APPENDIX 7

Water Resources Assessment

umwelt
Environmental & Social Consultants

apa

KURRI KURRI LATERAL PIPELINE

Surface Water and Hydrology Assessment

FINAL

March 2022

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Surface Water and Hydrology Assessment

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
APA Group

Project Director: Paul Douglass
Project Manager: Marion O'Neil
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Report No. 21450/R06
Date: March 2022

Environmental & Social Consultants

This report was prepared using Umwelt's ISO 9001 certified Quality Management System.

Acknowledgement of Country

Umwelt would like to acknowledge the traditional custodians of the country on which we work and pay respect to their cultural heritage, beliefs, and continuing relationship with the land. We pay our respect to the Elders – past, present, and future.

Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
Final	Darren Lyons	8/03/2022	Darren Lyons	8/03/2022

Abbreviations

<table>
<tr><th>Term/Acronym</th><th>Description</th></tr>
<tr><td>AHD</td><td>Australian Height Datum. A common national surface level datum approximately corresponding to mean sea level.</td></tr>
<tr><td>AEP (Annual Exceedance Probability)</td><td>The change of a flood of a given or large size occurring in any one year, usually expressed as a percentage. In this study AEP has been used consistently to define the probability of occurrence of flooding. The following relationships between AEP and ARI applies to this study (ARR, 2019).
<table>
<tr><th>Frequency Descriptor</th><th>EY</th><th>AEP (%)</th><th>AEP (1 in x)</th><th>ARI</th></tr>
<tr><td rowspan="6">Very frequent</td><td>12</td><td></td><td></td><td></td></tr>
<tr><td>6</td><td>99.75</td><td>1.002</td><td>0.17</td></tr>
<tr><td>4</td><td>98.17</td><td>1.02</td><td>0.25</td></tr>
<tr><td>3</td><td>95.02</td><td>1.05</td><td>0.33</td></tr>
<tr><td>2</td><td>86.47</td><td>1.16</td><td>0.50</td></tr>
<tr><td>1</td><td>63.2</td><td>1.58</td><td>1.00</td></tr>
<tr><td rowspan="5">Frequent</td><td>0.69</td><td>50.00</td><td>2</td><td>1.44</td></tr>
<tr><td>0.5</td><td>39.35</td><td>2.54</td><td>2.00</td></tr>
<tr><td>0.22</td><td>20.00</td><td>5</td><td>4.48</td></tr>
<tr><td>0.2</td><td>18.13</td><td>5.52</td><td>5.00</td></tr>
<tr><td>0.11</td><td>10.00</td><td>10.00</td><td>9.49</td></tr>
<tr><td rowspan="3">Infrequent</td><td>0.05</td><td>5.00</td><td>20</td><td>20.0</td></tr>
<tr><td>0.02</td><td>2.00</td><td>50</td><td>50.0</td></tr>
<tr><td>0.01</td><td>1.00</td><td>100</td><td>100</td></tr>
<tr><td rowspan="3">Rare</td><td>0.005</td><td>0.50</td><td>200</td><td>200</td></tr>
<tr><td>0.002</td><td>0.20</td><td>500</td><td>500</td></tr>
<tr><td>0.001</td><td>0.10</td><td>1000</td><td>1000</td></tr>
<tr><td rowspan="5">Extremely Rare</td><td>0.0005</td><td>0.05</td><td>2000</td><td>2000</td></tr>
<tr><td>0.0002</td><td>0.02</td><td>5000</td><td>5000</td></tr>
<tr><td></td><td></td><td rowspan="4">↓</td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Extreme</td><td></td><td></td><td>PMP</td><td></td></tr>
</table>
</td></tr>
<tr><td>ARI (Average Recurrence Interval)</td><td>The long-term average number of years between the occurrences of a flood as big as or larger than the selected event. For example, floods with a discharge as great as or greater than the 20 year ARI flood event will occur on average once every 20 years. ARI is another way of expressing the likelihood of occurrence of a flood event. Also refer to Average Exceedance Probability (AEP), which is the industry standard terminology for definition of design flood events.</td></tr>
<tr><td>ARR</td><td>Australian Rainfall and Runoff. Guidelines prepared by the Institute of Engineers Australia for the estimation of design floods. Reference is made to the 1987 or the 2016 versions of ARR, as specified.</td></tr>
<tr><td>ASS/PASS</td><td>Acid Sulfate Soils or Potential Acid Sulfate Soils</td></tr>
</table>

Term/Acronym	Description
Catchment	The land area draining through the mainstream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.
CEMP	Construction environmental management plan
DECCW	NSW Government Department on Environment, Climate Change and Water. Now the Department of Planning Industry and Environment (DPIE)
DIPNR	Former NSW Government Department of Infrastructure, Planning and Natural Resources. Now the Department of Planning Industry and Environment (DPIE).
discharge	The rate of flow of water measured in terms of volume per unit time, for example, cubic metres per second (m^3/s). Discharge is different from speed or velocity of flow, which is a measure of how fast the water is moving for example, metres per second (m/s).
DPIE	NSW Government Department of Planning Industry and Environment
EIS	Environment impact statement
EP&A Act	*Environmental Planning and Assessment Act 1979*
EY (exceedances per year)	The number of times an event is likely to occur or be exceeded within any given year.
Flood	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami.
flood liable land /flood prone land	Is synonymous with flood prone land (i.e.) land susceptibility to flooding by the probable maximum flood event. Note that the term flooding liable land covers the whole floodplain, not just that part below the FPL (see flood planning area)
Floodplain	Area of land which is subject to inundation by floods up to and including the probable maximum flood event, that is flood prone land.
Flood risk	Potential danger to personal safety and potential damage to property resulting from flooding. The degree of risk varies with circumstances across the full range of floods. Flood risk in this manual is divided into 3 types, existing, future and continuing risks. They are described below. Existing flood risk: the risk a community is exposed to as a result of its location on the floodplain. Future flood risk: the risk a community may be exposed to as a result of new development on the floodplain. Continuing flood risk: the risk a community is exposed to after floodplain risk management measures have been implemented. For a town protected by levees, the continuing flood risk is the consequences of the levees being overtopped. For an area without any floodplain risk management measures, the continuing flood risk is simply the existence of its flood exposure.
Flood storage areas	Those parts of the floodplain that are important for the temporary storage of floodwaters during passage of a flood. The extent and behaviour of flood storage areas may change with flood severity, and loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation. Hence, it is necessary to investigate a range of flood sizes before defining flood storage areas.
GDE	Groundwater dependent ecosystem
Hazard	A source of potential harm or situation with a potential to cause loss. In relation to this manual the hazard is flooding which has the potential to cause damage to the community.
HDD	Horizontal directional drilling

Term/Acronym	Description
Hydrology	The study of the rainfall and runoff process; in particular, the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of floods.
kL	Kilolitre, one thousand litres
L/s	Litres per second. Unit used to describe water usage or discharge.
LEP	Local Environmental Plan
Local overland flooding	Inundation by local runoff rather than overbank discharge from a stream, river, estuary, lake or dam
LPI	Land and Property Information
m AHD	Metres Australian Height Datum (AHD)
M bgl	Metres below ground level
ML	Megalitre, one million litres
m/s	Metres per second. Unit used to describe the velocity of floodwaters.
m^3/s	Cubic metres per second or "cumecs". A unit of measurement of creek or river flows or discharges. It is the rate of flow of water measured in terms of volume per unit time.
OEH	Office of Environment and Heritage
OEMP	Operational Environmental Management Plan
PMF (Probable maximum flood)	The largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation coupled with the worst flood producing catchment conditions. Generally, it is not physically or economically possible to provide complete protection against this event. The probable maximum flood defines the extent of flood prone land, that is, the floodplain.
Risk	Chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. In the context of the manual, it is the likelihood of consequences arising from the interaction of floods, communities and the environment.
runoff	The amount of rainfall which ends up as a streamflow, also known as rainfall excess.
scour	Erosion by mechanical action of water, typically of soil.
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
TEC	Threatened ecological community
TUFLOW	TUFLOW is a computer program which is used to simulate free-surface flow for flood and tidal wave propagation. It provides coupled 1D and 2D hydraulic solutions using a powerful and robust computation. The engine has seamless interfacing with GIS and is widely used across Australia.
WM Act	*Water Management Act 2000*

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1.0 Introduction

1.1 Project Overview

Snowy Hydro Limited is developing a gas-fired peaking power station, referred to as the Hunter Power Project (HPP), at the site of the former Hydro Australia Pty Ltd (Hydro) aluminium smelter at Kurri Kurri. The HPP aims to provide 750 megawatts (MW) of 'on-demand' electricity to supplement Snowy Hydro's generation portfolio with dispatchable capacity when the needs of electricity consumers are highest. The HPP was granted approval by the Secretary of Department of Planning, Industry and Environment (DPIE) in December 2021 and by the Commonwealth Minister for Environment in February 2022.

APA Group (APA) has been engaged by Snowy Hydro Limited to develop a gas supply solution for the HPP. APA has proposed the Kurri Kurri Lateral Pipeline (KKPL) Project (the Project) as the gas supply solution for the HPP.

The Project comprises the following primary components:

- A buried, steel, medium diameter (up to DN350), medium pressure (up to 6.9 megapascal (MPag)) transmission pipeline of approximately 20.1 km in length to provide a gas supply from the existing Sydney to Newcastle Pipeline (SNP), via receipt and delivery facilities, to the HPP site.
- A compressor station at the termination of the transmission pipeline to boost gas pressure prior to transfer to a storage pipeline.
- A buried, steel, medium diameter (up to DN350), high pressure (up to 15.3 MPag) interconnect pipeline of approximately 1.3 km in total length, providing an interface between the compressor station, storage pipeline and delivery station.
- A buried, steel, large diameter (up to DN1050), high pressure (up to 15.3 MPag) storage pipeline of approximately 24 km in total length downstream of the compressor station with approximately 70 terajoules (TJ) of useable gas storage ready to supply the HPP.
- A delivery station to receive gas from the storage pipeline and control temperature, pressure and flow rate prior to delivery of gas to the HPP.

The compressor station and delivery station are located within the HPP project site boundary.

A compressor station and storage pipeline are required as part of the Project as the SNP does not provide sufficient gas volumes or pressure to meet the supply requirements of the HPP. As such, a direct pipeline connection between the SNP and the HPP is not a viable solution for gas supply to the HPP.

The proposed alignment of the transmission pipeline would commence at the Project's proposed JGN offtake facility near Black Hill, approximately 15 km northwest of Newcastle and terminate at the HPP, approximately 2 km north of Kurri Kurri, as shown on **Figure 1.1**. The Project alignment and construction footprint is provided in **Appendix A**. A schematic outlining the relationship of these project components is provided in **Figure 1.2**.

Construction is planned to commence during Q4 2022 with a gas supply to the HPP provided during Q4 2023. The HPP is planned to be operational by the end of 2023.

The Project, including the ancillary surface facilities, would be designed, constructed, commissioned and operated in accordance with *Australian Standard 2885 Pipelines – Gas and Liquid Petroleum* (AS 2885 - a suite of standards outlining requirements for gas and petroleum pipelines which are designed, constructed and operated in Australia) and licenced under the *Pipelines Act 1967*.

1.2 Study Area

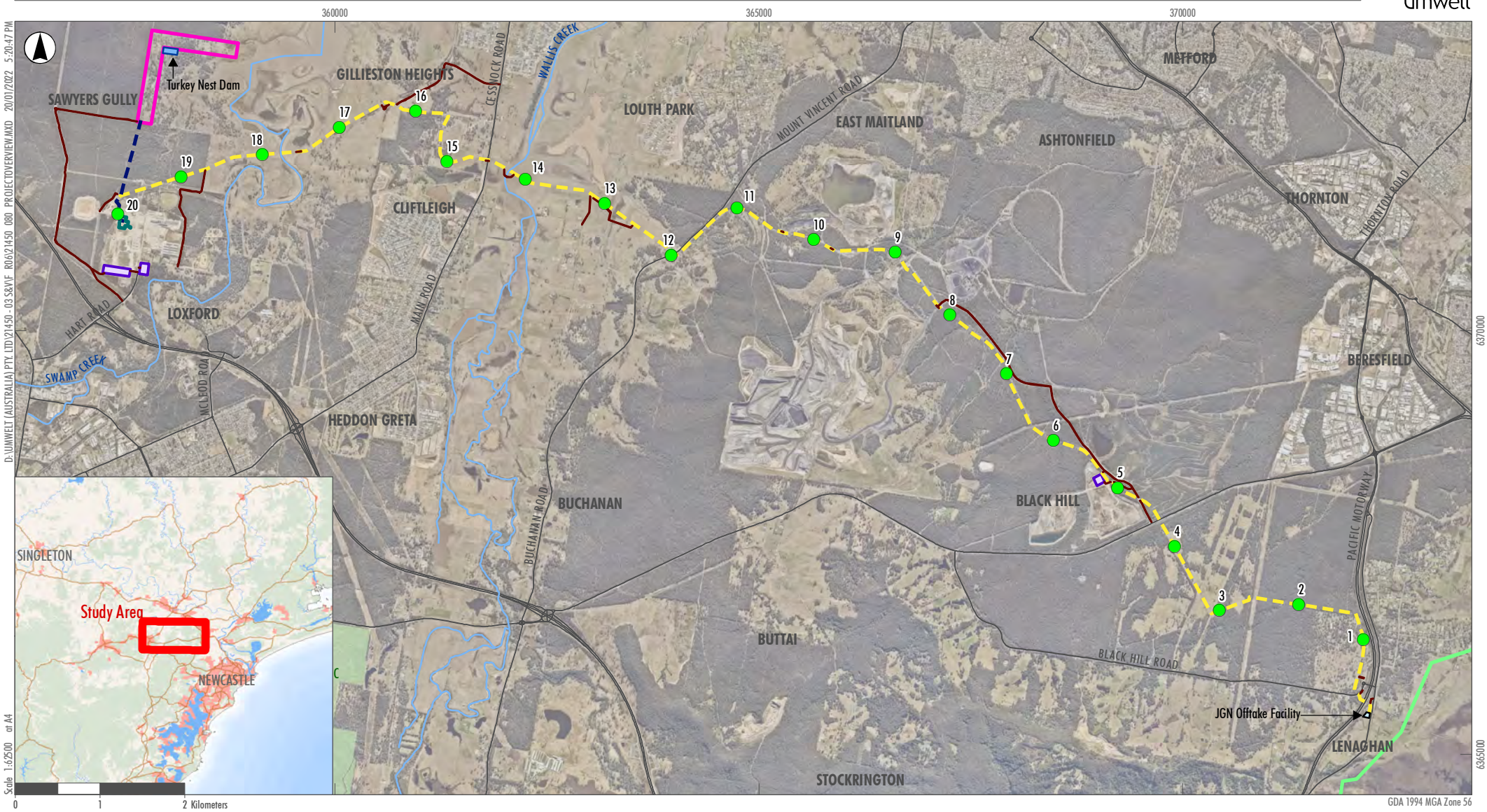
For the purposes of this assessment, the Study area is defined as the Project construction footprint which is located over approximately 103 ha as depicted in **Appendix A**. The Study area incorporates:

- The construction footprint for both the transmission and storage pipelines
- Extra workspaces required for construction of the transmission pipeline for truck turnarounds, vegetation storage, horizontal directional drilling (HDD) entry and exit locations, horizontal bore entry and exit locations, watercourse crossing workspaces and line pipe storage areas
- Access tracks to provide access to the construction footprint
- Construction footprints for the offtake facility, compressor station and delivery station.

1.3 Purpose of Report

This Water and Hydrology Assessment has been prepared by Umwelt (Australia) Pty Ltd (Umwelt) in accordance with the Secretary's Environmental Assessment Requirements (SEARs) issued by the Department of Planning, Industry and Environment (DPIE) on 23 July 2021, as further detailed in **Table 2.1**. This report provides an assessment of the potential surface water and groundwater, water quality and hydrology impacts associated with the construction and operation of the Project and includes the following scope:

- Identifying relevant regulatory requirements for the Project with respect to surface water resources in the Study Area.
- Confirming the environmental values and water quality objectives associated with surface water resources.
- Assessing the impacts of the project on groundwater aquifers and groundwater dependent ecosystems, having regard to the NSW Aquifer Interference Policy and relevant Water Sharing Plans Identifying potential impacts on surface water resources and flood regimes associated with the Project.
- Assessing the risk of potential impacts on surface water resources and flood regimes in the Study area and identify appropriate mitigation measures to manage the potential impacts.



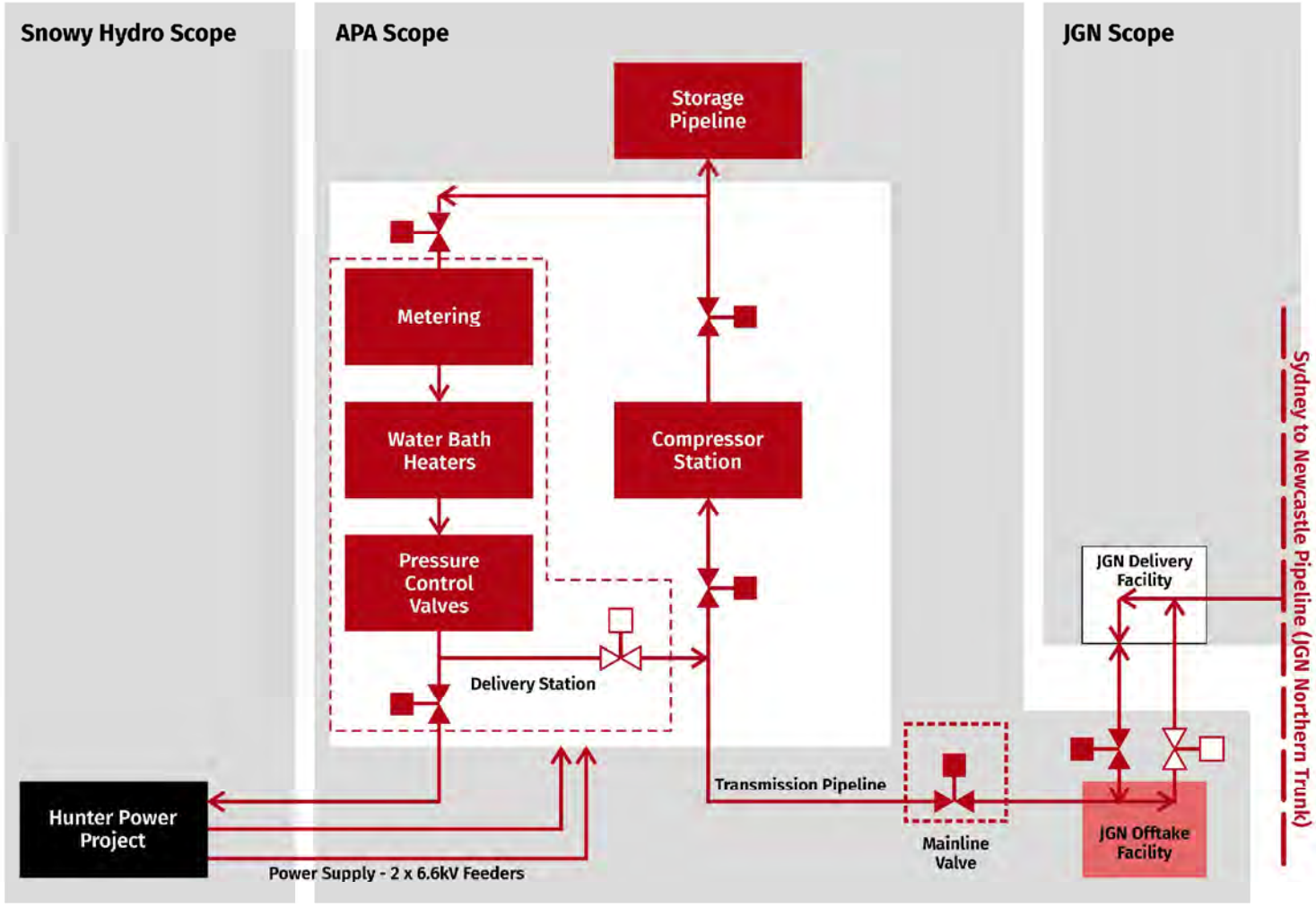
Legend

- Transmission Pipeline Alignment
- Interconnect Pipeline
- Sydney to Newcastle Pipeline (JGN Northern Trunk)
- Kilometre Point
- Compressor and Delivery Station
- Pipe Laydown Areas
- Storage Pipeline
- Turkey Nest Dam
- JGN Offtake Facility
- NSW Conservation Estates
- Access Tracks
- Roads
- Watercourses

FIGURE 1.1

Project Location

Image Source: Neamap (August 2021) Data source: NSW LPI (2020;2021)



Note: Not to Scale

FIGURE 1.2

Relationship of Project Components

2.0 Assessment Requirements

The SEARs for the Project identify key issues and referenced guidelines that must be addressed in the Environmental Impact Statement. **Table 2.1** presents the assessment requirements relevant to the Surface Water and Hydrology Assessment and where these have been addressed in this report.

The Agency Advice and where in the report it has been addressed is included in **Appendix B**.

Table 2.1 SEARs and where addressed

Requirement	Section where addressed
Water – including:	
• a detailed and consolidated site water balance, including a description of water demand, a breakdown of authorised and reliable water supplies and assessment of the available water entitlement for the project (if required), and the measures to minimise water use.	**Section 5.3**
• details of water requirements and supply arrangements for the project.	**Section 5.3**
• an assessment of the impacts of the project on groundwater aquifers and groundwater dependent ecosystems, having regard to the *NSW Aquifer Interference Policy* and relevant *Water Sharing Plans*	**Section 5.2**
• as assessment of the impacts of the project on the quantity and/or quality of the region's surface and groundwater resources, having regard to the *Guidelines for Controlled Activities on Waterfront Land, NSW Water Quality and River Flow Objectives (DECCW, 2006), Australian and New Zealand Guidelines for Fresh and Marine Water Quality (*ANZG, 2018) and *ANZECC Guidelines and Water Quality Objectives in NSW* (DEC, 2006)	**Section 5.1**
• an assessment of flooding and the hydrological impacts of the project	**Sections 4.11 and 5.2**
• identification of any licensing requirements or other approvals under the *Water Management Act 2000; and*	**Section 5.3**
• an assessment of the likely impacts of the project on watercourses, riparian land, water related infrastructure and other water users, including use and discharge of water during construction, commissioning and maintenance of the pipeline infrastructure and measure to mitigate the impacts.	**Section 6.0**

This report has been prepared in accordance with the following guidelines and legislative requirements:

- NSW *Water Management Act 2000* (WM Act)
- *Water Act 1912* (Water Act)
- Relevant Water Sharing Plans along the Study area
- Groundwater
  - NSW State Groundwater Policy Framework Document and component policies (DPIE)
  - NSW Aquifer Interference Policy 2012 (DPIE)
  - National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia (ARMCANZ/ANZECC)
  - Guidelines for Development in the Drinking Water catchments (Hunter Water, 2017).

- Flooding
  - Floodplain Development Manual (OEH)
  - Floodplain Risk Management Guideline (OEH)
  - Australian Rainfall and Runoff Guidelines 2019
- Surface Water
  - NSW State Rivers and Estuary Policy (DPIE Water)
  - NSW Government Water Quality and River Flow Objectives at http://www.environment.nsw.gov.au/ieo/
  - Using the ANZECC Guideline and Water Quality Objectives in NSW (DEC, 2006)
  - National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ)
  - Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (DECC, 2008)
  - Managing Urban Stormwater: Soils and construction (Landcom)
  - Technical Guidelines: Bunding and Spill Management (EPA)
  - NSW Guidelines for Controlled Activities (Various) (DPIE)
  - Water Quality Objectives
  - ANZECC (2000) Guidelines for Fresh and Marine Water Quality
  - Applying Goals for Ambient Water Quality Guidance for Operations Officers – Mixing Zones
  - Approved Methods for the Sampling and Analysis of Water Pollutant in NSW (DECC2004)
  - Guidelines for Controlled Activities on Waterfront Land: There a number of guidelines for Controlled Activities under the WM Act, developed by the former NSW Office of Water (now NSW Department of Planning, Industry and Environment - Water). The Project is a SSI, therefore sections of the WM Act are not relevant and in any case, pipelines are exempt from controlled activities on waterfront land. The following guidelines have never-the-less been considered in the method and recommendations in this assessment, as they are related to good management practices for activities that the Project will undertake:

- NSW Office of Water (2012) *Guidelines for laying pipes and cables in watercourses*. State of New South Wales through the Department of Environment, Climate Change and Water.
- NSW Office of Water (2012a) *Guidelines for riparian corridors on waterfront land*. Department of Primary Industries: Office of Water – through the Department of Trade and Investment, Regional Infrastructure and Services.
- NSW Office of Water (2012b) *Guidelines for instream works on waterfront land*. State of New South Wales through the Department of Trade and Investment, Regional Infrastructure and Investment.
- NSW Office of Water (2012c) *Guidelines for vegetation management plans on waterfront land*. State of New South Wales through the Department of Trade and Investment, Regional Infrastructure and Investment.
- NSW Office of Water (2012d) *Guidelines for watercourse crossings on waterfront land*. State of New South Wales through the Department of Trade and Investment, Regional Infrastructure and Investment.

- NSW Office of Water (2012e) *Controlled Activities on Waterfront Land*: *Controlled activity exemptions on waterfront land.* State of New South Wales through the Department of Trade and Investment, Regional Infrastructure and Investment.

3.0 Assessment Methodology

3.1 Surface Water Quality

The methodology for assessment of potential surface water quality impacts arising from the Project has broadly included:

- Desktop review and analysis of existing surface water quality information to understand the existing environment and identify potential waterway-specific risks.
- A qualitative assessment of the quality and quantity of pollutants that may be introduced during construction and operation of the Project, and the impact that this may have on surface water quality (with reference to the ANZG (2018) *Water Quality Guidelines* and with regard to relevant environment values as identified in the DECCW (2006) *NSW Water Quality and River Flow Objectives.*
- Recommendations for appropriate treatment measures to mitigate the impacts of construction and operation on surface water quality, including water quality controls and water quality monitoring program during construction and operation of the Project.

The methodology for determining existing water quality conditions included:

- Collating water quality data.
- Calculating summary statistics for each site including number of samples, mean, median, maximum and minimum value.
- Reporting the median historical data and mean sampled data in comparison with DECCW (2006) water quality objectives and ANZG (2018) default guideline values (DGVs).

3.2 Groundwater

The following tasks have been completed as part of the groundwater impact assessment:

- A desktop study of existing hydrogeological conditions at the Study Area including:
    - Description of aquifers, depth to groundwater, groundwater quality and groundwater flow directions.
    - Existing groundwater users, groundwater dependent ecosystems and groundwater-surface water interaction.
    - Review of relevant previous investigations.
- A bore census (i.e. WaterNSW records) has been undertaken to confirm the location of the bores and record total depth and depth to standing water level.
- Assess any potential dewatering requirements and associated drawdown impacts due to construction dewatering and any proposed ongoing water take associated with the Project.

3.3 Hydrology and Flooding

Overall, the methodology for the hydrology and flooding assessment included the following:

- Fieldwork was undertaken by Umwelt's water resource engineer during October 2021 to collect photos and assess the condition of the waterway crossings as well as to inform the parameters adopted in the flood modelling. Sites were inspected on the following dates:
  - 13 October 2021 – Buttai Creek and Wallis Creek.
  - 15 October 2021 – Mines, Woods Gully, Weakleys Flat Creek. Note: access to the Viney Creek crossing was not available at the time of the field inspection.
  - 22 October 2021 – Swamp Creek.
- Desktop review of publicly available flood study reports from local council(s) and other sources to characterise existing flooding conditions at the Study Area and the surrounding areas.
  - Maitland and Cessnock City Councils completed the Wallis and Swamp-Fishery Creek Flood Study in 2019 (WMAwater, 2019). This study incorporated detailed flood modelling and mapping of existing flood conditions for a full range of design flood magnitudes. The existing flood modelling covers all Project components to the west of Kilometre Point (KP) 11.2 of the transmission pipeline alignment. The Wallis and Swamp-Fishery Creek Flood Study focused on flooding resulting from runoff within the Swamp-Fishery and Wallis Creek catchment and did not assess coincident Hunter River flooding.
  - Maitland and Cessnock City Councils completed the Hunter River Branxton to Green Rocks Flood Study in 2010 (WMAwater, 2010) which covers the Project site at the Wallis Creek pipeline crossing. This study assessed Hunter River flooding and showed that backwater flooding in the lower Wallis Creek catchment can occur in large Hunter River flood events. Hunter River flooding is the dominant flooding mechanism at the Wallis Creek and Swamp Creek pipeline crossing in large events (1% AEP and greater). The design flood inundation from Hunter River flooding is provided in **Appendix G**.
- Undertake flood modelling for areas not covered by existing flood studies, i.e. east of KP 11.2 of the transmission pipeline alignment.
  - Additional flood modelling was undertaken to define existing flood conditions in watercourses traversed by the Project where no existing information is available. High level flood modelling (e.g. direct rainfall TUFLOW 2D) was undertaken to identify broad flood inundation and flooding characteristics (water level, depth, velocity, hazard) across the Project extent. The influence of climate change was also considered in modelling flood impacts on the Project. A summary of the flood assessment approach and model development is included **Appendix G**. The flood model results provide the spatial distribution and timing of flood level, depth, velocity and hazard across the Study Area for each modelled design magnitude flood event. A flood mapping series for the full extent of the pipeline corridor has been prepared using the combined outputs of the modelling undertaken for the current study and WMAwater (2019) study. The flood mapping is included as **Appendix H, Appendix I** and **Appendix J** for the flood depth, flood velocity and flood hazard maps respectively.
- Flood Planning and Management – a review of relevant flood planning legislation, local development controls and assessment guidelines was undertaken. The assessment considers existing flood management procedures and protocols that may influence the project design, construction and operation.

- Qualitative assessment of potential impacts to flooding as a result of construction and operation of the Project.
- Assessment of potential impacts to surface water hydrology as a result of construction and operation of the Project.
- Identify appropriate mitigation and management measures.

4.0 Existing Environment

4.1 Hydrology

The Study Area is situated in the Hunter River catchment in NSW, which drains a total area of about 22,000 km^2. The Hunter River flows in a south-westerly direction from Glenbawn Dam in the Liverpool Ranges to meet Goulburn River near Denman. From Denman, the river flows generally in a south easterly direction through Maitland (approximately 6 km north of the Study Area) before reaching the Tasman Sea at Newcastle.

The water features in the vicinity of the Project are shown on **Figure 4.1** and the waterway crossings and catchments are tabulated in **Table 4.1**. Further information on the watercourses and their condition is provided in **Section 4.2**. The local catchment topography is shown in **Figure 4.2**.

The principal watercourses traversed by the Project include:

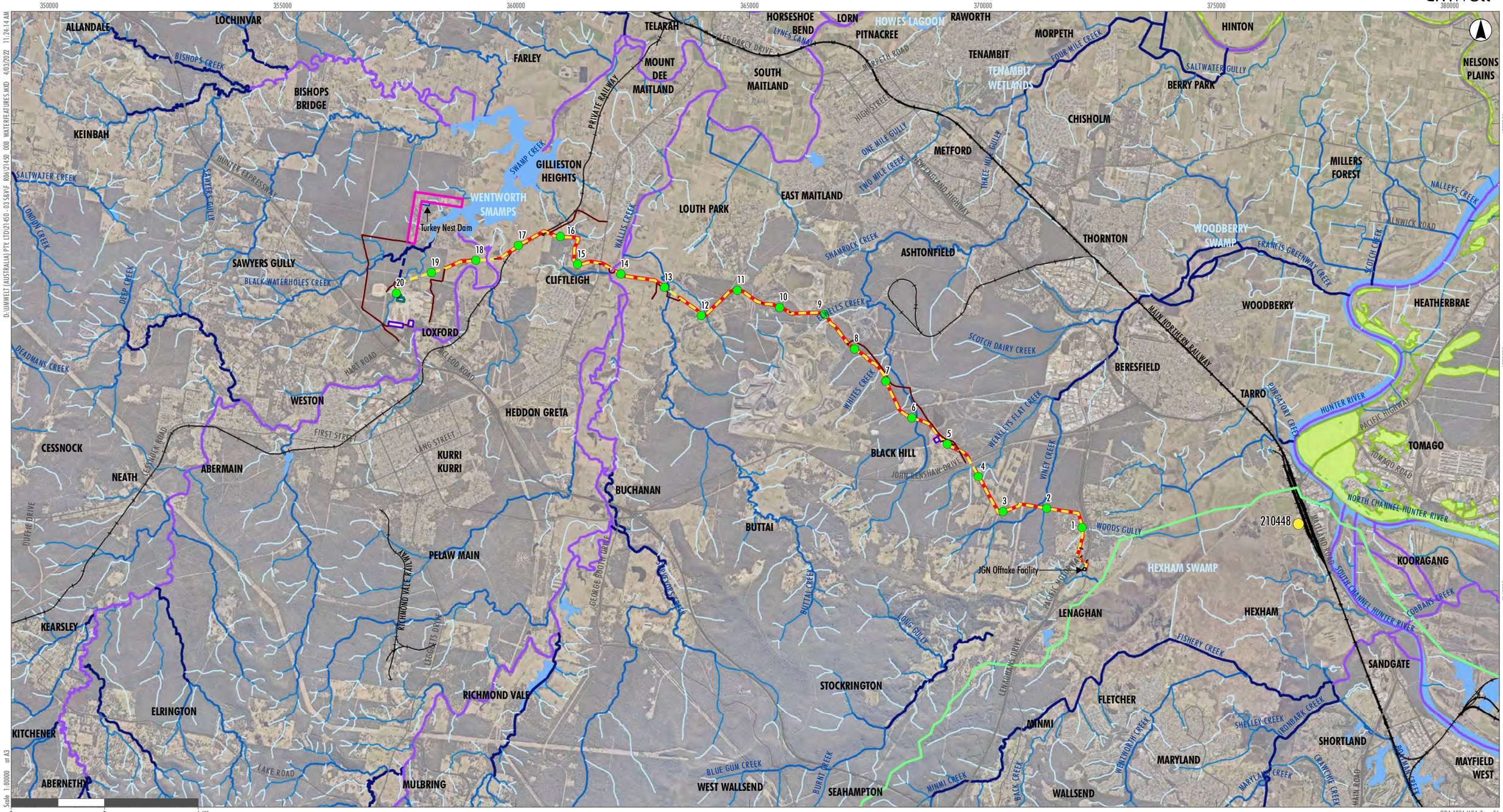
- Wood's Gully – The eastern end of the transmission pipeline alignment (KP0.9) traverses Wood's Gully which discharges to Hexham Swamp on the Hunter River floodplain.
- Viney Creek - The eastern section of the transmission pipeline alignment (KP2.2) traverses Viney Creek and associated tributaries which discharge through Woodberry Swamp prior to joining the Hunter River
- Weakleys Flat Creek – The eastern section of the transmission pipeline alignment (KP4.2) traverses Weakleys Flat Creek associated tributaries which discharge through Tenambit wetlands prior to joining the Hunter River.
- Four Mile Creek - The mid-section of the transmission pipeline alignment (KP5.9) traverses Four Mile Creek and associated tributaries which include Whites Creek (KP7) and Elwells Creek (KP8.9). Four Mile Creek discharges through Tenambit wetlands prior to joining the Hunter River.
- Swamp, Wallis and Buttai Creek - the central and western sections of the transmission pipeline alignment extend across the Buttai (KP12.9), Wallis (14.2) and Swamp (17.8) Creek systems. The Wallis Creek catchment is a tributary of the Hunter River, is approximately 400 km^2 (40,000 ha) and has a confluence with the Hunter River approximately 6.5 km northeast of the Study Area. Named tributaries of Wallis Creek include Swamp Creek, Deep Creek, Sawyers Creek, Black Waterholes Creek, Buttai Creek and Bishops Creek. Swamp Creek, a perennial waterway that flows south to north, has a confluence with Wallis Creek approximately 4.2 km north east of the Study area at its nearest point. Black Waterholes Creek and Swamp Creek converge approximately 2.25 km north-east of the Study Area into Wentworth Swamp. Downstream of Wentworth Swamp, Swamp Creek subsequently discharges into Wallis Creek approximately 1.5 km south of South Maitland. The downstream reaches of the Wallis and Swamp Creek system comprises numerous low-lying and shallow wetlands and surface water storages including the broad Wentworth Swamp. The catchment area upstream of the pipeline alignment is approximately 280 km^2 for the Swamp, Wallis and Buttai Creek catchments.
- An unnamed tributary of Black Waterholes Creek, which is an ephemeral waterway that flows generally south west to north east, is located immediately adjacent to the Study Area on the western boundary. Black Waterholes Creek is crossed by the interconnect pipeline between the compressor station and storage pipeline.

