report* (Worley, 2024) and shown in Figure 5-1 and Figure 5-2.

5.2 Hydraulic results summary

5.2.1 GIS mapping

Peak flood depth and velocity mapping for the Pit and WRD model domains for the 50%, 20%, 10%, 5%, 2%, 1%, 0.1% and PMF events are presented in Appendix C and Appendix D respectively. Peak flood level and velocity afflux (change) mapping is also presented for the Pit and WRD catchments in Appendix E and Appendix F, respectively.

Due to the direct rainfall modelling approach (and that every cell in the model is wet once losses are satisfied), the presented data has undergone a filtering process to aid in improved visualisation of key drainage features and removal of shallow sheet flows, with depths less than 50 mm not shown. The model results presented are the maximum envelope of critical

design storm durations across the Study Area using the median results from the ensemble of each design storm duration to derive the presented depth and velocity results.

The mapping is also based on downscaled model result (5 m resolution) interpolation using the underlying sub-grid bathymetry resolution (1 m resolution).

5.3 Hydrological and hydraulic change discussion

Given the inherent spatial variability of flood impact results across the Study Area, the following descriptions of predicted changes to peak flood hydraulic behaviours (elevation and velocity) are generalised descriptions of model results in the respective catchment areas. For detailed analysis of specific locations within the Study Area, review of model result data in a GIS environment is recommended.

5.3.1.1 Pit catchment

The reduction in contributing catchment area associated with the proposed Glacier Valley North and South pit shells has, as is to be expected, resulted in some reductions in peak flows, hydraulic behaviours and discharge volumes when compared to the baseline hydraulic regime in the Pit catchment area.

The largest predicted percentage change in peak flows within the Pit catchment are predicted to be immediately upstream of Mundagoora Pool (Pit 1 reporting location). Peak flows are estimated to change by between -59.5% (20% AEP) and -53.7% (2% AEP) when compared to the baseline condition due to this location being located less than 1 km downstream of the pit shells, which intercept or constitute a significant portion of the contributing catchment area to this location. Accordingly, the largest reductions in peak flood level occur upstream of the natural floodplain constrictions upstream of Mundagoora Pool with peak flood level reductions of approximately 900 mm (from a maximum peak flood depth of approximately 2.5 m in the baseline condition) predicted in the 1% AEP event. These changes reduce to approximately 300 mm (from a maximum peak flood depth of approximately 1.1 m in the baseline condition) in the more frequent 50% AEP event. Changes to peak velocities are predicted to be approximately a 0.3 m/s reduction in the 1% AEP event (from a maximum peak flood velocity of approximately 2.2 m/s in the baseline condition) and 0.2 m/s reduction in the 50% AEP event (from a maximum peak flood velocity of approximately 1.7 m/s in the baseline condition) in the same location.

Downstream of Mundagoora Pool in the single thread channels which typify the mid catchment reaches, peak flood level reductions in the 1% AEP event typically range between 300 mm and 400 mm (from a baseline maximum peak flood depth of approximately 2.0 m). These same reaches exhibit peak flood level reductions in the 50% AEP event in the order of 200 mm from the baseline maximum peak flood depth of approximately 0.9 m. Peak velocities are predicted to reduce by approximately 0.4 m/s and 0.3 m/s in the 1% AEP and 50% AEP events, from the baseline maximum peak flood velocities of approximately 2.2 m/s and 1.4 m/s, respectively in these locations.

Lower magnitudes of relative change in peak flows compared to the baseline condition are predicted immediately upstream of Pool_SW (Pit 3) of between -15.7% (20% AEP) and -13.5% (1% AEP). Given the smaller change on peak flows at this location, peak flood level

reductions upstream of Pool_SW are predicted to be below 300 mm and 100 mm in the 1% AEP and 50% AEP events, respectively (from maximum peak flood depths of approximately 1.8 m and 0.9 m in baseline conditions). Peak velocities at this location are predicted to reduce by less than 0.1 m/s in both the 1% AEP and 50% AEP events from baseline condition maximum peak flood velocities of approximately 2.5 m/s and 1.9 m/s respectively. In the mid catchment reaches below the pool, peak flood level reductions compared to the baseline condition are typically less than 200 mm and 100 mm in the 1% AEP and 50% AEP events (from maximum peak flood depths of approximately 2.0 m and 1.1 m in baseline conditions), respectively, with peak velocity change less than 0.1 m/s (from maximum peak flood velocities of approximately 2.5 m/s and 1.2 m/s in baseline conditions), reducing toward the downstream confluence.

At the Pit catchment outlet, peak flow changes range from -15.9% in the 20% AEP to -12.2% in the 1% AEP event are predicted, with resulting peak flood level reductions of less than 200 mm in the 1% AEP event (from a maximum peak flood depth of approximately 2.9 m in baseline condition) and less than 100 mm in the 50% AEP event (from a maximum peak flood depth of approximately 1.2 m in baseline condition). Peak velocities are predicted to reduce by approximately 0.1 m/s or less in the 1% AEP and 50% AEP events (from maximum peak flood velocities of approximately 2.8 m/s and 1.6 m/s in baseline conditions) respectively at this location. Discharge volumes at the Pit catchment outlet (PitVol1) are predicted to decrease by 13.1% due to the catchment area loss associated with the proposed Glacier Valley North and South pit shells at this location. This reduction in runoff volume decreases the further downstream of the tenement boundary as additional contributing catchment area reduces the overall relative change in catchment area loss associated with the proposed pits in the NSE scenario. At the PitVol4 reporting location (Central Pool) which is approximately 7.1 km downstream of the Pit catchment, the reduction in catchment area (and hence discharge volume) reduces to 2.4% when compared to the baseline scenario.

5.3.1.2 WRD catchment

As the proposed extension works in the WRD catchment are limited to the WRD landform, which is contained within the northern tributary sub-area of the overall WRD catchment, the following descriptions are concentrated on the northern tributary results and downstream areas.

Significant relative reductions in peak flow compared to the baseline condition are predicted at the WRD 1 reporting location [-95.7% (50% AEP) to -94.7% (1% AEP)], which is just downstream of the WRD landform (and just upstream of the tenement boundary) in the northern tributary arm. This is to be expected given the effective elimination of this catchment area due to the internally draining philosophy of the WRD landform.

Relative peak flow changes when compared to the baseline condition reduce further downstream as minor drainage lines and tributaries contribute additional flow to the northern tributary. Changes in peak flow reduce to between -36.6% (20% AEP) and -32.2% (1% AEP) at Pool_NJA21-006_US and reduce further to between -16.3% (50% AEP) and -11.6% (2% AEP) at Pool_NJA21-006_DS due to the additional runoff from catchment areas unaffected by the WRD landform. Smaller reductions in peak flow are predicted at Pool_NJA19-002 of between -5% (10% AEP) and -1.5% (50% AEP) as a result of the smaller impact of the WRD landform in that headwater catchment.

By the time flows reach the WRD catchment outlet, peak flow reductions range from -14.4% in the 50% AEP to -9.7% in the 1% AEP event, with changes in peak flood levels at the WRD model outlet compared to the baseline condition of approximately -150 mm in the 1% AEP event (from a maximum peak flood depth of approximately 2.7 m in the baseline condition) and -100 mm in the 50% AEP event (from a maximum peak flood depth of approximately 1.3 m in the baseline condition). Peak velocity change at this location is predicted to less than -0.1 m/s in both the 1% AEP and 50% AEP events, from maximum peak flood velocities of approximately 1.7 m/s and 1.3 m/s respectively in the baseline condition.

Discharge volumes near the WRD catchment outlet at the previously reported major confluence location (BG&E, 2021) and reported as WRDVol1 in this study, are predicted to decrease by 9.3% due to the catchment area loss associated with the WRD landform catchment area loss. This reduction in runoff volume decreases further downstream as additional contributing catchment area reduces the overall change in catchment area loss associated with the WRD landform in the NSE scenario. At the WRDVol4 reporting location, which is approximately 8.4 km downstream of the WRD catchment outlet, the change in discharge volume reduces to -1.9% when compared to the baseline scenario.

6. Conclusions

This study represents a hydrologic impact assessment of the waterways within the catchment areas associated with the NSE development. The assessment has been undertaken using desktop approaches as well as the model suite developed for *North Star Magnetite Project Extension Baseline Hydrology Report* (Worley, 2024) with the methods and data consistent with ARR2019 (Ball et al., 2019), the latest industry guidance on the derivation of hydrological estimates and flood risk.

Detailed responses and links to relevant report sections which address comments pertaining to this hydrological impact assessment in *Guidelines for the content of a draft Public Environment Report – North Star Magnetite Project Extension, Pilbara, WA (EPBC 2023/09466)* (DCCEEW, 2024) are presented in Table 6-1.

The following can be concluded from the assessment:

- The proposed Glacier Valley pit shells and WRD landform represent the main proposed landforms associated with the NSE development.
- The proposed Glacier Valley pit shells are situated in the headwater areas of the Pit catchment, capturing some minor upslope runoff areas and direct rainfall into the pit areas. This runoff interception, as well as the pit areas themselves, results in a 13.1% reduction in the total Pit catchment area.
- The WRD landform is situated in the headwaters of the northern tributary of the WRD catchment. The berms of the WRD landform are internally draining and the top lift is designed to discharge into the adjacent Site 12 Pool catchment at closure (not covered by this assessment), hence the catchment areas draining to or covered by the WRD landform within the Site 12 Pool catchment have been excluded from this assessment. The WRD landform and design philosophy results in a 9.3% reduction in the total WRD catchment area
- The predicted change in peak flows relative to the baseline condition immediately upstream of Mundagoora Pool are estimated to be between -59.5% (20% AEP) and -53.7% (2% AEP) due to it being located less than 1 km downstream of the pit shells which intercept or constitute a significant portion of the contributing catchment area to the pool. Peak flows at the Pool_SW have lower predicted changes in peak flows of between -15.7% (20% AEP) and -13.5% (1% AEP).
- At the Pit catchment outlet, peak flow change predictions range from -15.9% in the 20% AEP to -12.2% in the 1% AEP event.
- Peak flood level reductions when compared to the baseline condition at the Pit catchment outlet (representative of the tenement boundary) reduce to less than 200 mm in the 1% AEP event (from a maximum peak flood depth of approximately 2.9 m in baseline condition) and less than 100 mm in the 50% AEP event (from a maximum peak flood depth of approximately 1.2 m in baseline condition), with peak velocities predicted to reduce by approximately 0.1 m/s or less in the 1% AEP and 50% AEP events (from maximum peak flood velocities of approximately 2.8 m/s and 1.6 m/s in baseline conditions respectively).
- In the WRD catchment, the largest peak flow change relative to the baseline condition are mostly restricted to the northern tributary arm downstream of the WRD, as is to be expected due to the effective elimination of this catchment area. Changes in peak flow relative to the baseline condition reduce to between -36.6% (20% AEP) and -32.2% (1% AEP) further downstream at Pool_NJA21-006_US, due to the additional contributing

catchment area, and reduce further to between -16.3% (50% AEP) and -11.6% (2% AEP) at Pool_NJA21-006_DS. Smaller reductions are predicted at Pool NJA19 of between -5% (10% AEP) and -2.8% (20% AEP).

- At the WRD catchment outlet, peak flow reductions range from -14.4% in the 50% AEP to -9.7% in the 1% AEP event, with corresponding peak flood level reductions of approximately -150 mm in the 1% AEP event (from a maximum peak flood depth of approximately 2.7 m in the baseline condition) and -100 mm in the 50% AEP event (from a maximum peak flood depth of approximately 1.3 m in the baseline condition). Peak velocity change at this location is limited to less than -0.1 m/s in both the 1% AEP and 50% AEP events, from maximum peak flood velocities of approximately 1.7 m/s and 1.3 m/s respectively in the baseline condition.
- Catchment discharge volume change relative to the baseline condition in both catchments is a direct function of catchment area loss differential between the baseline and NSE scenarios, and hence is AEP-independent. At the catchment outlets the following reductions in catchment discharge volumes are predicted:
  - 13.1% reduction (change) in runoff volume at the Pit catchment outlet
  - 9.3% reduction (change) in runoff volume at the WRD catchment outlet
- The relative change in discharge volumes quickly reduces with distance and additional contributing catchment area downstream of the study area catchments. At Central Pool (7.1 km downstream of the Pit catchment), the relative change in discharge volume reduces to -2.4%. In the WRD catchment, predicted relative discharge volume changes reduce to -1.9% approximately 8.4 km downstream of the WRD catchment, when compared to the baseline condition.

Table 6-1: Relevant DCCEEW statements on previous BG&E study and applicable sections in this study

Item	DCCEEW statement	Relevant section in this report	Comment
63f	The testing used to identify the parameter values for initial and continuing loss for the waste rock dump footprint should be provided (BG&E 2021, p. 15).	Section 4.2.2	The WRD landform design intent mimics that of the DRL landform, in that the landform is proposed to be internally draining. The exception being that at closure the top surface of the WRD closure landform is designed to drain into the adjacent northern catchment reporting to Site 12 Pool, upstream of Six Mile Creek (assessed as part of a separate study). The dump surface top lift and internal drainage of berms and batters have been designed to a 1 in 2000 AEP standard. Given the design approach adopted for operations and closure for the WRD landform, all batter and bench areas associated with the WRD landform have been excluded from the NSE scenario TUFLOW impact modelling and volumetric calculations due to the effective elimination of this catchment area. As such, no consideration of landform-specific infiltration parameters or hydraulic roughness is required.
66	In order for potential impacts associated with catchment reduction from the project to be adequately assessed evidence to support the assertion that flows will return to within 10% of pre-development flows downstream of the major confluence (FMGIB 2023, p. 90) is required. Currently this does not appear to be explored within modelling results and is not investigated within the provided documentation.	Section 5.1 & 0	The assessment of potential changes in peak flows and associated flood hydraulic behaviours resulting from the proposed NSE landforms has been undertaken using the model suite developed for *North Star Magnetite Project Extension – Baseline Hydrology Report* (Worley, 2024) with the methods and data consistent with ARR2019 (Ball et al., 2019), the latest industry guidance on the derivation of hydrological estimates and flood risk. The assessment has predicted that in the WRD catchment peak flow changes are, as expected, predicted to be highest immediately downstream of the WRD landform due to effective elimination of this catchment area when compared to the baseline condition. As the WRD landform only influences the northern tributaries of the overall WRD catchment, changes to peak flows and hence hydraulic behaviours are limited to these watercourses and waterway areas downstream. Relative peak flow change to the baseline condition reduce further downstream of the WRD landform as additional catchment area contributes to the waterways. By the WRD catchment outlet, changes in peak flows relative to the baseline condition have reduced to -14.4% in the 50% AEP event to -9.7% in the 1% AEP event. This results in peak flood level reductions near the model outlet of approximately 150 mm in the 1% AEP event (from a maximum peak flood depth of approximately 2.7 m in the baseline condition) to 100 mm in the 50% AEP event (from a maximum peak flood depth of approximately 1.3 m in the baseline condition). Peak flood velocities are predicted to change by less than -0.1 m/s in the 1% AEP event (from a maximum peak flood velocity of approximately 1.7 m/s in the baseline condition) and less than -0.05 m/s in the 50% AEP event (from a maximum peak flood velocity of approximately 1.3 m/s in the baseline condition) near the WRD catchment outlet. In the Pit catchment, peak flow changes relative to the Baseline condition are greatest in the more frequent

Item	DCCEEW statement	Relevant section in this report	Comment
			(i.e., 50% AEP) events and locations closest to the proposed Glacier Valley North and South pit shells, due to the higher proportion of catchment loss at these comparison locations. Similarly to the WRD catchment, the relative loss of catchment area and peak flow change from the baseline condition reduces further downstream in the Pit catchment, with predicted change in peak flows ranging from -15.9% in the 20% AEP to -12.2% in the 1% AEP at the catchment outlet. Peak flood behaviour at the Pit model outlet (near the tenement boundary) is less than 200 mm in the 1% AEP event (from a maximum peak flood depth of approximately 2.9 m in baseline condition), reducing to less than 100 mm in the 50% AEP event (from a maximum peak flood depth of approximately 1.2 m in baseline condition). Peak velocities are predicted to change by approximately -0.1 m/s in both the 1% AEP and 50% AEP events, from maximum peak flood velocities of approximately 2.8 m/s and 1.6 m/s in baseline conditions respectively. Catchment discharge volume change in both catchments is a direct function of catchment area loss differential between the baseline and NSE scenarios and hence is AEP-independent. As such, changes in catchment discharge volumes when compared to the baseline condition are predicted to be -13.1% at the Pit model outlet, reducing to less than -2.5% at Central Pool, approximately 7.1 km downstream of the Pit model outlet. In the WRD catchment at the previously reported main confluence location (WRDVol1), a -9.3% reduction in catchment discharge volume is predicted when compared to the baseline condition, reducing to -1.9% approximately 8.1 km downstream of the WRD catchment boundary.