While all watercourses and drainage lines within the catchments traversed by the Project are ephemeral, the lower reaches of Wallis Creek are located on the extensive Hunter River floodplain and are subject to tidal influence from the Hunter River. The transmission pipeline crossing location of Wallis Creek is not subject to tidal influence.

Table 4.1 Waterways and Catchments Summary

Kilometre Point (KP)	Watercourse Name	Method of crossing by the Project	Landholder	Contributing Catchment Area (km^2)	Photo References (Appendix E)
0.9	Woods Gully	Open cut	TfNSW	0.46	Photo E.5, E.6
2.1	Viney Creek (east arm)	Open cut - special crossing	Stevens Group	1.46	
2.2	Viney Creek (west arm)	Open cut - special crossing	Stevens Group	2.98	Photo E.7
3.9	Unnamed watercourse (tributary of Weakleys Flat Creek)	Open Cut	Catholic Diocese	0.26	Photo E.8, E.9
4.2	Unnamed watercourse (tributary of Weakleys Flat Creek)	HDD (John Renshaw Drive)	Catholic Diocese	1.71	Photo E.10, E.11
5.9	Four Mile Creek	Open cut - special crossing	Donaldson	1.79	Photo E.13, E.14, E.15, E.16, E.17
7.2	Unnamed watercourse, constructed channel from Lake Kennerson to Four Mile Creek	Open Cut	Ashtonfields and Bloomfield	0.40	
7.3	White's Creek	Open Cut	Ashtonfields and Bloomfield	2.44	Photo E.19, E.20
7.5	Unnamed watercourse, constructed channel from Lake Kennerson to unnamed watercourse flowing to Lake Forster	Open Cut	Ashtonfields and Bloomfield	1.06	
7.7	Unnamed watercourse, constructed channel from Lake Kennerson to unnamed watercourse flowing to Lake Forster	Open Cut	Ashtonfields and Bloomfield	-	
7.8	Unnamed watercourse	Open Cut	Ashtonfields and Bloomfield	-	Photo E.21, E.22, E.23
8.9	Elwell's Creek	Open Cut	Ashtonfields and Bloomfield	2.79	Photo E.24
11.9	Unnamed watercourse	Open Cut	Ashtonfields and Bloomfield	1.04	Photo E.25, E.26, E.27
12.9	Buttai Creek	HDD	Gavan	19.84	Photo E.29, E.30, E.31
14.2	Wallis Creek	HDD	Boundary watercourse	160.73	Photo E.32, E.33, E.34
17.4	Unnamed watercourse	Open Cut	Regrowth Kurri Kurri		

Kilometre Point (KP)	Watercourse Name	Method of crossing by the Project	Landholder	Contributing Catchment Area (km²)	Photo References (Appendix E)
17.8	Swamp Creek	HDD	Regrowth Kurri Kurri	100.1	Photo E.46, E.47, E.48, E.49
Interconnect pipeline	Unnamed watercourse (constructed channel)	Open Cut	Regrowth Kurri Kurri	-	
Interconnect pipeline	Black Waterholes Creek and proposed stewardship area	HDD	Regrowth Kurri Kurri	-	Photo, E.50
Storage pipeline	Unnamed watercourse	Open Cut	Regrowth Kurri Kurri	-	
Storage pipeline	Unnamed watercourse	Open Cut	Regrowth Kurri Kurri	-	



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GDA 1994 MGA Zone 56

Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Sydney to Newcastle Pipeline (JGN Northern Trunk)
- Kilometre Point
- BOM Rainfall Gauges
- Wetlands
- Compressor and Delivery Station
- Pipe Laydown Areas
- Storage Pipeline
- JGN Offtake Facility
- Access Tracks
- Railway
- Roads

Strahler Stream Ordering

- 1
- 2
- 3
- 4
- ≥ 5

FIGURE 4.1

Surface Water Features and Catchments

Image Source: ESRI Basemap (2021) Data source: NSW DPI (2013); Umwelt (2021)

360000 365000 370000

6370000

6365000

SAWYERS GULLY
Turkey Nest Dam
GILLIESTON HEIGHTS
LOUTH PARK
EAST MAITLAND
METFORD
THREE MILE GULLY
FOUR MILE CREEK
ASHTONFIELD
THORNTON
SHAMROCK CREEK
BLACKWATERS CREEK
SWAMP CREEK
CLIFTLEIGH
EWELLS CREEK
LOXFORD
SCOTCH DAIRY CREEK
BUTTAI CREEK
WHITES CREEK
BERESFIELD
HEDDON GRETA
KURRI KURRI
BUCHANAN
BLACK HILL
WEAKLEYS FLAT CREEK
VINEY CREEK
STANFORD MERTHYR
BUTTAI
WOODS GULLY
JGN Offtake Facility
PELAW MAIN
WALLIS CREEK
SURVEYORS CREEK
LONG GULLY
LENAGHAN
STOCKRINGTON

Scale 1:43000 at A3

0 1 2 Kilometers

GDA 1994 MGA Zone 56

Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Sydney to Newcastle Pipeline (JGN Northern Trunk)
- Compressor and Delivery Station
- Pipe Laydown Areas
- Storage Pipeline
- Turkey Nest Dam
- JGN Offtake Facility
- Access Tracks
- Watercourses

Elevation (mAHD)
High : 213.072
Low : -63.573

FIGURE 4.2

Topography

Image Source: Nearmap (Aug 2021) Data source: NSW DPI (2013); Umwelt (2021)

4.2 Watercourse Condition Assessment

Site inspections of key watercourse crossings were undertaken to visualise the current condition of the watercourses and identify any features of the local reaches being susceptible to Project impacts. A summary of observations at each watercourse is provided below.

KP 0.9 Woods Gully

The Woods Gully watercourse crossing was inspected on the 13th October 2021. The inspection identified the following characteristics:

- dense stabilising vegetation, generally grasses, along the watercourse banks, with no erosion evident (Refer photos provided in **Appendix D**)
- Gentle bank slopes as can be seen in the cross section from LiDAR provided in **Appendix E**.

KP 2.1/KP 2.2 Viney Creek

Access to the proposed pipeline crossing at Viney Creek was not able to obtained at the time of the site inspection, however the condition of the creek was assessed in 2021 by Eco Logical for the *Black Hill Industrial Park – Vegetation Management Plan* and the condition of the creek was graded as being "moderate-good" (Eco Logical, 2021). A photo from the report is shown below in **Photo 4.1** showing evidence of bank erosion. Grass and vegetation cover is evident on the banks however the vegetation within the channel is generally sparse. A cross section of the watercourse crossing from LiDAR data shows relatively steep banks (**Appendix E**).

Photo 4.1 Viney Creek Typical Creek Bank Structure and Shape

(Source: Black Hill Industrial Park – Vegetation Management Plan (Eco Logical, 2021))

KP 3.9 - Unnamed Watercourse (tributary of Weakleys Flat Creek)

The watercourse crossing at KP 3.9 was inspected on 13 October 2021. Photos are provided in **Appendix D**. The inspection identified the following characteristics:

- Ponding of water in channels
- Bank slopes are gentle (also shown on the cross section provided in **Appendix E**)
- Intermittent flow, defined channel with incised banks
- Evidence of bank erosion
- Grass cover on the flats with sparse native vegetation.

KP 4.2 - Unnamed watercourse (tributary of Weakleys Flat Creek)

The watercourse crossing at KP 4.2 was inspected on 13 October 2021. Photos are provided in **Appendix D**. The inspection identified the following characteristics:

- Ponding of water in channel
- Dense stabilising vegetation cover (generally grasses) on banks and channel, particularly on the upstream side of causeway
- Bank slopes are gentle (also shown on the cross section provided in **Appendix E**)
- Defined channel with incised banks
- Evidence of bank erosion
- Grass cover on the flats with sparse native vegetation.

KP 5.9 - Four Mile Creek

The Four Mile Creek watercourse crossing at KP 5.9 was inspected on 15 October 2021. Photos are provided in **Appendix D**. The inspection identified the following characteristics:

- Ponding of water in channel
- Rock protection at existing crossings with vegetation and grass cover upstream and downstream.
- Bank slopes are steep (also shown on the cross section provided in **Appendix E**)
- Defined channel with highly incised banks
- Evidence of gully and bank erosion.

KP 7.3 – White's Creek

The White's Creek watercourse crossing at KP 7.3 was inspected on 15 October 2021. Photos are provided in **Appendix D**. The inspection identified the following characteristics:

- Ponded water
- Vegetation and grass cover
- Bank slopes are very gentle (also shown on the cross section provided in **Appendix E**)
- Undefined channel

- Minimal evidence of erosion.

KP 7.8 – Unnamed watercourse

The watercourse crossing at KP 7.3 was inspected on 15 October 2021. Photos are provided in **Appendix D**. The inspection identified the following characteristics:

- Creek was flowing with ponded water
- Small culverts under road crossing
- Dense grass cover in floodway
- Bank slopes are gentle (also shown on the cross section provided in **Appendix E**)
- Minimal evidence of erosion.

KP 8.9 – Elwell's Creek

The Elwell's Creek watercourse crossing at KP 8.9 was inspected on 15 October 2021. Photos are provided in **Appendix D**. The inspection identified the following characteristics:

- Ponding of water in channel
- Dense grass cover in floodway Bank slopes are relatively gentle (also shown on the cross section provided in **Appendix E**)
- Minimal evidence of erosion.

KP 11.9 – Unnamed watercourse

The Buttai Creek watercourse crossing at KP 12.9 was inspected on 13 October 2021. Photos are provided in **Appendix D**. The inspection identified the following characteristics:

- Ponded water on the downstream side
- Large box culvert at Buchanan Road
- Dense grass cover on flats and creek edges, as well as within channel
- Bank slopes are gentle (also shown on the cross section provided in **Appendix E**).

KP 12.9 - Buttai Creek

The Buttai Creek watercourse crossing at KP 12.9 was inspected on 13 October 2021. Photos are provided in **Appendix D**. The inspection identified the following characteristics:

- Floodplain was flowing
- Grass cover on flats and creek edges, as well as within channel
- Bank slopes are flat (also shown on the cross section provided in **Appendix E**).

KP 14.2 – Wallis Creek

The Wallis Creek watercourse crossing at KP 14.2 was inspected on 13 October 2021. Photos are provided in **Appendix D**. The inspection identified the following characteristics:

- Creek was flowing full

- Dense grass cover on flats and creek edges, as well as within channel
- Defined channel with incised banks
- Bank slopes on flats are gentle (also shown on the cross section provided in **Appendix E**).

KP 17.8 – Swamp Creek

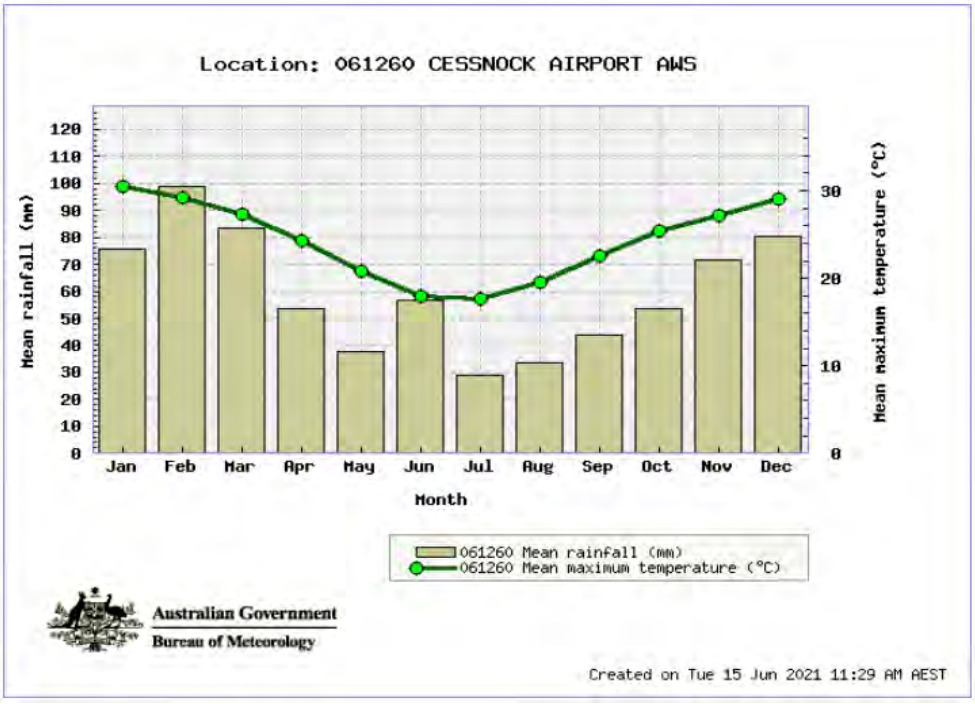
The Swamp Creek watercourse crossing at KP 17.8 was inspected on 22 October 2021. Photos are provided in **Appendix D**. The inspection identified the following characteristics:

- Creek was flowing full
- Dense grass cover on flats and creek edges
- Defined channel with incised banks
- Bank slopes on flats are gentle (also shown on the cross section provided in **Appendix E**).

4.3 Climate

The climate of the Hunter region is classified as warm and temperate, generally experiencing mild to hot summers and cool to mild winters. Average maximum temperature approaches 31°C in January and average maximum July temperatures are about 18°C (BoM, 2021b).

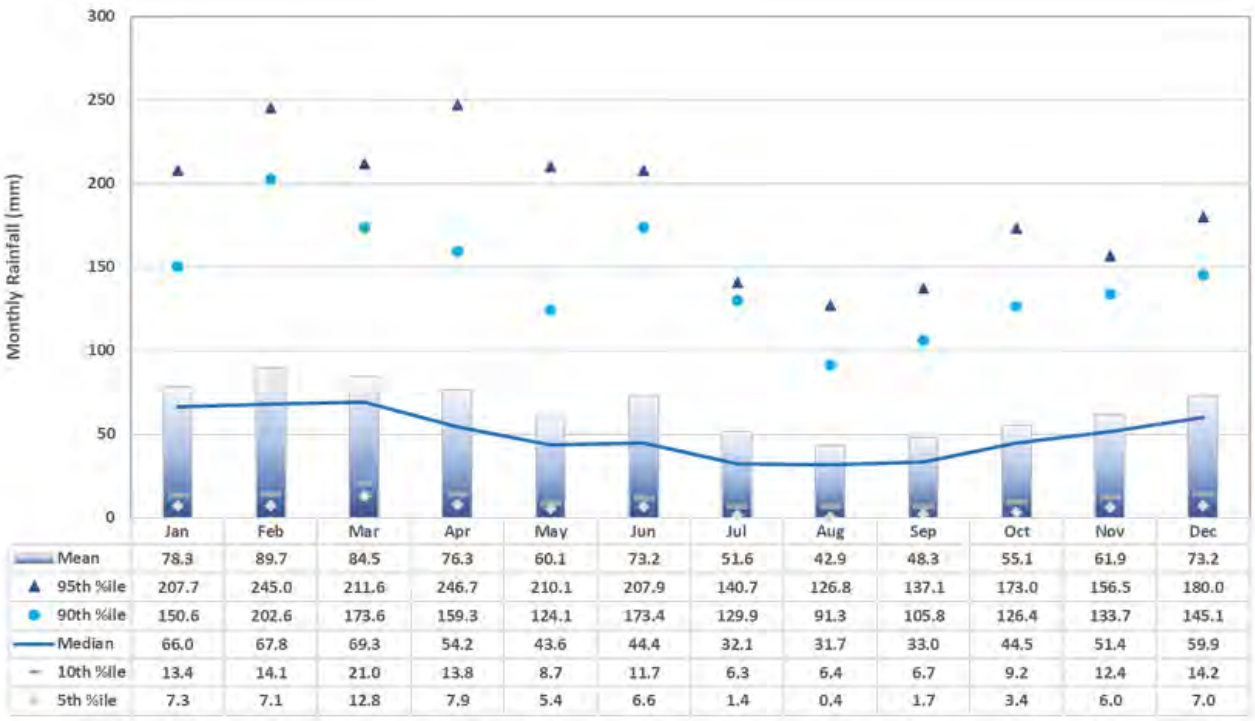
Between 2007 and 2021, average annual rainfall is approximately 770 mm (BoM, 2021c). During this period, the highest mean monthly rainfall for the Hunter region near Kurri Kurri occurred in June. High monthly rainfall also occurred between February and April which accounts for approximately one third of the average annual rainfall (refer to **Graph 4.1**) (BoM, 2021c).



Graph 4.1 Cessnock Airport AWS Mean Rainfall

The climate at the Study Area has a Köppen classification of temperate (no dry season (hot summer)) with a mean maximum summer temperature of 29.2 to 30.5°C and a mean maximum winter temperatures of 17.6 to 19.5°C (Cessnock Airport AWS 061260). Long term climate data from the Study Area was obtained from the Bureau of Meteorology (BoM) SILO Data Drill which is derived from the BoMs extensive database of recorded observations taken from its network of weather recording stations. Representative long-term rainfall data for the Study Area is presented in **Graph 4.2** and summarised below:

- Median annual rainfall is approximately 794 mm
- Annual rainfall variability is relatively low with a standard deviation of 200 mm and coefficient of variation of 0.25
- Monthly rainfall shows a low to moderate degree of seasonal distribution with a drier period of lower rainfall from July through November and a wetter period from December through April
- Median monthly rainfall is lowest in August (31.7 mm) and highest in February (67.8 mm).



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	78.3	89.7	84.5	76.3	60.1	73.2	51.6	42.9	48.3	55.1	61.9	73.2
95th %ile	207.7	245.0	211.6	246.7	210.1	207.9	140.7	126.8	137.1	173.0	156.5	180.0
90th %ile	150.6	202.6	173.6	159.3	124.1	173.4	129.9	91.3	105.8	126.4	133.7	145.1
Median	66.0	67.8	69.3	54.2	43.6	44.4	32.1	31.7	33.0	44.5	51.4	59.9
10th %ile	13.4	14.1	21.0	13.8	8.7	11.7	6.3	6.4	6.7	9.2	12.4	14.2
5th %ile	7.3	7.1	12.8	7.9	5.4	6.6	1.4	0.4	1.7	3.4	6.0	7.0

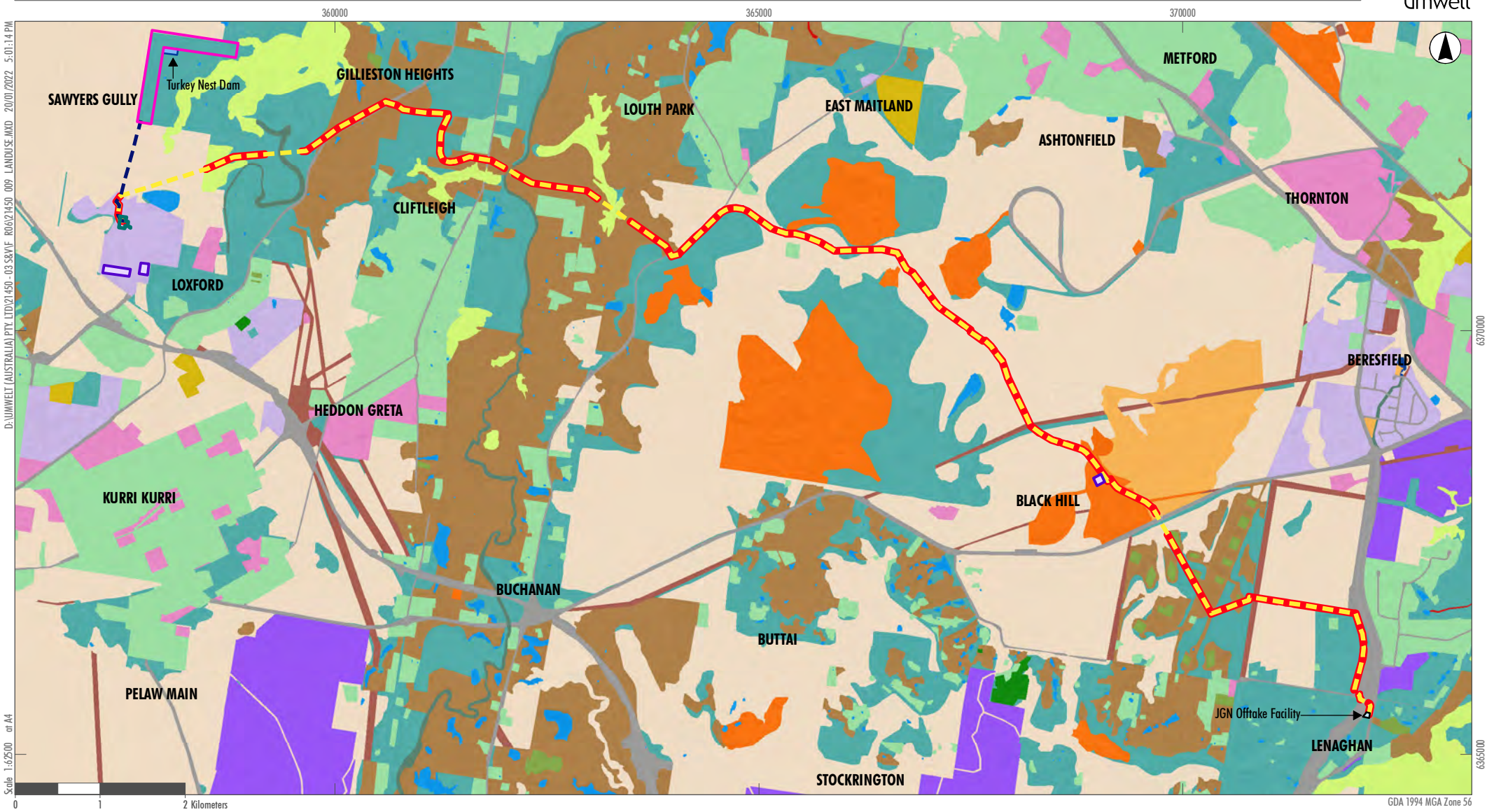
Graph 4.2 Monthly Rainfall Statistics (SILO Data Drill, 1900-2020)

4.4 Land Use

Broadly, the Hunter region supports a range of agricultural activities including wineries, dairying, vegetables, fodder, beef and horse breeding as well as over 20 of the largest coal mines in Australia and two operational coal-fired power stations. The Hunter River is regulated from Glenbawn Dam to Maitland, spanning a distance of approximately 250 km. Regulated rivers typically have flows controlled or supplemented from dams in order to supply irrigation, town and industrial water to for substantial distances downstream (DECCW, 2006).

Land within the study area predominantly comprises areas of historic and existing coal mining operations, private freehold land, state-owned corporation land (i.e. Hunter Water Corporation) and areas of public road. Land within and surrounding the study area has been subject to extensive vegetation clearing associated with mining, commercial and residential development and agricultural activities.

The zoning on land traversed by the Project corridor is predominantly RU2 – Rural Landscape with pockets of environmental zonings including E2 – Environmental Conservation in the lower floodplain areas of Swamp Creek and Wallis Creek (refer to **Figure 4.3**).



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Compressor and Delivery Station
- Pipe Laydown Areas
- Storage Pipeline
- Turkey Nest Dam
- JGN Offtake Facility

Land Use

- 1.1.0 Nature conservation
- 1.3.0 Other minimal use
- 2.1.0 Grazing native vegetation
- 3.2.0 Grazing modified pastures
- 3.4.0 Perennial horticulture
- 3.6.0 Land in transition
- 4.3.0 Irrigated cropping
- 5.2.0 Intensive animal production
- 5.3.0 Manufacturing and industrial
- 5.4.0 Residential and farm infrastructure
- 5.5.0 Services
- 5.6.0 Utilities
- 5.7.0 Transport and communication
- 5.8.0 Mining
- 5.9.0 Waste treatment and disposal
- 6.1.0 Lake
- 6.2.0 Reservoir/dam
- 6.3.0 River
- 6.4.0 Channel/aqueduct
- 6.5.0 Marsh/wetland

FIGURE 4.3

Land Use Map

Image Source: Neamap (August 2021) Data source: NSW LPI (2020;2021); NSW DPIE (2020)

4.5 Geology and Soil Landscapes

A review of NSW DPIE soil profile and soil map information website, 'eSPADE' and the soil landscapes at the site are shown in **Figure 4.4**. A description of the soil landscapes and geology in the vicinity of the Project from 'eSPADE' is provided below:

- 'Beresfield' soil landscape described as undulating low hills and rises on Permian sediments in the East Maitland Hills region with Yellow Podzolic Soils, Brown Podzolic Soils and brown Soloths occurring on crests with Red Podzolic Soils and red Soloths on upper slopes, brown Soloths and yellow Soloths on sideslopes and Yellow Podzolic Soils, yellow Soloths and Gleyed Podzolic Soils on lower slopes.
- Geology: Permian Tomago Coal Measures – shale, mudstone, sandstone, coal, tuff and clay; Permian Mulbring Siltstone – siltstone, claystone, thin sandstone and limestone.
- 'Shamrock Hill' soil landscape described as rolling low hills on Permian sediments in the East Maitland Hills region with Yellow Podzolic Soils and Red Podzolic Soils, some yellow Soloth on midslopes and some Bleached Loams.
- Geology: Permian Tomago Coal Measures – shale, mudstone, sandstone, coal, tuff, clay.
- 'Disturbed Terrain' soil landscape described as land extensively disturbed by human activity, including complete disturbance, removal or burial of soil.
- Geology: includes Quaternary, Tertiary and Permian sediments.
- 'Wallis Creek' soil landscape described as level to gently undulating floodplains on Quaternary alluvium with Alluvial Soils and Siliceous Sands.
- Geology: Quaternary alluvium.
- 'Bolwarra Heights' soil landscape described as rolling low hills on Permian sediments in the East Maitland Hills region with Yellow Podzolic Soils, Red Podzolic Soils and Brown Podzolic Soils and some Lithosols on crests and yellow Soloths on lower slopes.
- Geology: Branxton Formation – sandstone, conglomerate, erratics.
- 'Hunter' soil landscape covering the floodplains of the Hunter River and its tributaries with soils including Brown Clays, Black Earths, Chernozems, Alluvial Soils, Red Podzolic Soils, Lateritic Podzolic Soils.
- Geology: Quaternary alluvium.
- 'Neath' soil landscape described as undulating low rises and swamps to the east of Cessnock on Branxton Formation with the main soils Grey Solodic Soils and Yellow Solodic Soils.
- Geology: Branxton Formation - Sandstone, mudstone, siltstone, shale, tuff, coal, conglomerate and limestone.
- 'Branxton' soil landscape described as undulating low hills and rises and creek flats with Yellow Podzolic Soils on midslopes, Red Podzolic Soils on crests, Yellow Soloths on lower slopes and in drainage lines, and Alluvial Soils in some creeks with Siliceous Sands on flats.
- Geology: Farley, Rutherford and Branxton Formations - Sandstone, mudstone, siltstone, shale, tuff, coal, conglomerate and limestone.

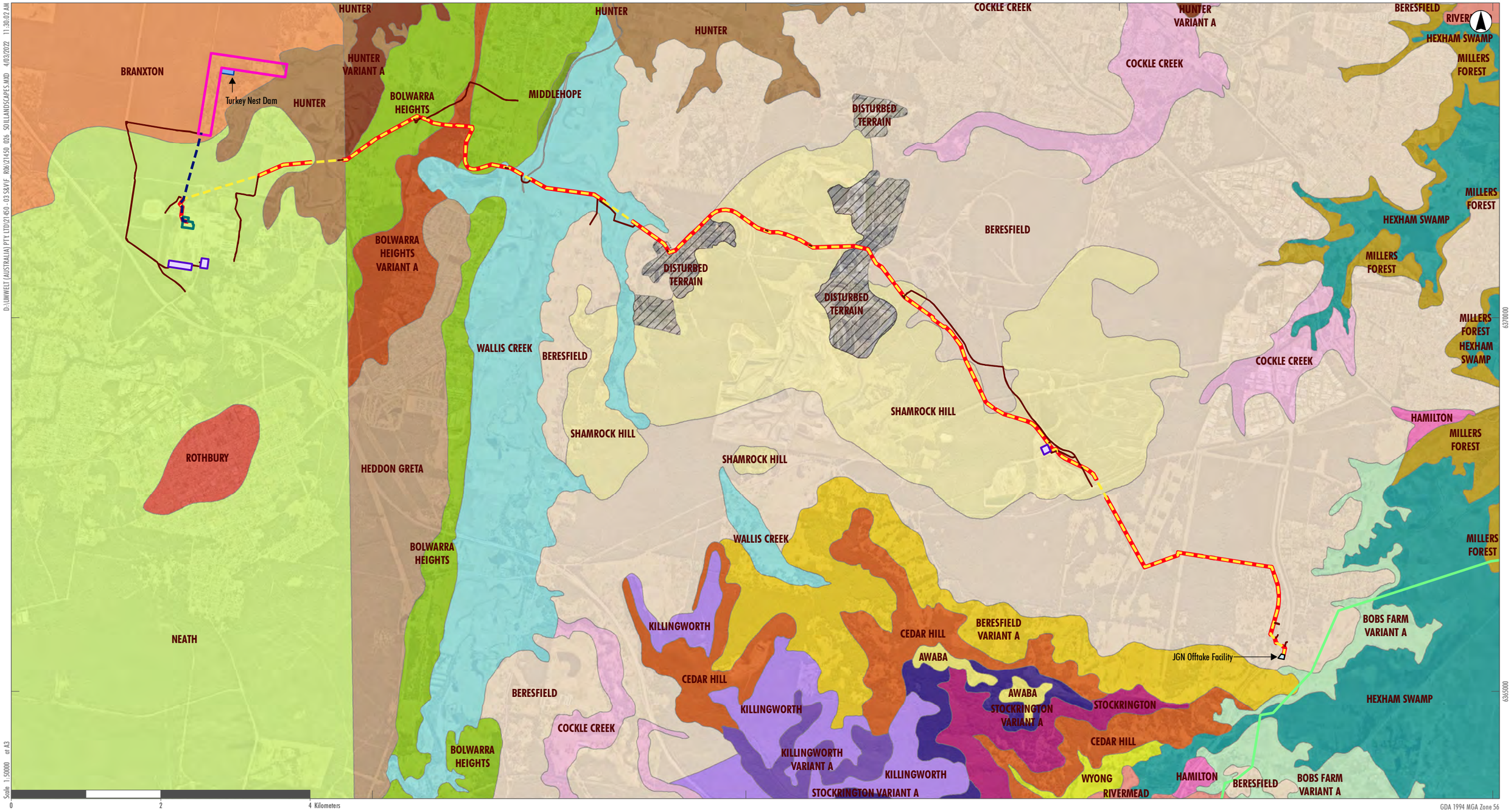
4.6 Acid Sulfate Soils

Acid Sulfate Soils (ASS) is mapped to be present along the Project area at Black Waterholes Creek, Swamp Creek, Wallis Creek and Buttai Creek according to probability mapping (DPIE, 2021) as shown in **Figure 4.5**. These areas are classed as High Risk of ASS occurring between 1 and 4 m below ground surface.

A sampling program was undertaken as part of the *Preliminary Site (Contamination) Assessment* (RCA, 2022) to assess potential for acid sulphate soils at eight locations as shown on **Figure 4.5**: seven on the transmission pipeline alignment where it traverses the Wallis Creek floodplain and adjacent to Swamp Creek, and one at the north eastern extremity of the storage pipeline construction footprint adjacent to Wentworth Swamp. Actual or potential acid sulfate soils were identified at the following locations within the Project area (refer to **Figure 4.5**):

- Potential acid sulfate soils were identified at 2.4 to 2.5 m depth at the storage pipeline construction footprint sampling location (BH1)
- Actual acid sulfate soil was identified from 1.4m depth at the proposed HDD pad immediately east of Wallis Creek (BH5).

Sampling at all other locations did not locate either actual or potential acid sulfate soil.



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Sydney to Newcastle Pipeline (JGN Northern Trunk)
- Compressor and Delivery Station
- Pipe Laydown Areas
- Storage Pipeline
- Turkey Nest Dam
- JGN Offtake Facility
- Access Tracks

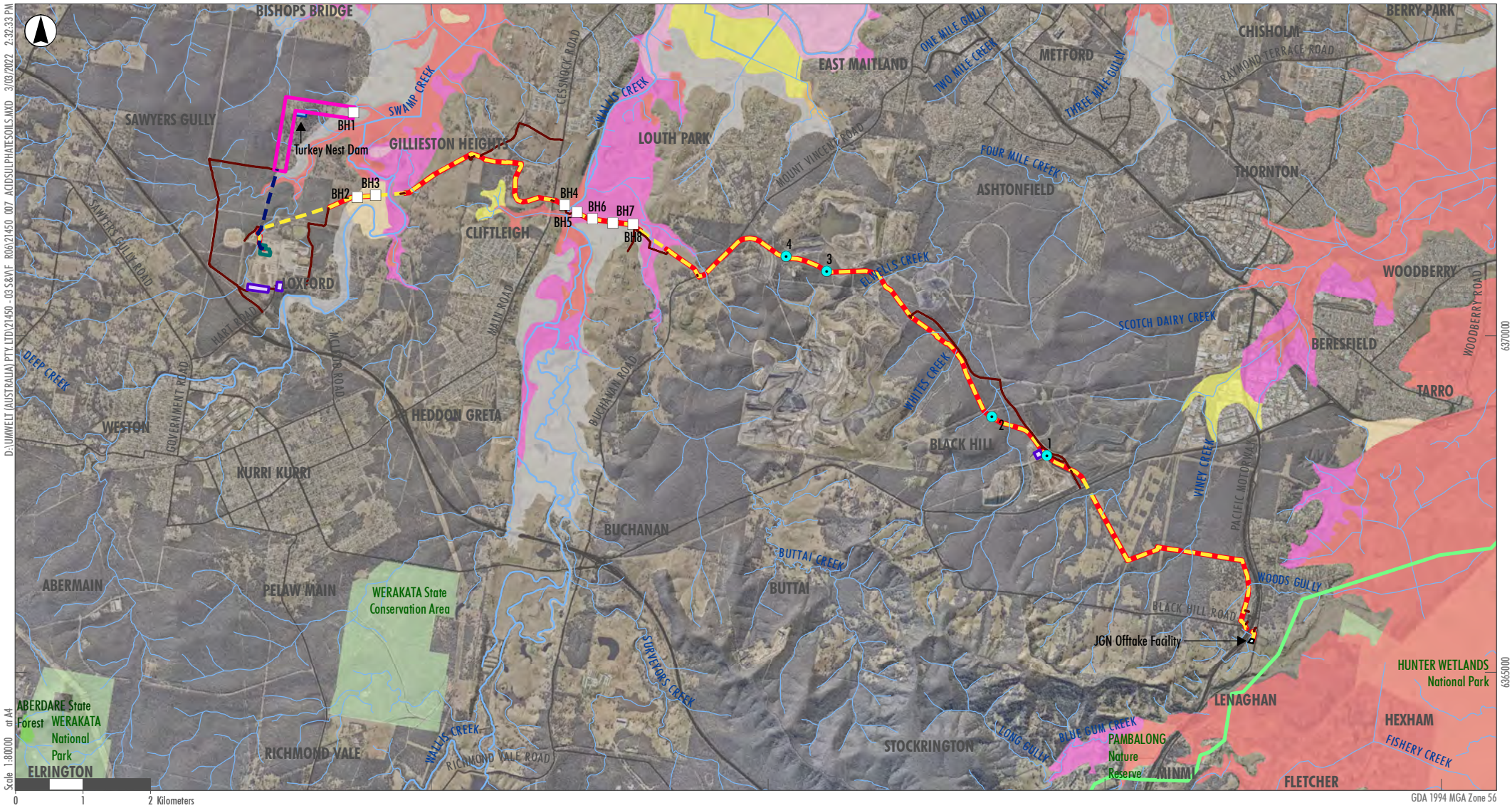
Soil Landscape

- Awaba
- Beresfield
- Beresfield variant a
- Bobs Farm variant a
- Bolwarra Heights
- Bolwarra Heights variant a
- Branxton
- Cedar Hill
- Cockle Creek
- Disturbed Terrain
- Hamilton
- Heddon Greta
- Hexham Swamp
- Hunter
- Hunter variant a
- Killingworth
- Killingworth variant a
- Middlehope
- Millers Forest
- Neath
- Rivermead
- Rothbury
- Shamrock Hill
- Stockrington
- Stockrington variant a
- Wallis Creek
- Wyong

FIGURE 4.4

Soil Landscapes

Image Source: Nearmap (Aug 2021) Data source: NSW DPIE (2020); Umwelt (2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Sydney to Newcastle Pipeline (JGN Northern Trunk)
- Compressor and Delivery Station
- Pipe Laydown Areas
- Storage Pipeline
- Turkey Nest Dam
- JGN Offtake Facility
- NSW Conservation Estates
- State Forest
- Access Tracks
- Roads
- Watercourses

Acid Sulfate Soil Risk

- High Risk 1-2m
- High Risk 2-4m
- High Risk above 4m
- Low Risk 1-2m
- Low Risk 2-4m
- Low Risk above 4m
- Low Risk Sediments
- No Risk

Sample Type

- ASS Sample
- Lead

FIGURE 4.5

Acid Sulphate Soils

Image Source: Neamap (August 2021) Data source: NSW LPI (2020;2021)

4.7 Groundwater

The hydrogeology underlying the Study Area is understood to comprise of two groundwater systems: an upper aquifer within alluvium and a lower aquifer of sedimentary rocks (BoM, 2021).