7. References

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors) (2019), *Australian Rainfall and Runoff: A Guide to Flood Estimation*, Commonwealth of Australia (Geoscience Australia)

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Department of Climate Change, Energy, the Environment and Water (2024), *Guidelines for the content of a draft Public Environment Report. North Star Magnetite Project Extension, Pilbara, WA (EPBC 2023/09466)*

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Appendix A. Peak flow estimates – Baseline and Mine Extension Scenarios

Table A1: Baseline condition peak flow estimates – frequent to rare events

Cat. ID	Reporting location ID	Peak flow (m^3/s) AEP event					
		50% (critical duration)	20% (critical duration)	10% (critical duration)	5% (critical duration)	2% (critical duration)	1% (critical duration)
PIT	Pit 1 (Mundagoora Pool)	14 (90 min)	35 (60 min)	45 (45 min)	58 (45 min)	81 (25 min)	98 (20 min)
	Pit 2	16 (90 min)	40 (90 min)	53 (90 min)	65 (45 min)	90 (45 min)	108 (45 min)
	Pit 3 (Pool_SW)	19 (90 min)	43 (60 min)	57 (45 min)	71 (30 min)	103 (25 min)	126 (20 min)
	Pit 4	30 (90 min)	67 (90 min)	90 (90 min)	113 (45 min)	155 (45 min)	185 (30 min)
	Pit 5	47 (120 min)	109 (90 min)	152 (90 min)	188 (90 min)	233 (45 min)	281 (45 min)
	Pit 6	47 (120 min)	107 (90 min)	148 (90 min)	188 (90 min)	228 (45 min)	278 (45 min)
WRD	WRD 1	16.8 (90 min)	38.4 (60 min)	49.9 (45 min)	67.3 (25 min)	94.6 (20 min)	121 (15 min)
	WRD 2	17.7 (90 min)	42.2 (60 min)	53.3 (45 min)	69.8 (30 min)	99.8 (20 min)	125 (20 min)
	WRD 3	27.1 (90 min)	60.1 (60 min)	80 (45 min)	99.5 (45 min)	140 (30 min)	171 (20 min)
	WRD 4	36.9 (90 min)	85.3 (60 min)	110 (45 min)	136 (45 min)	187 (25 min)	231 (25 min)
	WRD 5	36.2 (90 min)	96 (120 min)	150 (90 min)	193 (90 min)	245 (45 min)	313 (45 min)
	WRD 6	29.9 (90 min)	57.4 (180 min)	74.9 (120 min)	89.2 (120 min)	110 (90 min)	123 (90 min)
	WRD 7	65.1 (120 min)	148 (180 min)	218 (120 min)	273 (120 min)	332 (90 min)	408 (90 min)
	WRD 8	65.9 (120 min)	154 (180 min)	217 (120 min)	273 (120 min)	343 (90 min)	413 (90 min)
	WRD 9	64.7 (120 min)	152 (180 min)	211 (120 min)	268 (120 min)	335 (180 min)	403 (90 min)
	WRD10 (Pool_NJA19-002)	4.75 (90 min)	10.6 (60 min)	14.1 (30 min)	19.6 (25 min)	28.4 (20 min)	34.1 (20 min)
	WRD11 (Pool_NJA21-006_US)	38.1 (90 min)	90.9 (90 min)	111 (90 min)	142 (45 min)	193 (45 min)	230 (45 min)
	WRD12 (Pool_NJA21-006_DS)	64.9 (120 min)	148 (180 min)	213 (120 min)	269 (120 min)	328 (180 min)	396 (90 min)

Table A2: Baseline condition peak flow estimates – very rare and extreme events

Cat. ID	Reporting Location ID	Peak flow (m^3/s) AEP event					
		1 in 200 (critical duration)	1 in 500 (critical duration)	1 in 1000 (critical duration)	1 in 2000 (critical duration)	PMPF (critical duration)	PMF (critical duration)
PIT	Pit 1 (Mundagoora Pool)	115 (25 min)	145 (20 min)	173 (20 min)	201 (20 min)	566 (15 min)	611 (15 min)
	Pit 2	128 (45 min)	159 (45 min)	181 (30 min)	207 (30 min)	634 (25 min)	691 (25 min)
	Pit 3 (Pool_SW)	145 (15 min)	183 (15 min)	215 (15 min)	252 (15 min)	660 (20 min)	697 (20 min)
	Pit 4	223 (30 min)	274 (30 min)	316 (25 min)	365 (25 min)	1,142 (20 min)	1,269 (20 min)
	Pit 5	330 (45 min)	407 (60 min)	449 (45 min)	503 (45 min)	1,475 (45 min)	1,576 (45 min)
	Pit 6	338 (90 min)	405 (90 min)	448 (90 min)	501 (60 min)	1,534 (60 min)	1,604 (60 min)
WRD	WRD 1	141 (25 min)	183 (20 min)	217 (20 min)	244 (20 min)	564 (20 min)	628 (20 min)
	WRD 2	146 (25 min)	194 (20 min)	226 (20 min)	263 (20 min)	676 (20 min)	743 (20 min)
	WRD 3	209 (25 min)	260 (20 min)	318 (20 min)	376 (20 min)	1,045 (20 min)	1,197 (20 min)
	WRD 4	267 (25 min)	335 (20 min)	387 (20 min)	443 (20 min)	1,223 (20 min)	1,356 (20 min)
	WRD 5	379 (25 min)	474 (20 min)	544 (20 min)	616 (20 min)	2,210 (20 min)	2,347 (20 min)
	WRD 6	147 (25 min)	171 (20 min)	193 (20 min)	213 (20 min)	754 (20 min)	834 (20 min)
	WRD 7	520 (90 min)	620 (90 min)	695 (90 min)	773 (90 min)	2905 (120 min)	3,266 (120 min)
	WRD 8	508 (25 min)	610 (20 min)	684 (20 min)	762 (20 min)	2,364 (20 min)	2,488 (20 min)
	WRD 9	479 (25 min)	563 (20 min)	620 (20 min)	679 (20 min)	1,768 (20 min)	1,829 (20 min)
	WRD10 (Pool_NJA19-002)	43.5 (25 min)	56.4 (20 min)	64.4 (20 min)	76.1 (20 min)	183 (20 min)	213 (20 min)
	WRD11 (Pool_NJA21-006_US)	280 (25 min)	340 (20 min)	394 (20 min)	448 (20 min)	1,357 (20 min)	1,506 (20 min)
	WRD12 (Pool_NJA21-006_DS)	488 (25 min)	589 (20 min)	665 (20 min)	740 (20 min)	1,990 (20 min)	2,074 (20 min)

Table A3: Mine extension condition peak flow estimates (critical design event) – frequent to rare events

Cat. ID	Reporting location ID	Peak flow (m^3/s) AEP event					
		50% (critical duration)	20% (critical duration)	10% (critical duration)	5% (critical duration)	2% (critical duration)	1% (critical duration)
PIT	Pit 1 (Mundagoora Pool)	6.11 (90 min)	14.2 (60 min)	20.3 (45 min)	26 (25 min)	37.4 (20 min)	44.8 (15 min)
	Pit 2	10.1 (120 min)	22.1 (90 min)	32.2 (90 min)	40.2 (60 min)	55.7 (45 min)	68.5 (45 min)
	Pit 3 (Pool_SW)	16.3 (90 min)	36 (60 min)	48.6 (45 min)	60.1 (30 min)	88.3 (25 min)	109 (20 min)
	Pit 4	27.2 (90 min)	60.7 (90 min)	84.2 (90 min)	105 (45 min)	142 (45 min)	171 (30 min)
	Pit 5	39.8 (120 min)	90.2 (90 min)	128 (90 min)	161 (90 min)	202 (45 min)	246 (45 min)
	Pit 6	40 (120 min)	90 (90 min)	131 (90 min)	162 (90 min)	199 (60 min)	244 (45 min)
WRD	WRD 1	0.73 (90 min)	1.74 (60 min)	2.46 (25 min)	3.52 (20 min)	5.02 (15 min)	5.95 (15 min)
	WRD 2	17.7 (90 min)	42.2 (60 min)	53.3 (45 min)	69.8 (30 min)	99.8 (20 min)	125 (20 min)
	WRD 3	27.1 (90 min)	60.1 (60 min)	80 (45 min)	99.5 (45 min)	140 (30 min)	171 (20 min)
	WRD 4	22.4 (90 min)	51.9 (90 min)	66.7 (45 min)	82 (45 min)	113 (45 min)	136 (25 min)
	WRD 5	25.2 (120 min)	71.2 (90 min)	114 (90 min)	148 (120 min)	189 (60 min)	244 (45 min)
	WRD 6	29.9 (90 min)	57.4 (180 min)	74.9 (120 min)	89.2 (120 min)	110 (90 min)	123 (90 min)
	WRD 7	54.3 (120 min)	125 (120 min)	188 (120 min)	230 (120 min)	295 (90 min)	357 (90 min)
	WRD 8	56.1 (120 min)	135 (180 min)	191 (120 min)	237 (120 min)	307 (90 min)	369 (90 min)
	WRD 9	55.4 (120 min)	132 (180 min)	186 (120 min)	234 (120 min)	301 (180 min)	364 (180 min)
	WRD10 (Pool_NJA19-002)	4.68 (90 min)	10.3 (60 min)	13.4 (30 min)	18.9 (25 min)	27.2 (20 min)	32.8 (20 min)
	WRD11 (Pool_NJA21-006_US)	24.2 (90 min)	57.6 (90 min)	74.8 (90 min)	90.7 (45 min)	127 (45 min)	156 (45 min)
	WRD12 (Pool_NJA21-006_DS)	54.3 (120 min)	125 (180 min)	185 (120 min)	230 (120 min)	290 (90 min)	346 (90 min)

Table A4: Mine extension condition peak flow estimates (critical design event) – very rare and extreme events

Cat. ID	Reporting Location ID	Peak flow (m^3/s) AEP event					
		1 in 200 (critical duration)	1 in 500 (critical duration)	1 in 1000 (critical duration)	1 in 2000 (critical duration)	PMPF (critical duration)	PMF (critical duration)
PIT	Pit 1 (Mundagoora Pool)	53.7 (25 min)	71.1 (20 min)	83 (20 min)	93.8 (20 min)	269 (20 min)	292 (20 min)
	Pit 2	79.6 (25 min)	103 (20 min)	120 (20 min)	143 (20 min)	430 (20 min)	473 (20 min)
	Pit 3 (Pool_SW)	124 (25 min)	158 (20 min)	184 (20 min)	215 (20 min)	571 (20 min)	605 (20 min)
	Pit 4	206 (25 min)	267 (20 min)	297 (20 min)	353 (20 min)	1,090 (20 min)	1,203 (20 min)
	Pit 5	307 (25 min)	349 (20 min)	395 (20 min)	441 (20 min)	1,329 (20 min)	1,440 (20 min)
	Pit 6	294 (25 min)	354 (20 min)	405 (20 min)	466 (20 min)	1,421 (20 min)	1,478 (20 min)
WRD	WRD 1	7.71 (25 min)	10.6 (20 min)	12.5 (20 min)	14.3 (20 min)	37.9 (20 min)	47.9 (20 min)
	WRD 2	146 (25 min)	194 (20 min)	226 (20 min)	263 (20 min)	676 (20 min)	743 (20 min)
	WRD 3	209 (25 min)	260 (20 min)	318 (20 min)	376 (20 min)	1,045 (20 min)	1,197 (20 min)
	WRD 4	158 (25 min)	196 (20 min)	226 (20 min)	268 (20 min)	749 (20 min)	818 (20 min)
	WRD 5	305 (25 min)	374 (20 min)	447 (20 min)	488 (20 min)	1,823 (20 min)	2,005 (20 min)
	WRD 6	147 (25 min)	171 (20 min)	193 (20 min)	213 (20 min)	754 (20 min)	834 (20 min)
	WRD 7	459 (120 min)	548 (90 min)	618 (90 min)	689 (90 min)	2,601 (90 min)	2,880 (120 min)
	WRD 8	453 (25 min)	547 (20 min)	616 (20 min)	686 (20 min)	2,200 (20 min)	2,326 (20 min)
	WRD 9	435 (25 min)	513 (20 min)	569 (20 min)	623 (20 min)	1,682 (20 min)	1,743 (20 min)
	WRD10 (Pool_NJA19-002)	41.7 (25 min)	54.4 (20 min)	62.8 (20 min)	73.8 (20 min)	179 (20 min)	208 (20 min)
	WRD11 (Pool_NJA21-006_US)	183 (25 min)	217 (20 min)	265 (20 min)	284 (20 min)	944 (20 min)	1,026 (20 min)
	WRD12 (Pool_NJA21-006_DS)	430 (25 min)	520 (20 min)	589 (20 min)	696 (20 min)	1,882 (20 min)	1,974 (20 min)

Table A5: Mine extension condition peak flow estimates (Baseline condition critical design storms) – frequent to rare events