WaterNSW registered groundwater monitoring bores located in the vicinity of the Project (**Figure 4.6**) do not have recorded water level data available, however sampling from previous studies has shown that groundwater depths are shallow in the area between Buttai Creek and Wallis Creek (less than 1.7 m below surface level, but deeper across the majority of the Project area (up to 8.0 m below surface level in the vicinity of the Hunter Power Project, and up to 34.58 m below surface level within the Donaldson and Abel Mines).

A geotechnical engineer undertook fieldwork in the vicinity of Wallis for the assessment of groundwater and showed that shallow groundwater levels are expected at Swamp Creek (at a depth of 1.4 m below surface level) and Wallis Creek (between 0.9 and 2.1 m below surface level) (RCA, 2022).

A bore census was undertaken in November 2020 by Jacobs as part of the *Hunter Power Project EIS – Groundwater Assessment* (Jacobs, 2021) and the bores in the vicinity of the Hunter Power Plant had groundwater levels ranging from approximately 1.0 to 8.0 m bgl.

Geotechnical investigations undertaken for the HPP found groundwater at depths between 2.5 and 3.3 m bgl at the compressor station and delivery station locations (Jacobs, 2021).

4.8 Groundwater Dependent Ecosystems (GDEs)

Groundwater dependent ecosystems (GDEs) require access to groundwater on a permanent or intermittent basis to maintain their communities of flora and fauna, ecological and ecosystem processes. There are three types of GDEs based on the type of groundwater reliance. These are:

- Aquatic GDEs dependent on surface expression of groundwater and includes surface water systems which may have a groundwater component (i.e. groundwater fed wetlands or river baseflow ecosystems).
- Terrestrial GDEs dependent on subsurface expression of groundwater (i.e. terrestrial and riparian vegetation).
- Subterranean GDEs dependent on subterranean presence of groundwater (i.e. karst and cave ecosystems).

Assessment of the potential for the construction footprint to support GDEs was assessed using the BoM Groundwater Dependent Ecosystems Atlas and Statewide GDE mapping (BoM, 2022). GDE Atlas mapping is from two broad sources:

- National scale assessment based on a set of rules that describe potential for groundwater/ecosystem interaction from available GIS data, and
- Regional scale assessment which includes studies undertaken by States and/or regional agencies using approaches including fieldwork, satellite imagery analysis and application of conceptual models

The identification of potential GDEs in the Atlas does not necessarily confirm that a particular ecosystem is groundwater dependent.

No aquatic or subterranean GDEs are identified by the GDE Atlas within the Project construction footprint.

Potential terrestrial GDEs are identified in the Project construction footprint by the GDE Atlas, from regional assessments. The potential GDEs comprise eight Plant Community Types (PCTs), which could rely upon the subsurface expression of groundwater to support the vegetation community.

- PCT 1568 – moderate potential; Inflow Dependent Ecosystem (IDE) Score 10 (likelihood score between 1 (low) and 10 (high))
- PCT 1590 – moderate-low potential; IDE Score 4-6
- PCT 1592 – low potential; IDE Score 6
- PCT 1594 – moderate potential; IDE Score 8-10
- PCT 1598 – moderate-low; IDE Score 3-6
- PCT 1600 – low potential GDE; IDE Score 10
- PCT 1633 – low potential GDE; IDE Score 5-7
- PCT 1736 – high potential GDE; IDE Score 5-10

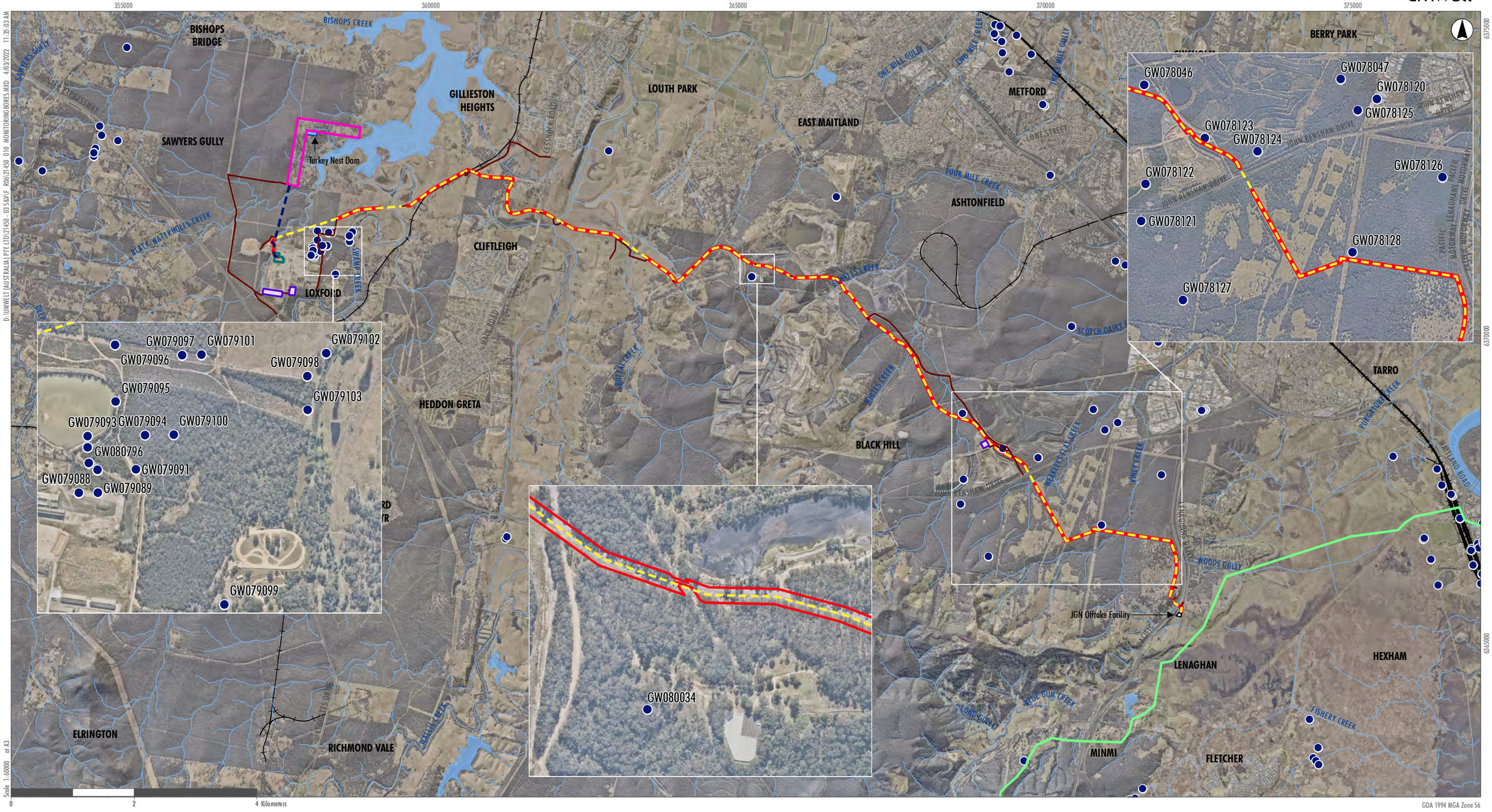
Figure 4.7 shows the location of potential GDEs within the study area. The GDE Atlas shows only one high probability GDE, being PCT 1736 Water Couch - Tall Spike Rush freshwater wetland of the Central Coast and lower Hunter, occurring within the construction footprint. This GDE predominantly occurs directly adjacent to Wallis Creek and Buttai Creek.

The Biodiversity Development Assessment Report (BDAR) prepared by Umwelt 2022 includes a detailed assessment of impacts to GDEs.

4.9 Water Sharing Plan

The Project is located with the Wallis Creek and Hunter River Tidal Pool Water Sources of the Water Sharing Plan (WSP) for the *Hunter Unregulated and Alluvial Water Sources 2009.*

The WSP for the *Hunter Unregulated and Alluvial Water Sources* declares the amount of water available for abstraction annually, and defines the sharing objectives and guidelines to ensure water sources are appropriately managed to ensure equitable sharing between users. Water extraction must be authorised under a water access license while basic landholder rights of owners, or occupiers, of land are protected.



Scale 1:60000 at A3

0 2 4 Kilometers

GDA 1994 MGA Zone 56

Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Sydney to Newcastle Pipeline (JGN Northern Trunk)
- Groundwater Monitoring Bores
- Compressor and Delivery Station
- Pipe Laydown Areas
- Storage Pipeline
- Turkey Nest Dam
- JGN Offtake Facility
- Access Tracks
- Railway
- Roads
- Watercourses

FIGURE 4.6

Monitoring Bore Locations

Image Source: ESRI Basemap (2021) Data source: NSW DFSI (2020); Umwelt (2021)

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BISHOPS BRIDGE
BISHOPS CREEK
SAWYERS GULLY
HUNTER EXPRESSWAY
GILLIESTON HEIGHTS
CESSNOCK ROAD
LOUTH PARK
EAST MAITLAND
ONE MILE GULLY
TWO MILE CREEK
NEW ENGLAND MOTORWAY
FIELDSEND STREET
METFORD
THREE MILE GULLY
LOWE STREET
CHISHOLM
BERRY PARK
RAYMOND TERRACE ROAD
MILLERS FOREST
SAWYERS GULLY
Turkey Nest Dam
FOUR MILE CREEK
ASHTONFIELD
THORNTON
THORNTON ROAD
MAIN NORTHERN RAILWAY
WOODBERRY
BLACK WATERHOLES CREEK
SWAMP CREEK
CLIFTLEIGH
LOXFORD
DEEP CREEK
HART ROAD
MCLOOD ROAD
MAIN ROAD
BUTTAI CREEK
EWELLS CREEK
SCOTCH DAIRY CREEK
BERESFIELD
TARRO
PURGATORY CREEK
MITCHELL AVENUE
PRIVATE RAILWAY
WESTON
HEDDON GRETA
KURRI KURRI
FIRST STREET
KANG STREET
BLACK HILL
WHITES CREEK
WEAKLEYS FLAT CREEK
VINEY CREEK
JOHN RENSHAW DRIVE
KENNIBURN DRIVE
STANFORD MERTHYR
BUCHANAN
WOODS GULLY
ABERMAIN
PELAW MAIN
RICHMOND VALE RAILWAY
GEORGE BOOTH DRIVE
BUTTAI
JGN Offtake Facility
PACIFIC HIGHWAY
HEXHAM
LENAGHAN
LONG GULLY
BLUE GUM CREEK
FISHERY CREEK
ELRINGTON
LEGGETTS DRIVE
WALLIS CREEK
RICHMOND VALE
STOCKRINGTON
SURVEYORS CREEK
MINMI
FLETCHER

Scale 1:60000 at A3

0 2 4 Kilometers

GDA 1994 MGA Zone 56

Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Sydney to Newcastle Pipeline (JGN Northern Trunk)
- Compressor and Delivery Station
- Pipe Laydown Areas
- Storage Pipeline
- Turkey Nest Dam
- JGN Offtake Facility
- Access Tracks
- Roads
- Railway
- Watercourses

Terrestrial GDEs

- High potential GDE - from regional studies
- Moderate potential GDE - from regional studies
- Low potential GDE - from regional studies

FIGURE 4.7

Groundwater Dependent Ecosystems (GDE)

Image Source: ESRI Basemap (2021) Data source: Bureau of Meteorology (2017); Umwelt (2021)

4.10 Existing Water Quality

At the time of this assessment, available water quality data for waterways within the study area was limited. Water quality data was obtained for the former Kurri Kurri aluminium smelter and mining areas as follows:

- Hydro Aluminium data for 2015-2017 provided in the HPP EIS – Surface water Quality and Aquatic Ecology Report (Jacobs, 2021)
- Abel Mine data for 2009-2021
- Donaldson Mine data for 2009-2021.

The data has been analysed and the median value for each parameter has been presented in **Table 4.2**, **Table 4.3** and **Table 4.4**. Results outside the recommended guidelines are highlighted in amber.

Table 4.2 Median Water Quality Data (Source: Hydro Aluminium, 2015 – 2017)

Parameter	Unit	Default Guideline Value (ANZG, 2018)	Tributary of Black Waterholes Creek		Black Waterholes Creek		Swamp Creek	
			Site 1[1]	SW1[2]	Site 9[1]	SW2[2]	Site 62[1]	SW3[2]
pH		6.5 – 8.5	7.4	6.7	6.7	5.9	7.6	6.7
Turbidity	NTU	6 – 50	-	18.0	-	38.6	-	**370**
Dissolved Oxygen	% saturation	85 - 110	-	**76.9**	-	**37.6**	-	**79.4**
Electrical conductivity	µS/cm	125 – 2200	1600	790	1500	1313	1250	858
Total Nitrogen	mg/L	0.35	-	**1.3**		**2.4**		**2.4**
Total Phosphorus	mg/L	0.025	-	0.2	-	**0.28**	-	**0.49**
Filterable Reactive Phosphorus	mg/L	0.020	-	**0.06**	-	<0.01	-	<0.01
Calcium	mg/L	1000[3]	-	16	-	10	-	19
Fluoride	mg/L	1.5[4]	**4.2**	**1.7**	**1.9**	**2.1**	0.85	0.8
Chloride	mg/L	250		191		**422**		148
Aluminium	mg/L	0.055		0.001		**0.34**		0.27
Arsenic	mg/L	0.024	-	<0.0001	-	<0.0001	-	<0.0001
Boron	mg/L	0.37	-	<0.05	-	<0.05	-	<0.05
Cadmium	mg/L	0.00006	-	<0.001	-	<0.001	-	<0.001
Chromium	mg/L	0.001	-	<0.001	-	<0.001	-	<0.001

Note:
[1] Sample sites from the Hydro Aluminium surface water monitoring programs (2015 – 2017).
[2] Project-specific grab sample sites collected by Jacobs in November 2020.
[3] DDGVs for primary industry (livestock drinking water) (ANZECC/ARMCANZ, 2000).
[4] DVGs for recreational water quality (NMHRC, 2008)

Table 4.3 Median Water Quality Data – Abel Mine (23 April 2009 to 17 November 2021)

Parameter	Unit	Default Guideline Value (ANZG, 2018)	Abel Mine			
			Site 1	Site 8	Site 10	Site 11
pH		6.5 – 8.5	6.98	6.94	7.23	7.07
Electrical conductivity	µS/cm	125 – 2200	499	499	1150	673
Total Suspended Solids (TSS)	mg/L	-	16.5	10	12	16.5

Table 4.4 Median Water Quality Data – Donaldson Mine (21 April 2009 to 19 November 2021)

Parameter	Unit	Default Guideline Value (ANZG, 2018)	Donaldson Mine					
			FMCU	FMCD	SDCU	SDCD	WFCU	WFCD
pH		6.5 – 8.5	7.03	7.43	**6.32**	6.13	7.26	6.69
Electrical conductivity	µS/cm	125 – 2200	289	173.2	236	195.7	220.2	287
Total Suspended Solids (TSS)	mg/L	-	13.5	10	24	24	12	38

4.11 Existing Flood Conditions

The 1% AEP flood depths for existing conditions are shown in **Figure 4.8** with the peak 1% AEP flood hazard across the Study area shown in **Figure 4.9**.

The greater extent of flood inundation across the Study area is associated with the watercourses in the west such as Buttai Creek, Wallis Creek, Swamp-Fishery Creek and Bishops Creek. These watercourses have significantly greater contributing catchment areas than the eastern watercourses. The greatest width of continuous inundation at the 1% AEP level is at the Buttai Creek – Wallis Creek floodplain crossing, where the Study area traverses approximately 2,050 m of inundated floodplain. Swamp-Fishery Creek is located at a narrower section of inundated floodplain just upstream of the broader Wentworth Swamp water body.

Typical peak flood velocity within the watercourses is in the range of 1-2 m/s, with typically lower flood velocity on the floodplain area beyond the riparian corridor. In the lower floodplain areas of Buttai Creek, Wallis Creek, Swamp-Fishery Creek and Bishops Creek flood velocities are typically lower associated with the broader extent of flooding and higher flood depths.

The majority of flood inundation in the eastern section of the Study area is typically confined within narrow extents along the minor watercourse alignments. This may be expected given the relatively steep topography for these streams, generally located in the upper reaches of the catchment.

355000 360000 365000 370000 375000

6375000

6370000

6365000

BISHOPS BRIDGE
GILLIESTON HEIGHTS
EAST MAITLAND
METFORD
CHISHOLM
BERRY PARK
MILLERS FOREST
SAWYERS GULLY
Turkey Nest Dam
LOUTH PARK
ASHTONFIELD
THORNTON
CLIFTLEIGH
WOODBERRY
LOXFORD
BERESFIELD
TARRO
HEDDON GRETA
WESTON
KURRI KURRI
BLACK HILL
STANFORD MERTHYR
BUCHANAN
ABERMAIN
BUTTAI
PELAW MAIN
JGN Offtake Facility
LENAGHAN
HEXHAM
STOCKRINGTON
ELRINGTON
RICHMOND VALE
MINMI
FLETCHER

Scale 1:60000 at A3

0 2 4 Kilometers

GDA 1994 MGA Zone 56

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Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Sydney to Newcastle Pipeline (JGN Northern Trunk)
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Umwelt Model Domain
- Compressor and Delivery Station
- Pipe Laydown Areas
- Storage Pipeline
- Turkey Nest Dam
- JGN Offtake Facility
- Access Tracks

Water Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

FIGURE 4.8

1% AEP Flood Depths for Existing Conditions

Image Source: Nearmap (Aug 2021) Data source: WMAwater (2019), Umwelt (2021

355000 360000 365000 370000 375000

6375000

6370000

6365000

BISHOPS BRIDGE
GILLIESTON HEIGHTS
EAST MAITLAND
METFORD
CHISHOLM
BERRY PARK
MILLERS FOREST
SAWYERS GULLY
Turkey Nest Dam
LOUTH PARK
ASHTONFIELD
THORNTON
CLIFTLEIGH
WOODBERRY
LOXFORD
BERESFIELD
TARRO
HEDDON GRETA
WESTON
KURRI KURRI
BLACK HILL
STANFORD MERTHYR
BUCHANAN
ABERMAIN
BUTTAI
PELAW MAIN
JGN Offtake Facility
LENAGHAN
HEXHAM
STOCKRINGTON
ELRINGTON
RICHMOND VALE
MINMI
FLETCHER

Scale 1:60000 at A3

0 2 4 Kilometers

GDA 1994 MGA Zone 56

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Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Sydney to Newcastle Pipeline (JGN Northern Trunk)
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Compressor and Delivery Station
- Pipe Laydown Areas
- Storage Pipeline
- Turkey Nest Dam
- JGN Offtake Facility
- Access Tracks

Water Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0- 2.0
- 2.0 - 3.0
- > 3.0

FIGURE 4.9

1% AEP Flood Velocities for Existing Conditions

Image Source: Nearmap (Aug 2021) Data source: WMAwater (2019), Umwelt (2021

4.12 Environmental Values and Water Quality Objectives

The NSW Water Quality Objectives (WQOs) have been developed to guide plans and actions to achieve healthy waterways. The WQOs are based on measurable environmental values (EVs) for protecting aquatic ecosystems, recreation, visual amenity, drinking water and agricultural water.

Based on the likely construction activities and operations at the Project and the environmental values listed above, the water quality objectives presented in **Table 4.5** are considered relevant to the Project.

Refer to **Appendix C** for full descriptions of the Hunter River WQOs and River Flow Objectives.

Table 4.5 Project Relevant Water Quality Objectives

Parameter	Units	Value/Range
pH	-	6.5 to 8.0
Salinity (Electrical conductivity)	µS/cm	30 to 350
Turbidity	NTU	2 to 25
Total Phosphorus	µg/L	20
Total Nitrogen	µg/L	250
Visual clarity and colour	-	Natural visual clarity should not be reduced by more than 20%. Natural hue of the water should not be changed by more than 10 points on the Munsell Scale. The natural reflectance of the water should not be changed by more than 50%.
Surface films and debris	-	Oils and petrochemicals should not be noticeable as a visible film on the water, nor should they be detectable by odour. Waters should be free from floating debris and litter.

5.0 Assessment of Potential Impacts

There are several watercourses within the Study area that will be intersected by the construction works, as identified in **Figure 4.1** and **Table 4.1**.

The transmission pipeline alignment will cross 16 watercourses and the storage pipeline will cross four watercourses, as detailed in **Section 4.1**.

Watercourse crossings will be constructed by open cut trenching or HDD depending upon the geomorphic and environmental characteristics and sensitivity of the watercourses, and geotechnical conditions. HDD is proposed for crossings of the following six watercourses:

- KP4.2, Weakleys Flat Creek, as part of the HDD of John Renshaw Drive
- KP12.9, Buttai Creek
- KP14.2, Wallis Creek
- KP17.8, Swamp Creek
- KP 18.7, an unnamed tributary of Black Waterholes Creek
- DN350 interconnect pipeline between the compressor station and the storage pipeline, Black Waterholes Creek.

Open trenching is proposed for all other watercourses however watercourses with steep banks will be characterised as special crossings and specific construction techniques applied. The remaining ephemeral watercourses will typically be crossed using open cut trenching using standard pipeline construction methods. The proposed trenching for the transmission line is limited to an anticipated maximum depth of 1.95 m below the natural surface, and the proposed trenching for the storage pipeline is excavated to a depth of approximately 2.1 m.

The principal water resources related impacts are expected during construction of the Project and are associated with surface water quality risks, mainly at the intersection of the construction works with watercourses and a general risk of erosion as a result of disturbed or exposed soils. These risks are discussed below and mitigation measures are summarised in **Section 6.0**.

There is also the potential for impacts associated with the use of water in the hydrostatic testing of the transmission and storage pipelines. This is discussed in **Section 5.3**.

5.1 Surface Water Quality Impacts

5.1.1 Construction

Construction activities have the potential to impact the surface water quality of watercourses within the Study and result in soil erosion and sedimentation in downstream waterways if management measures are not implemented, monitored and maintained. These activities and their associated surface water quality impacts include the following:

- Soil erosion and sedimentation caused by vegetation removal and earthworks (including excavation) which increases sediment load in downstream waterways negatively impacting habitat quality for aquatic life and organisms, and increasing turbidity and decreasing water clarity.

- Disturbance of acid sulfate soils (which are very likely in some sections of the Study Area) caused by earthworks which can lead to significant impacts downstream including adverse effects on downstream aquatic ecosystems and water quality and damage to structures.
- Open trenching of ephemeral watercourses, including establishment of temporary flow diversion techniques such as diversion of flow through a pipe, pumping of water around the construction area or controlling water running into the watercourse from the surrounding catchment by contour banks.
- Movement and use of heavy vehicles resulting in generation of dust generation and increase ground disturbance.
- Potential spills and runoff of "drilling mud" from HDD at creek crossings which can increase sediment load in downstream waterways.
- Release or discharge of water used for hydrostatic testing has the potential to release contaminants or increase erosion. Specifically, if the storage pipeline is internally unlined then mill scale (iron oxide) will be removed from the internal pipeline wall during the hydrotesting process.
- Construction of culvert crossing of Wallis Creek resulting in increased ground disturbance.

While sediment-laden runoff and pollutants have the potential to temporarily reduce the surface water quality of receiving and downstream waterways, it is unlikely to result in major or long-term impacts to the overall condition of these waterways as these activities would be of short duration and managed with the implementation of erosion and sediment controls (as detailed in **Section 6.1**) in addition to other environmental management measures outlined in **Section 6.0**. Erosion and sediment controls and other management measures would be established prior to commencement of construction activities (including vegetation clearing) to avoid and/or manage erosion and sedimentation impacts from construction activities.

As ASS are likely to be encountered during construction works, an acid sulfate management strategy would be prepared and implemented as part of the CEMP in accordance with the Acid Sulfate Soil Manual (ASSMAC, 1998).

Water from hydrotesting will be released onto adjoining land with appropriate slope, soil and groundcover characteristics to minimise erosion and sedimentation. Water release will occur through a dewatering structure designed to slow the flow of water. As the project design assumes that the storage pipeline will be unlined, a turkeys nest dam is proposed adjacent to the storage pipeline construction footprint to provide for water transfer between the storage pipeline test sections and to allow for the storage and management of water containing millscale (iron oxide) at the completion of hydrotesting.

With the implementation of the above measures and additional management measures proposed in **Section 6.1**, the risks to surface water quality during construction of the Project is expected to be minor.

5.1.2 Operation

During operation, the potential for erosion and sedimentation risks would be minimal as there would be no ongoing ground disturbance in operation and all exposed areas would be rehabilitated and landscaped following construction. There will be no water discharged during the operation of the Project.

As outlined in **Section 6.1.3.2**, it is recommended that an operational monitoring program be developed and included in the OEMP for the Project. This program would aim to observe any changes in surface water from operation of the Project and inform appropriate management responses during operation of the Project.

5.2 Groundwater Impacts

5.2.1 Construction

Groundwater is likely to be deep (>5m) for the majority of the Study area, although shallow groundwater levels are expected at Swamp Creek (at a depth of 1.4 m below surface level) and Wallis Creek (between 0.9 and 2.1 m below surface level) (RCA, 2022)/

APA have advised that shallow concrete pad foundations for the JGN offtake facility, compressor station and delivery station are not expected to be deeper than 1.8 m, which will be above known groundwater depths in the vicinity of these sites. Similar to HPP infrastructure, deep piling up to 18 m depths for the heaviest components of the compressor station and delivery station is likely to be required given the presence of alluvial sands beneath the former Kurri Kurri aluminium smelter site. Final method, numbers and depth of foundation piles will be subject to detailed design.

Direct impacts to riparian vegetations are addressed in the Biodiversity report. Impacts to groundwater resources including GDEs and bore users are not expected for most of the construction work within the Study area as the groundwater depths are deep and the groundwater table is unlikely to be intercepted during construction. However, shallow groundwater in the vicinity of Wallis Creek and Swamp Creek increases the risk for groundwater impacts to occur, particularly associated with contamination caused by spills and leaks and potential groundwater table interception from the proposed trench excavations.

A dewatering procedure will be prepared for the Project and incorporated into the CEMP, in the event that ephemeral or temporary groundwater is encountered during construction works. With the implementation of controlled dewatering during construction, and additional management measures proposed in **Section 6.2.1**, the risks to groundwater quality from the Project is expected to be low and unlikely to cause a major or long term impact to groundwater resources including GDEs and bore users. All trenching and backfilling between Buttai Creek and Wallis Creek has been proposed to be completed within three days which will minimize the time for both shallow groundwater influx into the trench and exposure of PASS.

Furthermore, given the typically elevated groundwater salinity and low permeability of the sediments at the Study Area, the alluvial water source is considered locally as a less productive water source based on the NSW Aquifer Interference Policy classification. During the construction phase, the level one minimal impact considerations of the *NSW Aquifer Interference Policy* (Department of Primary Industries, 2012) are met.

5.2.2 Operation

No impacts to groundwater are expected during operation and therefore the Project meets the Level 1 Minimal Impact Considerations for Aquifer Interference Activities of the *NSW Aquifer Interference Policy* (DPIE, 2012).

5.3 Water Supply Impacts

5.3.1 Water Use and Supply

Water will be required during the construction phase. Non-potable water will be required for dust control of the construction ROW and access tracks (with the quantity dependent on conditions and proximity to sensitive receptors), as well as for hydrostatic testing of both pipelines during construction. Water supply will be obtained from a non-potable water service provider or existing landholders with available allocations.

Existing clean water supplies include the dams on the Bloomfield Mine leases, the Stony Pinch and Buttai reservoirs operated by Hunter Water Corporation, reticulated municipal supplies to the former Hydro Aluminium site or local watercourses. All water use would occur under agreements and/or licences/permits with relevant landholders and authorities.

The estimated Project water usage includes:

- Dust control – approximately 110 kL/km for each pipeline, or approximately 5 ML in total
- Hydrotesting - up to 23 ML of non-potable water if water cannot be reused between test sections
- HDD operations for mixing of drilling fluids - approximately 0.146 ML per 100 m of HDD (total HDD length 3,200 m) or approximately 5 ML in total.

The total estimated water volume required for the construction phase of the Project is 33 ML. For context, general security license holders in the Hunter Regulated River currently have 150,719 ML available to use (WaterNSW, 2022).

In the event of construction occurring during severe drought, measures will be employed to avoid increasing demands on local water supplies. Alternative sources of water may include transport from non-drought affected areas, groundwater or other supplies of non-rainfall dependent water.

5.3.2 Water storage

Hydrotesting of the transmission, interconnect and storage pipelines, will require water storages to be constructed near the break point of each hydrotest section. Water storages are likely to be break tanks located on the ROW near the centre of the transmission pipeline, near the compressor station if the existing reticulated water supply to the former Hydro smelter is used as a water source, and a turkeys nest dam located near the centre of the storage pipeline construction footprint. The turkeys nest dam may be retained following construction. The estimated area required for the turkeys nest storage is 1.2 ha.

5.4 Flooding and Hydrology Impacts

5.4.1 Flooding

Potential impacts on flooding regimes are typically related to changes to existing flow distributions and/or loss of temporary flood storage. The Project is expected to have no significant impact on existing flooding given:

- The transmission, interconnect and storage pipelines are buried with surface disturbance reinstated to pre-existing contours
- No permanent surface infrastructure located within the mapped 1% AEP flood inundation extents providing for no obstruction to existing instream and overland flow
- No changes to existing surface topography/ground levels providing for no change to existing flow distribution or loss of flood storage (through floodplain filling).

Accordingly, there would be no changes to flood behaviour affecting existing developments, infrastructure or flood emergency evacuation routes.

During the construction phase, minor earthworks associated with access road construction, temporary waterway crossings and diversions, pipeline construction and trenching, site construction facilities and materials storage have the potential to interact with surface water in the event a flood occurs. Given the scale of potential temporary works in the riparian corridors relative to the broader floodplain at each waterway crossing, impacts of temporary works would be localised to within or in near vicinity of the construction footprint.

The CEMP to be implemented as part of the Project would consider extent and nature of temporary works, including equipment storage, with respect to the flood risk described by the mapped inundation extents, flood depth, velocity and hazard. In addition, the HDD pad on the eastern bank of Wallis Creek is proposed to be relocated outside of the 50% AEP to reduce the risk of flooding impacting on construction works.

5.4.1.1 Consideration of Climate Change

Potential impacts of climate change that may influence flooding conditions include increase in the intensity and frequency of flood producing rainfall and sea level rise which would impact the lower Hunter River estuary. The peak flooding conditions in the watercourses traversed by the pipeline alignment are dominated by fluvial (catchment derived) conditions and accordingly the rainfall intensity increase is the relevant climate change influence for consideration.

Increased flooding risks are to be considered over the expected an operational life of the Project of approximately 30 years. Interim climate change factors for the year 2050 for an upper range projection scenario of anthropogenic greenhouse gas emissions are available from Australian Rainfall and Runoff 2019. This source suggests a nine per cent increase in storm rainfall intensities in the Hunter Region between 2021 and 2050.

Based on a review of information presented in the *Wallis and Swamp-Fishery Creek Flood Study report* (WMAwater, 2019), the 1% AEP flood level within the Wallis and Swamp/Fishery Creek catchment is estimated to increase by approximately 0.2 m with an increase in rainfall intensity of approximately 12-15%, and approximately 0.5m to 1m with an increase in rainfall intensity of 32-36%.

Given that most infrastructure required for the Project is buried and surface infrastructure has been positioned significantly above the 1% AEP flood level, no impacts from changed flood conditions are anticipated.

5.4.2 Hydrology

- Construction of the Project could potentially affect hydrology (frequency, volume, rate, duration and velocity) and increase peak stormwater flows during storm events as a result of the following activities:
- Vegetation clearance and reduced rates of stormwater infiltration associated with further soil compaction and introduction of impervious layers
- Temporary alteration or restriction of existing drainage paths and catchments
- Additional impervious surfaces and formalised drainage

Development of the Study Area could potentially increase peak stormwater flows during storm events due to additional impervious surfaces and formalised drainage.

Given that very minor changes to vegetation cover, impervious surface and drainage channels are proposed relative to the size of the overall catchments, the potential impacts to hydrology as a result of the Project are considered to be negligible.

6.0 Management and Mitigation Measures

6.1 Surface Water Quality

This section outlines the water quality concept strategy recommended for the Project. This concept strategy would be developed during the detailed design stages of the Project.

6.1.1 Construction Phase Water Quality Strategy

Recommended measures to avoid, minimise or manage surface water and aquatic ecosystem impacts as a result of the Project are detailed in **Table 6.1**. The finalised and adopted surface water quality management measures would be outlined in the CEMP and OEMP and would include (but not limited to) preparation of a Construction Soil and Water Management Plan (CSWMP), Erosion and Sediment Control Plans (ESCP), emergency spill response procedures, and additional mitigation measures specific to design of the Project.

Further, it is recommended that the environmental management measures should include a surface water quality monitoring program which would include the collection of baseline data for comparison to construction and operational monitoring data where applicable.

The water quality design criteria for the construction phase are to minimise potential water quality impacts in accordance with measures outlined in *Managing Urban Stormwater, Soils and Construction guidelines, Volume 1* (Landcom, 2004) ('the Blue Book'). As per the Blue Book, the pollutants of concern during the construction process are total suspended solids (TSS), pH and oil and grease.

During construction, erosion and sediment controls are proposed to capture and treat runoff from all disturbed areas of the Study Area before discharging into the receiving waterways.

6.1.2 Acid Sulfate Soils Management Strategy

An acid sulfate management strategy would be prepared and implemented as part of the Construction Environmental Management Plan (CEMP) in accordance with the Acid Sulfate Soil Manual (ASSMAC, 1998).

6.1.3 Recommended Surface Water Quality Monitoring

Surface water monitoring is recommended to observe any changes in surface water quality that may be attributable to the Project and to inform appropriate management responses.

Monitoring would be undertaken in accordance with the following guidelines:

- ANZECC/ARMCANZ (2000) and ANZG (2018) Water Quality Guidelines
- Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (DECC, 2004)
- Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC/ARMCANZ, 2000b).

The following surface water quality monitoring is recommended during construction and operation of the Project.

6.1.3.1 Construction Monitoring

A construction monitoring program is recommended to be developed and included in the CSWMP for the Project to observe any changes in surface water quality during construction and inform appropriate management measures.

Sampling locations and monitoring methodology to be undertaken during construction is recommended to be further developed during the detailed design phase of the Project in accordance with the ANZG (2018) water quality guidelines. It is recommended to include collection of samples for analysis from Swamp Creek, Wallis Creek, Buttai Creek, Four Mile Creek and Viney Creek, visual monitoring of other points of release of construction waters and monitoring upstream and downstream of waterway crossing locations where appropriate.

The monitoring frequency during construction is recommended to be confirmed during detailed design, however, it is recommended to include at least monthly construction monitoring at all monitoring sites which are recommended to be preferentially monitored following wet weather events.

Should the results of monitoring identify that the water quality management measures are not effective in adequately mitigating water quality impacts, additional mitigation measures are recommended to be identified and implemented as required.

Surface water quality monitoring is recommended to include both field parameters and indicators for laboratory analysis. The following indicators are proposed for monitoring:

- Field parameters (electrical conductivity, pH, turbidity, dissolved oxygen and temperature)
- Heavy metals (aluminium, arsenic, boron, cadmium, chromium, copper, lead, mercury, nickel, zinc, iron and manganese)
- Nutrients (including ammonia, oxidised nitrogen, total nitrogen, total phosphorus, filtrable reactive phosphorous (FRP))
- Oil and grease
- Total dissolved solids (TDS)
- Total suspended solids (TSS).

6.1.3.2 Operational Monitoring

An operational monitoring program is recommended to be developed and included in the OEMP for implementation following completion of construction to observe any changes in surface water from operation of the Project and inform appropriate management responses.

The monitoring program is recommended to include:

- In the event of any uncontrolled surface water discharge from the Project, should there be concerns in relation to water quality, a monitoring process would be implemented.
- Visual assessment of downstream waterway condition including the tributary to Black Waterholes Creek and Black Waterholes Creek, Four Miles Creek, Swamp Creek, Buttai Creek, Viney Creek, etc.

6.2 Groundwater

6.2.1 Construction

The following measures are recommended to mitigate and manage identified potential groundwater impacts during construction of the Project:

- Development and implementation of a Construction Environment Management Plan (CEMP) that addresses temporary storage and handling of fuels, oils and chemicals, including a Spill Response Plan.
- Preparation of a Dewatering Procedure to be implemented in the event of excavations encountering ephemeral or temporary groundwater, including shoring advice to minimise groundwater inflows, water quality requirements before discharge, any recommended treatment, discharge location and method, monitoring requirements and permits and records required.
- Excavation activities will implement testing and management procedures for potential acid sulfate soils. The procedures will be set out in an Acid Sulfate Soil management plan, which will be prepared during detailed design.

6.2.2 Operation

The following measures are recommended to mitigate and manage identified potential groundwater impacts during operation of the Project:

- Preparation and implementation of a Spill Response Plan as part of the OEMP that addresses storage and handling of fuels, oils and chemicals, including a Spill Response Plan.

6.3 Hydrology and Flooding

Potential impacts during the construction and operation phase of the Project are recommended to be mitigated and managed through implementation of the following measure:

- Monitoring of the receiving waterways downstream of the pipeline location to identify any evidence of channel erosion and scour. Monitoring is recommended at the following watercourses:
    - Black Waterholes Creek
    - Swamp Creek
    - Wallis Creek
    - Buttai Creek
    - Four Miles Creek
    - Viney Creek.

The mitigation strategies provided in **Table 6.1** are recommended to be articulated in the Construction Environmental Management Plan that will form part of the contractors' contract.

6.4 Summary of Recommended Environmental Safeguards and Management Measures

A summary of the recommended environmental safeguards and management measures is provided below in **Table 6.1**.

Table 6.1 Recommended Environmental Safeguards and Management Measures

Impact	Environmental Management Measure	Timing
Erosion and Sedimentation	A CSWMP will be prepared as a sub-plan of the CEMP for the Project. The plan will outline measures to manage soil and water impacts associated with the construction and commissioning works. The CSWMP will include but not be limited to: • Measures to minimise/manage erosion and sediment transport both within the construction footprint and off-site including requirements for the preparation of ESCP for all stages of construction • Processes for dewatering of construction sediment basins, including relevant discharge criteria • Measures to manage accidental spills including the requirement to maintain materials such as spill kits • Measures to manage any potential Acid Sulphate Soils found in excavated fill material, in accordance with the Acid Sulphate Soil Guidelines • Measures to manage potential tannin leachate • Details of surface water quality monitoring to be undertaken throughout and following construction (refer to **Section 7.1**).	Preconstruction, Construction
	A Construction ESCP would be developed as a sub plan of the CEMP and would detail the erosion and sediment control measures to be implemented at the Study Area in accordance with the principles and requirements of *Managing Urban Stormwater – Soils and Construction, Volume 1* (Landcom, 2004), commonly referred to as the "Blue Book". The Construction ESCP would include but not be limited to: • Plans for temporary drainage, scour protection and control measures to reduce erosion and water quality impacts from increased sediment loads from the construction site. The ESCP would identify locations of the proposed construction sediment basin • Dust suppression to enable no downstream sedimentation or air quality impacts to occur.	
Construction – Spills and litter	Study Area specific controls and procedures would be developed and implemented as part of the CSWMP to reduce the risk of litter and spills and leaks entering downstream waterways. The CSWMP would include (but not be limited to) the following measures: • All fuels, chemicals and liquids would be stored on level ground at least 20 m away from waterways (including existing stormwater drainage systems) and would be stored in a sealed bunded area within the construction site • An emergency spill response procedure would be prepared as part of the CSWMP • Regular visual water quality checks (for hydrocarbon spills/slicks, turbid plumes and other water quality issues) will be carried out at waterways in proximity to works (particularly tributary of Black Waterholes Creek) • Installing and maintaining control measures such as silt fencing and gross pollutant traps, etc.	Preconstruction, Construction

Impact	Environmental Management Measure	Timing
Concrete works	To avoid ingress of concrete waste material into downstream waterways, the CEMP would outline procedures to capture, contain and appropriately dispose of any concrete waste from concrete works.	Preconstruction, Construction
Operation – Spills and leaks	Site specific controls and procedures would be developed and implemented as part of the OEMP to reduce the risk of litter off-site and spills and leaks entering downstream waterways. The OEMP would include (but not be limited to) the following measures: • An emergency spill response procedure • Bunding requirements (already part of the Project design) for process areas in accordance with AS1940 • A surface water monitoring program including regular visual water quality checks (for hydrocarbon spills/slicks, and other water quality parameters) will be carried out at waterways in proximity to the Project (refer to **Section 7.1** for further detail).	Operation
Erosion Control	Runoff management measures to be established where the pipeline traverses or is adjacent to a road or track. Erosion control measures and rehabilitation and landscaping works to be undertaken at above ground facilities. Clearing and grading activities scheduled to ensure the period of time between the initial clearing and respreading of topsoil (reestablishment) is minimised. Grubbing (removal of stumps) is to be minimised and voids left by large stumps are to be backfilled. Temporary and more permanent erosion control banks, drains and sediment collection devises shall be installed (or re-instated if current) across slopes and in the vicinity of drainage lines as necessary. Backfilling of the trench is to be higher than the adjacent ground (maximum 0.1 m crown) to allow for subsequent settlement.	
Watercourse crossings	Watercourses only to be traversed by trenching if the bed is dry. Work is not to be undertaken in wet weather. Vehicle access to the river bed is to be confined to the easement. Trenching of a water course bank is to start at the top of the slope and work downwards. Temporary bunding, silt fencing and sediment dam installation are to be constructed if required. Watercourse walls are to be re-established to a stable slope consistent with the 'natural' slope. Shaping should remove irregularities that would interfere with flows. Where the watercourse has a surface layer of coarse material (Rocks, pebbles, gravel) care should be taken to restore this surface layer. Rock armouring of the bed and base of the wall is to be undertaken.	

7.0 Conclusion

This Surface Water and Hydrology Assessment has reviewed information and data to understand the potential impacts of the Project relating to the following within the Study area:

- Surface water quality
- Groundwater
- Hydrology and flooding

The potential impacts associated with the construction and operation can be appropriately managed through implementation of a range of conventional mitigation measures. The impact assessments are summarised in the sections below:

7.1 Surface Water Quality Assessment

The surface water quality assessment for the construction and operation of the Project has been prepared based on a review and analysis of available water quality data, aerial photography, topography, database searches, relevant literature, background reports, applicable legislation, policies and guidelines.

It was determined that the most important potential impacts during construction are mobilisation of sediment and contaminants to downstream receiving environments by wind or stormwater runoff and subsequent indirect impacts on aquatic ecosystems. During construction, the following potential impacts were identified:

- Erosion of soils and sedimentation of waterways
- Reduced water quality from elevated turbidity, increased nutrients and other contaminants
- Smothering of aquatic organisms from increased sediments and associated low dissolved oxygen levels
- Potential increased occurrence of algal blooms associated with reduced water quality
- Migration of litter off-site
- Contamination accidental leaks or spills of chemicals and fuels.

These potential impacts are considered unlikely and/or temporary and would be managed through the implementation of proposed erosion and sediment controls and other identified management measures. A surface water quality monitoring plan has been recommended for implementation during construction and operation of the Project to monitor water quality and confirm that controls are working effectively. During operation, there is not expected to be any impacts to water quality.

The assessment concludes that impacts to the surface water quality downstream of the Project are expected to be minor provided that appropriate mitigation measures are implemented, and therefore, the water quality objectives would be met and aquatic ecosystems maintained.

7.2 Groundwater Assessment

The groundwater impact assessment included a desktop study of existing hydrogeological conditions at the Study Area including review of:

- relevant previous investigations
- identification of aquifers, depth to groundwater, groundwater quality and groundwater flow directions
- identification of existing groundwater users, groundwater dependent ecosystems and groundwater-surface water interaction.
- potential dewatering requirements and associated drawdown impacts due to construction dewatering and any proposed ongoing water take associated with the project.

Review of groundwater levels indicates that the majority of proposed excavations are unlikely to intercept the groundwater table however shallow groundwater depths in the vicinity of Wallis Creek and Swamp Creek are expected. There is a risk of groundwater impacts of contamination caused by spills and leaks and potential groundwater table interception from the proposed excavations in this area.

Where intersection of the groundwater table is expected, dewatering is not anticipated to be required due to the limited depth of excavation below the water table as well as the generally low permeability of the underlying alluvium and any resulting groundwater drawdown would be very shallow and localised. No impacts are anticipated for other groundwater users or environmental values and the level one minimal impact considerations of the *NSW Aquifer Interference Policy* (Department of Primary Industries, 2012) are met. During the operational phase, no significant groundwater impacts are anticipated and as such the Project meets the level one minimal impact considerations of the NSW Aquifer Interference Policy.

Recommendations made to mitigate and manage identified potential groundwater impacts during construction and operation of the Project including a range of soil and water related management plans.

7.3 Hydrology and Flooding Assessment

The flood risk assessment conducted in this study assessed the flood behaviour for both the existing and Climate Change conditions. The 10%, 1%, 0.5% and 0.2% Annual Exceedance Probability, and Probable Maximum Flood were assessed using flood depth, velocity, and hazard levels. The majority of flood inundation in the eastern section of the pipeline alignment is typically confined within narrow extents along the minor watercourse alignments. The greater extent of flood inundation is typically associated with the more significant watercourses in the western section of the alignment which includes Buttai Creek, Wallis Creek, Swamp-Fishery Creek and Bishops Creek. The storage pipeline is predominantly located outside the 1% AEP inundation extents.

Minimum changes to the land topography, impervious fraction and therefore runoff and groundwater infiltration are expected due to the nature of the Project. With the preparation of the Project CEMP and OEMP (to be approved prior to construction/operation commencement), the Project is not likely to have any major residual impacts on hydrology or flooding.

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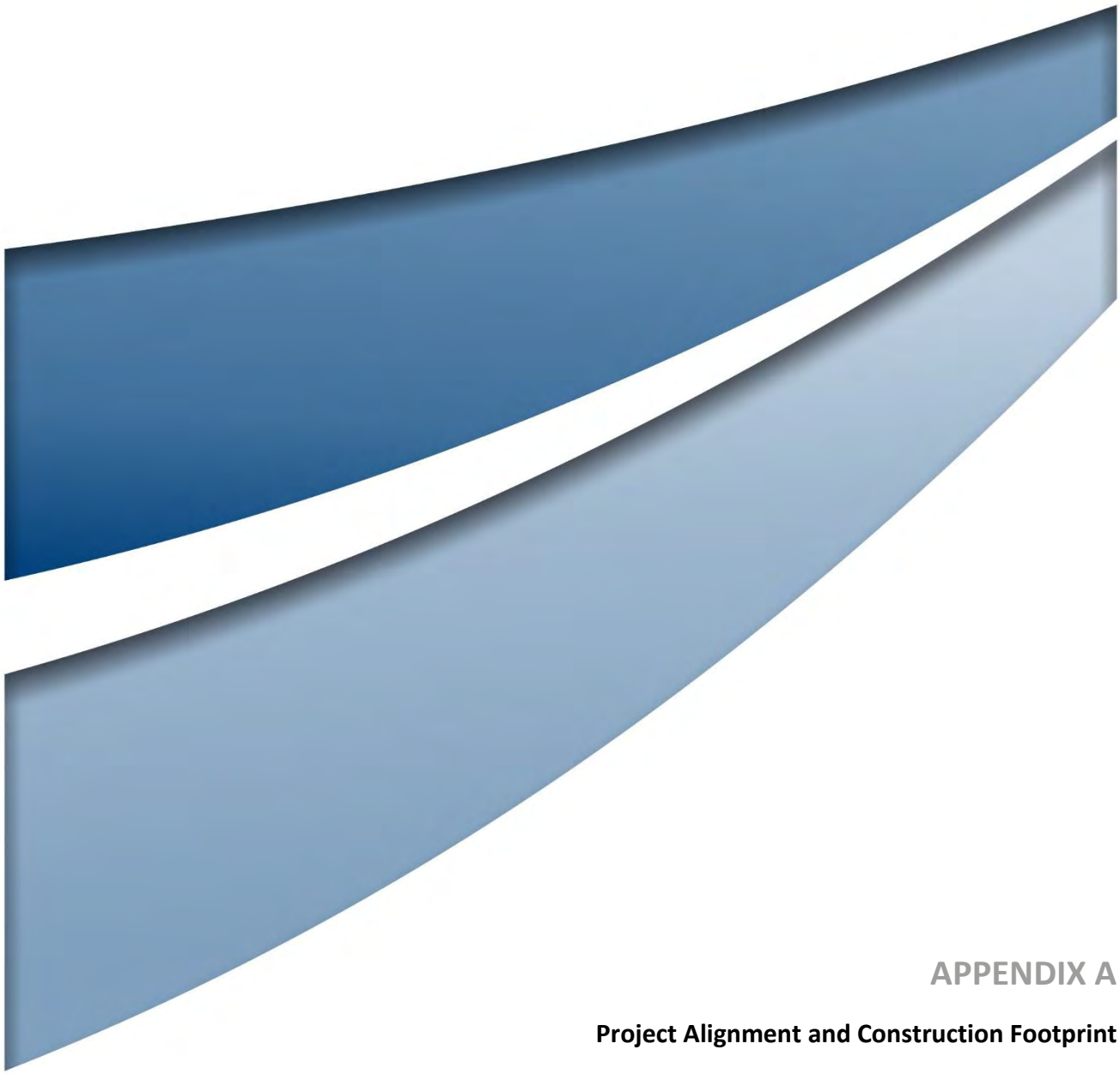
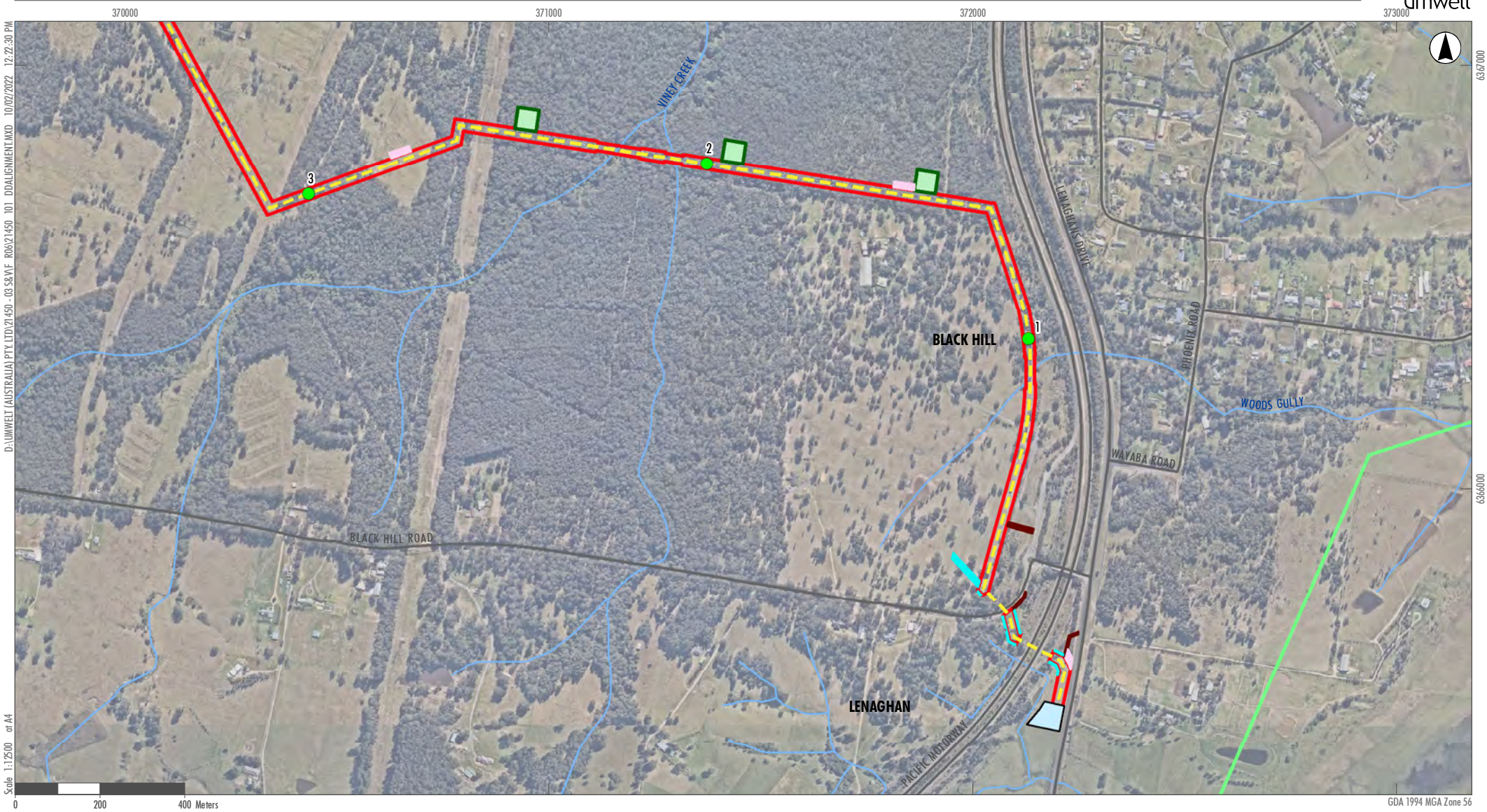


APPENDIX A

Project Alignment and Construction Footprint



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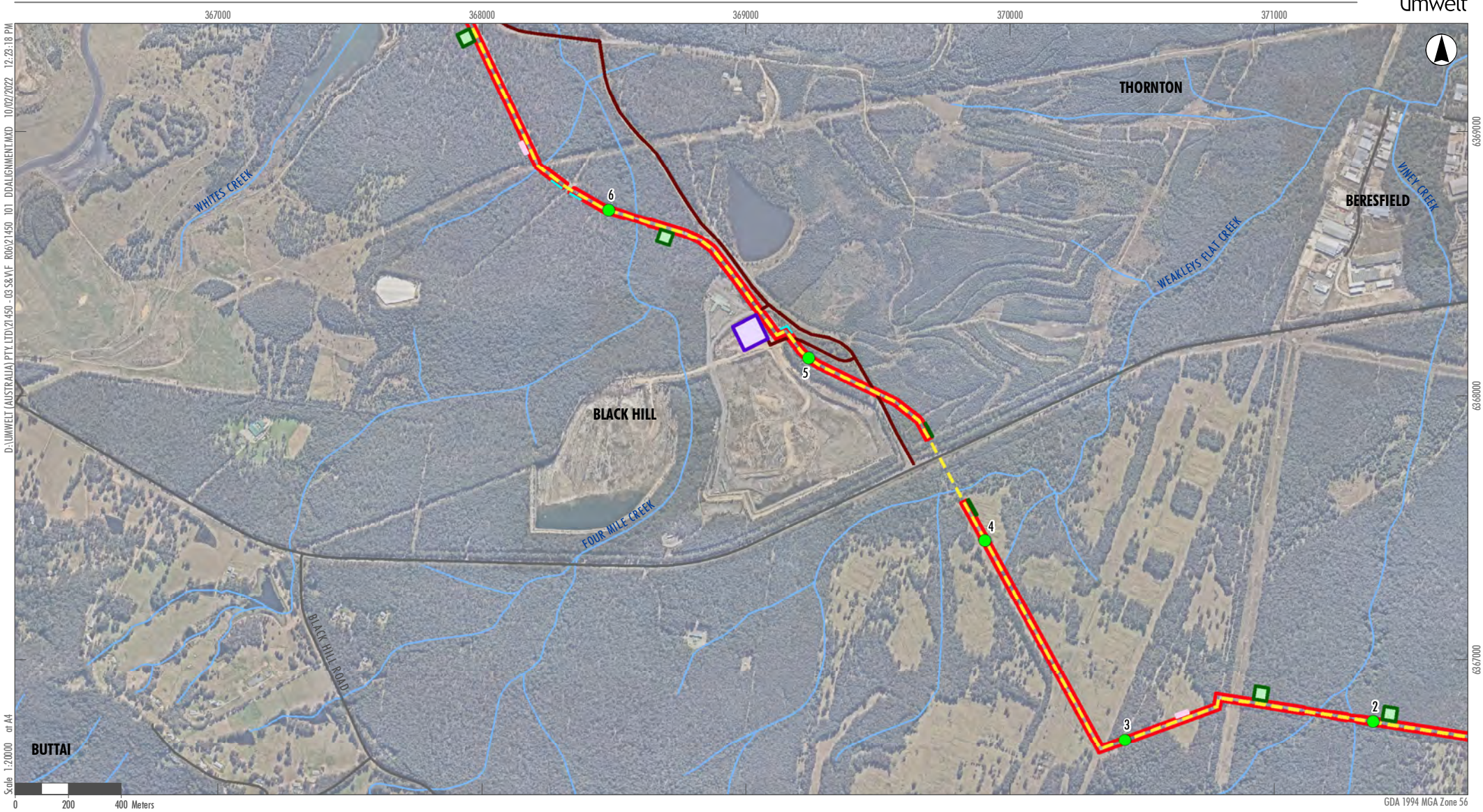
Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Sydney to Newcastle Pipeline (JGN Northern Trunk)
- HDD Workspace
- Horizontal Bore Workspace
- Kilometre Point
- JGN Offtake Facility
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

APPENDIX A-1A

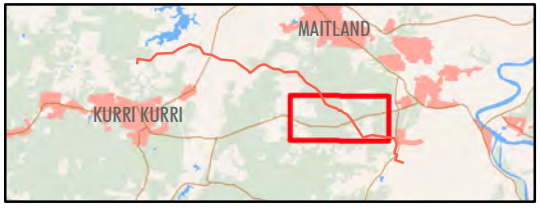
Project Alignment and Construction Footprint

Image Source: Neamap (August 2021) Data source: NSW LPI (2020;2021)



Legend

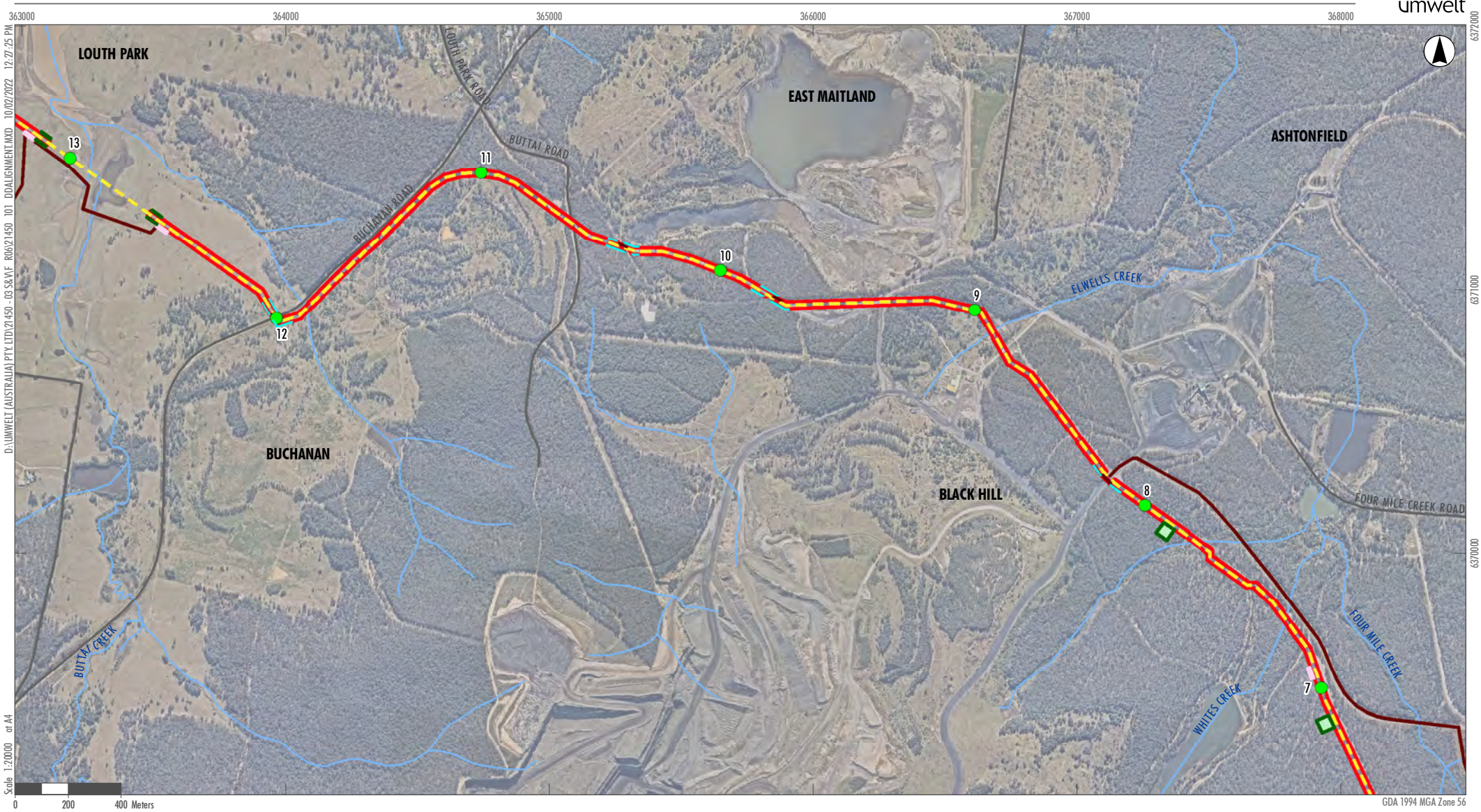
- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- HDD Workspace
- Horizontal Bore Workspace
- Kilometre Point
- Pipe Laydown Areas
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses



APPENDIX A-1B

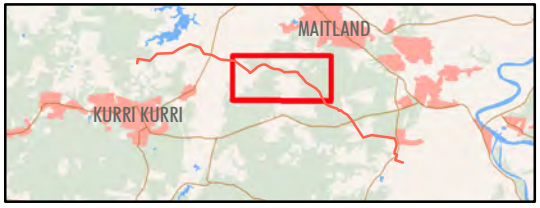
Project Alignment and Construction Footprint

Image Source: Neamap (August 2021) Data source: NSW LPI (2020;2021)



Legend

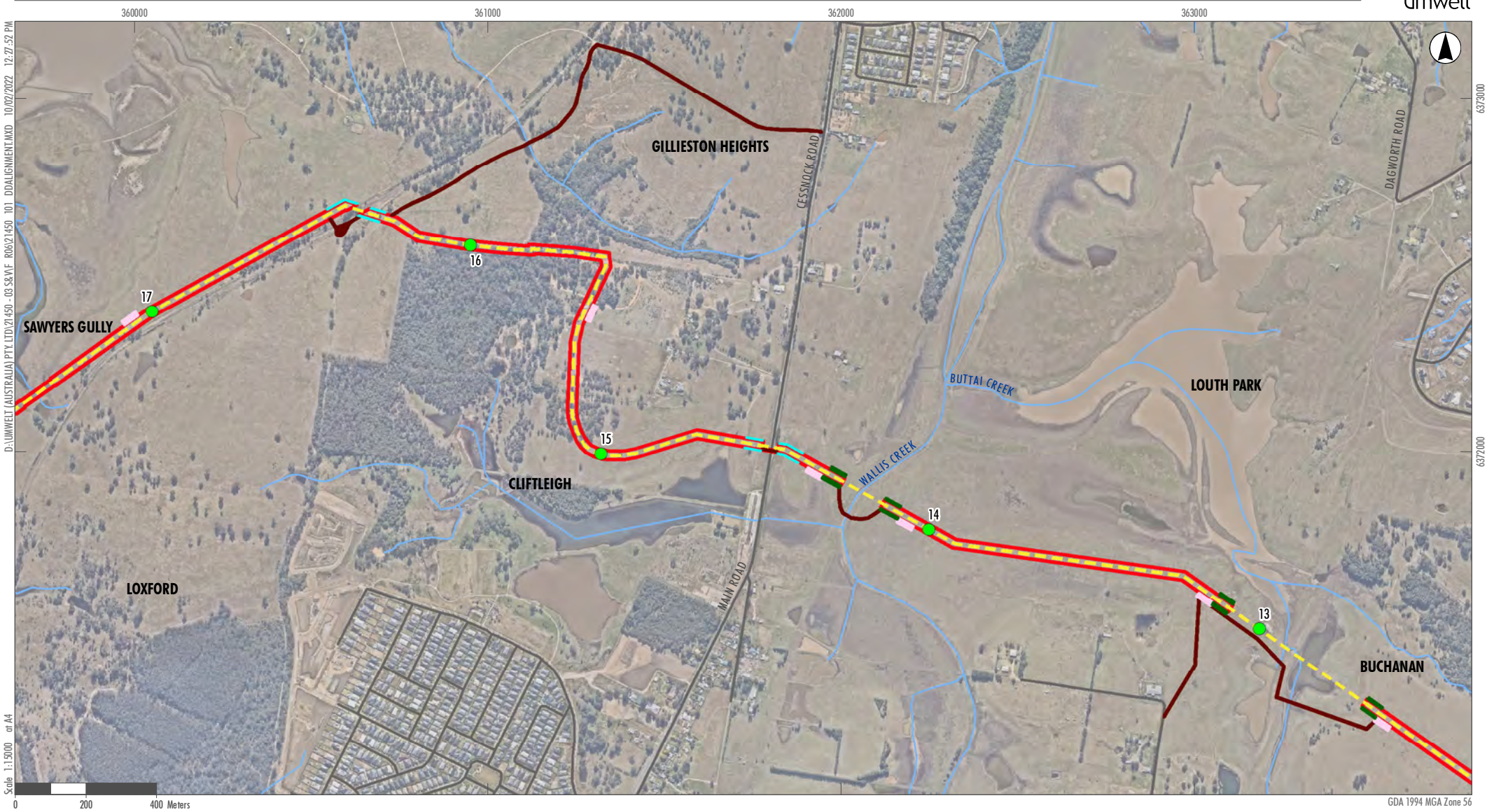
- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- HDD Workspace
- Horizontal Bore Workspace
- Kilometre Point
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses



APPENDIX A-1C

Project Alignment and Construction Footprint

Image Source: Neamap (August 2021) Data source: NSW LPI (2020;2021)



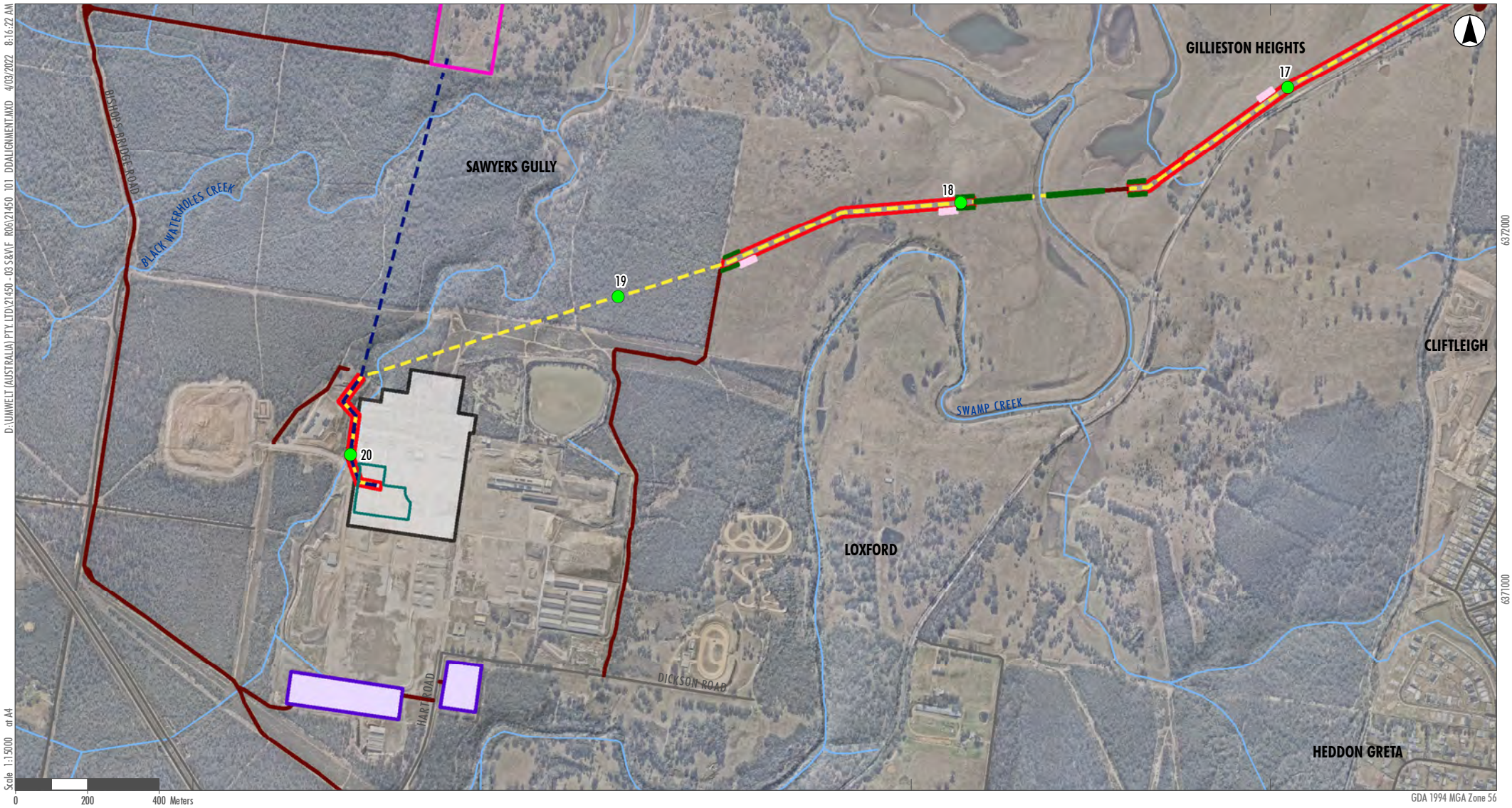
Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- HDD Workspace
- Horizontal Bore Workspace
- Kilometre Point
- Truck Turnarounds
- Access Tracks
- Roads
- Watercourses

APPENDIX A-1D

Project Alignment and Construction Footprint

Image Source: Neamap (August 2021) Data source: NSW LPI (2020;2021)



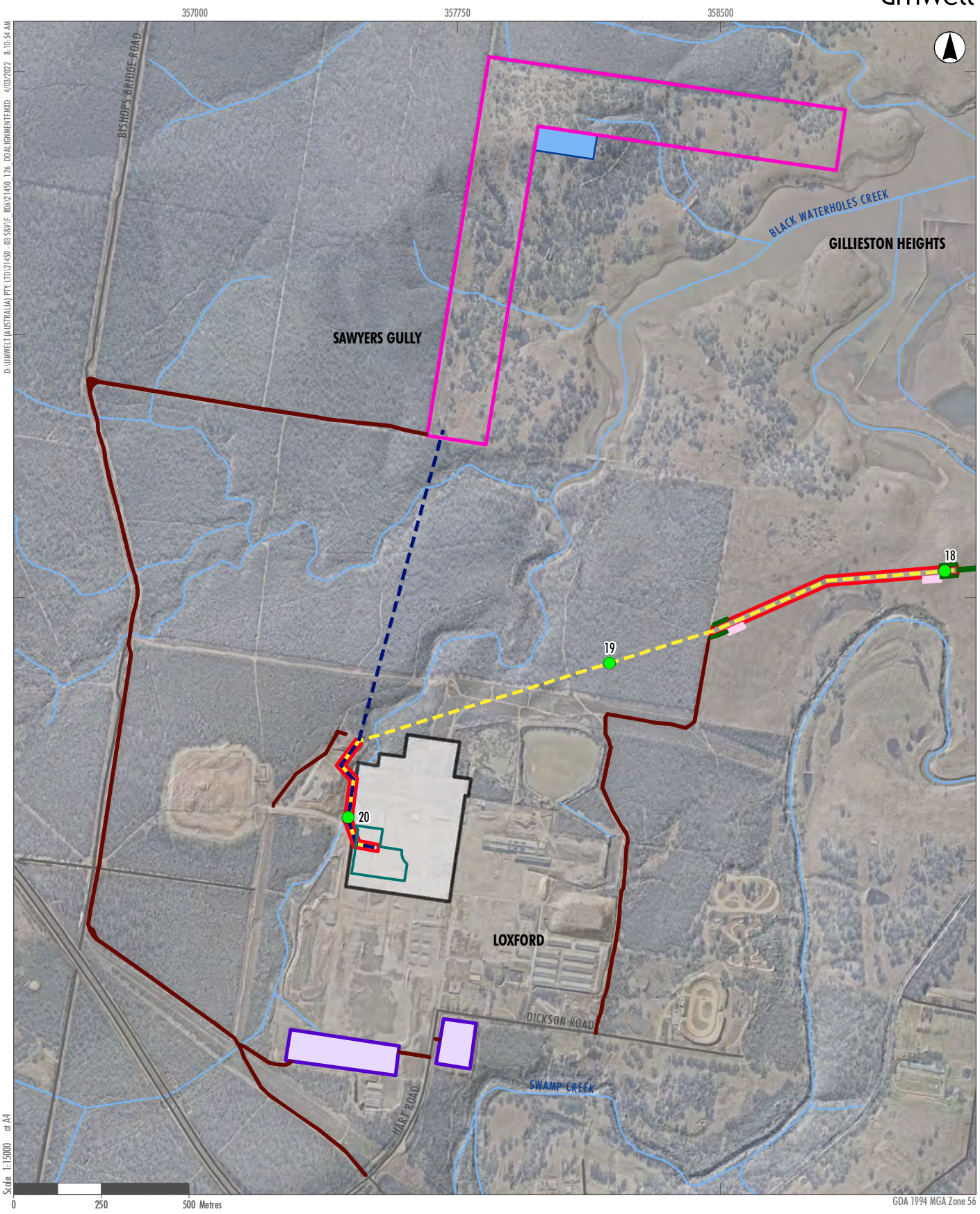
Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- HDD Workspace
- Horizontal Bore Workspace
- Kilometre Point
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Access Tracks
- Roads
- Watercourses