Cat. ID	Reporting location ID	Peak flow (m^3/s) AEP event					
		50% (critical duration)	20% (critical duration)	10% (critical duration)	5% (critical duration)	2% (critical duration)	1% (critical duration)
PIT	Pit 1 (Mundagoora Pool)	6.34 (90 min)	15.8 (60 min)	20.3 (45 min)	24.4 (45 min)	35.8 (25 min)	43.6 (20 min)
	Pit 2	9.46 (90 min)	22.1 (90 min)	32.2 (90 min)	39.6 (45 min)	55.5 (45 min)	68.5 (45 min)
	Pit 3 (Pool_SW)	16.3 (90 min)	36 (60 min)	48.6 (45 min)	60.1 (30 min)	88.3 (25 min)	109 (20 min)
	Pit 4	27.2 (90 min)	60.7 (90 min)	84.2 (90 min)	105 (45 min)	143 (45 min)	171 (30 min)
	Pit 5	39.8 (120 min)	90.2 (90 min)	128 (90 min)	161 (90 min)	200 (45 min)	246 (45 min)
	Pit 6	40 (120 min)	90 (90 min)	131 (90 min)	162 (90 min)	199 (60 min)	244 (45 min)
WRD	WRD 1	0.79 (90 min)	1.55 (60 min)	2.16 (45 min)	3.86 (25 min)	4.36 (20 min)	5.95 (15 min)
	WRD 2	17.7 (90 min)	42.2 (60 min)	53.3 (45 min)	69.8 (30 min)	99.8 (20 min)	125 (20 min)
	WRD 3	27.1 (90 min)	60.1 (60 min)	80 (45 min)	99.5 (45 min)	140 (30 min)	171 (20 min)
	WRD 4	22.4 (90 min)	51.6 (60 min)	66.7 (45 min)	82 (45 min)	109 (25 min)	136 (25 min)
	WRD 5	23.4 (90 min)	71.1 (120 min)	114 (90 min)	150 (90 min)	190 (45 min)	244 (45 min)
	WRD 6	29.9 (90 min)	57.4 (180 min)	74.9 (120 min)	89.2 (120 min)	110 (90 min)	123 (90 min)
	WRD 7	54.3 (120 min)	130 (180 min)	188 (120 min)	237 (120 min)	295 (90 min)	367 (90 min)
	WRD 8	56.1 (120 min)	132 (180 min)	191 (120 min)	237 (120 min)	302 (90 min)	369 (90 min)
	WRD 9	55.4 (120 min)	132 (180 min)	186 (120 min)	234 (120 min)	298 (180 min)	364 (90 min)
	WRD10 (Pool_NJA19-002)	4.71 (90 min)	10.3 (60 min)	13.4 (30 min)	18.9 (25 min)	27.7 (20 min)	32.8 (20 min)
	WRD11 (Pool_NJA21-006_US)	24.2 (90 min)	59.5 (90 min)	75.1 (90 min)	90.7 (45 min)	127 (45 min)	158 (45 min)
	WRD12 (Pool_NJA21-006_DS)	54.3 (120 min)	130 (180 min)	185 (120 min)	235 (120 min)	294 (180 min)	349 (90 min)

Table A6: Mine extension condition peak flow estimates (Baseline condition critical design storms) – very rare and extreme events

Cat. ID	Reporting Location ID	Peak flow (m^3/s) AEP event					
		1 in 200 (critical duration)	1 in 500 (critical duration)	1 in 1000 (critical duration)	1 in 2000 (critical duration)	PMPF (critical duration)	PMF (critical duration)
PIT	Pit 1 (Mundagoora Pool)	50.9 (25 min)	72.5 (20 min)	77.8 (20 min)	102 (20 min)	282 (20 min)	283 (20 min)
	Pit 2	75.8 (25 min)	91.2 (20 min)	121 (20 min)	138 (20 min)	418 (20 min)	473 (20 min)
	Pit 3 (Pool_SW)	124 (25 min)	158 (20 min)	184 (20 min)	217 (20 min)	571 (20 min)	605 (20 min)
	Pit 4	208 (25 min)	257 (20 min)	299 (20 min)	342 (20 min)	1,090 (20 min)	1,203 (20 min)
	Pit 5	288 (25 min)	352 (20 min)	390 (20 min)	437 (20 min)	1,328 (20 min)	1,440 (20 min)
	Pit 6	293 (25 min)	362 (20 min)	405 (20 min)	456 (20 min)	1,407 (20 min)	1,467 (20 min)
WRD	WRD 1	8.55 (25 min)	9.97 (20 min)	12.5 (20 min)	14.2 (20 min)	28.4 (20 min)	45.9 (20 min)
	WRD 2	146 (25 min)	194 (20 min)	226 (20 min)	263 (20 min)	676 (20 min)	743 (20 min)
	WRD 3	209 (25 min)	260 (20 min)	318 (20 min)	376 (20 min)	1,045 (20 min)	1,197 (20 min)
	WRD 4	157 (25 min)	196 (20 min)	215 (20 min)	249 (20 min)	728 (20 min)	818 (20 min)
	WRD 5	305 (25 min)	374 (20 min)	433 (20 min)	487 (20 min)	1,837 (20 min)	1,950 (20 min)
	WRD 6	147 (25 min)	171 (20 min)	193 (20 min)	213 (20 min)	752 (20 min)	833 (20 min)
	WRD 7	461 (90 min)	560 (90 min)	632 (90 min)	706 (90 min)	2,598 (120 min)	2,880 (120 min)
	WRD 8	453 (25 min)	547 (20 min)	616 (20 min)	680 (20 min)	2,227 (20 min)	2,326 (20 min)
	WRD 9	435 (25 min)	513 (20 min)	569 (20 min)	621 (20 min)	1,682 (20 min)	1,743 (20 min)
	WRD10 (Pool_NJA19-002)	41.6 (25 min)	54.4 (20 min)	62.8 (20 min)	73.4 (20 min)	179 (20 min)	208 (20 min)
	WRD11 (Pool_NJA21-006_US)	184 (25 min)	220 (20 min)	251 (20 min)	284 (20 min)	953 (20 min)	1,026 (20 min)
	WRD12 (Pool_NJA21-006_DS)	430 (25 min)	520 (20 min)	592 (20 min)	659 (20 min)	1,898 (20 min)	1,974 (20 min)

Appendix B. Volumetric Runoff Calculations – Baseline and Mine Extension Scenarios

Table B1: Baseline condition discharge volume estimates (ML) – critical storm duration (peak flow)

Reporting ID	AEP event					
	50%	20%	10%	5%	2%	1%
Pit (PitVol1)	238 (120 min)	462 (90 min)	639 (90 min)	815 (90 min)	945 (60 min)	977 (45 min)
WRD (WRDVol1)	439 (120 min)	1,144 (180 min)	1,320 (120 min)	1,688 (120 min)	2,191 (90 min)	2,733 (90 min)

Table B2: Baseline discharge volume estimates (ML) – critical storm duration (volume)

Reporting ID	AEP event					
	50%	20%	10%	5%	2%	1%
PitVol1	355 (168 hr)	1,024 (120 hr)	1,578 (120 hr)	2,088 (72 hr)	2,923 (72 hr)	3,589 (24 hr)
PitVol2	796 (168 hr)	2,299 (120 hr)	3,546 (120 hr)	4,679 (72 hr)	6,556 (72 hr)	8,006 (24 hr)
PitVol3	1,244 (168 hr)	3,597 (120 hr)	5,552 (120 hr)	7,318 (72 hr)	10,259 (72 hr)	12,484 (24 hr)
PitVol4 (Central Pool)	1,918 (168 hr)	5,550 (120 hr)	8,571 (120 hr)	11,288 (72 hr)	15,836 (72 hr)	19,199 (24 hr)
WRDVol1	652 (168 hr)	1,885 (120 hr)	2,907 (120 hr)	3,838 (72 hr)	5,376 (72 hr)	6,575 (24 hr)
WRDVol2	2,296 (168 hr)	6,645 (120 hr)	10,264 (120 hr)	13,515 (72 hr)	18,968 (72 hr)	22,959 (24 hr)
WRDVol3	2,672 (168 hr)	7,736 (144 hr)	11,950 (120 hr)	15,735 (72 hr)	22,088 (72 hr)	26,703 (24 hr)
WRDVol4	3,233 (168 hr)	9,361 (144 hr)	14,461 (120 hr)	19,038 (96 hr)	26,733 (72 hr)	32,271 (24 hr)

Table B3: NSE condition discharge volume estimates (ML) – critical storm duration (peak flow)

Reporting ID	AEP event					
	50% (critical duration)	20% (critical duration)	10% (critical duration)	5% (critical duration)	2% (critical duration)	1% (critical duration)
Pit (PitVol1)	207 (120 min)	401 (90 min)	555 (90 min)	708 (90 min)	821 (60 min)	849 (45 min)
WRD (WRDVol1)	398 (120 min)	1,038 (180 min)	1,198 (120 min)	1,531 (120 min)	1,987 (90 min)	2,479 (90 min)

Table B4: NSE condition discharge volume estimates (ML) – critical storm duration (volume)

Reporting ID	AEP event					
	50%	20%	10%	5%	2%	1%
PitVol1	309 (168 hr)	890 (120 hr)	1,372 (120 hr)	1,815 (72 hr)	2,541 (72 hr)	3,122 (24 hr)
PitVol2	750 (168 hr)	2,166 (120 hr)	3,341 (120 hr)	4,409 (72 hr)	6,177 (72 hr)	7,547 (24 hr)
PitVol3	1,198 (168 hr)	3,465 (120 hr)	5,347 (120 hr)	7,048 (72 hr)	9,881 (72 hr)	12,028 (24 hr)
PitVol4 (Central Pool)	1,872 (168 hr)	5,418 (120 hr)	8,367 (120 hr)	11,020 (72 hr)	15,460 (72 hr)	18,746 (24 hr)
WRDVol1	592 (168 hr)	1,710 (120 hr)	2,637 (120 hr)	3,483 (72 hr)	4,878 (72 hr)	5,971 (24 hr)
WRDVol2	2,236 (168 hr)	6,473 (120 hr)	9,998 (120 hr)	13,166 (72 hr)	18,476 (72 hr)	22,369 (24 hr)
WRDVol3	2,613 (168 hr)	7,565 (144 hr)	11,685 (120 hr)	15,385 (72 hr)	21,597 (72 hr)	26,113 (24 hr)
WRDVol4	3,174 (168 hr)	9,190 (144 hr)	14,196 (120 hr)	18,690 (96 hr)	26,244 (72 hr)	31,774 (24 hr)

Appendix C. Mine Extension Flood Mapping – Pit catchment

NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE C1

PIT CATCHMENT
50% AEP PEAK FLOOD DEPTH

Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Depth (m)

- <= 0.05 (not shown)
- 0.05 - 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 1.0
- 1.0 - 2.0
- > 2.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m

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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE C2

PIT CATCHMENT
50% AEP PEAK FLOOD VELOCITY

Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity (m/s)

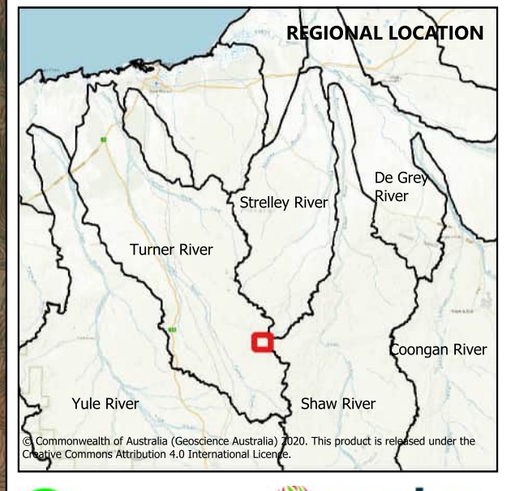
- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 4.0
- > 4.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE C3

PIT CATCHMENT
20% AEP PEAK FLOOD DEPTH

Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Depth (m)

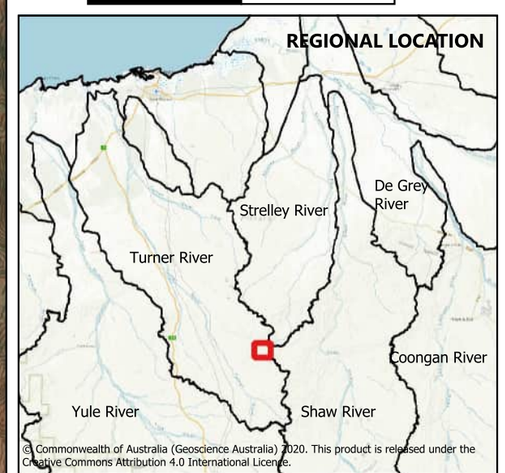
- <= 0.05 (not shown)
- 0.05 - 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 1.0
- 1.0 - 2.0
- > 2.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE C4

PIT CATCHMENT
20% AEP PEAK FLOOD VELOCITY

Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity (m/s)

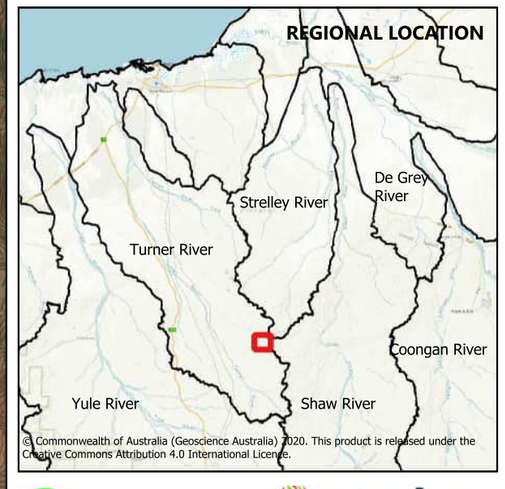
- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 4.0
- > 4.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE C5

PIT CATCHMENT
10% AEP PEAK FLOOD DEPTH

Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Depth (m)

- <= 0.05 (not shown)
- 0.05 - 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 1.0
- 1.0 - 2.0
- > 2.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m

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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE C6

PIT CATCHMENT
10% AEP PEAK FLOOD VELOCITY

Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity (m/s)

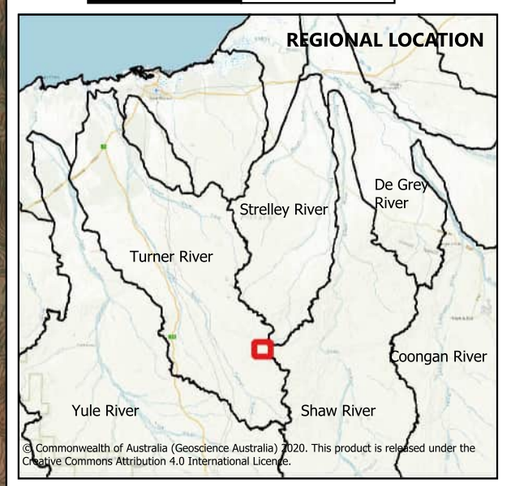
- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 4.0
- > 4.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE C7

PIT CATCHMENT
5% AEP PEAK FLOOD DEPTH

Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Depth (m)

- <= 0.05 (not shown)
- 0.05 - 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 1.0
- 1.0 - 2.0
- > 2.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m

REGIONAL LOCATION

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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE C8