APPENDIX A-1E

Project Alignment and Construction Footprint

Image Source: Neamap (August 2021) Data source: NSW LPI (2020;2021)



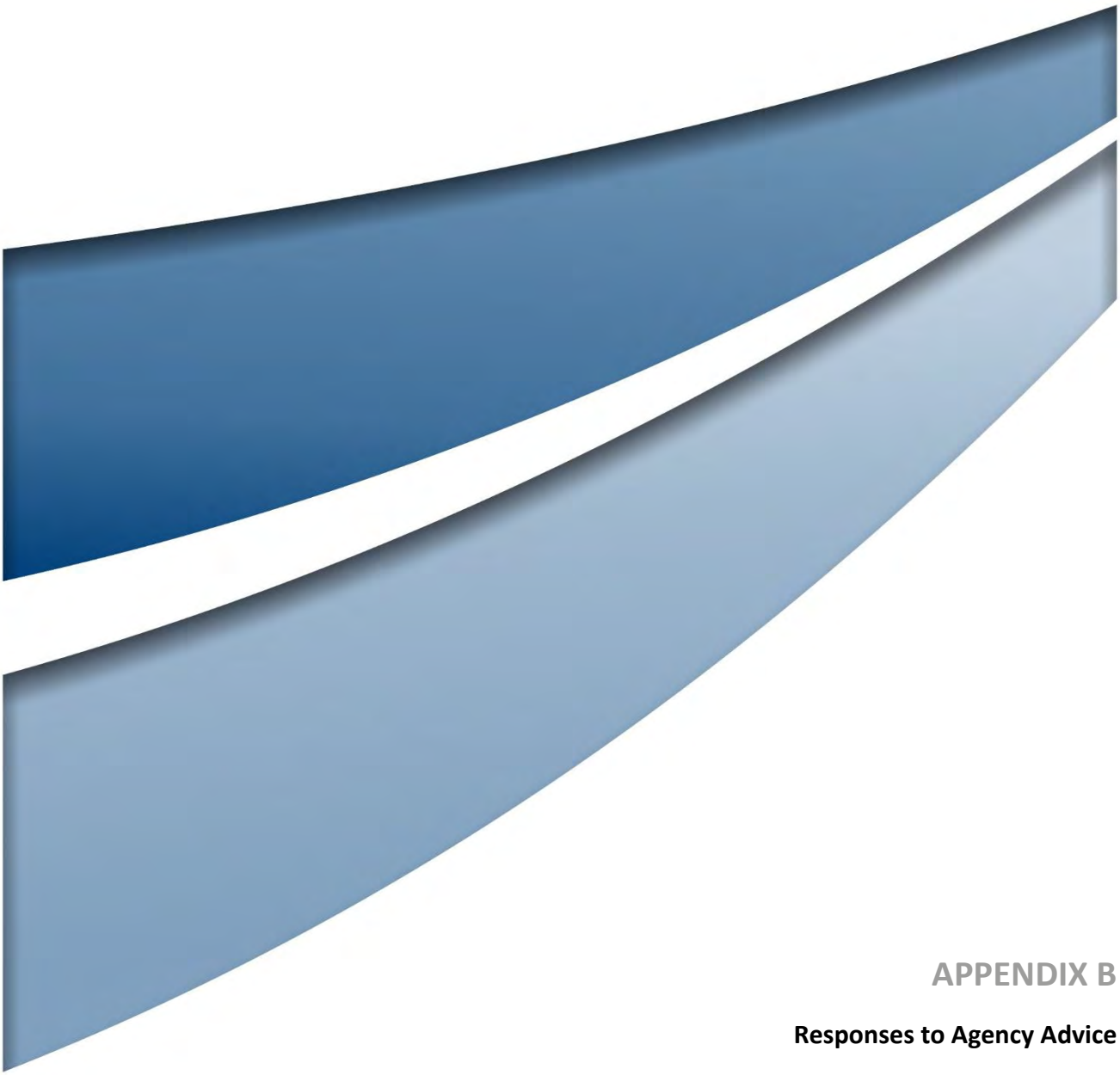
Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- HDD Workspace
- Kilometre Point
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Storage Pipeline
- Turkey Nest Dam
- Access Tracks
- Roads
- Watercourses

APPENDIX A-1F

Project Alignment and Construction Footprint

Image Source: Neamap (August 2021) Data source: NSW LPI (2020;2021)



APPENDIX B

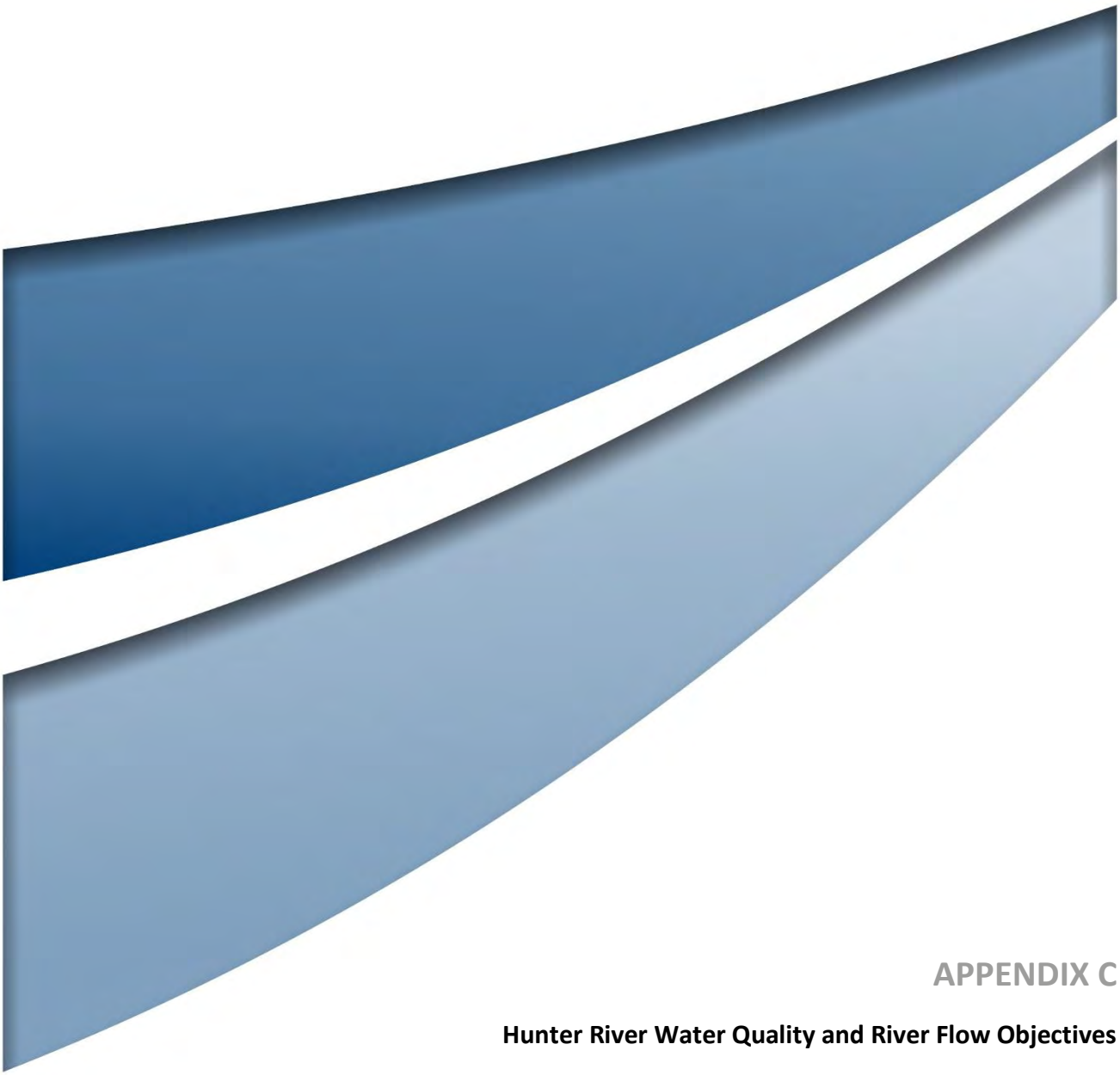
Responses to Agency Advice

Table B.1 Agency Advice and where it has been addressed in the report

SEARS Items	Responses	Where Addressed in the report
Water and soils		
5	The EIS must map the following features relevant to water and soils including:	
a.	Acid sulfate soils (Class 1, 2, 3 or 4 on the Acid Sulfate Soil Planning Map).	**Section 4.6.**
b.	Rivers, streams, wetlands, estuaries (as described in s4.2 of the Biodiversity Assessment Method).	**Section 4.0**
c.	Wetlands as described in 4.2 of the Biodiversity Assessment Method.	**Section 4.0**
d.	Groundwater.	**Section 4.7**
e.	Groundwater dependent ecosystems.	**Section 4.8**
f.	Proposed intake and discharge locations.	**Section 4.8**
6	The EIS must describe background conditions for any water resource likely to be affected by the development, including:	
a.	Existing surface and groundwater.	**Section4.0**
b.	Hydrology, including volume, frequency and quality of discharges at proposed intake and discharge locations.	**Section 4.0**
c.	Water Quality Objectives (as endorsed by the NSW Government http://www.environment.nsw.gov.au/ieo/index.htm) including groundwater as appropriate that represent the community's uses and values for the receiving waters.	**Section 4.12** and **Appendix C**
d.	Indicators and trigger values/criteria for the environmental values identified at (c) in accordance with the ANZECC (2000) Guidelines for Fresh and Marine Water Quality and/or local objectives, criteria or targets endorsed by the NSW Government.	**Section 4.12** and **Appendix C**
7	The EIS must describe background conditions for any water resource likely to be affected by the development, including:	
a.	The nature and degree of impact on receiving waters for both surface and groundwater, demonstrating how the development protects the Water Quality Objectives where they are currently being achieved, and contributes towards achievement of the Water Quality Objectives over time where they are currently not being achieved. This should include an assessment of the mitigating effects of proposed stormwater and wastewater management during and after construction.	**Sections 4.0** and **5.0**
b.	Identification of proposed monitoring of water quality.	**Section 5.1**
8	The EIS must assess the impact of the development on hydrology, including:	
a.	Water balance including quantity, quality and source.	**Section 5.0**
b.	Effects to downstream rivers, wetlands, estuaries, marine waters and floodplain areas.	**Section 5.0**
c.	Effects to downstream water-dependent fauna and flora including groundwater dependent ecosystems.	**Section 5.0**
d.	Impacts to natural processes and functions within rivers, wetlands, estuaries and floodplains that affect river system and landscape health such as nutrient flow, aquatic connectivity and access to habitat for spawning and refuge (e.g. river benches).	**Section 5.0**
e.	Changes to environmental water availability, both regulated/licensed and unregulated/rules-based sources of such water.	**Section 5.0**

SEARS Items	Responses	Where Addressed in the report
f.	Mitigating effects of proposed stormwater and wastewater management during and after construction on hydrological attributes such as volumes, flow rates, management methods and re-use options.	**Section 5.0**
g.	Identification of proposed monitoring of hydrological attributes.	**Section 5.0**
Flooding and coastal erosion		
9	The EIS must map the following features relevant to flooding as described in the Floodplain Development Manual 2005 (NSW Government 2005) including:	
a.	Flood prone land.	**Section 4.11, Appendix H, Appendix I, Appendix J**
b.	Flood planning area, the area below the flood planning level.	**Section 4.11, Appendix H, Appendix I, Appendix J**
c.	Hydraulic categorisation (floodways and flood storage areas).	**Appendix G**
10	The EIS must describe flood assessment and modelling undertaken in determining the design flood levels for events, including a minimum of the 1 in 10 year, 1 in 100 year flood levels and the probable maximum flood, or an equivalent extreme event.	**Section 4.11** and **Appendix G**
11	The EIS must model the effect of the proposed development (including fill) on the flood behaviour under the following scenarios:	
a.	Current flood behaviour for a range of design events as identified in 11 above. This includes the 1 in 200 and 1 in 500 year flood events as proxies for assessing sensitivity to an increase in rainfall intensity of flood producing rainfall events due to climate change.	**Section 4.11, Appendix G, Appendix H, Appendix I,** and **Appendix J**
12	Modelling in the EIS must consider and document:	
a.	The impact on existing flood behaviour for a full range of flood events including up to the probable maximum flood.	**Section 4.11, Appendix G, Appendix H, Appendix I, Appendix J**
b.	Impacts of the development on flood behaviour resulting in detrimental changes in potential flood affection of other developments or land. This may include redirection of flow, flow velocities, flood levels, hazards and hydraulic categories.	**Section 4.11** and **5.2, Appendix G, Appendix H, Appendix I, Appendix J**
c.	Relevant provisions of the NSW Floodplain Development Manual 2005.	**Section 4.11** and **5.2, Appendix G, Appendix H, Appendix I, Appendix J**
13	The EIS must assess the impacts on the proposed development on flood behaviour, including:	
a.	Whether there will be detrimental increases in the potential flood affectation of other properties, assets and infrastructure.	**Sections 4.11** and **5.2**
b.	Consistency with Council floodplain risk management plans.	**Sections 4.11** and **5.2**
c.	Compatibility with the flood hazard of the land.	**Sections 4.11** and **5.2**
d.	Compatibility with the hydraulic functions of flow conveyance in floodways and storage in flood storage areas of the land.	**Section 4.11** and **5.2**
e.	Whether there will be adverse effect to beneficial inundation of the floodplain environment, on, adjacent to or downstream of the site.	**Sections 4.11** and **5.2**
f.	Whether there will be direct or indirect increase in erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.	**Section 5.2**

SEARS Items	Responses	Where Addressed in the report
g.	Any impacts the development may have upon existing community emergency management arrangements for flooding. These matters are to be discussed with the SES and Council.	**Section 5.2**
h.	Whether the Project incorporates specific measures to manage risk to life from flood. These matters are to be discussed with the SES and Council.	**Section 5.2**
i.	Emergency management, evacuation and access, and contingency measures for the development considering the full range or flood risk (based upon the probable maximum flood or an equivalent extreme flood event). These matters are to be discussed with and have the support of Council and the SES.	**Section 5.2**
j.	Any impacts the development may have on the social and economic costs to the community as consequence of flooding.	**Section 5.2**
14	The [EIS/EA] must describe the potential effects of coastal processes and hazards (within the meaning of the *Coastal Management Act 2016*), including sea level rise and climate change:	
a.	On the proposed development	**Section 5.2**
b.	Arising from the proposed development.	**Section 5.2**
15	The [EIS/EA] must consider have regard to any certified Coastal Management Program (or Coastal Zone Management Plan) and be consistent with the management objectives described in the *Coastal Management Act 2016* and development controls for coastal management areas mapped under the State Environmental Planning Policy (Coastal Management) 2018.	**Section 5.2**



APPENDIX C

Hunter River Water Quality and River Flow Objectives

Table C.1 Hunter River Water Quality Objectives for Estuary Waterways Affected by Urban Development

Protection, Purpose and Application	Indicator	Numerical Criteria (Trigger Values)
Aquatic Ecosystems • *Maintaining or improving the ecological condition of waterbodies and their riparian zones over the long term* • *All natural waterways;* • *Even in areas greatly affected by human use, continuing improvement is needed towards healthier, more diverse aquatic ecosystems;* • *Water quality in artificial watercourses should ideally be adequate to protect native species that use them, as well as being adequate for human uses;* • *At any point where water from the artificial watercourse flows into a natural waterway.*	Total Phosphorus	Upland rivers: 20 µg/L Lowland rivers: 25 µg/L for rivers flowing to the coast; 50 µg/L for rivers in the Murray-Darling Basin Lakes & reservoirs: 10 µg/L Estuaries: 30 µg/L
	Total Nitrogen	Upland rivers: 250 µg/L Lowland rivers: 350 µg/L for rivers flowing to the coast; 500 µg/L for rivers in the Murray-Darling Basin Lakes & reservoirs: 350 µg/L Estuaries: 300µg/L
	Chlorophyll-a	Upland rivers: not applicable Lowland rivers: 5 µg/L Lakes & reservoirs: 5 µg/L. Estuaries: 4 µg/L.
	Turbidity	Upland rivers: 2–25 NTU Lowland rivers: 6–50 NTU Lakes & reservoirs: 1–20 NTU Estuaries: 0.5–10 NTU
	Salinity (EC)	Upland rivers: 30–350 µS/cm Lowland rivers: 125–2200 µS/cm
	Dissolved Oxygen	Upland rivers: 90–110% Lowland rivers: 85–110% Freshwater lakes & reservoirs: 90–110% Estuaries: 80–110%
	pH	Upland rivers: 6.5–8.0 Lowland rivers: 6.5–8.5 Freshwater lakes & reservoirs: 6.5–8.0 Estuaries: 7.0–8.5 Changes of more than 0.5 pH units from the natural seasonal maximum or minimum should be investigated.

Protection, Purpose and Application	Indicator	Numerical Criteria (Trigger Values)
	Temperature	See ANZECC 2000 Guidelines, table 3.3.1.
	Chemical Contaminants	See ANZECC 2000 Guidelines, chapter 3.4 and table 3.4.1.
	Biological indicators	This form of assessment directly evaluates whether management goals for ecosystem protection are being achieved (e.g. maintenance of a certain level of species diversity, control of nuisance algae below a certain level, protection of key species, etc). Many potential indicators exist and these may relate to single species, multiple species or whole communities. Recognised protocols using diatoms and algae, macrophytes, macroinvertebrates, and fish populations and/or communities may be used in NSW and interstate (e.g. AusRivAS).
Visual Amenity • *Aesthetic qualities of waters* • *All waters, particularly those used for aquatic recreation and where scenic qualities are important*	Visual Clarity and Colour	Natural visual clarity should not be reduced by more than 20%. Natural hue of the water should not be changed by more than 10 points on the Munsell Scale. The natural reflectance of the water should not be changed by more than 50%.
	Surface Films and Debris	Oils and petrochemicals should not be noticeable as a visible film on the water, nor should they be detectable by odour. Waters should be free from floating debris and litter.
	Nuisance Organisms	Macrophytes, phytoplankton scums, filamentous algal mats, blue-green algae, sewage fungus and leeches should not be present in unsightly amounts.
Secondary Contact Recreation • *Maintaining or improving water quality for activities such as boating and wading, where there is a low probability of water being swallowed* • *All waters but may not be achievable for some time in some areas* • *In waterways where communities do not require water quality of a level suited to primary contact recreation, or where primary contact reaction will be possible only in the future.*	Faecal coliforms	Median bacterial content in fresh and marine waters of < 1000 faecal coliforms per 100 mL, with 4 out of 5 samples < 4000/100 mL (minimum of 5 samples taken at regular intervals not exceeding one month).
	Enterococci	Median bacterial content in fresh and marine waters of < 230 enterococci per 100 mL (maximum number in any one sample: 450-700 organisms/100 mL).
	Algae & blue-green algae	< 15 000 cells/mL
	Nuisance organisms	Use visual amenity guidelines. Large numbers of midges and aquatic worms are undesirable.
	Chemical contaminants	Waters containing chemicals that are either toxic or irritating to the skin or mucous membranes are unsuitable for recreation. Toxic substances should not exceed values in tables 5.2.3 and 5.2.4 of the ANZECC 2000 Guidelines.
	Visual clarity and colour	Use visual amenity guidelines.
	Surface films	Use visual amenity guidelines.

Protection, Purpose and Application	Indicator	Numerical Criteria (Trigger Values)
Primary Contact Recreation • *Maintaining or improving water quality for activities such as swimming in which there is a high probability of water being swallowed* • *In the immediate future to waters within and immediately upstream of recognised recreation site. For many other waters, this is a long-term objective*	Turbidity	A 200 mm diameter black disc should be able to be sighted horizontally from a distance of more than 1.6 m (approximately 6 NTU).
	Faecal coliforms	Beachwatch considers waters are unsuitable for swimming if: • the median faecal coliform density exceeds 150 colony forming units per 100 millilitres (cfu/100mL) for five samples taken at regular intervals not exceeding one month, or • the second highest sample contains equal to or greater than 600 cfu/100mL (faecal coliforms) for five samples taken at regular intervals not exceeding one month. ANZECC 2000 Guidelines recommend: • Median over bathing season of < 150 faecal coliforms per 100 mL, with 4 out of 5 samples < 600/100 mL (minimum of 5 samples taken at regular intervals not exceeding one month).
	Enterococci	Beachwatch considers waters are unsuitable for swimming if: • the median enterococci density exceeds 35 cfu/100mL for five samples taken at regular intervals not exceeding one month, or • the second highest sample contains equal to or greater than 100 cfu/100mL (enterococci) for five samples taken at regular intervals not exceeding 1 month. ANZECC 2000 Guidelines recommend: • Median over bathing season of < 35 enterococci per 100 mL (maximum number in any one sample: 60-100 organisms/100 mL).
	Protozoans	Pathogenic free-living protozoans should be absent from bodies of fresh water. (Note, it is not necessary to analyse water for these pathogens unless temperature is greater than 24 degrees Celsius).
	Algae & blue-green algae	< 15 000 cells/mL
	Nuisance organisms	Use visual amenity guidelines. Large numbers of midges and aquatic worms are undesirable.
	pH	5.0-9.0
	Temperature	15°-35°C for prolonged exposure.

Protection, Purpose and Application	Indicator	Numerical Criteria (Trigger Values)
	Chemical contaminants	Waters containing chemicals that are either toxic or irritating to the skin or mucus membranes are unsuitable for recreation. Toxic substances should not exceed the concentrations provided in tables 5.2.3 and 5.2.4 of the ANZECC 2000 Guidelines 2000.
	Visual clarity and colour	Use visual amenity guidelines
	Surface films	Use visual amenity guidelines
Irrigation Water Supply • *Protecting the quality of waters applied to crops and pasture* • *All current and potential areas of irrigated crops, both small- and large-scale* • *Local requirements for irrigation water quality, such as salinity, apply*	Algae & blue-green algae	Should not be visible. No more than low algal levels are desired to protect irrigation equipment.
	Salinity (electrical conductivity)	To assess the salinity and sodicity of water for irrigation use, a number of interactive factors must be considered including irrigation water quality, soil properties, plant salt tolerance, climate, landscape and water and soil management. For more information, refer to Chapter 4.2.4 of ANZECC 2000 Guidelines.
	Thermotolerant coliforms (faecal coliforms)	Trigger values for thermotolerant coliforms in irrigation water used for food and non-food crops are provided in table 4.2.2 of the ANZECC Guidelines
	Heavy metals and metalliods	Long term trigger values (LTV) and short-term trigger values (STV) for heavy metals and metalloids in irrigation water are presented in table 4.2.10 of the ANZECC 2000 Guidelines.
Aquatic Foods • *Protecting water quality so that is suitable to produce aquatic foods for human consumption and aquaculture activities* • *Applies to all waters where aquatic foods are taken for non-commercial and commercial harvesting*	Algae & blue-green algae	No guideline is directly applicable, but toxins present in blue-green algae may accumulate in other aquatic organisms.
	Faecal coliforms	*Guideline in water for shellfish:* The median faecal coliform concentration should not exceed 14 MPN/100mL; with no more than 10% of the samples exceeding 43 MPN/100 mL. *Standard in edible tissue:* Fish destined for human consumption should not exceed a limit of 2.3 MPN *E Coli* /g of flesh with a standard plate count of 100,000 organisms/g.
	Toxicants (as applied to aquaculture activities)	Metals: • Copper: less than 5 µgm/L. • Mercury: less than 1 µgm/L. • Zinc: less than 5 µgm/L. Organochlorines: • Chlordane: less than 0.004 µgm/L (saltwater production) • PCBs: less than 2 µgm/L.
	Physico-chemical indicators (as applied to aquaculture activities)	• Suspended solids: less than 40 micrograms per litre (freshwater) • Temperature: less than 2 degrees Celsius change over one hour.

Table C.2 Hunter River – River Flow Objectives for Estuary Waterways Affected by Urban Development

Objective	Description	Measures to achieve objectives
Protect pools in dry times *Protect natural water levels in pools of creeks and rivers and wetlands during periods of no flows*	During dry times, some streams stop flowing and form pools. Pools and wetlands are refuges for aquatic plants and animals. Pumping water from these areas can make it more difficult for many species to recover after a drought.	• There should be no water extraction from streams or wetlands in periods of no flow. • If conditions on water licences do not provide for this objective to be met, priority should be given to implementing it by actions appropriate to local circumstances.
Protect natural low flows *Protect natural low flows*	Water extraction and storage are high in dry times and impose long artificial droughts that increase the stress on aquatic plants and animals.	• Share low flows between the environment and water users and fully protect all very low natural flows. o Very low flows: flows below the level naturally exceeded on 95% of all days with flow. o Low flows: flows below the level naturally exceeded on 80% of all days with flow. • Unless environmental, social and economic evaluations give an appropriate alternative, the following limits on water extraction apply: o Environmental share in high-conservation-value streams: all very low flows and most of low flows; no increase in extraction of low flows. o Environmental share in other streams: all very low flows and 50-70% of daily low levels (i.e. 30 to 50% of daily low flows could be extracted.) • New or transferred licences should not allow extraction below the 80th percentile during low flows. • In streams with little water use or important conservation values, minimise risks to ecosystems during low flows. • Review management of town water supplies to assess whether changes may help achieve the objective without significantly affecting reliability.

Objective	Description	Measures to achieve objectives
Protect important rises in water levels *Protect or restore a proportion of moderate flows ('freshes') and high flows*	Rain causes peaks in river flows. This 'pulsing' of flows may trigger migration of animals and reproduction of plants and animals; provide over-bank flows to wetlands and floodplains; shape the river channel; control water quality and nutrients; and provide necessary freshwater inputs to estuaries. Water storage and extraction can alter or remove freshes, inhibiting these vital processes. The height, duration, season and frequency of higher flows are all important.	• Unless local information shows appropriate alternative targets, the following limits on extraction are recommended for use by river management committees: o No extraction of more than 30-50% of moderate to high flows (i.e. 30-50% of flows greater than the flows that would naturally be exceeded on 80% of all days with flow) on a daily basis. o No increase in extractions from high-conservation streams. • Where use exceeds the above limit, appropriate ways of limiting the volume or controlling the timing of extraction are needed.
Maintain wetland and floodplain inundation *Maintain or restore the natural inundation patterns and distribution of floodwaters supporting natural wetland and floodplain ecosystems*	Floodplain and wetland ecosystems develop in response to the flow patterns and the nature of the landscape between the river and wetlands or floodplains. Floodplain works can change the flooding patterns, which will lead to changes in habitat and vegetation. These changes can be expected to reduce or change (or both) the diversity and abundance of species in the ecosystem. In particular, they can lead to reduced numbers of native fish and to water quality problems	In management plans and actions for waterways, include strategies to: • maintain, restore or mimic natural inundation and drying patterns in natural and seminatural wetlands and remaining native floodplain ecosystems • ensure adequate access for native fish to and from floodplain wetlands Flooding patterns should not be altered without proper environment assessment
Mimic natural drying in temporary waterways *Mimic the natural frequency, duration and seasonal nature of drying periods in naturally temporary waterways*	In urban areas, the preponderance of hard-surfacing (e.g. paved or concreted areas) and garden-watering can cause streams and wetlands to be 'wetter' than natural. In streams and wetlands that would dry out naturally if these impacts were absent, this can create problems in maintaining habitat and vegetation, nutrient cycling, and signals for breeding. It can also lead to a high-water table and associated salinity problems. Natural wetting and drying cycles produce diversity of habitat and, therefore, high species diversity.	Identify any streams where unnatural flows have greatly reduced drying periods. Assess potential short-and long-term environmental, economic and social effects of this change and of possible management alternatives. Decide what, if any, action is appropriate to implement this objective in streams and wetlands on a case-by-case basis, after giving due consideration to local views.

Objective	Description	Measures to achieve objectives
Maintain natural flow variability *Maintain or mimic natural flow variability in all streams*	Australia's rainfall and river flows are naturally variable. The way that we currently store and divert river water can reduce natural pulsing of water down rivers and maintain artificially high or stable river heights. In urban areas and other places where the ability of the land to absorb or detain rainfall is reduced, more water runs off rapidly, so water levels will rise higher. These changes often create problems with streambank stability, biodiversity and signals for breeding and migration	Identify streams with unnatural flow variability and develop appropriate actions to mimic natural variability. Identify streams or development proposals with potential to have or cause flow variability problems and take early action.
Maintain natural rates of change in water levels *Maintain rates of rise and fall of river heights within natural bounds*	Water levels may rise too quickly in urban areas, with risk to people and aquatic plants and animals. If water levels fall too fast, water does not drain properly from riverbanks and they may collapse. Migration of aquatic animals may also be restricted by such sudden falls in river height.	Identify locations where water levels often rise or fall faster than they would naturally. Identify the reasons (in urban areas, usually the result of increased hard-surfacing) and impacts. Remedial action requires case-by-case assessment. Identify potential problems and take early action
Manage groundwater for ecosystems *Maintain groundwater within natural levels and variability, critical to surface flows and ecosystems*	Some shallow groundwaters are directly linked to flows in streams and wetlands. They may provide base flows in rivers during dry periods and they may be primary sources of water for floodplain and riparian vegetation. Also, seriously depleting groundwater in dry times may lead to unnatural recharge of groundwater from surface waters during the next flow event. Lowering groundwater levels in many coastal areas may expose acid sulfate soils.	Implement the State Groundwater Policy (DLWC 1997a, 1998b). Identify any streams or ecosystems that may depend on high groundwater levels and assess whether impacts on these may be caused by changed recharge rates or excessive pumping or drainage. Identify areas where groundwater may be rising and likely to threaten ecosystems or surface water quality. Determine appropriate action to keep groundwater level changes within acceptable bounds.
Minimise effects of weirs and other structures *Minimise the impact of instream structures*	Most instream structures (e.g. weirs) convert flowing water to still water, thus altering habitat and increasing risks of algal blooms or other water quality problems. Barriers prevent passage of plant propagules (e.g. seeds) and animals.	Implement the NSW Weirs Policy (DLWC 1997b). Identify and take action to minimise the impact on native plants and animals of other structures (e.g. floodgates, tidal barriers, culverts) that impede movement of water.

Objective	Description	Measures to achieve objectives
Maintain or rehabilitate estuarine processes and habitats	Coastal lagoons, estuaries and river mouths often change naturally in response to storms and tides. Flood mitigation structures, weirs and other works also affect estuaries by limiting tidal flow, changing salinity conditions or altering water levels. Development of estuarine areas can also disturb acid sulfate deposits, which may release large amounts of sulfuric acid and toxic metals into the estuarine environment. Upstream management of rivers also affects estuaries and lagoons. Stormwater carries nutrients, organic matter and sediments. Scouring because of flooding can affect the opening and closing of river mouths. Reduced freshes and flooding in estuaries severely depletes food sources for estuarine species. These effects can contribute to the decline in the number and abundance of species that use estuaries as habitat, nursery grounds or both.	Dredging beyond the minimum needed to maintain navigation channels should be subject to environmental assessment before proceeding. Minimise draining or disturbance of potential acid sulfate soils. Ensure water-based activities have minimal impact on fish habitat. Tidal wetlands should continue to receive tidal flushing; minimise the impact of flood levees and gates, roads and other barriers. Other processes potentially affecting estuary health should be addressed such as the impact of increasing urbanisation.