PIT CATCHMENT
5% AEP PEAK FLOOD VELOCITY

Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 4.0
- > 4.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m

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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE C9

PIT CATCHMENT
2% AEP PEAK FLOOD DEPTH

Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Depth (m)

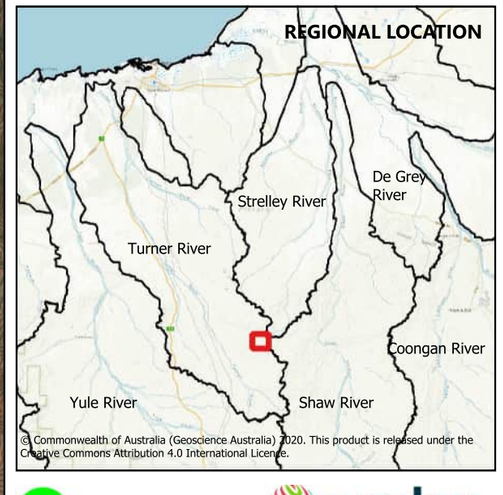
- <= 0.05 (not shown)
- 0.05 - 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 1.0
- 1.0 - 2.0
- > 2.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE C10

PIT CATCHMENT
2% AEP PEAK FLOOD VELOCITY

Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 4.0
- > 4.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m

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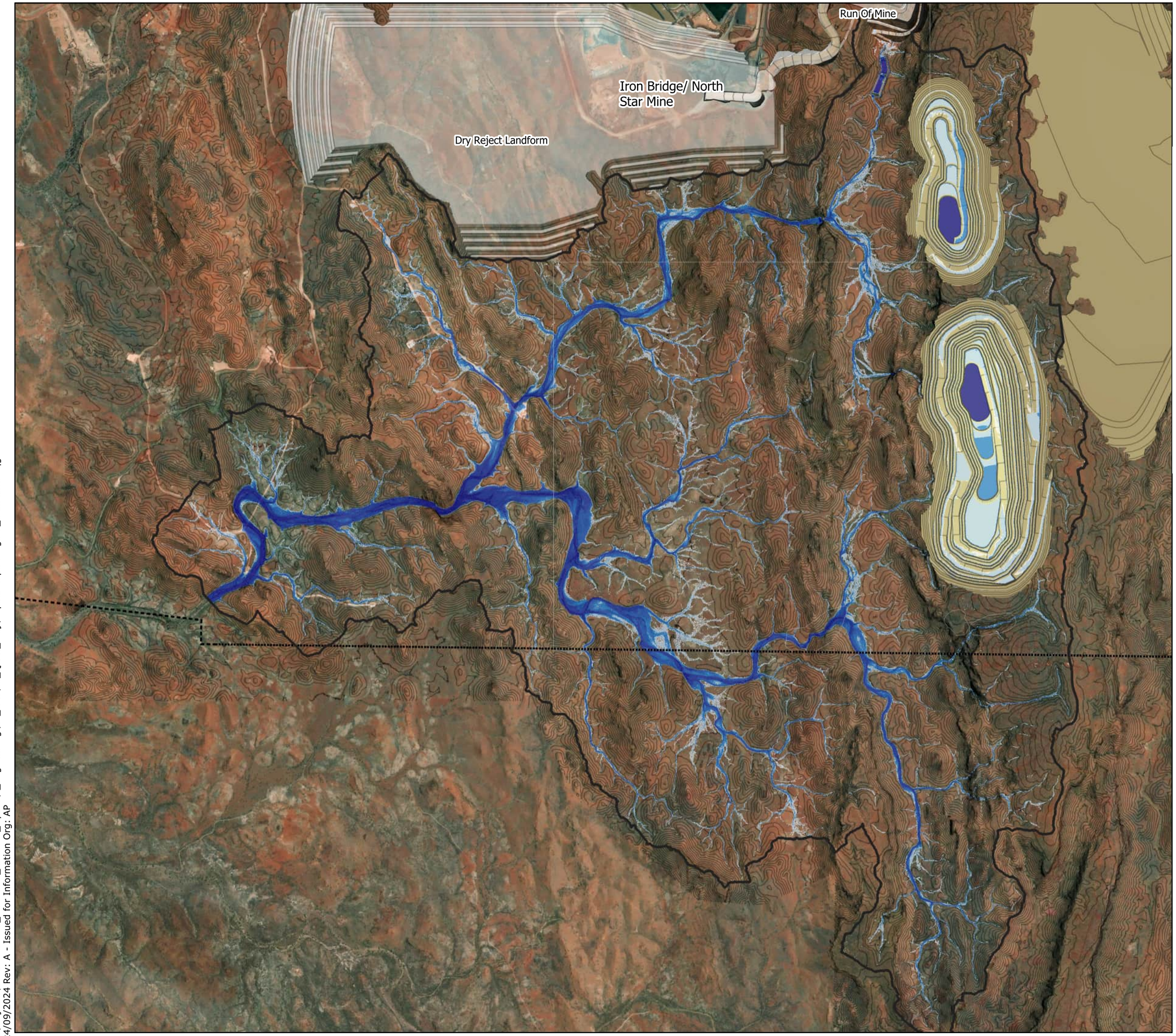
NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE C11

PIT CATCHMENT
1% AEP PEAK FLOOD DEPTH



Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Depth (m)

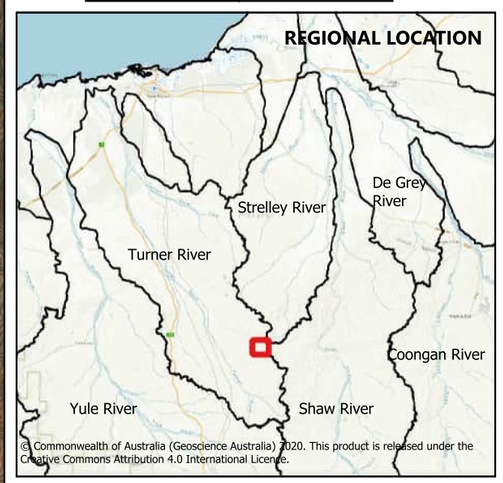
- <= 0.05 (not shown)
- 0.05 - 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 1.0
- 1.0 - 2.0
- > 2.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE C12

PIT CATCHMENT
1% AEP PEAK FLOOD VELOCITY

Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 4.0
- > 4.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m

REGIONAL LOCATION

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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE C13

PIT CATCHMENT
1 IN 1000 AEP PEAK FLOOD DEPTH

Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Depth (m)

- <= 0.05 (not shown)
- 0.05 - 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 1.0
- 1.0 - 2.0
- > 2.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m

REGIONAL LOCATION

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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE C14

PIT CATCHMENT
1 IN 1000 AEP PEAK FLOOD VELOCITY

Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 4.0
- > 4.0

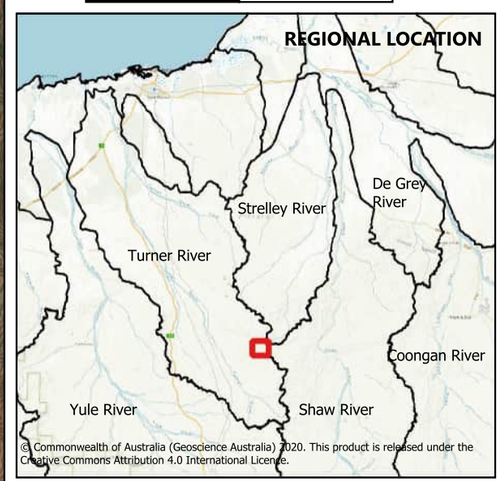
Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m

REGIONAL LOCATION



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE C15

PIT CATCHMENT
PMF PEAK FLOOD DEPTH

Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Depth (m)

- <= 0.05 (not shown)
- 0.05 - 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 1.0
- 1.0 - 2.0
- > 2.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m

REGIONAL LOCATION

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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE C16

PIT CATCHMENT
PMF PEAK FLOOD VELOCITY

Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 4.0
- > 4.0

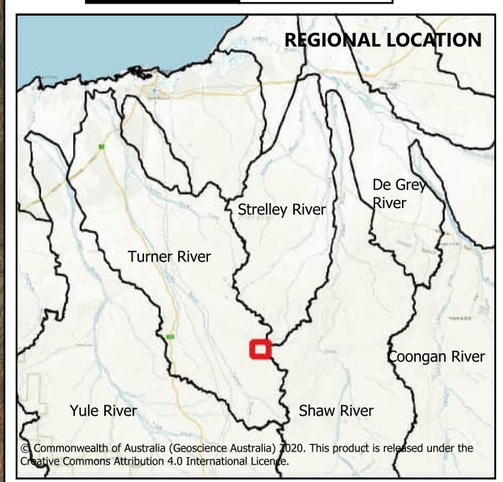
Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m

REGIONAL LOCATION



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Appendix D. Mine Extension Flood Mapping – WRD catchment

NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE D1

WRD CATCHMENT
50% AEP PEAK FLOOD DEPTH

Iron Bridge/ North Star Mine

Legend

- WRD catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Depth (m)

- <= 0.05 (not shown)
- 0.05 - 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 1.0
- 1.0 - 2.0
- > 2.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m

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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE D2

WRD CATCHMENT
50% AEP PEAK FLOOD VELOCITY

Iron Bridge/ North Star Mine

Legend

- WRD catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity (m/s)

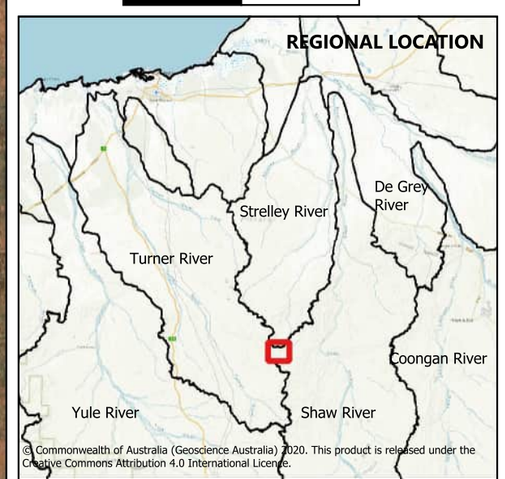
- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 4.0
- > 4.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE D3

WRD CATCHMENT
20% AEP PEAK FLOOD DEPTH

Iron Bridge/ North Star Mine

Legend

- WRD catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Depth (m)

- <= 0.05 (not shown)
- 0.05 - 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 1.0
- 1.0 - 2.0
- > 2.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m

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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE D4

WRD CATCHMENT
20% AEP PEAK FLOOD VELOCITY

Iron Bridge/ North Star Mine

Legend

- WRD catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity (m/s)

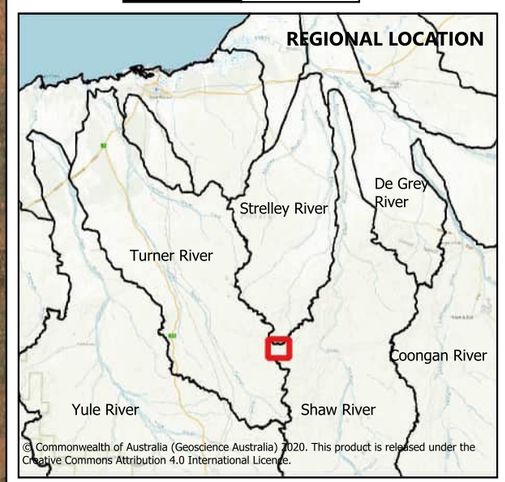
- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 4.0
- > 4.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE D5

WRD CATCHMENT
10% AEP PEAK FLOOD DEPTH

Iron Bridge/ North Star Mine

Legend

- WRD catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Depth (m)

- <= 0.05 (not shown)
- 0.05 - 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 1.0
- 1.0 - 2.0
- > 2.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m

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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE D6

WRD CATCHMENT
10% AEP PEAK FLOOD VELOCITY

Iron Bridge/ North Star Mine

Legend

- WRD catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 4.0
- > 4.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m

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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE D7

WRD CATCHMENT
5% AEP PEAK FLOOD DEPTH

Iron Bridge/ North Star Mine

Legend

- WRD catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Depth (m)

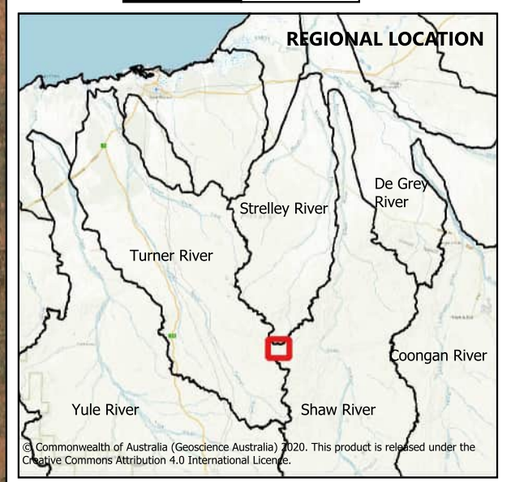
- <= 0.05 (not shown)
- 0.05 - 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 1.0
- 1.0 - 2.0
- > 2.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE D8

WRD CATCHMENT
5% AEP PEAK FLOOD VELOCITY

Iron Bridge/ North Star Mine

Legend

- WRD catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity (m/s)

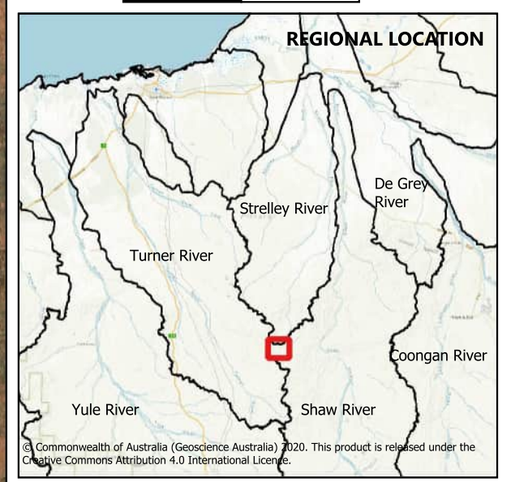
- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 4.0
- > 4.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE D9

WRD CATCHMENT
2% AEP PEAK FLOOD DEPTH

Iron Bridge/ North Star Mine

Legend

- WRD catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Depth (m)

- <= 0.05 (not shown)
- 0.05 - 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 1.0
- 1.0 - 2.0
- > 2.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m

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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE D10

WRD CATCHMENT
2% AEP PEAK FLOOD VELOCITY

Iron Bridge/ North Star Mine

Legend

- WRD catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity (m/s)

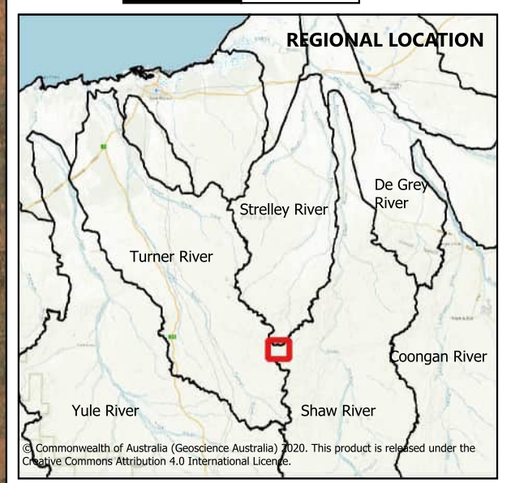
- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 4.0
- > 4.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE D11