APPENDIX D

Site Visit Photos

Photo D.1 Woods Gully

Photo D.2 Woods Gully

Photo D.3 Unnamed Watercourse (Tributary of Weakleys Flat Creek) - Looking Downstream

Photo D.4 Unnamed Watercourse (Tributary of Weakleys Flat Creek) - Looking Downstream

Photo D.5 Weakleys Flat Creek, looking upstream

Photo D.6 Weakleys Flat Creek, looking downstream

Photo D.7 Four Mile Creek

Photo D.8 Four Mile Creek, looking upstream

Photo D.9 Four Mile Creek

Photo D.10 Four Mile Creek

Photo D.11 Four Mile Creek

Photo D.12 Whites Creek

Photo D.13 Whites Creek

Photo D.14 KP 7.8 – Unnamed Watercourse

Photo D.15 KP 7.8 – Unnamed Watercourse

Photo D.16 KP 7.8 – Unnamed Watercourse, looking downstream

Photo D.17 Elwells Creek

Photo D.18 Downstream side of Buchanan Road, looking downstream

Photo D.19 Upstream side of Buchanan Road, looking upstream

Photo D.20 Culvert at Buchanan Road

Photo D.21 Buttai Creek, looking upstream

Photo D.22 Buttai Creek

Photo D.23 Buttai Creek

Photo D.24 Buttai Creek

Photo D.25 Wallis Creek

Photo D.26 Wallis Creek

Photo D.27 Wallis Creek

Photo D.28 Erosion at Testers Hollow

Photo D.29 Erosion at Testers Hollow

Photo D.30 Testers Hollow approximately 180 m south of alignment

Photo D.31 Testers Hollow approximately 180 m south of alignment

Photo D.32 Swamp Creek, looking downstream

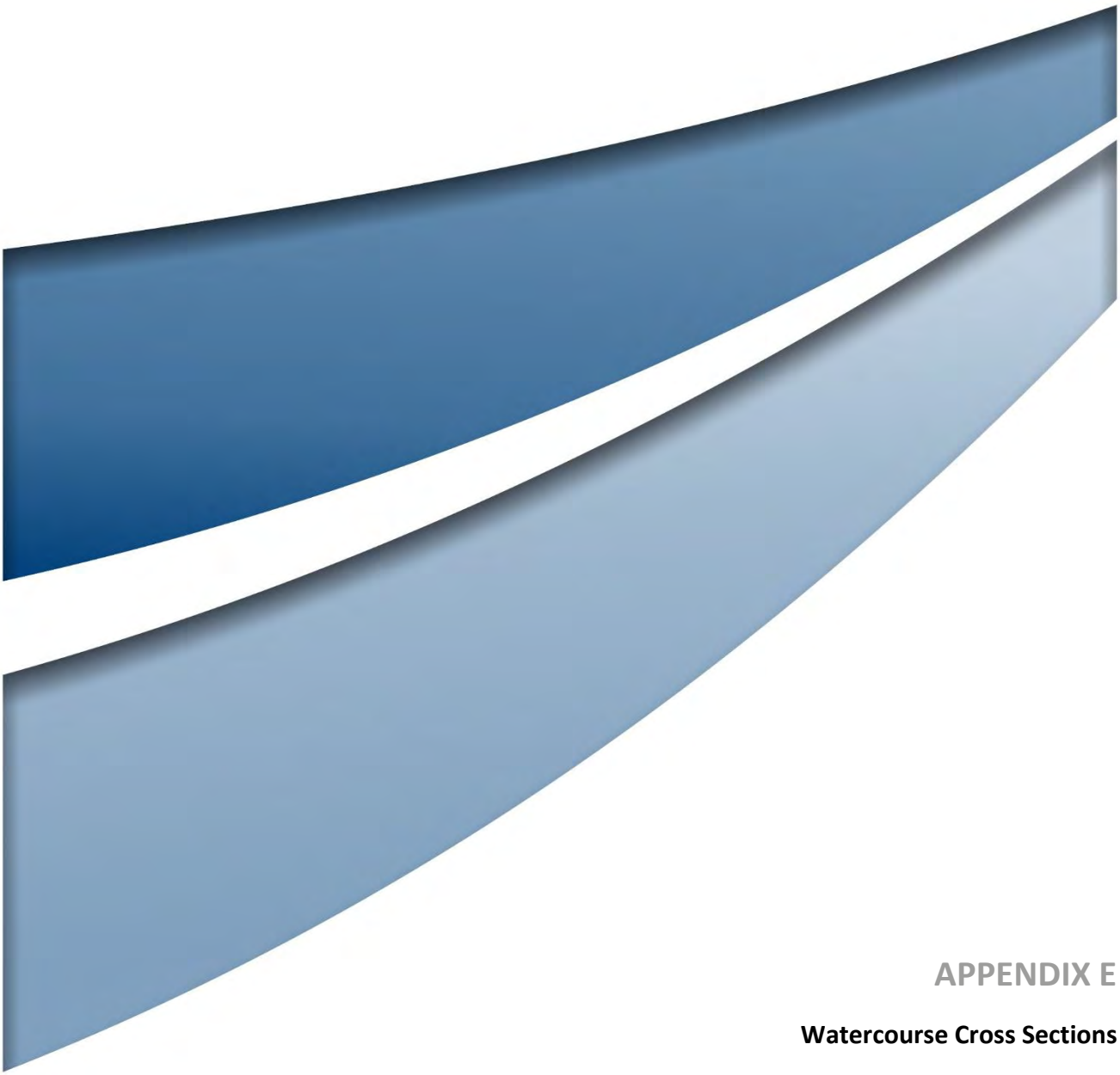
Photo E.33 Swamp Creek, looking upstream

Photo D.34 Swamp Creek, looking downstream

Photo E.35 Swamp Creek, looking upstream

Photo D.36 Black Waterholes Creek

Photo D.37 Looking towards Swamp Creek adjacent northern part of storage bottle



APPENDIX E

Watercourse Cross Sections

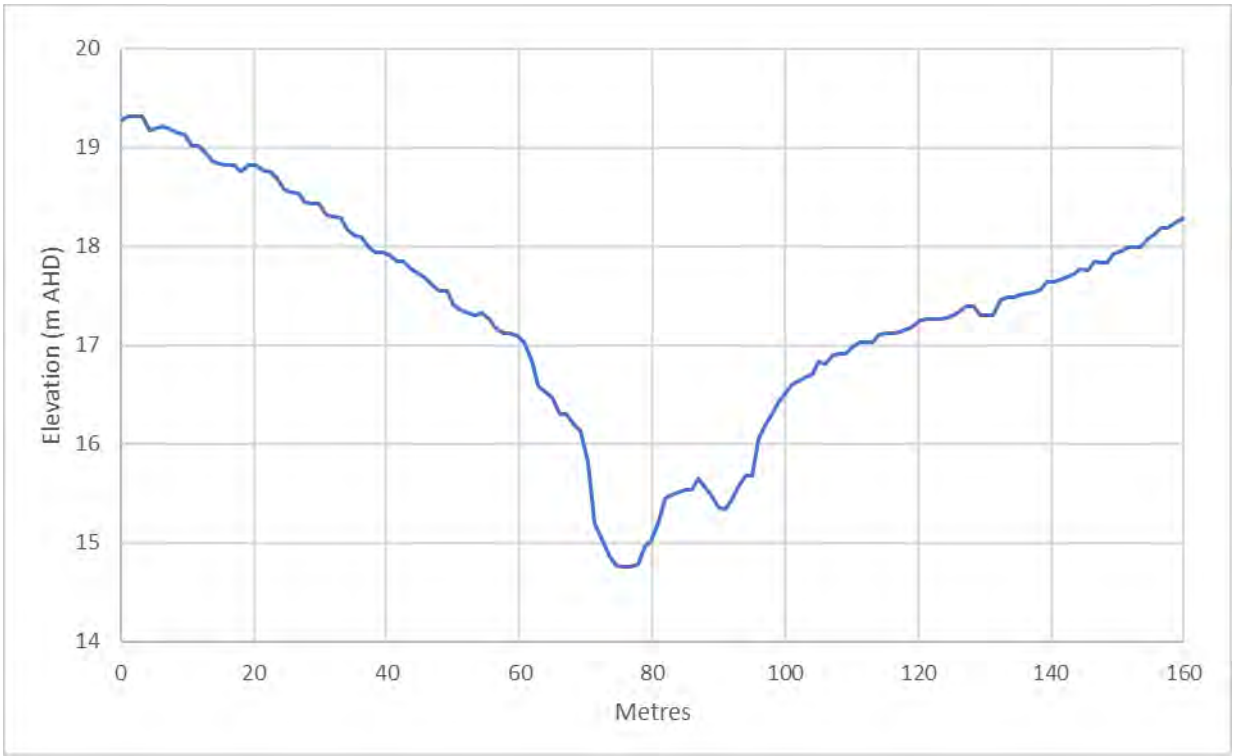


Figure E.1 KP 0.9 (Woods Gully) – Cross-Section at Waterway Crossing (Looking Downstream)

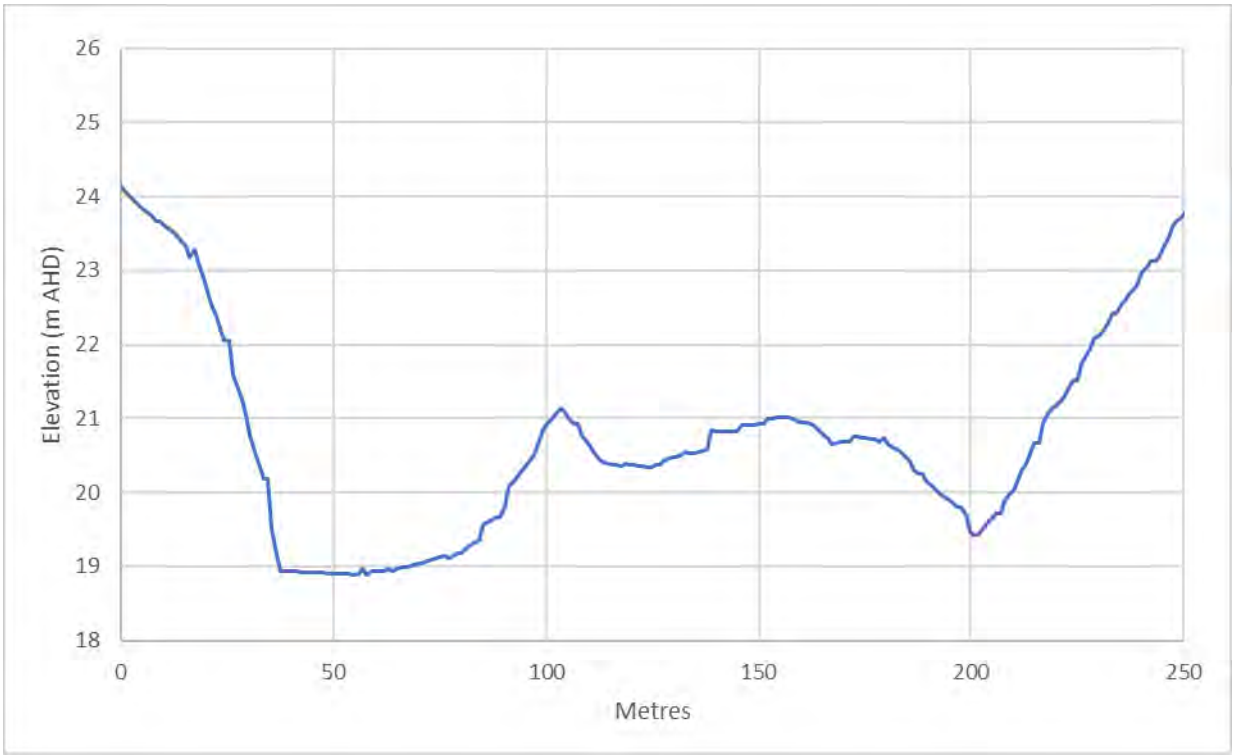


Figure E.2 KP 2.1 / 2.2 (Viney Creek West and East) – Cross-Section at Waterway Crossing (Looking Downstream)

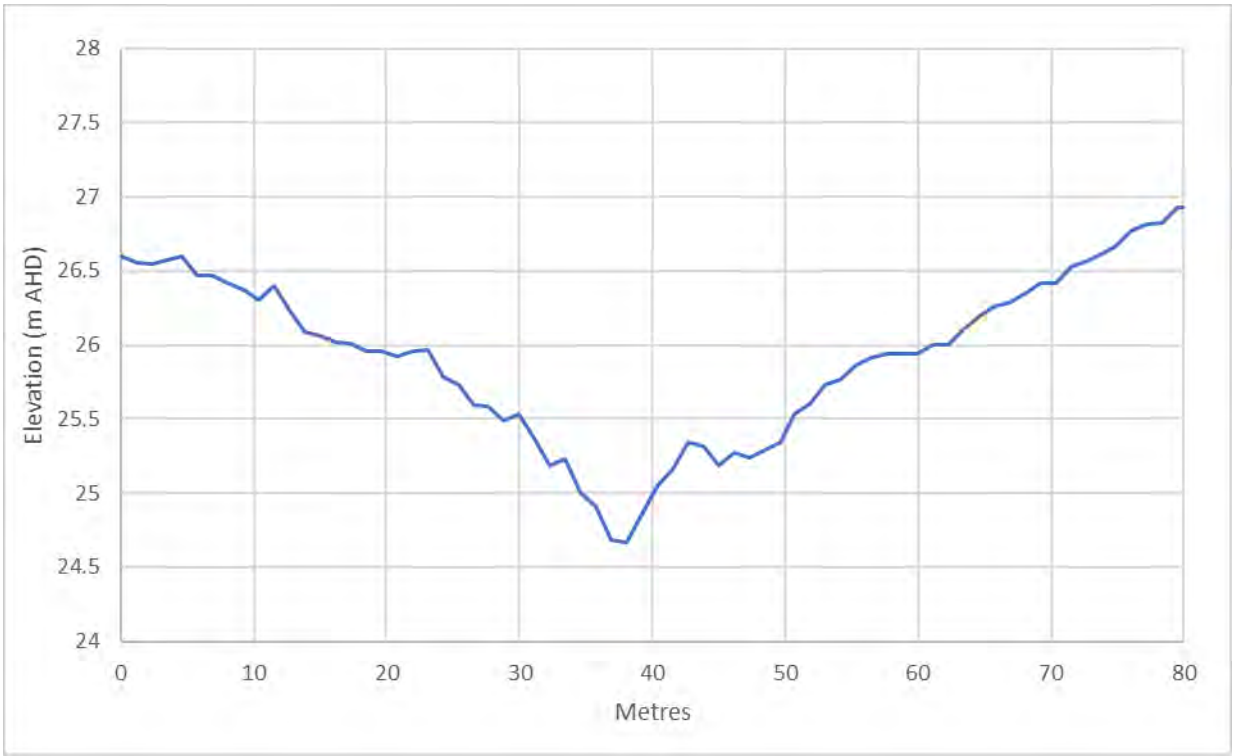


Figure E.3 KP 3.9 (Tributary of Weakleys Flat Creek) – Cross-Section at Waterway Crossing (Looking Downstream)

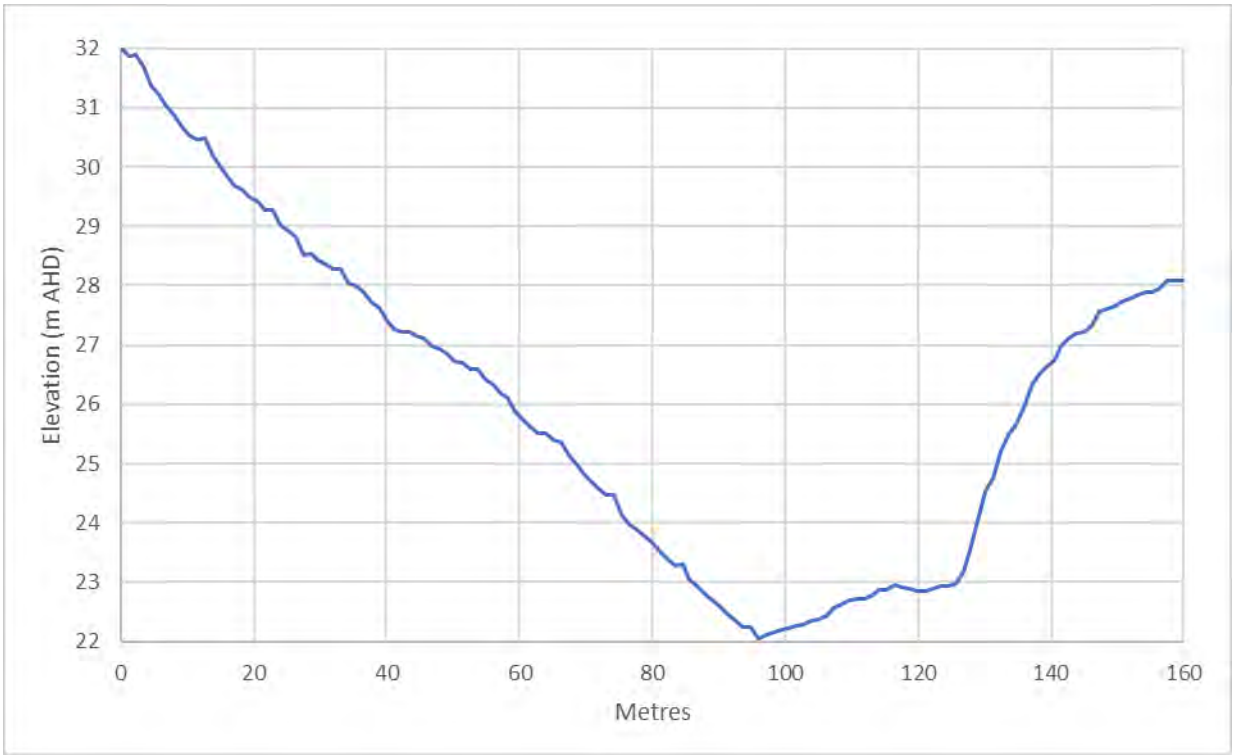


Figure E.4 KP 4.2 (Weakleys Flat Creek) – Cross-Section at Waterway Crossing (Looking Downstream)

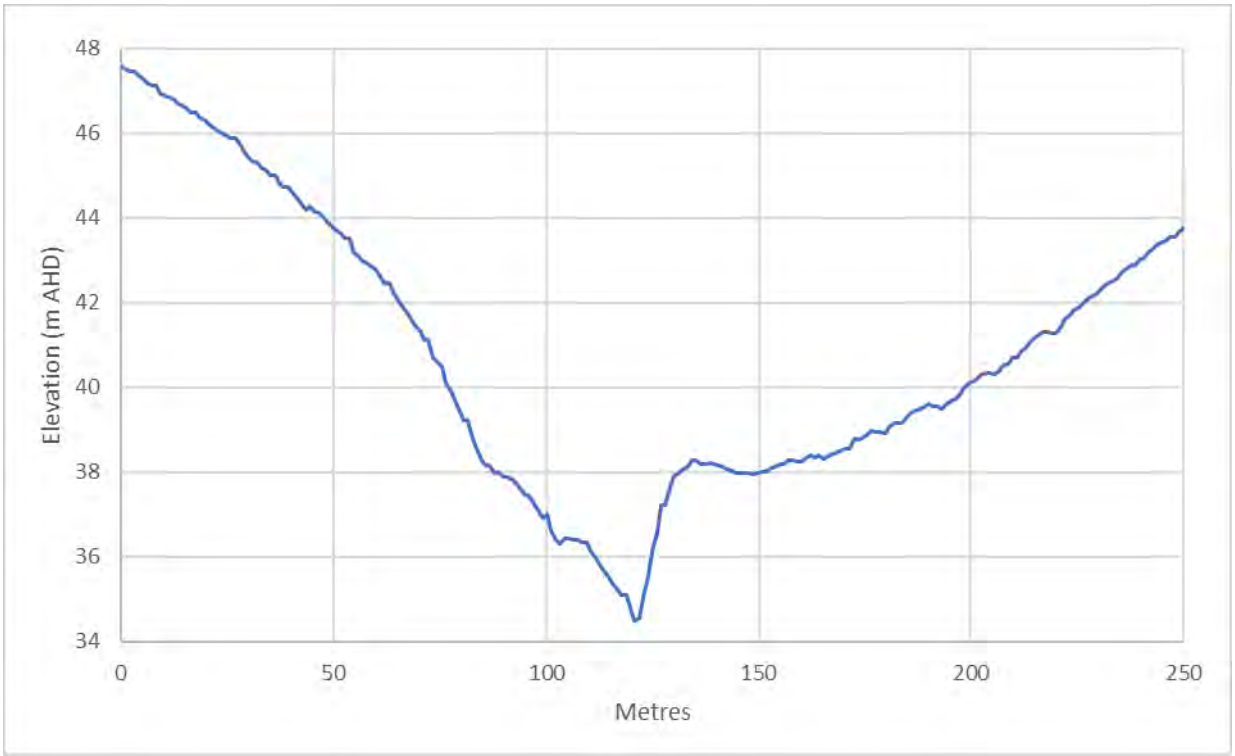


Figure E.5 **KP 5.9 (Four Mile Creek) – Cross-Section at Waterway Crossing (Looking Downstream)**

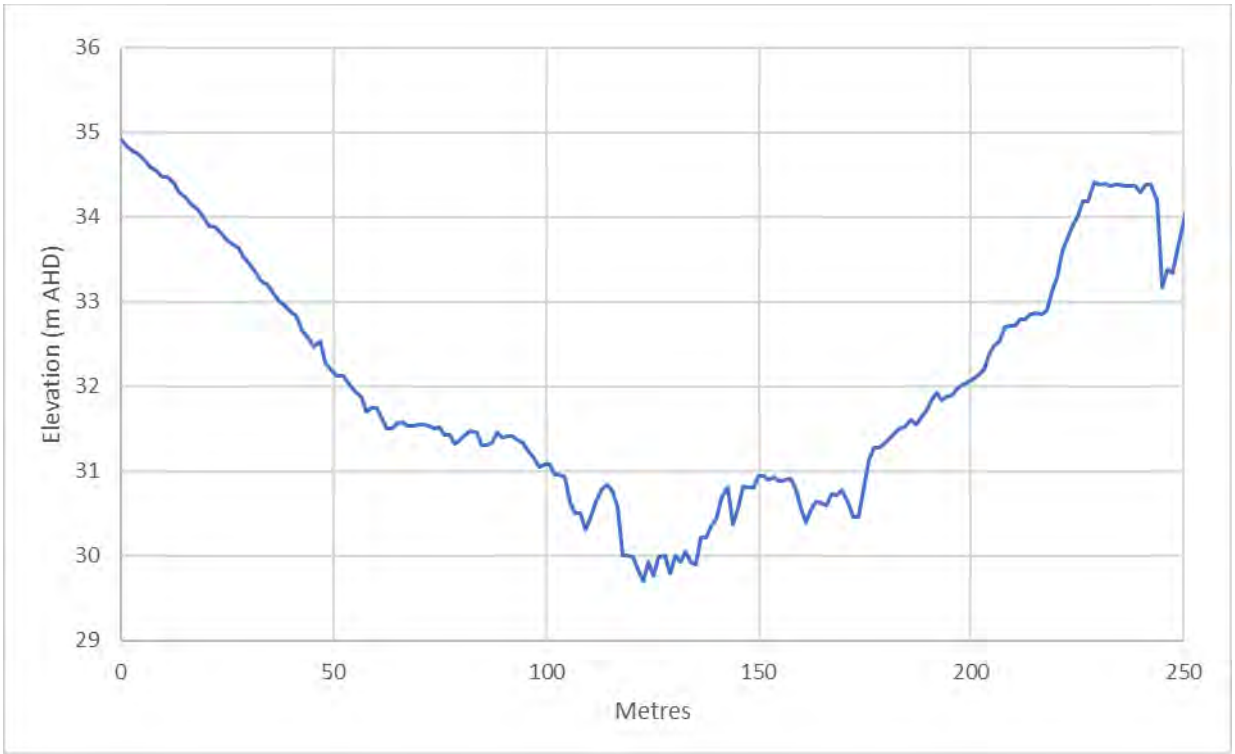


Figure E.6 **KP 7.3 (White's Creek) – Cross-Section at Waterway Crossing (Looking Downstream)**

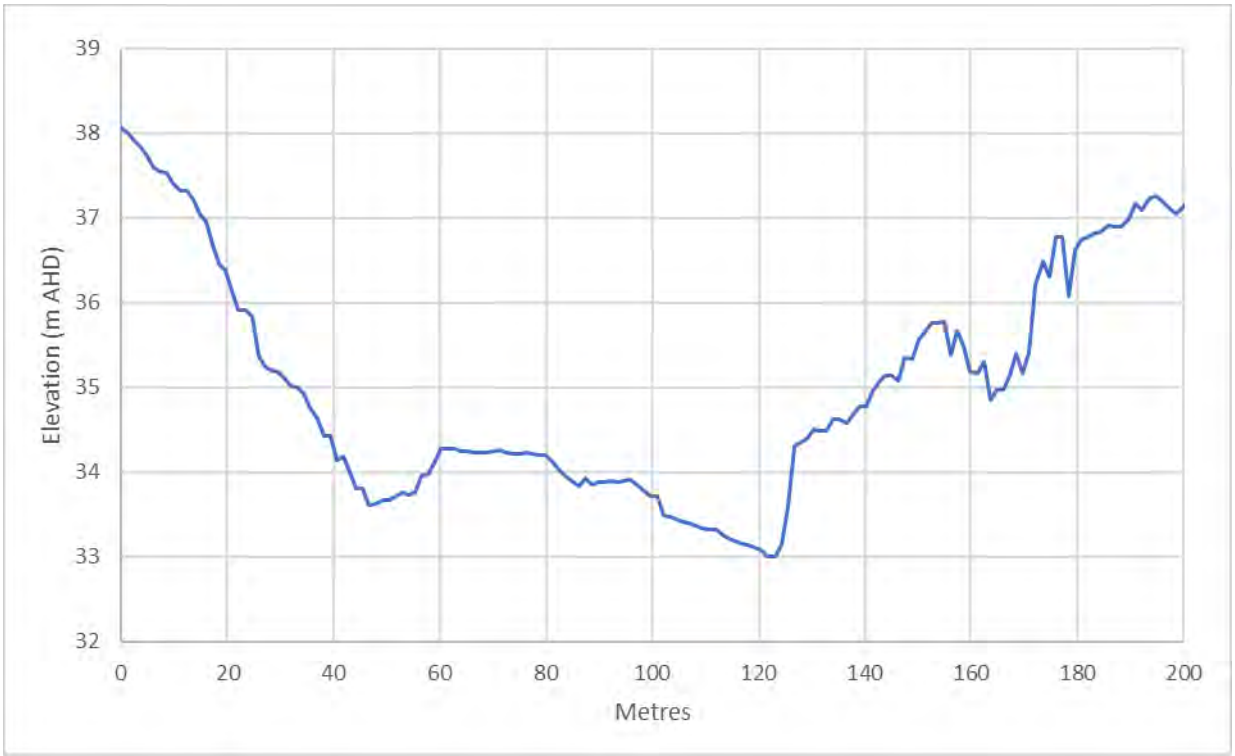


Figure E.7 KP 7.8 (Unnamed Watercourse) – Cross-Section at Waterway Crossing (Looking Downstream)

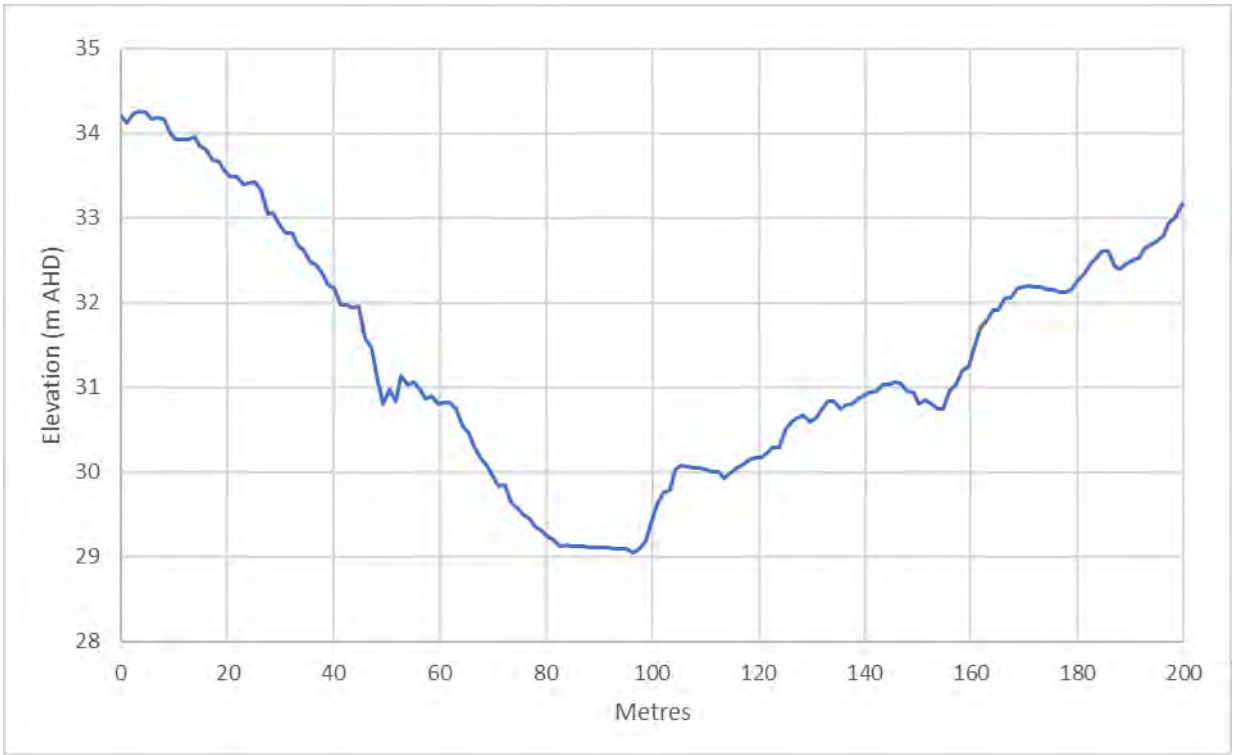


Figure E.8 KP 8.9 (Elwells Creek) – Cross-Section at Waterway Crossing (Looking Downstream)

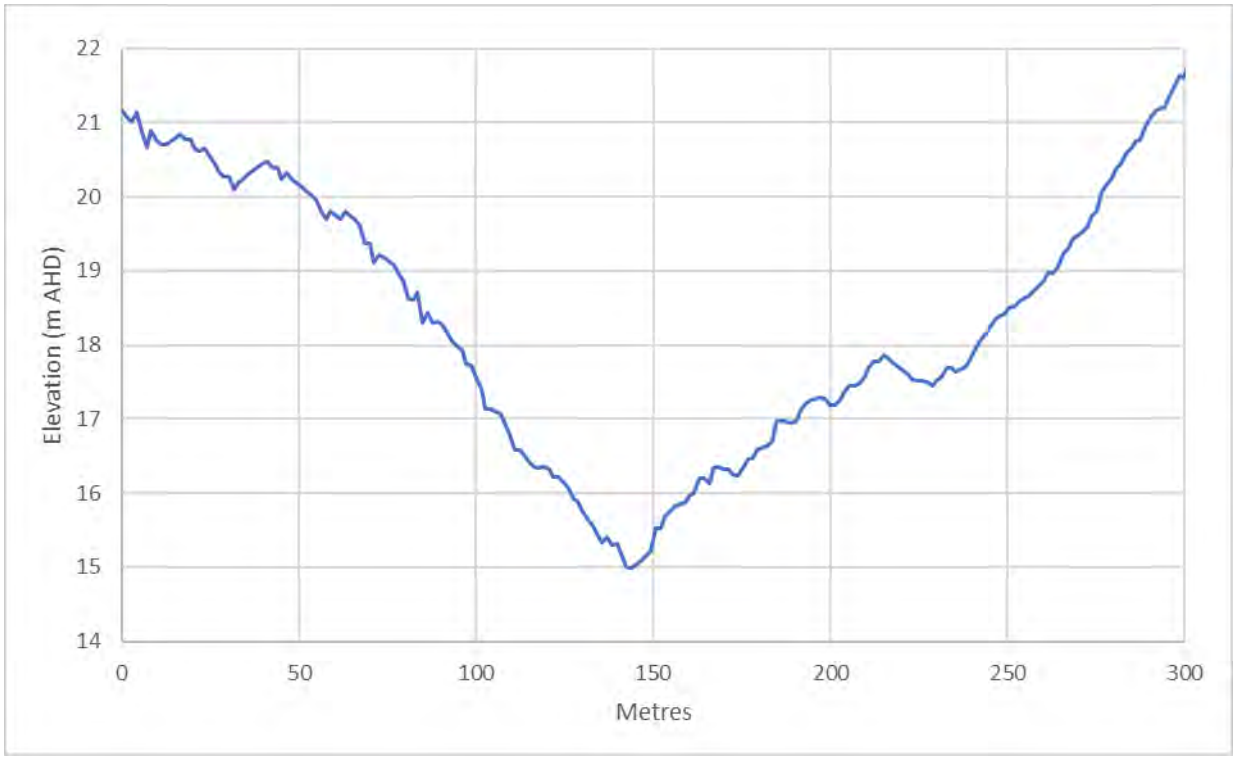


Figure E.9 KP 11.9 (Unnamed watercourse) - Cross-Section at Waterway Crossing (Looking Downstream)

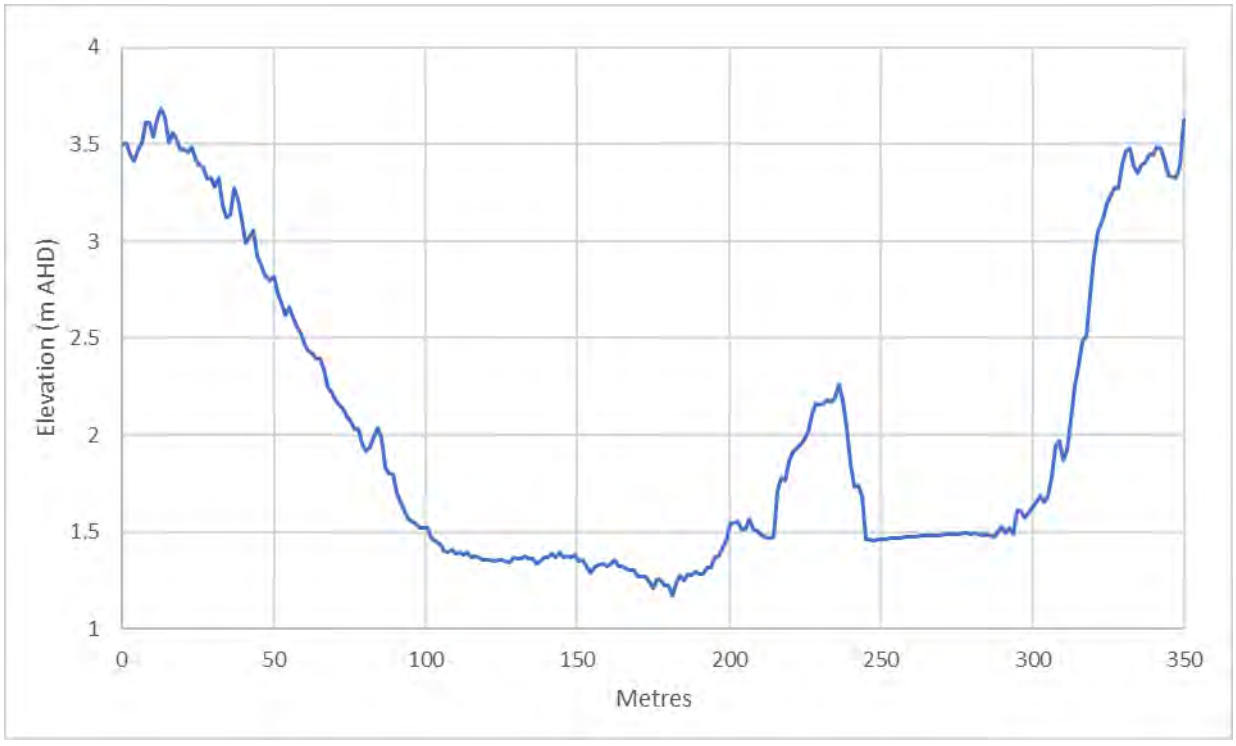


Figure E.11 KP 12.9 (Buttai Creek) – Cross-Section at Waterway Crossing (Looking Downstream)

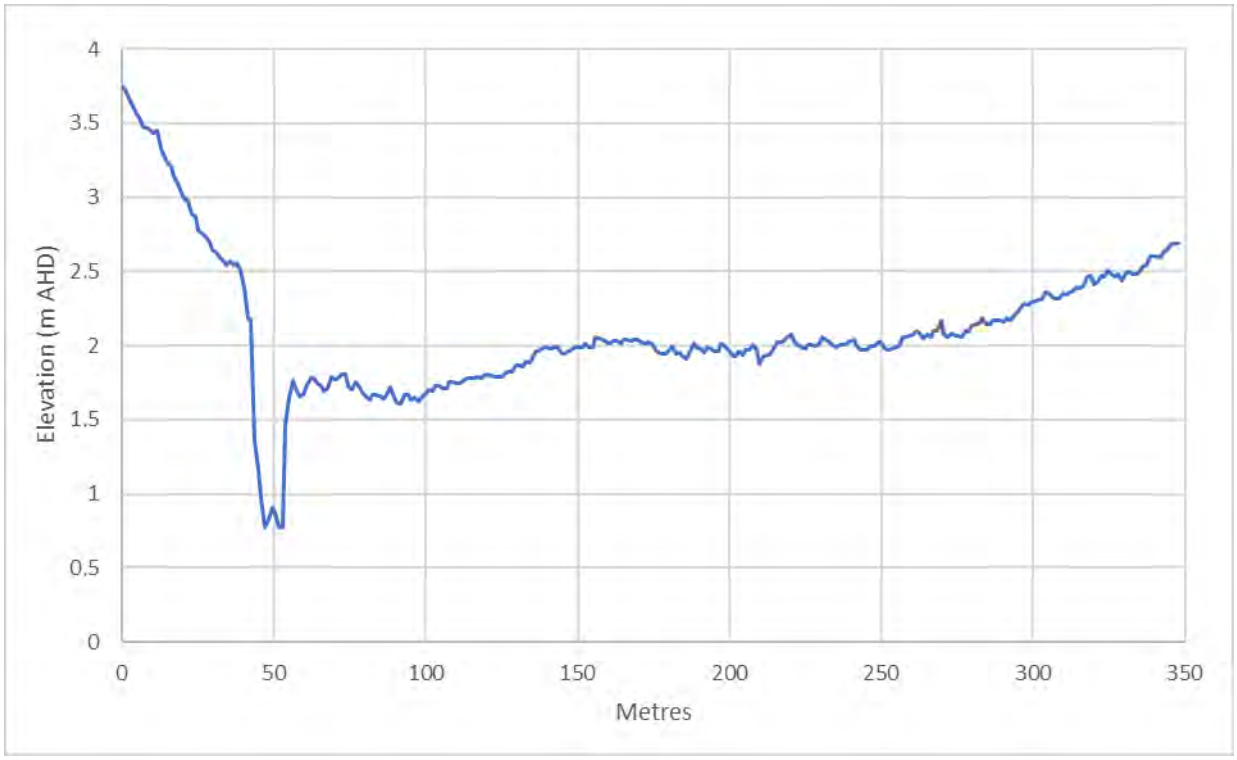


Figure E.12 KP 14.2 (Wallis Creek) – Cross-Section at Waterway Crossing (Looking Downstream)

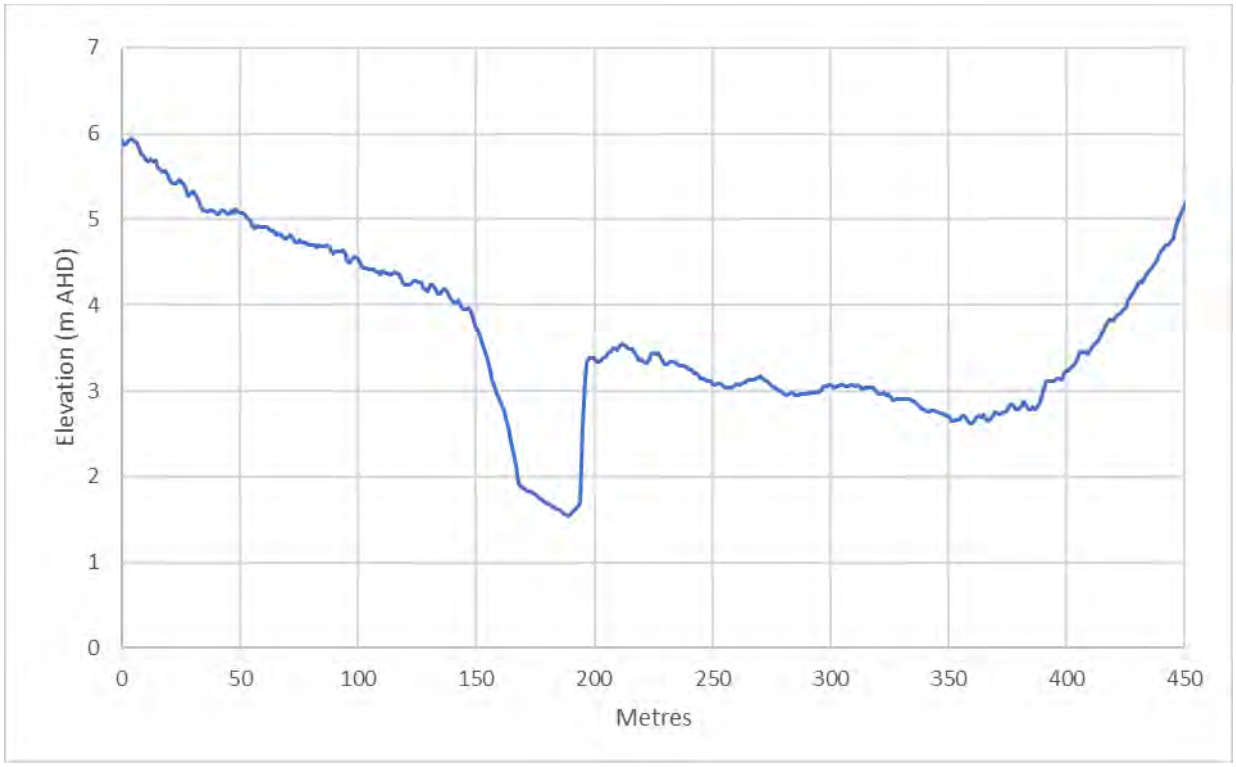
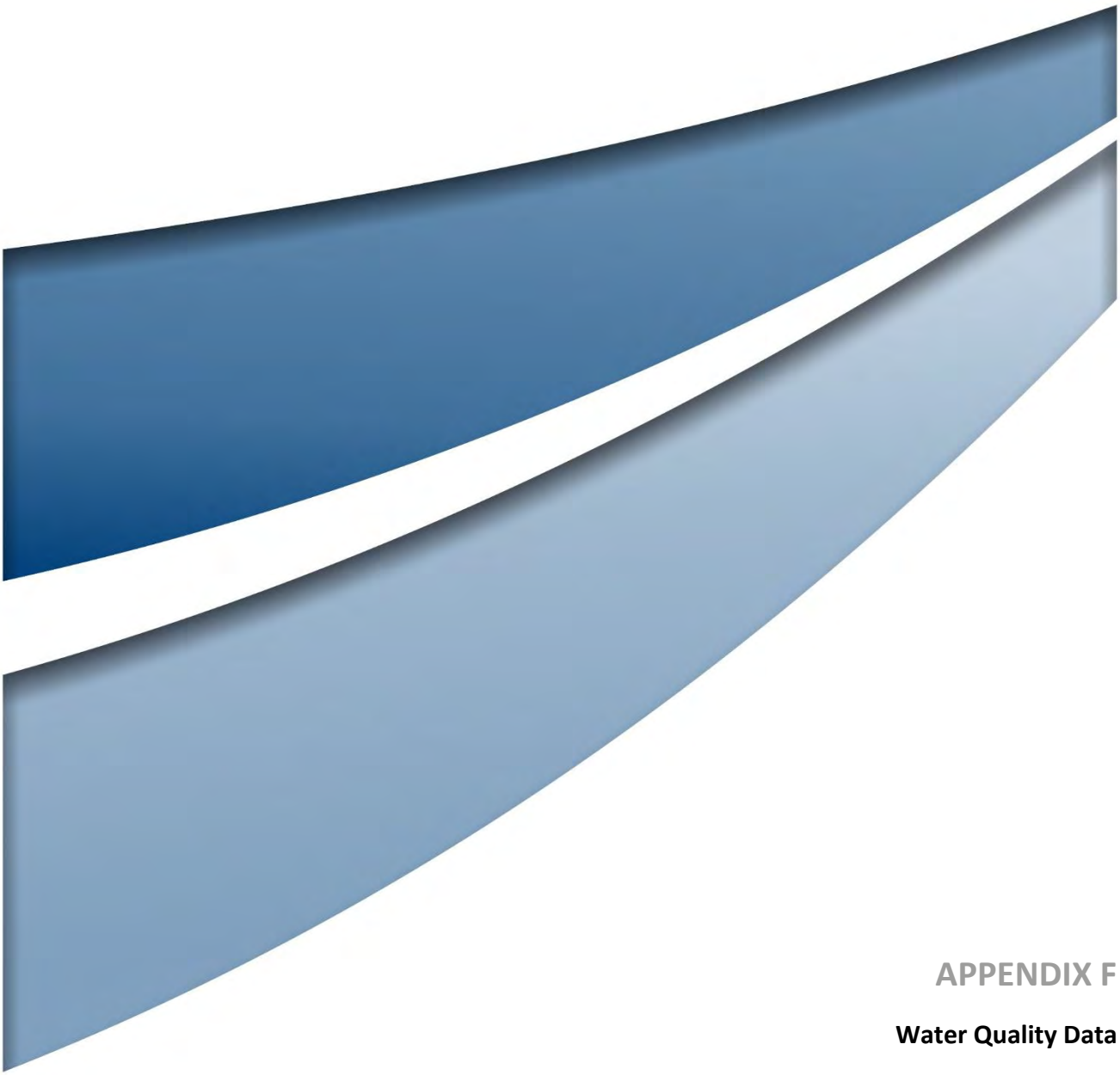


Figure E.13 KP 17.8 (Swamp Creek) – Cross-Section at Waterway Crossing (Looking Downstream)



APPENDIX F

Water Quality Data

Environmental Protection Licence- 12856

Download the current full EPL following the link below:
http://www.epa.nsw.gov.au/prpoeoapp/

Licence Details
Number: 12856
Anniversary Date: 09-July

Licensee
DONALDSON COAL PTY LTD
PO BOX 2275
GREENHILLS NSW 2323

Premises
ABEL UNDERGROUND MINE
1132 JOHN RENSHAW DRIVE
BLACK HILL NSW 2322

Scheduled Activity
Coal Works
Mining for Coal

Fee Based Activity
Coal works
Mining for coal

Scale
0-2000000 T handled
> 500000-2000000 T Produced

Region
North East- Hunter
Ground Floor, NSW Govt Offices, 117 Bull Street
NEWCASTLE WEST NSW 2302
Phone: (02) 4908 6800
Fax: (02) 4908 6810

PO Box 488G NEWCASTLE
NSW 2300


D6
D7
D11
D8
D9
Beresfield Golf Course PM10
Site 11
D4
DPZ-7A
DPZ-13
D12
DPZ-6
D10
D5A
Site 1
D3
JRD1
DPZ-12
Black Hill PM10
Black Hill TSP
D1
D2
Site 10
Site 8
Image © 2013 Sinclair Knight Merz
Google earth

Surface Water Monitoring (Abel Surface Water)

	Site 1			Site 8			Site 10			Site 11		
Frequency	Once a month			Once a month			Once a month			Once a month		
Date	pH	Conductivity (µS/cm)	TSS (mg/L)	pH	Conductivity (µS/cm)	TSS (mg/L)	pH	Conductivity (µS/cm)	TSS (mg/L)	pH	Conductivity (µS/cm)	TSS (mg/L)
23/04/09	6.6	720	4	7	490	4	7.1	1010	10	6.8	990	11
21/05/09	6.7	810	10	7.1	655	44	7.2	1060	5	7.1	930	3
25/06/09	7.4	500	15	7	625	<2	6.9	670	23	6.9	520	8
29/07/09	6.8	905	9	7	835	<2	7.2	1330	9			
26/08/09	7.3	1010	15	7.1	870	11	7.2	1710	16	7.1	1720	18
22/09/09	6.8	1070	5	6.9	755	10	7.4	1820	8	7.1	1700	10
21/10/09	6.8	1160	10				7.4	2120	3	7.1	1640	7
24/11/09	7.2	1160	22				7	1940	10	7	1610	26
22/12/09										7.5	1640	18
19/01/10										7.1	2200	37
15/02/10										6.6	1620	17
16/03/10										7.5	1500	8
13/04/10										7.1	1469	72
31/05/10												
24/06/10	5.8	459	19				7.2	1120	8	7.3	623	20
20/07/10	6.22	504	18	7.16	1110	2	7.12	1350	8	7.06	865	13
13/08/10	6.55	492	12	6.75	988	1	6.67	1220	10	6.89	602	13
22/09/10	7.05	464	4	7.14	947	3	7.25	1700	2	7.00	671	14
21/10/10	7.19	484	5	7.29	1010	2	7.59	1840	6	7.22	734	16
17/11/10	6.89	402	12	7.13	461	2	7.09	751	32	6.95	340	6
21/12/10	6.68	436	28	7.16	732	6	7.17	1410	10	6.85	493	36
11/01/11	6.92	536	36	7.19	943	<5	7.41	1680	5	7.05	568	18
11/02/11	6.73	424	100	7.25	624	49	7.16	519	31	7.44	1570	20
17/03/11				7.29	151	20				7.13	578	16
19/04/11				7.27	650	9	7.12	487	230	6.82	577	48
20/05/11				7.22	717	5	6.99	1203	5	6.87	320	22
23/06/11	6.55	607	25	6.63	771	20	6.69	854	25	6.56	757	14
22/07/11	6.59	227	38	6.6	255	16	6.65	248	74	6.54	200	91
24/08/11	6.93	527	24	6.81	301	14	7.11	821	102	6.93	1060	29
23/09/11	6.78	674	8	6.81	770	7	7.18	1410	<5	6.97	866	26
20/10/11	6.96	781	<5	7.09	932	<5	7.08	1150	6	7.13	606	624
24/11/11	7.05	455	173	6.97	217	18	7.23	285	342	7.22	1180	16
29/12/11	7.01	545	30	7.49	615	10	7.32	752	24	7.31	526	49
25/01/12	7.19	673	14	7.33	296	60	7.36	1440	33	7.56	494	85
20/02/12	7.29	388	44	7.5	480	20	7.47	618	30	7.4	393	25
20/03/12	7.04	687	16	7.64	668	16	7.51	850	18	7.31	767	8
23/04/12	7	579	36	7.44	448	12	7.5	753	24	7.25	510	16
18/05/12	6.96	1190	37	7.36	634	<5	7.54	1440	22	7.35	1010	78
19/06/12	6.97	699	22	7.35	841	<5	7.41	825	22	7.1	822	19
23/07/12	6.97	906	<5	7.3	431	32	7.66	1020	12			
23/08/12	7.13	1330	17	7.36	717	174	7.67	1520	9	7.43	1070	25
13/09/12	7.18	1590	17				7.62	1720	106	7.4	1290	95
15/10/12	7.24	1760	18				7.67	1750	12	7.62	1650	57
20/11/12										7.67	2550	108
20/12/12												
23/01/13												
25/02/13	6.9	483	28				7.08	724	18	6.72	391	23
13/03/13	6.97	922	24				7.47	1210	6	6.98	595	13
15/04/13	7.09	1030	8				7.42	1490	6	7.1	675	10
29/05/13	6.97	648	22				7.55	1070	38	7.16	603	15
11/06/13	6.97	702	<5				7.54	1240	<5	7.09	799	5
4/07/13	6.59	593	7				6.98	787	12	6.84	392	5
1/08/13	6.81	955	9				7.44	1350	<5	7.16	569	31
10/09/13	7.32	1120	18				7.81	1500	9	7.74	1040	609
14/10/13	7.28	1090	9				7.64	1920	<5	8.03	1260	126
6/11/13	7.21	1060	5				7.6	2060	34	7.05	585	16
17/12/13	6.72	706	9				7.02	1130	13	6.85	542	30
7/01/14	6.88	740	84				7.42	1270	6	7.32	896	66
3/02/14	7.3	865	10				7.66	1690	<5			
6/03/14	7.04	276	32				7.4	815	14	6.85	532	20
4/04/14	6.87	166	24				7.32	533	28	7.03	531	27
2/05/14	6.66	502	6				7.16	730	<5	6.77	513	<5
2/06/14	7.11	481	10				7.67	936	8	6.99	352	290
21/07/14	7.01	530	<5				7.49	1490	<5	7.07	756	<5
20/08/14	No Flow			No Flow			7.41	931	40	6.8	860	8
22/09/14	7.03	497	<5	No Flow			7.55	1120	<5	7.1	512	<5
28/10/14	7.01	420	18	No Flow			7.6	1410	22	7.29	585	24
21/11/14	No Flow			No Flow			7.15	1360	7	7.22	718	87
22/12/14	No Flow			No Flow			No Flow			No Flow		
20/01/15	6.52	218	64	5.55	116.3	17	7.02	673	104	6.17	229	51
18/02/15	6.44	2910	14	No Flow			6.95	766	<5	6.75	545	19
12/03/15	No Flow			No Flow			6.89	1107	<5	No Flow		
13/04/15	6.67	382	22	6.45	506	<5	6.69	803	<5	6.62	1334	53
15/05/15	6.28	838	6	6.15	478	<5	6.46	977	<5	6.23	1140	23
22/06/15	6.02	599	<5	5.97	482	<5	6.35	834	<5	6.15	1426	<5
14/07/15	6.97	872	<5	6.56	642	<5	7.03	1364	<5	7.22	1492	<5
31/08/15	5.8	762	<5	7.62	533	7	7.52	1315	<5	7.67	1072	7
29/09/15	7.3	698	15	7.25	499	<5	7.7	1237	<5	6.72	714	8
26/10/15	7.04	578	13	7.04	459	9	7.57	1332	8	6.92	822	18
27/11/15	7.27	442	<5	6.99	452	<5	7.38	1022	<5	7.13	1945	40
23/12/15	7.14	286	30	7.07	294	<5	7.28	901	6	7.08	626	10
28/01/16	6.85	765	6	7.22	545	<5	7.2	1215	6	6.87	828	6
18/02/16	7.09	1004	<5	7.04	541	<5	7.24	1230	<5	7.07	1091	16
18/03/16	7.4	1060	<5	7.34	556	<5	7.5	1421	5	7.39	1388	16
19/04/16	7.81	498	151	7.34	270	10	7.42	1484	6	7.69	1105	15
19/05/16	7.35	487	22	7.3	479	<5	7.35	1701	<5	7.53	1421	22
17/06/16	7.19	226	32	6.92	437	<5	7.23	1044	<5	7	901	6
19/07/16	7.41	238	12	6.96	427	<5	7.34	1267	<5	7.08	1245	14
24/08/16	7.09	432	<5	6.95	408	<5	7.22	1569	<5	7.34	972	7
21/09/16	7.34	374	10	6.91	374	<5	7.27	1303	<5	7.07	321	8
20/10/16	7.32	400	10	7.21	394	7	7.39	1653	8	7.29	152.1	10
24/11/16	7.34	403	10	7.13	398	<5	7.18	1893	11	7.16	154.2	<5
12/12/16	7	378	63	6.86	328	11	7.28	1946	12	No Flow		
17/01/17	6.91	259	113	No Flow			No Flow			6.51	142.1	9
15/02/17	6.93	443	16	No Flow			No Flow			6.6	171.9	22
23/03/17	6.34	404	<5	5.89	580	<5	6.76	1092	9	6.5	904	10
19/04/17	6.92	592	11	6.33	521	<5	6.85	1044	<5	6.94	978	10
19/05/17	6.93	603	17	6.7	685	16	7.34	1473	30	5.88	348	14

23/06/17	6.67	450	6	6.67	455	<5	6.68	811	8	6.75	1278	15
21/07/17	7.84	565	<5	7.04	506	<5	7	1438	<5	7.37	387	14
24/08/17	8.06	494	<5	7.33	536	<5	7.27	1361	<5	7.31	476	176
22/09/17	7.41	586	37	7.21	581	28	6.89	2071	30	7.64	222	24
19/10/17	No Flow			No Flow			7.07	2240	111	No Flow		
16/11/17	7.27	202.1	33	6.28	348	<5	7	456	21	No Flow		
14/12/17	6.38	242	24	No Flow			6.43	1185	41	No Flow		
24/01/18	No Flow			No Flow			No Flow			6.69	178.2	16
23/02/18	No Flow			No Flow			No Flow			6.59	158.9	13
14/03/18	No Flow			6.87	389	7	6.91	1071	235	7.03	275	<5
17/04/18	7.14	580	10	6.85	583	8	6.82	1121	16	7.4	311	<5
24/05/18	7.08	625	10	6.8	650	9	7.35	1436	<5	7.2	182.8	<5
27/06/18	6.96	302	9	6.15	410	<5	6.96	1157	8	6.85	359	<5
25/07/18	No Flow			7.13	630	24	7.19	1776	11	7	276	5
30/08/18	7.28	253	31	No Flow			7.25	1343	<5	6.95	134.4	<5
27/09/18	6.87	225.6	57	No Flow			6.9	1469	5	6.85	139.9	<5
24/10/18	6.68	486	<5	6.58	367	<5	6.98	1077	<5	6.74	272	<5
21/11/18	6.74	324	10	6.89	441	12	6.94	1437	12	6.74	182.9	22
19/12/18	6.41	294	15	6.32	326	6	6.95	523	23	6.65	204	14
23/01/19	6.92	350	15	No Flow			6.78	1676	9	7.26	163.5	<5
20/02/19	6.98	443	26	No Flow			No Flow			7.26	196.6	10
26/03/19	6.55	193.9	50	6.41	498	26	6.54	410	28	6.94	214	<5
17/04/19	5.73	329	27	6.3	275.2	10	6.64	673.7	22	7.25	241	<5
24/05/19	6.83	330	48	No Flow			6.85	961	10	6.94	249	<5
20/06/19	7.1	294	NR	No Flow			6.82	1027	NR	7.09	238	NR
17/07/19	7	296.6	15	7.2	451.3	11	7.36	751.6	<5	7.37	183.9	<5
23/08/19	No Flow			No Flow			7.19	1004	9	7.47	257	<5
26/09/19	6.76	315	20	No Flow			7	666	10	7.27	588	10
24/10/19	7.13	341	<5	No Flow			7.7	931	8	7.68	160.3	<5
29/11/19	6.72	369	44	No Flow			7.28	1100	6	6.65	314	24
19/12/19	No Flow - Dry			No Flow - Dry			7.23	1285	12	6.65	366	38
17/01/20	No Flow - Dry			No Flow - Dry			No Flow - Dry			6.94	527	16
17/02/20	6.62	272.7	16	6.33	469	15	6.82	600	29	6.55	662	32
18/03/20	7.26	295	36	6.8	474	522	6.96	359	8	9.28	549	14
20/04/20	6.74	291.1	15	6.7	585.8	<5	7.15	749.6	12	6.71	714.6	20
18/05/20	7.3	253.2	<5	6.94	327.7	6	7.23	851	20	6.75	597.3	8
19/06/20	7.26	172.3	46	6.68	380.1	<5	7.42	468.3	9	7.37	1216	10
17/07/20	7.07	250.8	13	6.29	235.8	<5	7.35	366	15	8.73	947	76
18/08/20	6.82	583	6	6.64	507	<5	7.3	864	6	6.87	915	7
17/09/20	7.05	564	5	6.31	559	7	7.43	1051	5	7.02	888	7
19/10/20	7.11	524	42	6.39	480	11	7.28	1300	13	7	976	22
19/11/20	6.86	450	14	6.31	431	8	6.99	940	6	6.99	1416	<5
21/12/20	7.01	394	25	6.43	546	8	7.25	707	5	6.91	1169	25
27/01/21	6.99	457	28	6.6	607	8	6.97	1439	14	7	957	8
23/02/21	6.98	360	14	7.1	488	7	6.97	426	15	7.07	1289	20
23/03/21	6.34	223.4	42	6.15	194.3	31	6.26	194.8	28	6.57	222.7	40
28/04/21	6.85	720.1	8	6.88	538.8	<5	7.26	1175	<5	7	1113	9
25/05/21	7.05	999	8	6.74	656	<5	6.74	656	<5	7.52	1690	23
24/06/21	7.32	884.8	6	6.92	588.5	6	7.4	1682	5	7.13	1369	14
26/07/21	7.09	934.8	5	6.57	594	<5	7.34	1768	<5	6.95	1612	<5
27-Aug-21	7.12	785.5	17	6.63	311.3	13	7.37	1193	6	7.08	3078	10

NR-not recorded-lab did not log TSS and therefore test not conducted.

Groundwater Monitoring

Frequency	DPZ-6 Once a month				DPZ-13 Once a month				JRD1 Once a month				DPZ-7A Once a month				DPZ-12 Once a month			
Date	Depth (m)	pH	Conductivity (µS/cm)	TSS (mg/L)	Depth (m)	pH	Conductivity (µS/cm)	TSS (mg/L)	Depth (m)	pH	Conductivity (µS/cm)	TSS (mg/L)	Depth (m)	pH	Conductivity (µS/cm)	TSS (mg/L)	Depth (m)	pH	Conductivity (µS/cm)	TSS (mg/L)
21/04/09	26.89	6.7	3300	192	7.17	6.8	14370	<2					22.71	6.5	2050	196	16.07	6.9	7900	727
20/05/09	27.23	6.7	4290	136	7.11	6.9	13060	18					22.87	6.8	2460	264	21.6	6.8	11730	454
24/06/09	27.72	6.6	4390	459	7.04	6.9	12500	15					22.95	6.6	2050	551				
28/07/09	28.14	6.7	4470	945	7.07	6.8	14570	25					23.09	6.6	2290	103	16.1	6.8	5370	1380
27/08/09	24.48	6.9	4570	807	7.04	6.9	13400	20					23.98	6.7	2330	16	24.15	6.7	8120	15
24/09/09	29.6	6.5	4490	119	8.94	6.7	13170	14					24.64	6.8	2430	12				
21/10/09	24.66	6.7	4220	51	7.07	6.8	12580	12					23.5	6.8	2110	147				
23/11/09	30.7	6.7	4840	266	8.27	6.8	12620	14					25	6.8	2270	246				
23/12/09	30.56	6.9	4130	193	8.28	7	11160	26					24.63	6.8	2350	14				
20/01/10	29.99	6.6	4960	173	7.66	6.8	13110	31					23.19				20.67	6.7	13200	37
16/02/10	31.63	6.6	4840	193	8.36	6.8	12890	28					23.17				17.74	6.4	8370	46
15/03/10	31.2			394	7.57			32					23.2				17			30
15/04/10	31.24	6.7	4210	397	7.54	6.8	2255	18					23.2				17.01	6.6	8895	67
31/05/10		6.89	1590	268									35.2				18.2	6.75	8310	34
28/06/10	33.8	6.86	3320	206	7.6	7.63	10300	12					24.1				16.3	7.29	3200	63
27/07/10		7.23	3920	194	7.76	6.64	13100	6	34.7	6.65	3520	22	24.86	6.81	2630	22	16.69	6.41	7790	50
23/08/10		6.37	4020	234	7.75	6.65	13400	16	32.98	7.24	3960	22	24.91	6.8	2680	62	16.83	6.85	7840	12
21/09/10		7.05	3700	412	7.73	6.78	11800	5	32.28	8.03	3840	16	24.96	4.76	2580	36	17.61	6.78	7800	22
13/10/10		6.58	2320	152	7.71	6.99	12000	9	31.93	8.05	4380	76	25.04	7.03	2660	86	18.15	6.6	10800	17
9/11/10		6.64	1090	141	7.78	6.97	13100	10	34.24	8.34	4720	57	25.09	7.21	2870	65	16.06	6.44	3260	30
9/12/10		6.54	1410	244	7.4	6.84	11000	5	31.88	8.31	4460	229	25.7	7.01	2670	232	16.23	6.31	2390	71
24/01/11		6.51	3020	708	7.27	6.86	12400	30	32.28	7.87	4990	51	24.99	6.92	2800	68	17.63	6.39	7560	40
7/02/11		6.47	2850	173	7.37	6.60	12400	25	31.4	7.93	4660	69	25.05	6.80	2760	147	18.51	6.35	7480	94
10/03/11		6.68	2590	380	7.43	6.86	12200	24	31.08	8.23	4710	32	25.09	7.04	2560	39	19.05	6.58	13800	12
7/04/11		7.36	3950	287	7.33	7.54	14300	12	31.14	8.38	4840	24	25.03	7.69	2780	150	19.15	7.46	14200	82
9/05/11		6.7	4140	84	7.15	6.88	12600	42	30.5	8.2	4970	76	24.87	7.01	2860	18	17.97	6.5	9230	24
7/06/11	34.73	6.72	4020	143	7.03	6.99	8970	16	30.35	8.18	4750	26	24.81	6.84	2720	18	16.33	6.46	6820	18
13/07/11	29.84	7.17	4120	123	7.1	7.37	11000	14	36.02	8.18	4720	18	24.64	7.2	2380	40	16.6	6.7	1840	210
12/08/11	29.36	6.78	3530		7.49	6.98	3770		33.25	8.25	4640		24.5	6.47	2160	258	16.38	7.33	1540	
13/09/11	31.74	6.77	3890	144	7.41	6.89	11000	17					24.6	6.56	2190	154	16.38	6.29	4560	40
11/10/11	27.32	6.69	2370	94	8.08	6.88	10200	36					24.22	6.31	1540	113	16.18	6.01	1080	108
9/11/11	31.1	7.28	3730	194	8	7.34	11400	15	29.72	8.25	4620	52	24.36	7.06	2010	15	16.14	6.83	4290	101
7/12/11	31.86	7.04	2680	262	8.01	7.28	9180	66					24.22	6.78	2050	142	15.82	6.18	2720	80
11/01/12	33.13	7.08	2740	542	8.14	7.24	11000	21	28.18	8.17	4120	36	24.42	7.18	2190	240	16.47	6.35	9120	22
9/02/12	31.91	7.1	3260	66	8.33	7.21	8210	22	29.78	8.26	4260	14	24.13	7.21	2180	40	16.12	6.12	1460	27
8/03/12	31.38	7.11	3140	35	8.09	7.03	3710	14	27.08	8.05	4170	40	24.18	7.04	2190	124	13.1	6.17	517	46
16/04/12	32.05	7.29	3120	222	11.93	7.25	11600	108	29.28	8.18	4500	57	24.69	7.55	2740	105	15.88	6.5	2170	161
10/05/12	32.2	7.16	3170	174	12.47	7.34	11200	80	30.43	8.17	4380	26	24.84	7.49	2720	106	16.36	6.37	1250	130
13/06/12	34.79	7.04	662	6400	13.03	7.3	7560	87	32.19	8.36	4280	40	24.36	7.14	2340	78	12.69	6.28	452	40
11/07/12	31.56	7.15	3320	384	13.04	7.25	11200	57	28.65	8.63	4590	54	23.73	7.47	2750	94	16.16	6.44	1980	84
8/08/12	34.97				13.2	7.48	9580	63	32.16	8.41	4530	17	24.83	7.41	2760	78	16.26	6.39	1030	63
5/09/12					14.7	7.37	11500	19	31.46	8.42	4550	22	24.86	7.53	2820	166	16.54	6.57	1400	99
11/10/12					16.62	7.29	12400	11	31.55	8.44	4660	12	25.3	7.08	2410	61	17.29	6.59	1910	118
15/11/12					18.14	7.09	12400	44	31.5	8.31	4730	8	25.86	7.07	2490	232	17.87	6.78	3060	96
13/12/12					18.83	7.56	11600	66	30.59	8.41	4480	22	25.68	7.1	1190	90	18.44	7.42	4340	93
9/01/13					19.39	7.45	12100	158	32.55	8.3	4590	22	25.62	6.78	2170	34	18.28	7.02	5770	130
7/02/13					19.57	7.4	8840	69	30.68	8.26	4810	31	25.02	7.38	2760	16	16.11	6.45	1010	27
11/03/13					24.93	7.26	6050	328	30.24	8.33	4460	38	24.74	7.19	2550	18	15.95	6.31	636	73
11/04/13					24.95	7.4	7330	280	30.85	8.31	4540	32	25.5	6.79	1280	72	16.14	6.73	1800	61
28/05/13	38.06				24.93	7.46	6660	130	30.52	8.37	4610	37	24.09	7.12	2160	136	16.63	6.78	2520	81
14/06/13	38.15				24.93	7.62	6280	136	29.74	8.28	4560	94	24.94	6.98	2910	<5	16.2	6.92	3750	664
8/07/13	38.18	6.45	807	11600	23.4	7.2	6910	1520	30.27	8.46	4350	68	24.82	7.26	2530	1620	21.08	6.85	4200	3530
12/08/13	37.82	6.86	2590	6840	24.93	7.82	10200	820	29.64	8.26	4320	150					18.35	7.02	5310	3070
3/09/13	37.78	7.04	2410	4800	24.94	7.42	5950	180	30.16	8.04	4390	30					20.38	6.9	6590	892
16/10/13	37.92	6.69	2350	2560	24.9	7.49	5320	43	29.85	8.31	4350	9					20.12	7.12	9590	157
12/11/13	37.95	7.06	2300	207	24.92	7.64	5950	22	29.42	8.39	4560	18					18.92	6.94	11100	332
3/12/13	38.02	6.81	967	44	24.95	7.42	5670	118	28.66								16.06	6.07	1940	14
13/01/14	37.64	6.86	2260	655	24.94	7.28	6170	135	31.24	8.39	4440	45					17.03	6.74	8240	120
18/02/14	37.34	7.12	2350	1950	24.96	7.51	6430	78	28.28	8.35	4520	28								
20/03/14	37.32	6.98	2240	512	24.96	7.47	5480	133	27.98	8.35	4220	70								
23/04/14	36.1	7.21	2400	790	24.98	7.61	8120	531	28.22	8.36	4330	121								
26/05/14	36.01	7.04	2350	3590	24.97	7.3	5260	36	31.52	8.35	4200	57								
Jun-14																				
28/07/2014	36.64	7.04	2110	872	24.93	7.43	5380	415	29.37	8.35	4100	18								
29/08/2014	39.5	6.64*	174*	2220*	24.94	6.48	4350	#	29.2	8.51	3990	63								
26/09/2014	35.71	7.29	2370	1300					31.65		*									
30/10/2014	35.5	7.58	2400	342	24.93	7.33	5280	22												
27/11/2014	35.69	7.29	2500	63	24.93	7.35	6130	88												
30/12/2014	35.74	6.75	2280	234	24.93	7.15	4910	75												
30/01/2015	35.82	6.64	2190	550	24.98	7.06	5490	75												
27/02/2015	35.13	6.74	2310	38	24.99	6.97	5480	40												
27/03/2015	34.96	6.78	2350	424	24.98	6.91	5890	76												
30/04/2015	34.08	6.45	2440	626	24.97	6.68	3220	86												
29/05/2015	33.76	6.53	2270	44	24.97	6.95	4030	27												
30/06/2015	33.76	6.47	2290	38	25	6.92	4250	71												
30/07/2015	33.76	6.94	2099	90	24.94	7.28	2540	94												
28/08/2015	33.67	7.4	2260	62	24.96	7.45	4780	122												
29/09/2015	34.11	6.65	2399	31	24.96	7.1	4810	62												
28/10/15	34.14	6.74	2267	68	24.96	7.01	4040	23												
26/11/15	34.17	6.83	2450	103	24.95	6.9	4350	17												
18/12/15	34.24	6.81	2417	342	24.97	7.15	5290	30												
21/01/16	33.83	6.72	2425	128	24.94	7.03	3060	584												
17/02/16	34.17	6.64	2580	63	24.97	6.89	3670	20												
17/03/16	34.2	6.67	2650	25	24.92	6.99	4410	33												
20/04/16	33.8	6.72	2194	50	24.95	7.13	4240	31												
18/05/16	34.33	6.8	2550	154	24.95	6.99	4840	45												
16/06/16	34.18	6.7	2230	148	24.96	6.99	4540	19												
19/07/16	34.07	6.68	2390	47	24.95	7.09	5310	146												
24/08/16	32.32	6.68	2560	10	24.95	6.98	4200	9												
22/09/16	32.67	6.73	2480	65	24.95	7.06	4040	10												
21/10/16	33.16	6.9	2560	148	24.93	7.06	4240	18												
23/11/2016	33.06	6.83	2550	160	24.96	7.09	4200	14												
13/12/16	33.62	6.57	2502	47	24.93	6.98	4520	30												
16/01/17	32.8	6.93	2469	152	24.96	7.02	4260	22												
15/02/17	33.38	6.68	2163	89	24.95	6.87	4250	46												
23/03/17	33.86	6.62	2470	100	24.98	6.93	4560	42												
20/04/17	33.16	6.6	2219	104	No access															
19/05/17	33.66	6.69	2350	98	No access															
22/06/17	33.28	6.54	1720	30	No access															
20/07/17	33.24	6.53	2230	92	No access															
24/08/17	32.96	6.75	2130	611	No access															
22/09/17	33.92	6.63	2250	183	No access															
18/10/17	33.33	6.51	2340	55	No access															
15/11/17	33.37	5.44	363	658	No access															
15/12/17	36.69	5.93	1875	378	No access															
25/01/18	33.97	Dry Bore			No access															
22/02/18	33.84	5.87	202.8	190	No access															
16/03/18	33.5	5.98	170.6	27	No access															
18/04/18	33.52	6.59	2220	114	No access															
25/05/18	33.59	6.8	2180	108	No access															
28/06/18	33.24	6.67	2400	38	No access															
26/07/18	33.99	6.66	2310	34	No access															
29/08/18	34.19	6.26	2036	161	No access															
26/09/18	34.35	6.64	2280	37	No access															
25/10/18	34.29	6.63	2240	72	No access															
22/11/18	34.39	6.78	2360	27	No access															
20/12/18	33.63	6.26	1177	616	No access															
23/01/19	34.34	6.59	2420	77	No access															
21/02/19	34.59	6.82	2310	60	No access															
21/03/19	34.72	6.65	2170	134	No access															
17/04/19	34.91	6.7	2340	74	No access															
23/05/19	35.16	6.84	2360	55	No access															
21/06/19	35.25	6.7	1960	28	No access															
17/07/19	35.24	6.77	1997	90	No access															
22/08/19	35.26	6.88	1350	26	No access															
25/09/19	35.31	6.66	2080	26	No access															
23/10/19	35.2	6.89	2404	23	No access															
27/11/19	35.18	6.96	2370	28	No access															
18/12/19	35.25	6.93	2410	18	No access															
15/01/20	35.4	6.76	2210	42	No access															
14/02/20	34.15	No Water			No access															
17/03/20	35.13	6.76	2615	443	No access															
22/04/20	34.74	6.92	2710	46	No access															
19/05/20	34.85	6.88	2689	70	No access															
19/06/20	35.12	5.89	188.4	75	No access															
16/07/20	35.49	5.96	275	168	No access															
20/08/20	35.65	5.77	271.9	124	No access															
18/09/20	35.34	6.84	2065	627	No access															
16/10/20	35.19	6.64	2391	181	No access															
16/11/20	33.82	5.88	120.3	127	No access															
23/12/20	35.48	6.58	2116	526	No access															
21/01/21	35.37	6.76	1825	164	No access															
19/02/21	34.72	6.13	138.7	126	No access															
26/03/21	34.94	6.03	602.2	203	No access															
22/04/21	34.32	6.71	2484	20	No access															
20/05/21	34.29	6.7	2166	81	No access															
18/06/21	34.2	6.65	2103	55	No access															
22/07/21	34.58	6.61	2267	70	No access															
18/08/21	34.58	6.61	2308	44	No access															

Damaged- Blocked

Damaged- Blocked

Bore Damaged

Surface Water Quality Monitoring

Download the current full EPL following the link below:

http://www.epa.nsw.gov.au/prpoeoapp/

Licence Details Conductivity

Number: 11080

Anniversary Date: 13-September

Licensee

DONALDSON COAL PTY LTD

PO BOX 2275

GREENHILLS NSW 2323

Premises

DONALDSON COAL PTY LTD

RENSHAW

MAITLAND NSW 2320

Scheduled Activity

Coal Works

Mining for Coal

Fee Based A Scale

Coal works 0-2000000 T handled

Mining for co > 500000-2000000 T Produced

Region

North East- Hunter

Ground Floor, NSW Govt Offices, 117 Bull Street

NEWCASTLE WEST NSW 2302

Phone: (02) 4908 6800

Fax: (02) 4908 6810

PO Box 488G NEWCASTLE

NSW 2300


D6
D7
Reg DPZ-1
D11
SDCD
D8
D9
Beresfield Golf Course PM10
SDCU
FMCD
WFCD
DPZ-3
DPZ-10
WFCU
DPZ-8
D4
DPZ-7A
FMCU
DPZ-6
DPZ-13
D12
D10
D5A
D3
DPZ-12
Black Hill TSP
D1
Black Hill PM10
D2
Image © 2013 Sinclair Knight Merz
Google earth
2007
Imagery Date: 12/19/2009 32°48'30.64" S 151°37'08.44" E elev 42 m eye alt 11.67 km