WRD CATCHMENT
1% AEP PEAK FLOOD DEPTH

Iron Bridge/ North Star Mine

Legend

- WRD catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Depth (m)

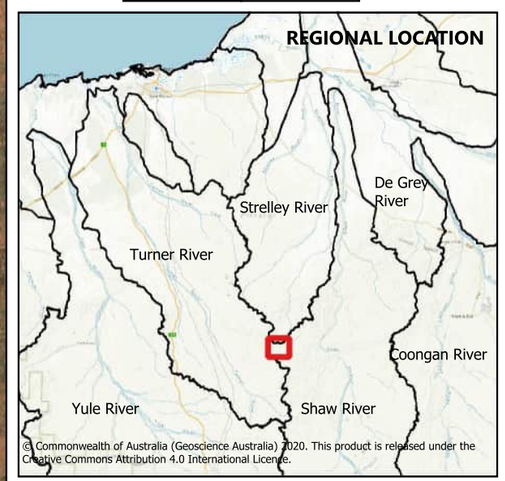
- <= 0.05 (not shown)
- 0.05 - 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 1.0
- 1.0 - 2.0
- > 2.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m



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Iron Bridge/ North Star Mine

NORTH STAR EXTENSION HYDROLOGIC IMPACT ASSESSMENT

FIGURE D12

WRD CATCHMENT 1% AEP PEAK FLOOD VELOCITY

Legend

- WRD catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity (m/s)

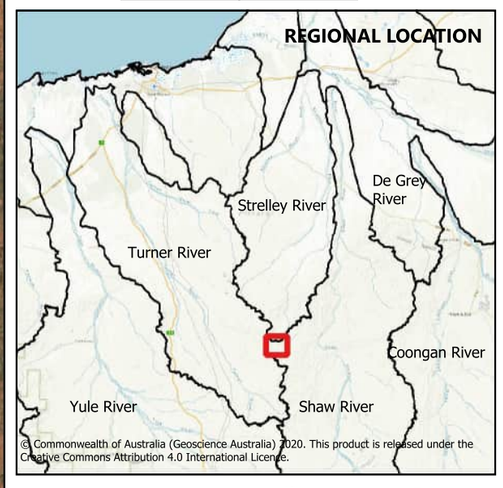
- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 4.0
- > 4.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m



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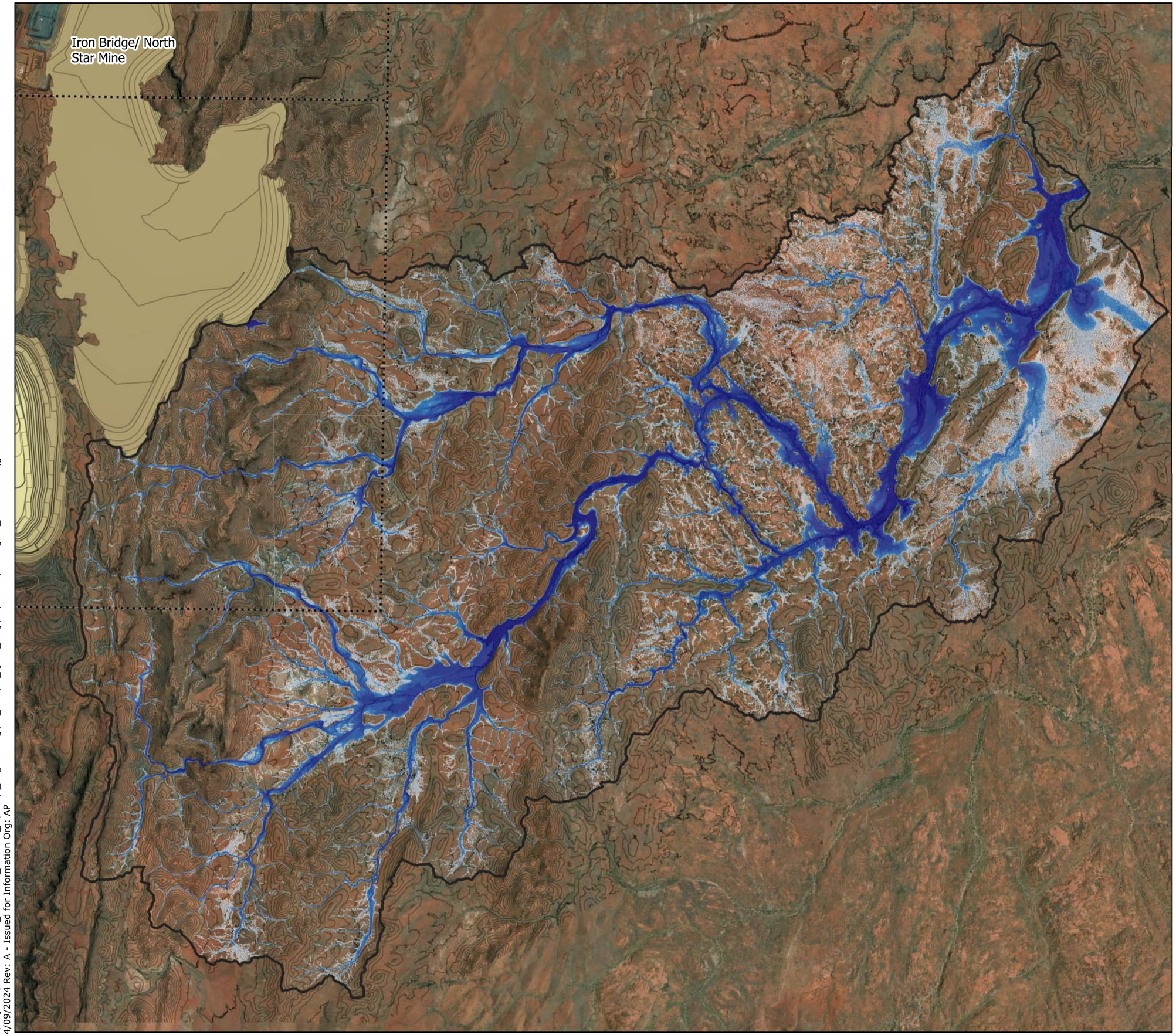
NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE D13

WRD CATCHMENT
1 IN 1000 AEP PEAK FLOOD DEPTH



Legend

- WRD catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Depth (m)

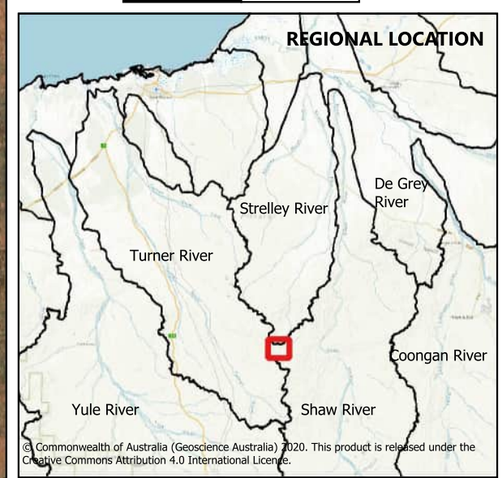
- <= 0.05 (not shown)
- 0.05 - 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 1.0
- 1.0 - 2.0
- > 2.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m



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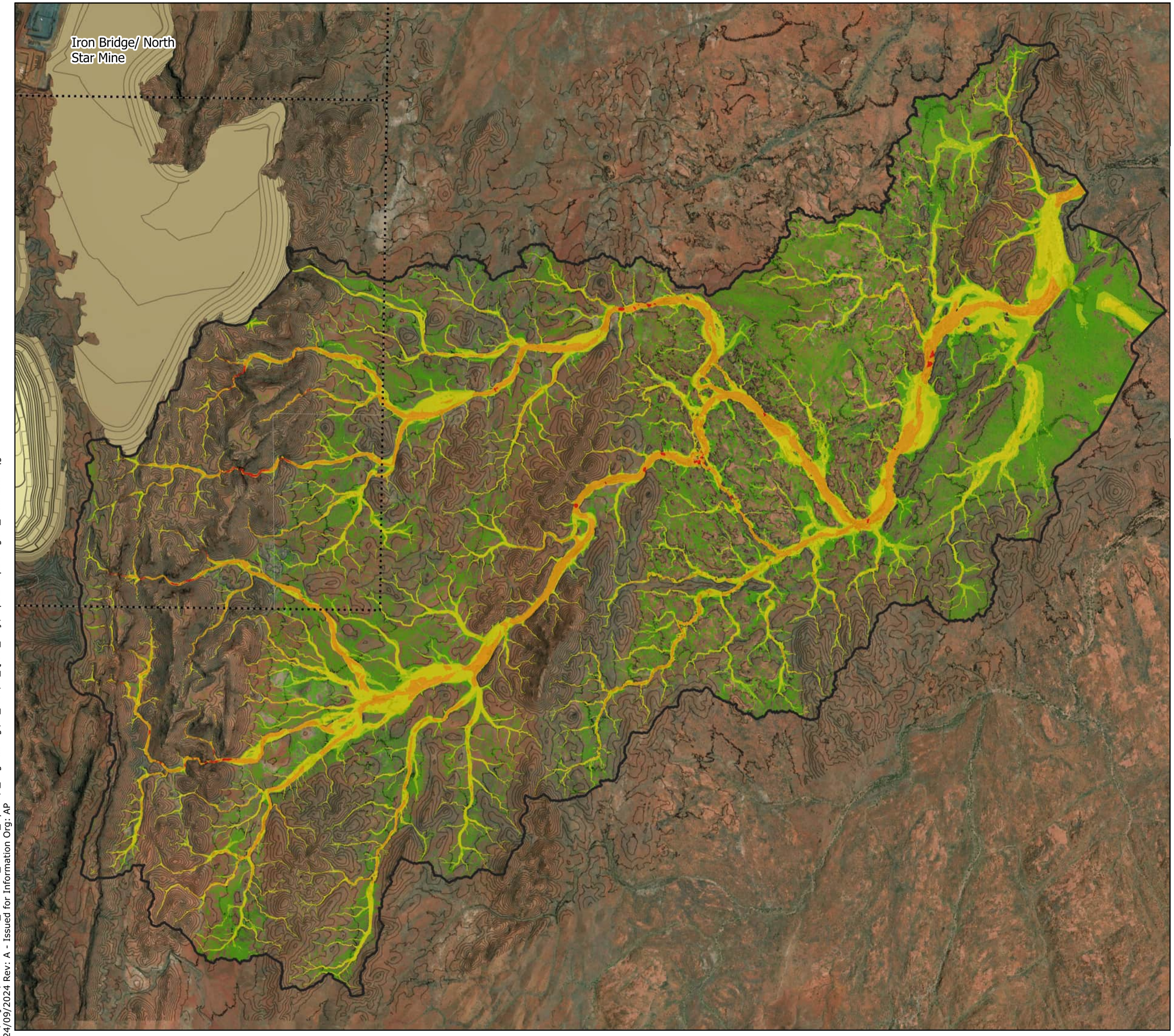
NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE D14

WRD CATCHMENT
1 IN 1000 AEP PEAK FLOOD VELOCITY



Legend

- WRD catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 4.0
- > 4.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m

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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE D15

WRD CATCHMENT
PMF PEAK FLOOD DEPTH

Iron Bridge/ North Star Mine

Legend

- WRD catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Depth (m)

- <= 0.05 (not shown)
- 0.05 - 0.1
- 0.1 - 0.3
- 0.3 - 0.6
- 0.6 - 1.0
- 1.0 - 2.0
- > 2.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m

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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE D16

WRD CATCHMENT
PMF PEAK FLOOD VELOCITY

Iron Bridge/ North Star Mine

Legend

- WRD catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity (m/s)

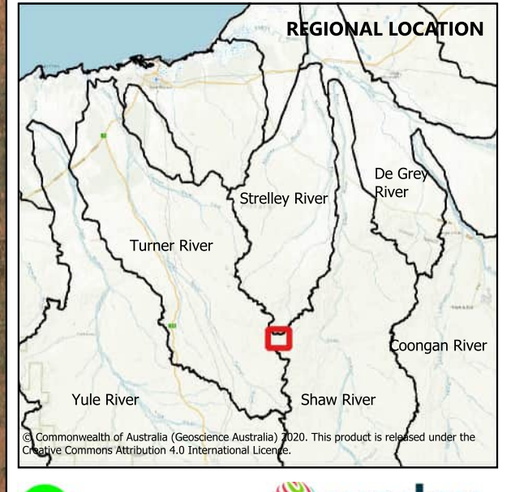
- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 4.0
- > 4.0

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m



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Appendix E. Flood Impact Mapping – Pit catchment

Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

NORTH STAR EXTENSION HYDROLOGIC IMPACT ASSESSMENT

FIGURE E1

PIT CATCHMENT 50% AEP PEAK FLOOD LEVEL AFFLUX

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Level Afflux (m)

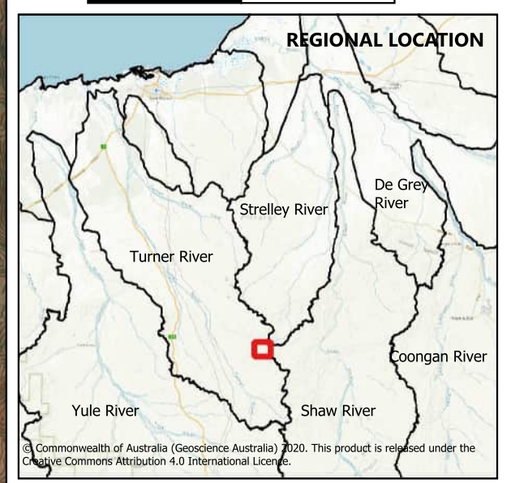
- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m



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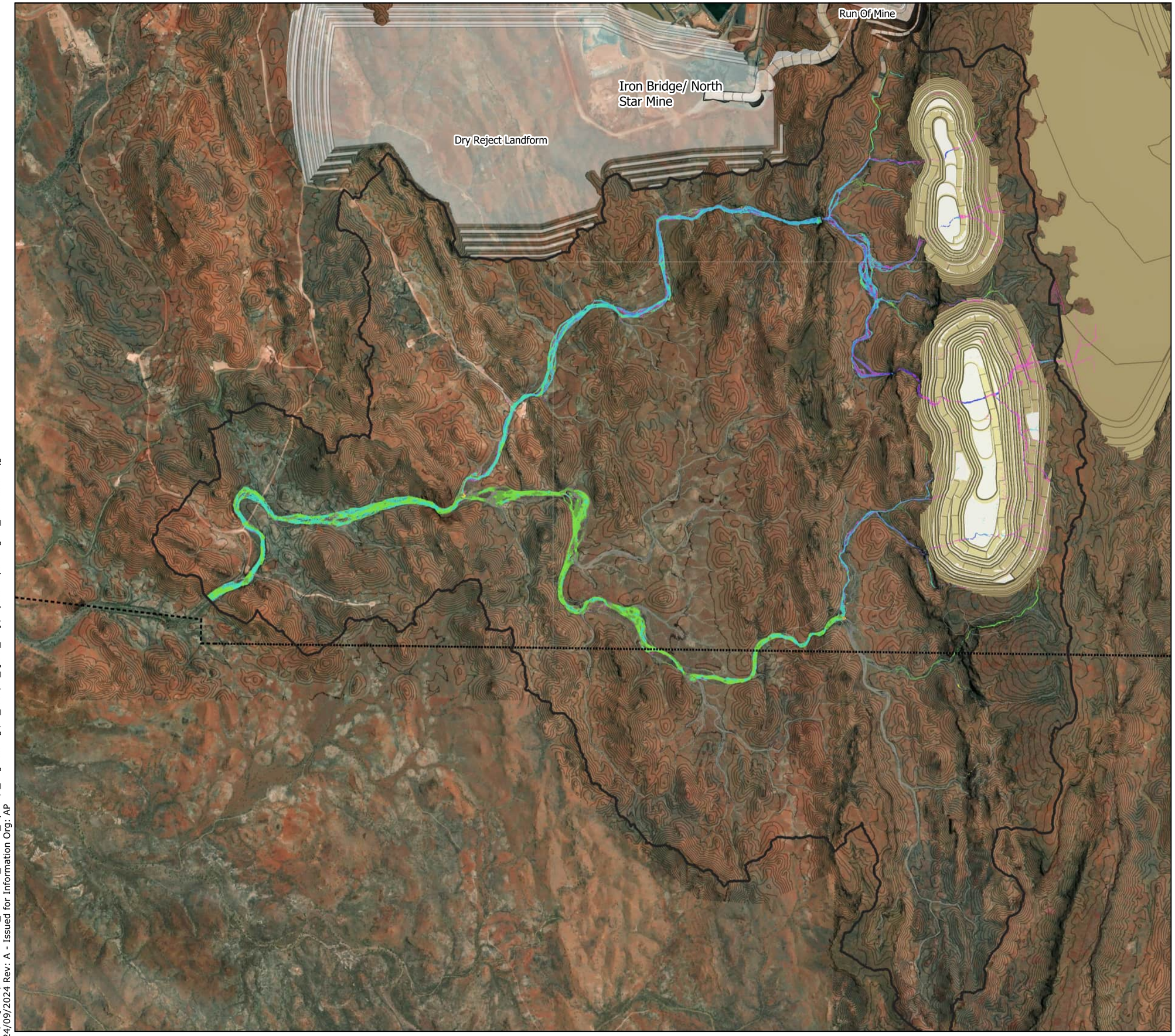
NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE E2

PIT CATCHMENT
50% AEP PEAK FLOOD VELOCITY AFFLUX



Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity Afflux (m/s)

- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m

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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE E3

PIT CATCHMENT
20% AEP PEAK FLOOD LEVEL AFFLUX

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Level Afflux (m)

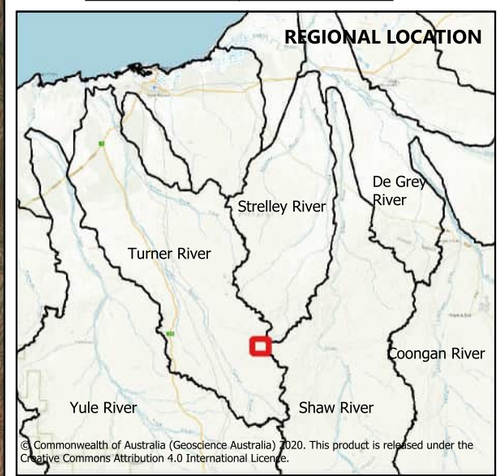
- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE E4

PIT CATCHMENT
20% AEP PEAK FLOOD VELOCITY AFFLUX

Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity Afflux (m/s)

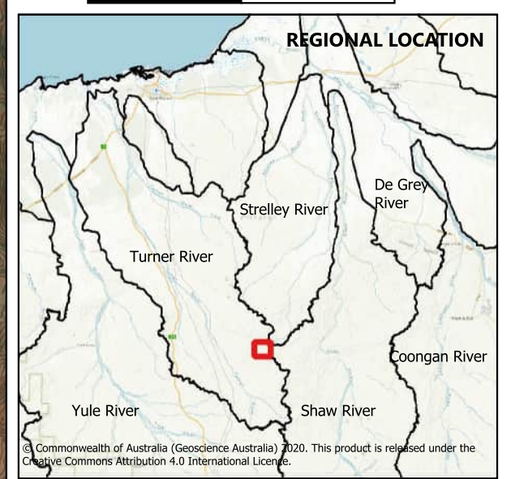
- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE E5

PIT CATCHMENT
10% AEP PEAK FLOOD LEVEL AFFLUX

Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Level Afflux (m)

- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m

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Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

NORTH STAR EXTENSION HYDROLOGIC IMPACT ASSESSMENT

FIGURE E6

PIT CATCHMENT 10% AEP PEAK FLOOD VELOCITY AFFLUX

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity Afflux (m/s)

- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m

REGIONAL LOCATION

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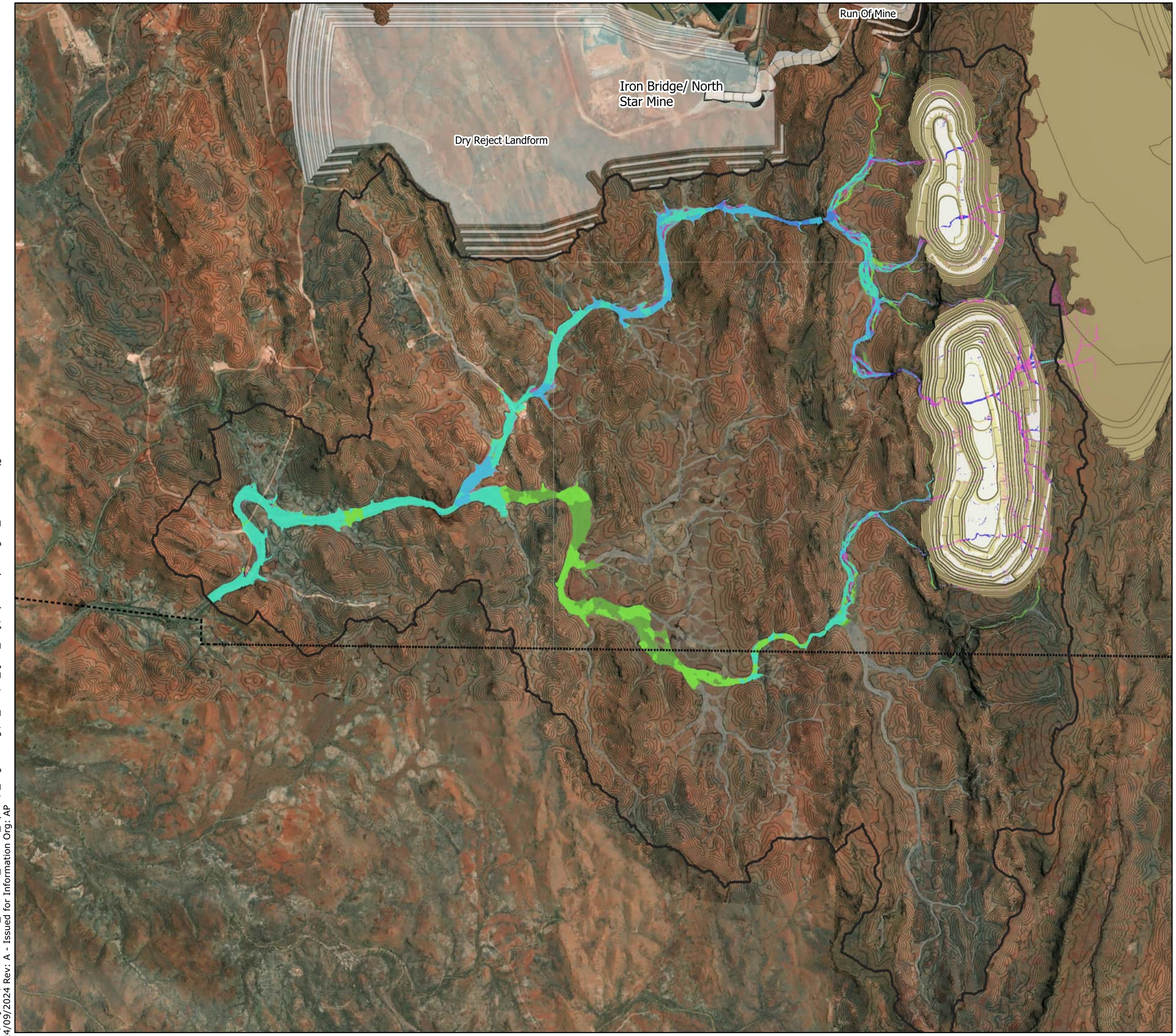
NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE E7

PIT CATCHMENT
5% AEP PEAK FLOOD LEVEL AFFLUX



Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Level Afflux (m)

- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m

Fortescue

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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE E8

PIT CATCHMENT
5% AEP PEAK FLOOD VELOCITY AFFLUX

Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity Afflux (m/s)

- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m

REGIONAL LOCATION

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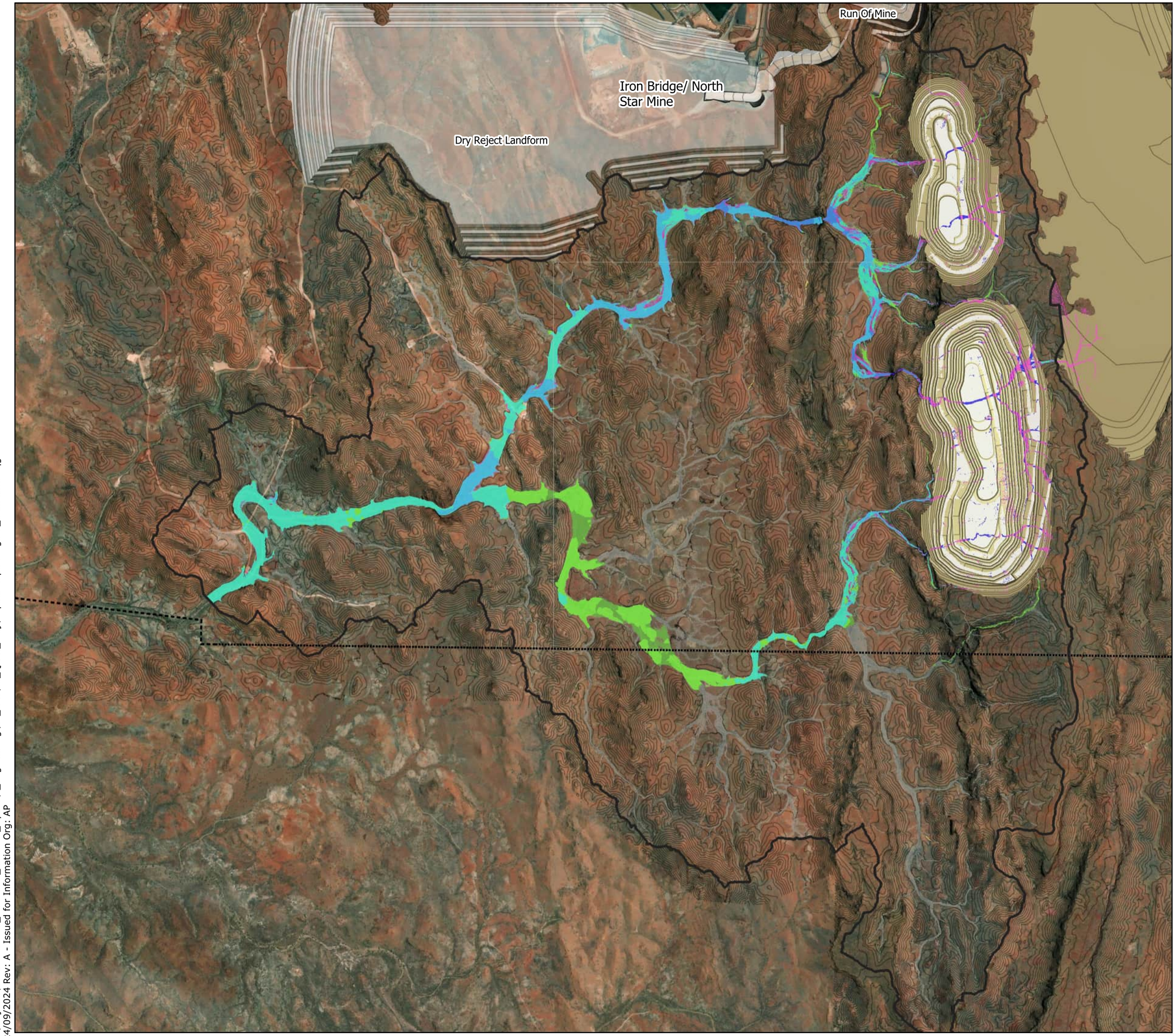
NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE E9

PIT CATCHMENT
2% AEP PEAK FLOOD LEVEL AFFLUX



Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Level Afflux (m)

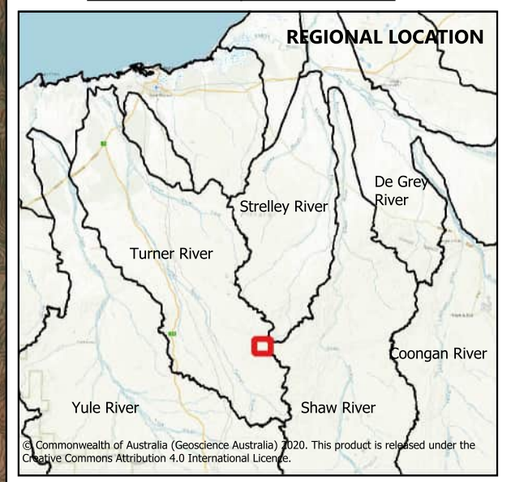
- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE E10

PIT CATCHMENT
2% AEP PEAK FLOOD VELOCITY AFFLUX

Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity Afflux (m/s)

- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m

REGIONAL LOCATION

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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE E11

PIT CATCHMENT
1% AEP PEAK FLOOD LEVEL AFFLUX

Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Level Afflux (m)

- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m

REGIONAL LOCATION

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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE E12

PIT CATCHMENT
1% AEP PEAK FLOOD VELOCITY AFFLUX

Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity Afflux (m/s)

- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m

REGIONAL LOCATION

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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE E13

PIT CATCHMENT
1 IN 1000 AEP PEAK FLOOD LEVEL AFFLUX

Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Level Afflux (m)

- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m

REGIONAL LOCATION

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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE E14

PIT CATCHMENT
1 IN 1000 AEP PEAK FLOOD VELOCITY AFFLUX

Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity Afflux (m/s)

- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m

REGIONAL LOCATION

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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE E15

PIT CATCHMENT
PMF PEAK FLOOD LEVEL AFFLUX

Run Of Mine

Iron Bridge/ North Star Mine

Dry Reject Landform

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Level Afflux (m)

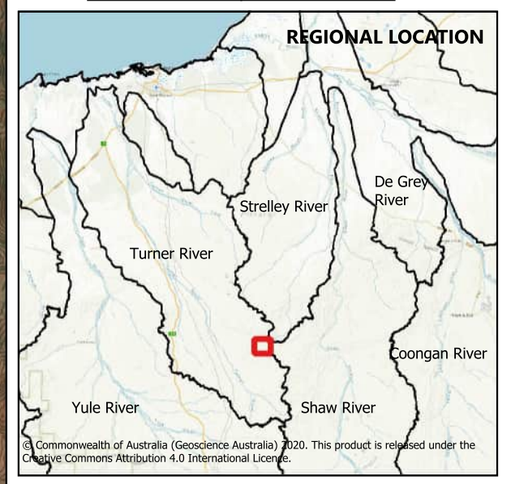
- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m



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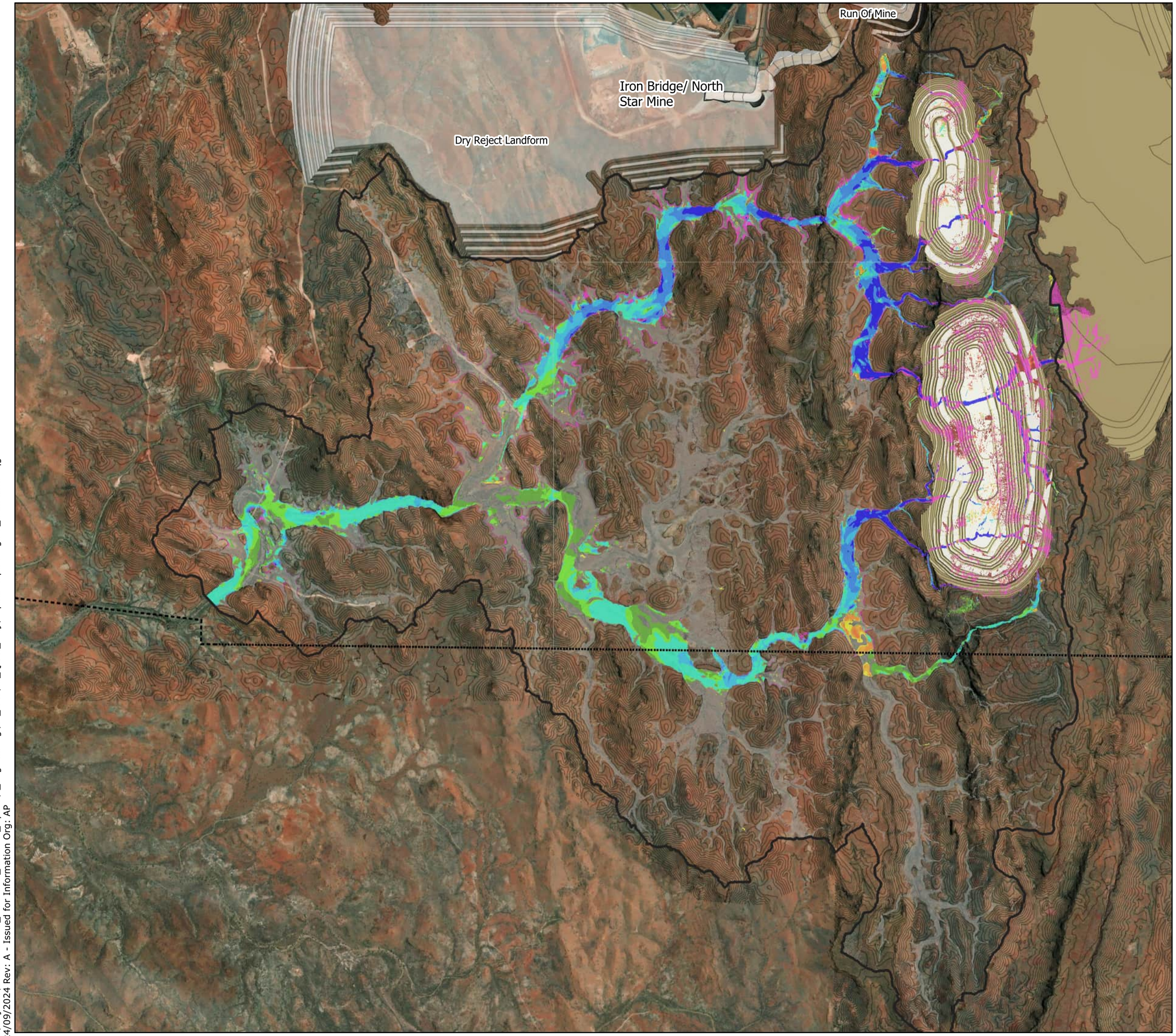
NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE E16

PIT CATCHMENT
PMF PEAK FLOOD VELOCITY AFFLUX



Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity Afflux (m/s)

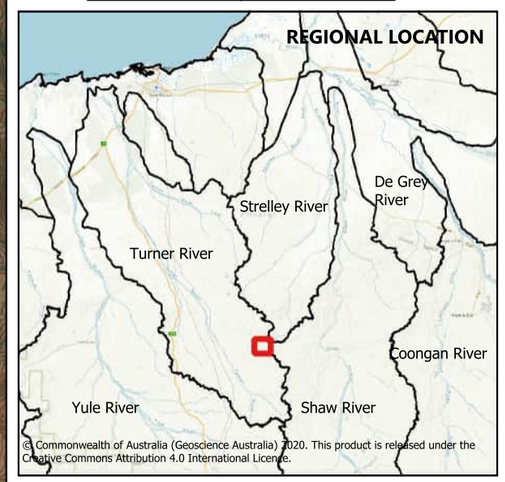
- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 20,000

0 500 1,000 m



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Appendix F. Flood Impact Mapping – WRD catchment

NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE F1

WRD CATCHMENT
50% AEP PEAK FLOOD LEVEL AFFLUX

Iron Bridge/ North Star Mine

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Level Afflux (m)

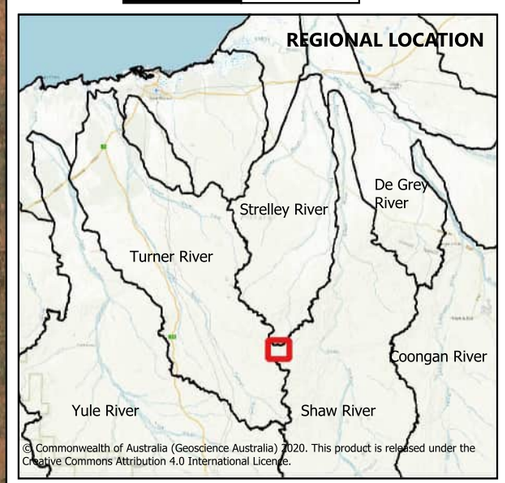
- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE F2

WRD CATCHMENT
50% AEP PEAK FLOOD VELOCITY AFFLUX

Iron Bridge/ North Star Mine

Legend

- WRD catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity Afflux (m/s)

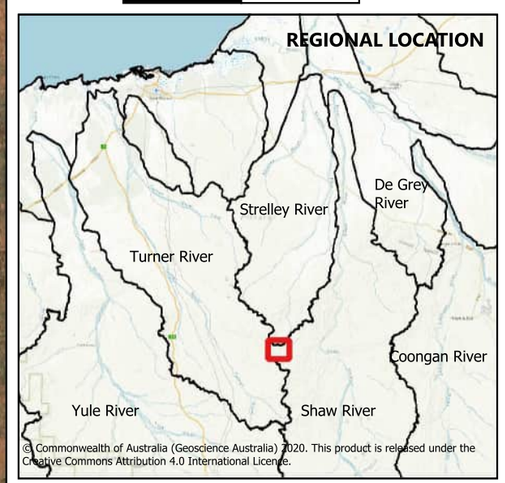
- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE F3

WRD CATCHMENT
20% AEP PEAK FLOOD LEVEL AFFLUX

Iron Bridge/ North Star Mine

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Level Afflux (m)

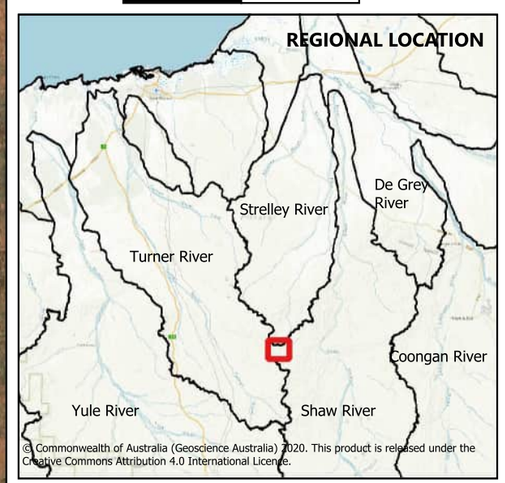
- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE F4

WRD CATCHMENT
20% AEP PEAK FLOOD VELOCITY AFFLUX

Iron Bridge/ North Star Mine

Legend

- WRD catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity Afflux (m/s)

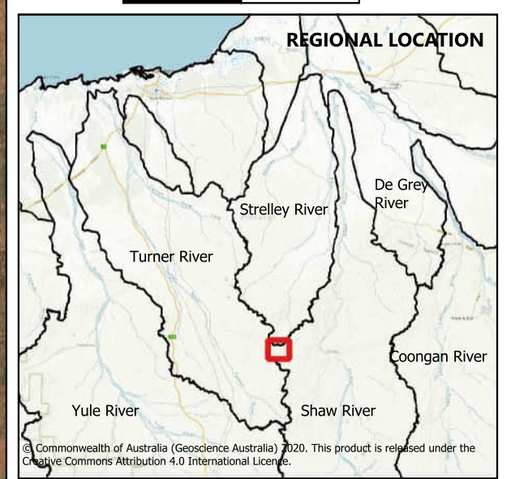
- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE F5

WRD CATCHMENT
10% AEP PEAK FLOOD LEVEL AFFLUX

Iron Bridge/ North Star Mine

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Level Afflux (m)

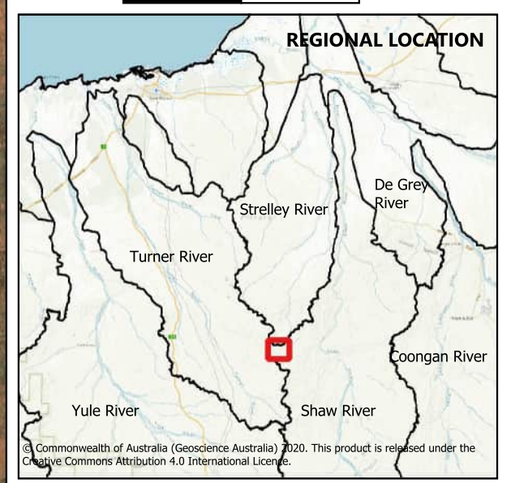
- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE F6

WRD CATCHMENT
10% AEP PEAK FLOOD VELOCITY AFFLUX

Iron Bridge/ North Star Mine

Legend

- WRD catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity Afflux (m/s)

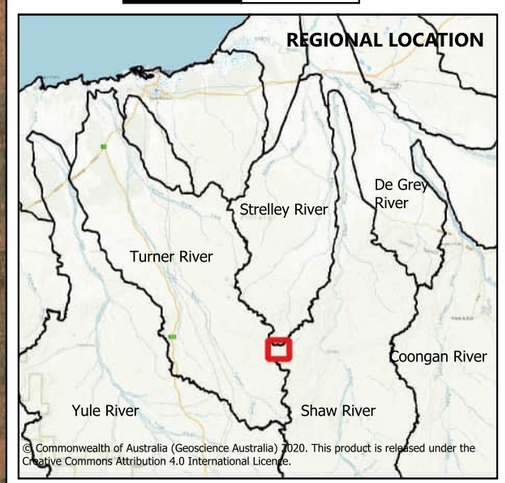
- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE F7

WRD CATCHMENT
5% AEP PEAK FLOOD LEVEL AFFLUX

Iron Bridge/ North Star Mine

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Level Afflux (m)

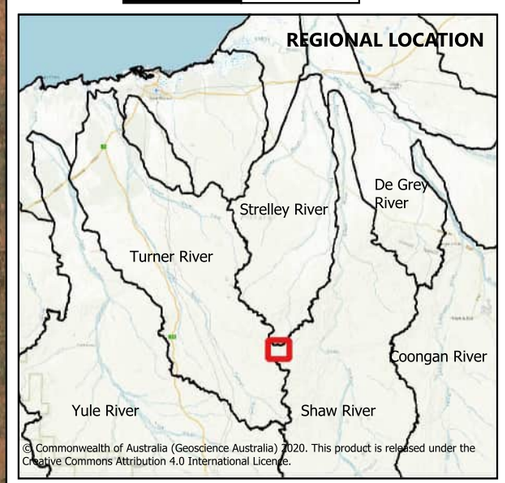
- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE F8

WRD CATCHMENT
5% AEP PEAK FLOOD VELOCITY AFFLUX

Iron Bridge/ North Star Mine

Legend

- WRD catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity Afflux (m/s)

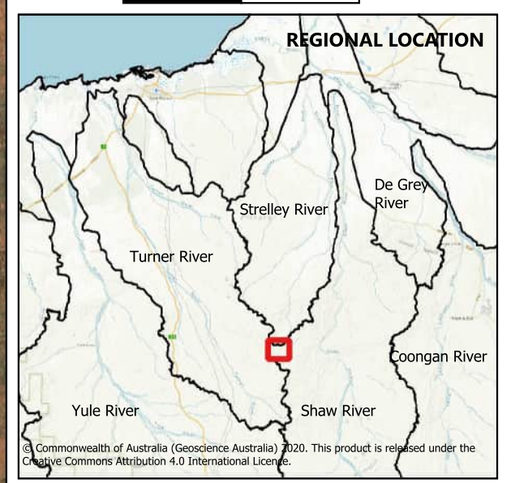
- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE F9

WRD CATCHMENT
2% AEP PEAK FLOOD LEVEL AFFLUX

Iron Bridge/ North Star Mine

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Level Afflux (m)

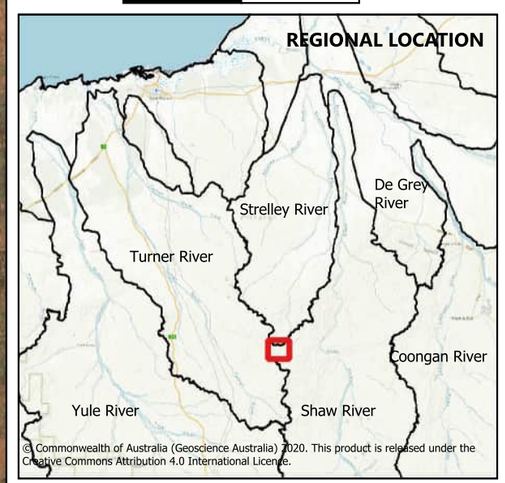
- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE F10

WRD CATCHMENT
2% AEP PEAK FLOOD VELOCITY AFFLUX

Iron Bridge/ North Star Mine

Legend

- WRD catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity Afflux (m/s)

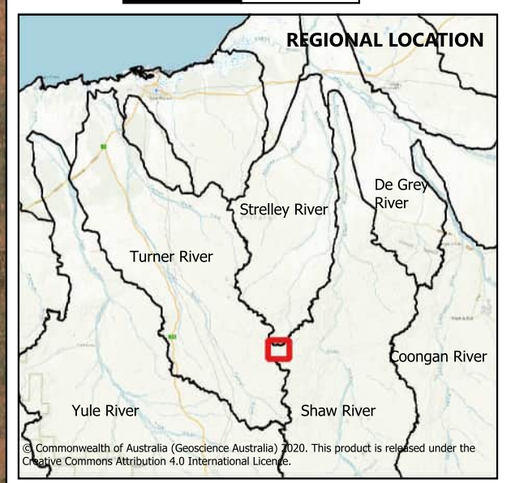
- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE F11

WRD CATCHMENT
1% AEP PEAK FLOOD LEVEL AFFLUX

Iron Bridge/ North Star Mine

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Level Afflux (m)

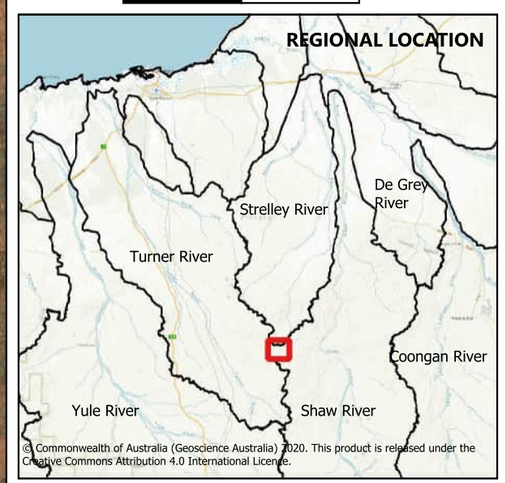
- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE F12

WRD CATCHMENT
1% AEP PEAK FLOOD VELOCITY AFFLUX

Iron Bridge/ North Star Mine

Legend

- WRD catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity Afflux (m/s)

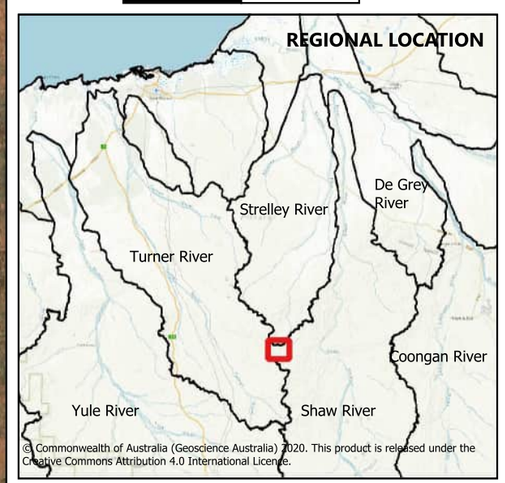
- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m



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NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE F13

WRD CATCHMENT
1 IN 1000 AEP PEAK FLOOD LEVEL AFFLUX

Iron Bridge/ North Star Mine

Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Level Afflux (m)

- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m

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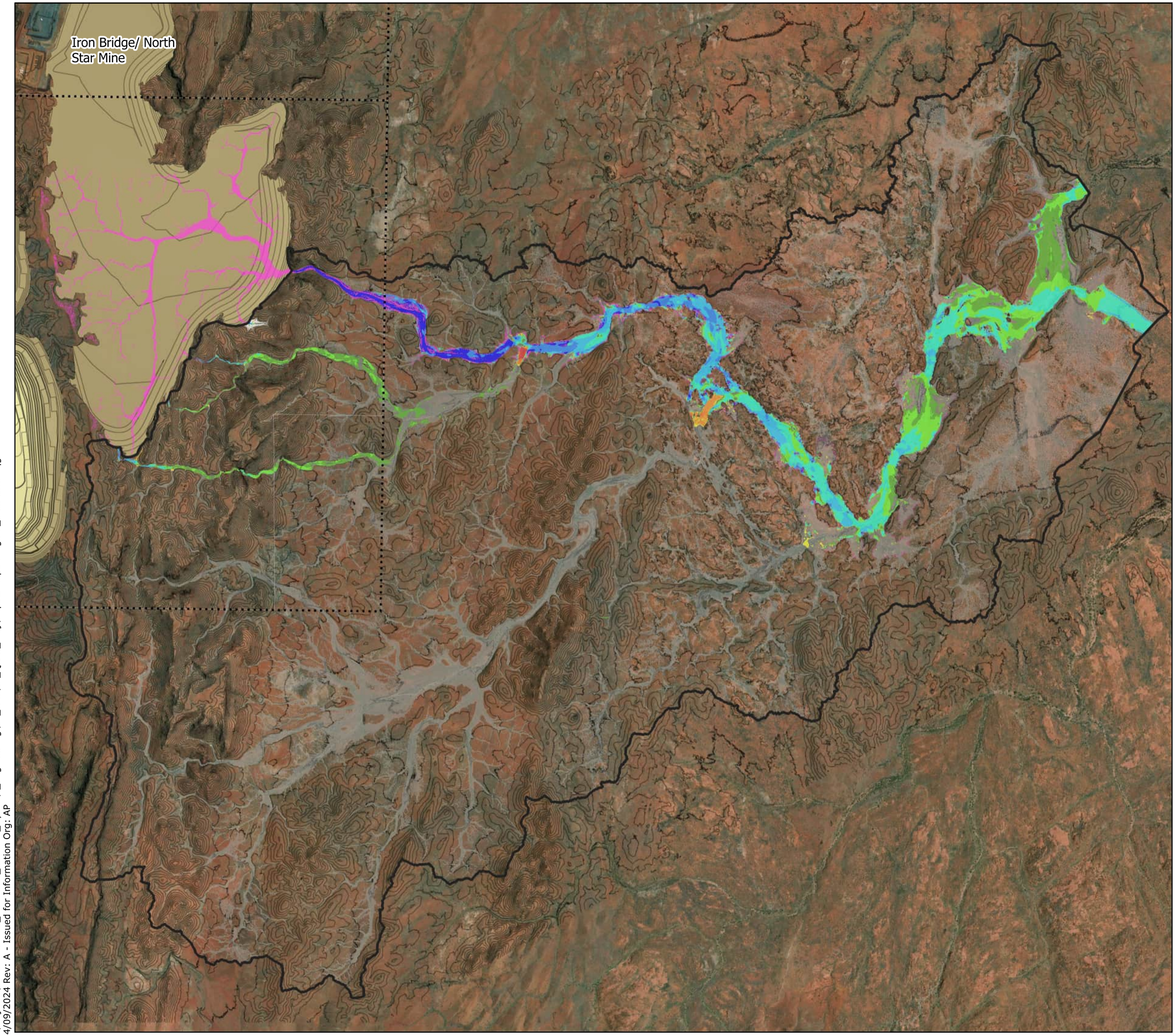
NORTH STAR EXTENSION
HYDROLOGIC IMPACT ASSESSMENT

FIGURE F14

WRD CATCHMENT
1 IN 1000 AEP PEAK FLOOD VELOCITY AFFLUX



Legend

- WRD catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity Afflux (m/s)

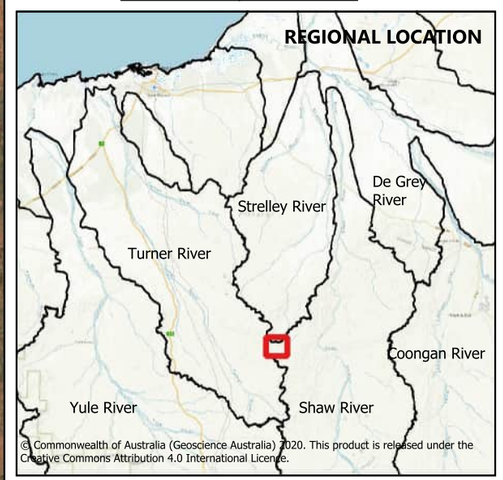
- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m



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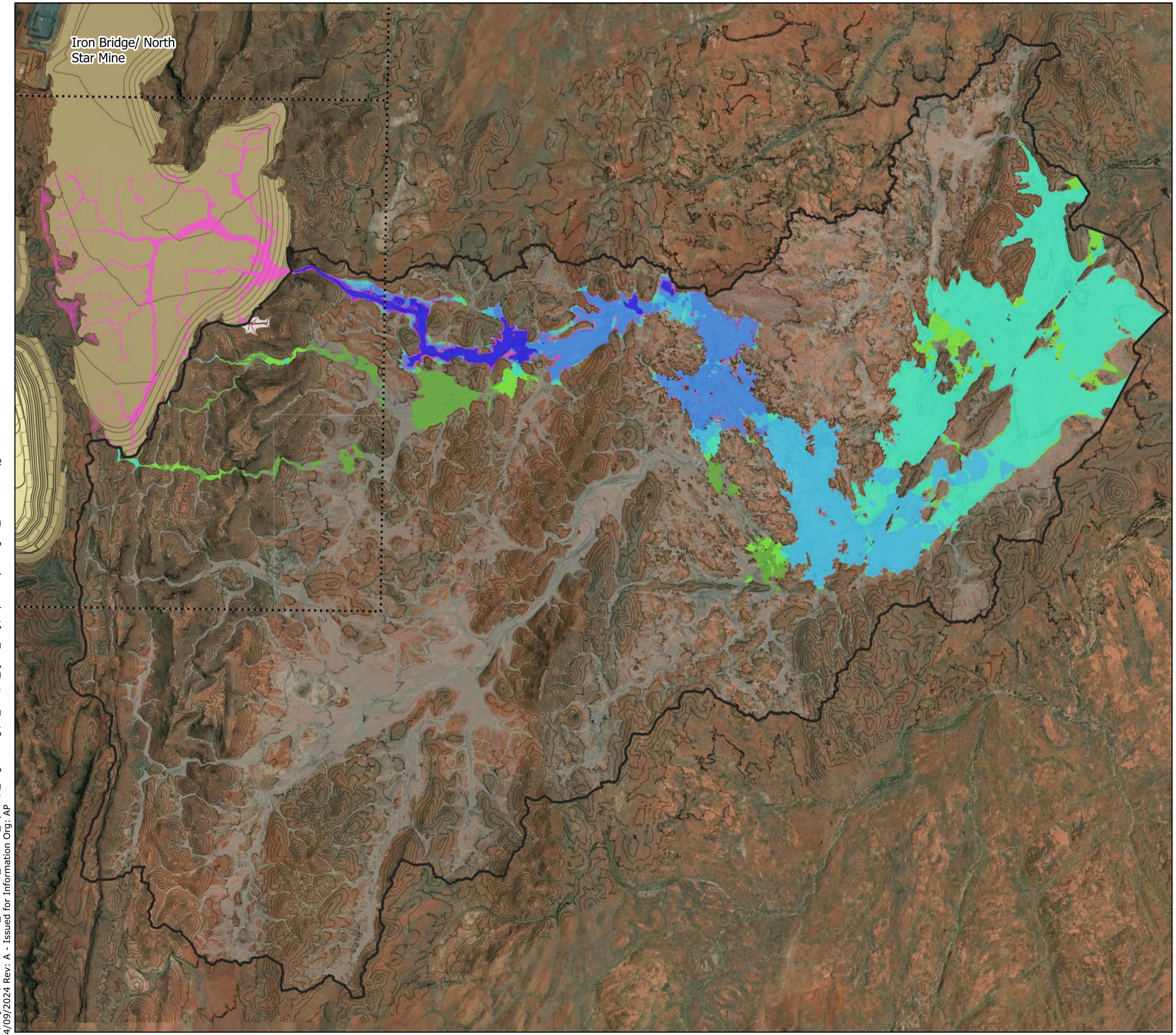
HYDROLOGIC IMPACT ASSESSMENT

FIGURE F15

WRD CATCHMENT
PMF PEAK FLOOD LEVEL AFFLUX



Legend

- Pit catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Level Afflux (m)

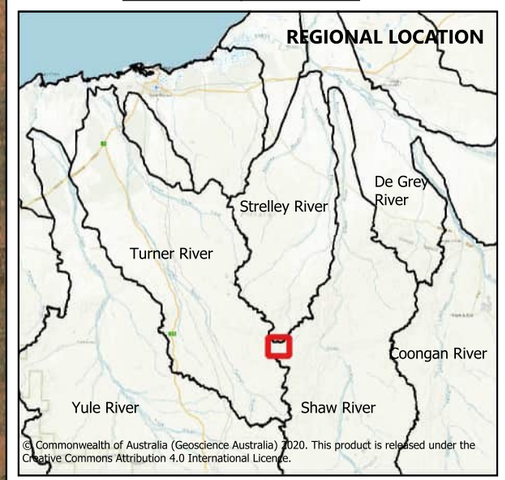
- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m



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Iron Bridge/ North Star Mine

NORTH STAR EXTENSION HYDROLOGIC IMPACT ASSESSMENT

FIGURE F16

WRD CATCHMENT PMF PEAK FLOOD VELOCITY AFFLUX

Legend

- WRD catchment model boundary
- 5 m interval topographic contour
- Mining Tenements
- North Star Exension - Development Envelope

Mine expansion scenario landform

- High elevation
- Low elevation

Peak Flood Velocity Afflux (m/s)

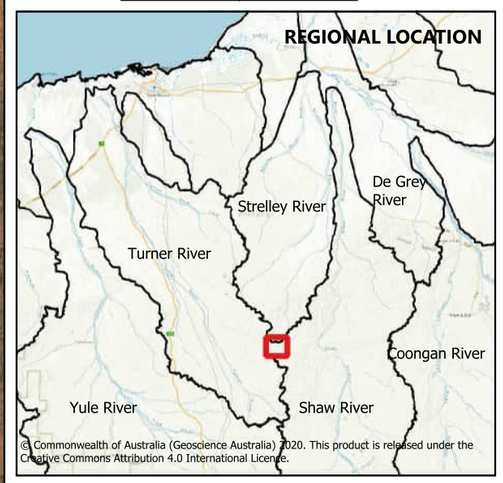
- <= -1.0
- -1.0 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - -0.05
- -0.05 - -0.02
- -0.02 - 0.02 (grey)
- 0.02 - 0.05
- 0.05 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- > 1.0
- Was wet now dry
- Was dry now wet

Coordinate System: GDA94 / MGA zone 50
Projection: Universal Transverse Mercator (UTM)
Datum: GDA 1994
False Easting: 500,000

N

Scale at A3 - 1: 26,000

0 500 1,000 m



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