Surface Water Quality Monitoring

FMCU Once a month			FMCD Once a month			SDCU Once a month			SDCD Once a month			WFCU Once a month			WFCD Once a month			Lab Details			
pH	onductiv (µS/cm)	Conductivity (mg/L)	pH	onductiv (µS/cm)	TSS (mg/L)	pH	onductiv (µS/cm)	TSS (mg/L)	pH	Conductivity (µS/cm)	TSS (mg/L)	pH	onductiv (µS/cm)	TSS (mg/L)	pH	onductiv (µS/cm)	TSS (mg/L)	Sent	Received	ublished	Comment
6.8	325	17	7	200	51	5.3	390	354	5.9	170	22	6.8	330	32	6.9	460	70				
6.8	550	10	6.8	170	2	5.5	420	66	6	170	65	7	500	12	6.7	395	12				
7.1	270	12	7	230	20	6	260	15	5.8	195	60	6.8	300	54	6.6	250	237				
6.5	570	23	6.8	145	69	6.2	340	131	6.1	210	60	6.6	770	5	6.5	600	38				
7.2	680	21	7.3	140	<2	6.7	370	70	6.4	220	15	6.7	2010	46	6.7	1110	45				
									6.9	210	52	6.8	1490	32	7	920	10				Not Sampled (FMCU, FMCD, SDCU)
																					Not Sampled (FMCU, FMCD, SDCU, SDCD, WFCU, WFCD)
												7.1	510	30							Not Sampled (FMCU, FMCD, SDCU, SDCD, WFCD)
												6.9	1180	48							Not Sampled (FMCU, FMCD, SDCU, SDCD, WFCD)
												6.8	670	15							Not Sampled (FMCU, FMCD, SDCU, SDCD, WFCD)
												6.9	605	4							Not Sampled (FMCU, FMCD, SDCU, SDCD, WFCD)
																					Not Sampled (FMCU, FMCD, SDCU, SDCD, WFCU, WFCD)
																					Not Sampled (FMCU, FMCD, SDCU, SDCD, WFCU, WFCD)
7.03	328	14	7.9	165		7.2	220	110	5.67		96	7.18		53	6.25		166				
6.93	388					7.02	364		7.6	277		7.4	136		7.56	137					Not Sampled (FMCD)
7.9	590	8	7.99	128	1	6.74	463	155	7.23	288	12	7.27	570	8	7.14	275	119				
7.31	543	7	7.38	130	2	7.09	237	124	7.26	380	12	7.15	426	42	7.17	350	28				
7.29	534	4	7.44	121	1	6.06	380	39	6.12	232	61	7.09	2880	8	6.98	334	62				
7.07	456	7	6.93	121	1	6.35	383	20	5.77	208	16	6.95	1340	6							Not Sampled (WFCD)
6.94	509	16	7.14	294	23	5.89	360	32	5.89	360	32	7.12	371	13	6.69	309	38				
6.78	465	7	7.21	1580	<5	6.24	286	24	5.58	233	20	7.06	366	10	6.69	268	32				
6.68	528	14	6.79	138	6	6.81	334	30	6.5	256	59	7.46	960	14							Not Sampled (WFCD)
6.69	488	16	6.85	139	<5	6.78	300	67	5.32	255	10	7.31	2040	9							Not Sampled (WFCD)
			6.73	122	<5	7.07	309	12				7.04	555	8							Not Sampled (FMCU, SDCD, WFCD)
7.05	292	20	7.26	133	<5	7.49	351	36				7.55	327	15							Not Sampled (SDCD, WFCD)
7	460	8	7.48	138	8	5.99	545	18	5.78	190	6	7.4	348	34	6.92	283	92				
6.87	639	<5	7.03	146	16	6	331	8	5.39	262	12	6.74	626	55	6.42	226	157				
7.74	611		6.95	180	<5	5.58	331	24	5.32	255	10	8.18	565		6.3	708	36				
6.81	502	10	7.08	200	10	5.76	442	50	5.41	230	198	7.12	251	12	6.69	274	133				
6.78	597	12	6.98	180	11	5.77	260	40	5.68	205	28	6.82	333	8	6.47	586	168				
7.1	270	51	7.17	133	132	6.27	263	83	6.46	187	37	7.41	355	10	6.84	281	90				
7.24	452	8	7.33	248	<5	6.36	219	36	6.12	192	22	7.54	302	42	6.87	678	32				
7.37	511	18	7.51	147	10	6.73	211	40	6.35	294	48										Not Sampled (WFCU, WFCD)
7.07	384	16	7.49	253	55	6.04	239	52	6.04	182	24	7.28	335	12	6.99	302	116				
6.89	199	21	6.96	186	42	5.89	151	34	5.76	132	14	6.95	179	16	6.86	258	74				
7.34	432	26	7.52	196	228	6.71	221	48	6.09	186	191	7.64	200	90	7.35	370	20				
7.37	491	15	7.59	192	33	6.56	238	42	6.19	184	36	7.54	251	16	7.04	639	51				
7.03	228	29	7.13	215	26	5.89	187	26	5.86	149	22	7.06	226	54	6.85	243	115				
7.35	624	40	7.52	230	40	6.2	248	16	6.33	186	51	7.41	362	39	6.96	378	21				
7.32	477	6	7.52	235	6	6.72	302	20	6.1	207	8	7.51	460	10	7.15	612	18				
7.21	500	7	7.57	206	<5	6.23	314	44	6.19	217	58	7.4	502	14							Not Sampled (WFCD)
7.37	453	16	7.65	171	8	6.65	330	28	6.76	225	28	7.61	456	8							Not Sampled (WFCD)
7.11	549	36	7.44	149	43	6.75	359	44	6.63	259	101	7.27	627	8							Not Sampled (WFCD)
7.4	427	16	7.69	142	5	7.28	333	64				7.64	282	10							Not Sampled (WFCD)
7.66	461	20	7.77	157	<5	7.5	345	53				7.74	220	<5							Not Sampled (WFCD)
6.68	325	5	7.21	257	6	6.16	257	16	5.92	204	11	7.35	351	16	6.66	360	79				
7.14	284	26	7.19	300	<5	6.37	208	184	5.97	198	11	7.16	296	8	6.66	539	115				
7.05	269	25	7.37	172	82	6.5	200	40	6.24	211	10	7.57	312	45	6.65	253	415				
7.27	259	208	7.53	178	6	6.17	228	51	6.11	130	196	7.63	201	<5	7	296	121	28/05/13	#####	#####	
7.17	306	83	7.55	140	<5	5.82	257	24	6.16	119	74	7.45	262	35	6.46	278	34	14/06/13	#####	#####	
7.16	334	24	7.6	142	<5	5.63	263	24	6.07	194	<5	7.27	265	6	6.5	332	55	8/07/13	#####	#####	
7	354	<5	7.5	132	<5	6.09	276	13	6.43	210	223	7.5	221	<5	7.12	436	102	12/08/13	#####	#####	
7.21	377	<5	7.52	128	<5	6.32	278	20	6.52	207	24	7.35	175	<5				3/09/13	#####	#####	Not Sampled (WFCD)
7.31	428	12	7.33	132	<5	6.81	293	25	6.8	200	15	7.3	212	<5				16/10/13	#####	#####	Not Sampled (WFCD)

6.85	202	6	6.88	274	5	5.36	224	<5	6.16	189	108	7.43	279	6				12/11/13	#####	#####	Not Sampled (WFCD)
6.59	337	6	7.27	187	<5	5.79	219	16	5.63	182	10	7.13	224	<5	6.39	268	38	3/12/13	#####	#####	
6.93	353	7	7.19	140	<5	6.44	231	31	6.13	173	803	7.36	173	<5				3/01/14	#####	#####	Not Sampled (WFCD)
7.45	460	25	7.65	146	<5							7.54	173	<5				10/02/14	#####	#####	Not Sampled (SDCU, SDCD, WFCD)
6.87	169	18	7.23	139	11	6.46	201	51	6.42	90	44	7.3	180	<5				13/03/14	#####	#####	Not Sampled (WFCD)
6.62	140	11	7.18	134	21	6.08	172	48	6.41	83	29	7.36	182	20	6.69	166	32	10/04/14	#####	#####	
6.79	209	9	7.44	131	<5	6.03	200	8	6.34	73	42	7.46	191	<5	6.34	197	53	8/05/14	#####	#####	
7.05	185	7	7.19	119	25	6.16	201	8	6.05	77	9	7.47	189	<5	6.74	129	11	5/06/14	#####	#####	
7.35	223	6	7.74	129	<5	6.37	217	8	Dry			7.63	162	<5	Dry			22/07/14	#####	#####	
6.8	151	<5	7.09	140	<5	No Flow			No Flow			7.17	178	14	7.06	173	12	22/08/14	#####	#####	No Flows not sampled
No Flow			7.53	144	<5	No Flow			No Flow			7.6	199	16	No Flow			25/09/14	#####	#####	
No Flow			7.54	127	<5	No Flow			No Flow			7.64	197	7	No Flow			31/10/14	#####	#####	
No Flow			7.42	203	<5	No Flow			No Flow			7.35	242	<5	No Flow			24/11/14	#####		
No Flow			7.43	189	<5	No Flow			No Flow			7.4	239	<5	No Flow			31/12/14	#####	#####	
6.49	204	13	6.97	201	10	5.76	247	<5	5.62	201	25	7.03	225	<5	6.95	193	14	29/01/15	#####	#####	
No Flow			7.12	164.5	<5	No Flow			No Flow			6.82	270	<5	No Flow			26/02/15	#####	#####	
No Flow			7.53	170	<5	No Flow			No Flow			6.97	265	<5	No Flow			24/03/15	#####		
7.11	307	14	6.13	372	9	5.08	224	9	4.81	189	<5	6.36	305	10	5.97	328	10	28/04/15	#####	#####	
7.04	214	13	6.71	217	9	5.79	226	6	5.91	189	8	6.85	301	7	6.48	319	26	26/05/15	#####		
6.33	202	6	6.08	200	<5	5.44	268	10	5.47	196	10	6.12	266	12	6.16	287	12	30/06/15	#####	#####	
No Flow			7.27	223	<5	No Flow			No Flow			6.86	316	<5	6.54	442	<5	17/07/15	#####		
7.88	267	<5	7.92	145.7	17	5.85	246	6	6.93	213.9	7	7.99	243	<5	No Flow						Sent to and Received from Lab by CBE
7.21	252	8	8	135.4	<5	7.5	254.3	14	6.5	220.1	15	7.87	219	8	No Flow						Sent to and Received from Lab by CBE
7.01	226.9	<5	7.6	134.9	<5	6.36	228.6	10	6.35	177.6	6	7.61	227.2	<5	No Flow						
7.52	232.5	<5	7.4	148.9	<5	6.53	221.8	10	6.16	189.9	8	6.79	145.8	<5	No Flow						
7.15	208.3	14	7.58	175.1	<5	6.76	242.1	34	6.53	207.5	26	7.49	285	<5	No Flow						
6.65	200.9	<5	7.08	208.2	<5	5.94	196.6	<5	6.09	167.8	<5	6.52	256	<5	No Flow						
7.19	259	<5	7.3	193.6	<5	6.12	182.2	10	5.9	200.6	24	7.38	207.7	<5	No Flow						
7.17	289	18	7.8	183.2	<5	6.77	195.4	27	6.65	244.1	26	6.87	166.3	<5	No Flow						
7.36	229.5	5	8.07	133.8	<5	7.14	134.9	<5	6.82	109.5	30	8.02	172.5	<5	No Flow						
6.97	226	<5	7.65	133.6	<5	6.54	137.3	7	6.63	114.3	34	7.33	142.7	<5	No Flow						
6.8	176.3	<5	7.6	142.9	18	6.08	143.1	12	6.37	76.3	32	7.4	142.8	<5	No Flow						
7.3	169.7	<5	7.67	158.1	10	6.19	150.7	12	6.3	128.8	46	7.44	134.4	<5	No Flow						
7.45	173.2	<5	8.06	148.8	<5	6.09	229	<5	6.26	178.8	36	7.65	221	<5	No Flow						
7.34	197.4	<5	14.6	134.5	17	13.2	218	9	14	130.4	28	15.7	175.4	8	No Flow						
7.37	194.9	5	7.8	172.8	<5	6.53	226	25	6.68	127.1	10	7.58	179.4	<5	No Flow						
7.2	175.1	8	7.62	145.2	<5	6.92	236	17	6.58	89	17	7.04	171.2	<5	No Flow						
7.05	213.9	30	7.29	176.6	<5	6.98	250.3	30	6.55	129.7	12	7.14	219.4	<5	No Flow						
7.05	181.7	22	7.19	164.4	9	6.79	257	41	6.63	125.9	65	7.33	189.4	15	No Flow						
6.98	198.3	23	7.49	173.2	5	6.93	306	48	No Flow			7.42	175.2	11	No Flow						
6.09	252.9	8	7.45	241	9	5.46	306	8	5.72	226.4	10	6.83	314	12	No Flow						
6.55	289	6	7.29	186.6	<5	5.83	253	6	5.56	243	6	6.92	243	<5	No Flow						
7.48	291	<5	6.94	168.6	<5	6.91	270	26	7.6	266	20	5.65	253	18	No Flow						
7.38	267	8	8.24	186	5	7.58	197.8	9	6.82	164.8	14	7.22	234	9	No Flow						
7.5	298	14	8.15	110.1	<5	7.25	219	11	6.49	204.9	15	7.45	157.2	<5	No Flow						
6.73	303	122	6.83	110.8	86	7.49	222	19	6.97	195.3	14	7.39	116.9	15	No Flow						
7.39	340	<5	7.22	202.3	<5	6.09	245.5	19	6.42	212.1	18	7.43	132.3	<5	No Flow						
6.2	468	23	8.15	225	<5	7.46	285	52	6.62	244	6	7.39	156.8	8	No Flow						
6.46	163.5	10	7.53	149.2	5	6.53	206.3	32	5.88	102.5	30	7.28	124.3	<5	No Flow						
6.54	190.8	16	7.75	170.9	<5	7.03	236	71	6.77	118.2	38	6.85	141.2	8	No Flow						
No Flow			7.2	190.9	<5	7.06	343	92	No Flow			7.07	174.2	5	No Flow						
5.42	313	16	7.98	208.2	10	7.55	285	345	6.46	109.6	90	7.12	152.8	<5	No Flow						
6.67	245	6	7.89	151.8	8	6.84	340	20	6.43	151.2	61	7.02	197	<5	No Flow						
6.06	291	7	7.12	157.1	<5	6.76	256	<5	5.87	232	18	6.88	124.2	<5	No Flow						

7.11	288	6	8.44	154.8	<5	7.4	182.3	9	6.68	161.8	41	6.27	119.2	<5	No Flow
6.63	193.9	<5	7.8	147.7	26	5.88	211.3	<5	5.63	176.7	15	7.6	118.2	<5	No Flow
6.77	210	<5	8.02	255	<5	6.61	204	<5	6.05	212	26	6.9	144.5	<5	No Flow
6.34	239	13	7.35	149.5	7	7.11	221	9	6.24	224	20	5.54	114.4	<5	No Flow
6.84	193.9	10	7.76	126.6	6	7.23	217	14	6.37	129.5	18	6.75	130.9	6	No Flow
6.52	434	10	8.03	148.4	11	6.32	202.7	22	6.07	210.4	18	6.24	135.8	<5	No Flow
6.85	440	15	8.08	166.9	5	7.58	239	19	6.6	246	26	6.38	147.1	14	No Flow
6.86	239	<5	7.24	240	26	6.2	213	26	6.16	222	26	6.89	195	<5	No Flow
6.95	314	28	7.44	190.3	<5	6.72	208.7	36	6.39	189.2	44	7.54	151.8	8	No Flow
Dry			7.84	147.9	<5	7.13	250	30	No Flow			6.34	126.9	<5	No Flow
7.09	163	10	7.64	224	26	6.63	213	13	5.77	166.7	30	7.34	152.7	<5	No Flow
6.87	189	<5	7.45	283	<5	6	192.8	<5	5.99	172.5	18	7.06	248	<5	No Flow
7	178.9	12	8.67	241	<5	6.41	180.9	<5	6.35	151.6	16	6.24	226	<5	No Flow
7.22	151.8	10	8.1	219	6	6.21	159.9	8	6.1	106.7	15	6.41	234	5	No Flow
6.7	219.3	<5	7.69	237	<5	6.19	151.9	<5	5.59	175.3	23	7.78	158.3	<5	No Flow
No Flow			7.88	256	<5	6.28	166.5	12	5.94	213	11	6.67	230	<5	No Flow
6.93	162.9	18	7.57	225	5	6.05	211.1	14	5.49	174.9	32	6.74	205	5	No Flow
6.93	210.6	21	7.68	232.7	<5	6.24	204.3	<5	6.3	178.7	20	7.96	174.5	<5	No Flow
No Flow - Dry			7.86	274	10	6.66	231	74	No Flow - Dry			6.63	146.9	<5	No Flow - Dry
No Flow - Dry			7.79	332	68	7.09	283	52	No Flow - Dry			8.02	263	<5	No Flow - Dry
No Flow - Dry			7.73	501	74	7.2	326	104	No Flow - Dry			7.86	259	<5	No Flow - Dry
6.66	276.4	<5	6.61	304.5	15	5.6	244.1	<5	5.81	199.6	<5	6.79	274.5	<5	No Flow - Dry
6.71	350	12	6.99	236.1	6	6.23	252.5	<5	5.96	252.1	10	8.97	9.5	<5	No Flow - Dry
7.19	335.4	14	7.01	212.9	<5	6.7	281.1	<5	7.08	237	121	7.63	177.9	<5	No Flow - Dry
7.31	233.4	17	7.58	231	<5	6.85	274.4	10	6.63	238.8	7	7.33	240.5	<5	No Flow - Dry
6.79	161.2	22	7.83	235.8	<5	6.5	193.9	14	5.78	80.4	187	7.15	153.7	<5	5.38 115.8 15
6.92	210.6	19	7.26	193.4	18	6.36	195	21	5.57	234.1	208	7.19	169.6	155	6.77 141.8 13
6.77	338.2	<5	6.98	338.8	<5	5.56	298.3	<5	5.53	283.7	22	7.16	225	<5	No Flow - Dry
6.96	307	7	7.37	151.3	<5	6.13	250.4	15	6.11	274	16	6.68	157.8	<5	No Flow - Dry
7.02	335.1	8	7.21	191.5	5	6.58	317	29	6.41	328.8	16	6.47	156.3	15	No Flow - Dry
6.67	301.2	7	6.59	230.8	9	6.05	166.8	10	6.08	163.7	38	7.04	177	7	6.3 171.9 15
6.62	268.3	15	6.9	211.7	9	5.64	169	21	5.72	196.2	56	7.07	188.8	6	o Flow - Too low samp
6.85	285	16	7.11	199	18	6.14	175.5	85	6.06	170.8	37	7.5	133	<5	No Flow - Dry
6.95	258.1	<5	7.33	237.4	17	6.15	169.9	20	5.84	296.5	460	6.95	169.9	18	5.26 103.6 38
6.99	321.8	18	6.96	263	27	5.54	179.9	12	5.69	163.7	387	6.96	324.4	87	5.02 235.2 18
6.94	350	<5	7	347.8	5	5.9	214.5	5	6.03	278.4	14	7.35	155.1	<5	No Flow - Dry
7.21	361.5	<5	7.17	176.6	<5	6.11	181.5	<5	6.34	250.9	5	7.41	214.4	6	
7.32	292.8	13	7.86	174.7	42	6.37	175.7	8	6.18	259	46	7.92	154.7	<5	o flow - Too low to sam
7.21	288.3	<5	7.34	159.2	<5	6.02	179.5	<5	6.33	333.2	9	7.24	220.2	<5	o flow - Too low to sam
7.36	315.3	<5	7.38	153.4	<5	6.05	180.4	9	6.55	298.2	23	7.44	146.9	<5	No Flow - Dry

Surface Water Quality Monitoring

Groundwater Monitoring

DPZ-3 Once a month				DPZ-6 Once a month				DPZ-7A Once a month				DPZ-8 Once a month				DPZ-10 Once a month				DPZ-12 Once a month				DPZ-13 Once a month				Reg DPZ-1 Once a month			
Depth (m)	pH	Conductivity (µS/cm)	TSS (mg/L)	Depth (m)	pH	Conductivity (µS/cm)	TSS (mg/L)	Depth (m)	pH	Conductivity (µS/cm)	TSS (mg/L)	Depth (m)	pH	Conductivity (µS/cm)	TSS (mg/L)	Depth (m)	pH	Conductivity (µS/cm)	TSS (mg/L)	Depth (m)	pH	Conductivity (µS/cm)	TSS (mg/L)	Depth (m)	pH	Conductivity (µS/cm)	TSS (mg/L)	Depth (m)	pH	Conductivity (µS/cm)	TSS (mg/L)
9.29	6.7	7870	1410	26.89	6.7	3300	192	22.71	6.5	2050	196	31.66				12.97	6.7	3550	36	16.07	6.9	7900	727	7.17	6.8	14370	<2	21.55	5.4	1610	17
8.96	6.7	11440	38	27.23	6.7	4290	136	22.87	6.8	2460	264	30.82				12.97	6.7	3550	41	21.6	6.8	11730	454	7.11	6.9	13060	18	21.54	4.1	1620	10
8.58	5.4	260	321	27.72	6.6	4390	459	22.95	6.6	2050	551	31.16	5.1	2650	2120	12.92	6.7	3320	58					7.04	6.9	12500	15	21.51	5.3	1580	31
8.41	6.6	13080	266	28.14	6.7	4470	945	23.09	6.6	2290	103	30.6	3.7	2370	184	13	6.7	3520	57	16.1	6.8	5370	1380	7.07	6.8	14570	25	21.52	5.4	1640	26
8.56	6.8	13350	59	24.48	6.9	4570	807	23.98	6.7	2330	16		3.4	2550	328	13.06	6.7	3650	56	24.15	6.7	8120	15	7.04	6.9	13400	20	22.09	5.2	1680	13
9.39	6.7	13300	34	29.6	6.5	4490	119	24.64	6.8	2430	12	31.05	4.1	2440	708	13.92	6.6	3590	26					8.94	6.7	13170	14	28.77	5.2	1650	7
9.07	6.7	13270	60	24.66	6.7	4220	51	23.5	6.8	2110	147	30.12	3.6	2410	1670	13.13	6.6	3560	46					7.07	6.8	12580	12	21.48	5.4	1570	14
9.87	6.7	13190	21	30.7	6.7	4840	266	25	6.8	2270	246	31.08	4.1	2440	534	14.27	6.7	3540	138					8.27	6.8	12620	14	29.78	6.1	1700	15
9.67	6.9	12590	23	30.56	6.9	4130	193	24.63	6.8	2350	14	31.11	4.7	2370	94	15.3	6.8	3650	75					8.28	7	11160	26	19.4	5.3	1650	8
8.84	6.7	13800	37	29.99	6.6	4960	173	23.19				23.58	5.7	2550	329	14.1	6.6	3630	23	20.67	6.7	13200	37	7.66	6.8	13110	31	22.63	6.6	7970	21
10.24	5.4	460	126	31.63	6.6	4840	193	23.17				31.24	3.9	2450	1222	14.4	6.8	3380	62	17.74	6.4	8370	46	8.36	6.8	12890	28	22.46	5.2	1670	9
12.09			94	31.2			394	23.2				21.12	6.1	3890	52	13.7	6.9	3450	76	1700			30	7.57			32	21.83			13
12.11	6.6	2150	30	31.24	6.7	4210	397	23.2				21.14	3.5	2525	615	13.74	6.9	3495	24	17.01	6.6	8895	67	7.54	6.8	2255	18	21.9	5.4	1684	13
18.2	6.71	9290	115		6.89	1590	268	35.2				33.2					6.81	3390	26	18.2	6.75	8310	34						5.18	1790	89
9.4	6.46	311	124	33.8	6.86	3320	206	24.1				30.7	5.9	1800	624	13.1	6.97	2980	20	16.3	7.29	3200	63	7.6	7.63	10300	12	21.04	7	1710	16
9.83	6.7	363	66		7.23	3920	194	24.86	6.81	2630	22	30.73	5.3	2190	466	13.5	6.98	3440	26	16.69	6.41	7790	50	7.76	6.64	13100	6	21.64	6.1	1660	10
9.51	6.54	696	186		6.37	4020	234	24.91	6.8	2680	62	30.68	6.3	2270	122	13.41	6.38	3360	27	16.83	6.85	7840	12	7.75	6.65	13400	16	21.63	6.2	1680	5
9.3	6.42	2380	39		7.05	3700	412	24.96	4.76	2580	36	30.79	6.77	2110	98	13.42	6.45	3130	25	17.61	6.78	7800	22	7.73	6.78	11800	5	21.65	5.28	1580	14
9.24	6.34	2300	12		6.58	2320	152	25.04	7.03	2660	86	30.73	3.45	2470	70	14.33	7.16	3390	18	18.15	6.6	10800	17	7.71	6.99	12000	9	21.61	5.2	1680	5
9.24	5.2	410	152		6.64	1090	141	25.09	7.21	2870	65	30.74	3.45	2640	534	13.44	6.94	3490	30	16.06	6.44	3260	30	7.78	6.97	13100	10	21.64	5.31	1730	12
10.05	5.13	320	348		6.54	1410	244	25.7	7.01	2670	232	30.65	3.2	2670	48	13.39	6.78	3190	12	16.23	6.31	2390	71	7.4	6.84	11000	5	21.56	5.24	1660	<5
9.28	6.23	1000	166		6.51	3020	708	24.99	6.92	2800	68	30.6	2.89	3170	89	13.4	6.47	3670	42	17.63	6.39	7560	40	7.27	6.86	12400	30	21.51	5.89	2080	308
9.43	6.29	793	104		6.47	2850	173	25.05	6.80	2760	147	30.61	3.00	3030	35	13.47	6.52	3600	18	18.51	6.35	7480	94	7.37	6.60	12400	25	21.61	5.62	1320	140
9.54	6.47	2050	21		6.68	2590	380	25.09	7.04	2560	39	30.63	3.11	3040	88	13.54	6.54	3620	14	19.05	6.58	13800	12	7.43	6.86	12200	24	21.58	5.48	1440	30
9.69	7.4	14100	21		7.36	3950	287	25.03	7.69	2780	150	30.66	3.25	2920	56	13.61	7.32	3810	14	19.15	7.46	14200	82	7.33	7.54	14300	12	21.68	6.04	1720	44
9.78	5.33	427	103	34.73	6.72	4020	143	24.81	6.84	2720	18	30.65	3.25	2990	56	13.58	6.42	3730	30	16.33	6.46	6820	18	7.03	6.99	8970	16	21.61	5.3	1760	8
9.95	6.11	388	260	29.84	7.17	4120	123	24.64	7.2	2380	40	30.62	5.6	2980	61	13.48	7.23	3540	22	16.6	6.7	1840	210	7.1	7.37	11000	14	21.58	5.84	1810	26
9.92	5.71	321	171	29.36	6.78	3530		24.5	6.47	2160	258	28.32	4.65	3070	102	13.34	6.68	3550	19	16.38	7.33	1540		7.49	6.98	3770		21.33	5.84	1691	
9.59	6.05	455	162	31.74	6.77	3890	144	24.6	6.56	2190	154	29.81	3.9	3340	<5	13.29	6.8	3500	137	16.38	6.29	4560	40	7.41	6.89	11000	17	21.34	5.29	1750	50
9.32	5.59	220	374	27.32	6.69	2370	94	24.22	6.31	1540	113	30.56	3.18	3420	132	13.21	6.5	3020	35	16.18	6.01	1080	108	8.08	6.88	10200	36	21.24	5.34	1730	35
9.27	6.44	351	101	31.1	7.28	3730	194	24.36	7.06	2010	15	30.56	3.01	3200	244	13.2	7.19	3210	37	16.14	6.83	4290	101	8	7.34	11400	15	21.1	5.87	1710	64
9.37	5.71	272	100	31.86	7.04	2680	262	24.22	6.78	2050	142	30.58	3.29	3280	99	13.12	6.88	3690	14	15.82	6.18	2720	80	8.01	7.28	9180	66	21.03	5.8	1690	18
9.53	6.11	309	92	33.13	7.08	2740	542	24.42	7.18	2190	240	30.58	3.11	3370	88	13.08	6.84	3710	14	16.47	6.35	9120	22	8.14	7.24	11000	21	20.99	5.73	1740	11
9.71	6	295	65	31.91	7.1	3260	66	24.13	7.21	2180	40	30.57	3.24	3240	45	13.14	6.9	3560	8	16.12	6.12	1460	27	8.33	7.21	8210	22	20.94	5.77	1700	6
9.73	6.25	308	49	31.38	7.11	3140	35	24.18	7.04	2190	124	29.88	2.99	3310	40	12.97	7.07	3380	12	13.1	6.17	517	46	8.09	7.03	3710	14	20.88	5.75	1690	9
9.86	6.83	572	23	32.05	7.29	3120	222	24.69	7.55	2740	105	30.56	3.21	3270	102	12.93	7.01	3270	24	15.88	6.5	2170	161	11.93	7.25	11600	108	20.74	5.87	1720	9
9.89	6.58	536	30	32.2	7.16	3170	174	24.84	7.49	2720	106	30.57	2.96	2990	200	12.91	6.98	3170	20	16.36	6.37	1250	130	12.47	7.34	11200	80	21.17	5.86	1700	40
9.84	6.41	404	76	34.79	7.04	662	6400	24.36	7.14	2340	78	28.27	3.57	2980	54	12.9	6.96	3140	26	12.69	6.28	452	40	13.03	7.3	7560	87	20.5	6	1660	24
9.66	6.54	475	56	31.56	7.15	3320	384	23.73	7.47	2750	94	28.2	3.81	3180	89	12.85	6.93	3320	35	16.16	6.44	1980	84	13.04	7.25	11200	57	20.55	5.7	1670	16
9.57	6.6	1240	12	34.97				24.83	7.41	2760	78	30.56	3.71	3020	59	12.83	7.07	3190	16	16.26	6.39	1030	63	13.2	7.48	9580	63	20.45	5.82	1660	<5
9.56	6.86	7060	30					24.86	7.53	2820	166	30.56	3.17	3180	21	12.84	7.02	3280	22	16.54	6.57	1400	99	14.7	7.37	11500	19	20.35	5.88	1730	30
9.6	6.94	7690	22					25.3	7.08	2410	61	30.56	3.33	3280	67	12.94	6.91	3470	14	17.29	6.59	1910	118	16.62	7.29	12400	11	20.34	5.65	1770	16
9.76	6.82	10900	24					25.86	7.07	2490	232	30.55	3.16	3180	23	13.08	6.62	3580	44	17.87	6.78	3060	96	18.14	7.09	12400	44	20.42	5.38	1820	10
9.97	7.31	10900	10					25.68	7.1	1190	90	30.57	3.24	2950	30	13.22	7.08	3330	24	18.44	7.42	4340	93	18.83	7.56	11600	66	20.52	5.59	1800	14
9.97	7.22	12200	28					25.62	6.78	2170	34	30.52	3.28	3090	108	13.28	7.05	3510	34	18.28	7.02	5770	130	19.39	7.45	12100	158	20.42	5.82	1730	22
14.27	5.85	341	71					25.02	7.38	2760	16	30.55	3.28	3270	33	13.4	6.96	3620	35	16.11	6.45	1010	27	19.57	7.4	8840	69	20.54	5.62	1380	16
14.16	5.84	309	91					24.74	7.19	2550	18	30.5	3.26	3060	54	12.2	6.72	3360	22	15.95	6.31	636	73	24.93	7.26	6050	328	21.52	6.23	205	35
10.21	6.22	345	21					25.5	6.79	1280	72	30.5	3.31	3280	23	13.24	6.88	3200	26	16.14	6.73	1800	61	24.95	7.4	7330	280	20.34	5.97	945	20
10.07	6.61	569	50	38.06				24.09	7.12	2160	136	30.41	3.21	3340	29	13.29	7.18	3300	42	16.63	6.78	2520	81	24.93	7.46	6660	130	20.28	5.77	1420	11
9.96	6.56	5050	37	38.15				24.94	6.98	2910	<5	30.44				13.26	6.73	3450	42	16.2	6.92	3750	664	24.93	7.62	6280	136	20.27	5.87	1680	15
10.01	7.03	7630	4220	38.18	6.45	807	11600	24.82	7.26	2530	1620	30.49	5.78	3110		13.28	6.83	3430	537	21.08	6.85	4200	3530	23.4	7.2	6910	1520	20.4	6.22	1480	<5
9.93	6.9	6790	9	37.82	6.86	2590	6840					30.44	3.18	3310	20	13.25	6.9	3340	8	18.35	7.02	5310	3070	24.93	7.82	10200	820	20.19	5.75	1620	<5
10.07	7.19	6900	<5	37.78	7.04	2410	4800					30.46	5.55	3170	2030	13.34	7.09	3370	63	20.38	6.9	6590	892	24.94	7.42	5950	180	20.37	5.14	1320	<5
10.17	6.97	8740	1220	37.92	6.69	2350	2560					30.2	3.24	3480	<5	13.4	7.17	3320	46	20.12	7.12	9590	157	24.9	7.49	5320	43	20.32	5.94	1480	<5
10.28	6.75	7890	62	37.95	7.06	2300	207					30.35	4.07	3320	466	13.49	6.84	3340	46	18.92	6.94	11100	332	24.92	7.64	5950	22	20.31	5.84	1710	<5
10.35	5.93	354	20	38.02	6.81	967	44									13.45	6.8	3510	116	16.06	6.07	1940	14	24.95	7.42	5670	118	20.26	5.43	1390	<5
10.52	5.93	581	23	37.64	6.86	2260	655					30.42	3.06	3570	23	13.45	6.83	3470	21	17.03	6.74	8240	120	24.94	7.28	6170	135	20.22	5.49	1120	<5

10.52	6.78	996	10	37.34	7.12	2350	1950
10.7	6.27	1140	56	37.32	6.98	2240	512
10.67	6.67	3480	1740	36.1	7.21	2400	790
10.77	6.38	1700	22	36.01	7.04	2350	3590
10.88	6.78	5420	1370	36.64	7.04	2110	872
11	6.89	2640	19	39.5	6.64*	174*	2220*
11.04	6.69	2540	<5	35.71	7.29	2370	1300
11.1	6.72	2610	<5	35.5	7.58	2400	342
11.2	7.09	6800	14	35.69	7.29	2500	63
11.15	5.99	1930	34	35.74	6.75	2280	234
11.14	5.28	551	75	35.82	6.64	2190	550
11.2	6.17	1626	6	35.13	6.74	2310	38
11.29	5.96	853	18	34.96	6.78	2350	424
11.26	5.76	331	188	34.08	6.45	2440	626
11.19	6.31	495	25	33.76	6.53	2270	44
11.16	6.01	676	11	33.76	6.47	2290	38
10.9	6.78	487	11	33.76	6.94	2099	90
10.63	7.21	7440	95	33.67	7.4	2260	62
10.41	6.77	9080	33	34.11	6.65	2399	31
10.32	6.81	9130	<5	34.14	6.74	2267	68
10.21	6.68	10080	7	34.17	6.83	2450	103
10.31	6.86	10410	<5	34.24	6.81	2417	342
10.32	6	863	50	33.83	6.72	2425	128
10.4	6.47	1336	40	34.17	6.64	2580	63
10.39	6.89	11150	<5	34.2	6.67	2650	25
10.45	6.85	11480	23	33.8	6.72	2194	50
10.41	6.77	11640	14	34.33	6.8	2550	154
10.47	6.77	6600	32	34.18	6.7	2230	148
10.38	6.74	10210	20	34.07	6.68	2390	47
10.2	6.71	10250	19	32.32	6.68	2560	10
10.08	6.79	11260	34	32.67	6.73	2480	65
9.97	6.75	11540	12	33.16	6.9	2560	148
9.87	6.75	11160	10	33.06	6.83	2550	160
9.92	6.64	12040	9	33.62	6.57	2502	47
9.97	6.82	12280	18	32.8	6.93	2469	152
10.05	6.64	12220	20	33.38	6.68	2163	89
10.13	6.6	10890	21	32.86	6.62	2470	100
10.25	6.68	2540	8	33.16	6.6	2219	104
10.26	6.55	11000	20	33.66	6.69	2350	98
10.35	6.67	8460	20	33.28	6.54	1720	30
10.36	6.5	10390	16	33.24	6.53	2230	92
10.5	6.73	10310	10	32.96	6.75	2130	611
10.38	6.7	10870	<5	33.92	6.63	2250	183
10.68	6.83	11850	5	33.33	6.51	2340	55
10.6	6.53	10160	21	33.37	5.44	363	658
10.45	6.76	9120	14	36.69	5.93	1875	378
10.26	6.96	11300	35	33.97	Dry Bore		
10.17	6.84	11470	270	33.84	5.87	202.8	190
10.06	6.8	11270	18	33.5	5.98	170.6	27
9.96	6.73	11000	7	33.52	6.59	2220	114
9.89	6.89	9900	14	33.59	6.8	2180	108
9.86	6.67	10580	16	33.24	6.67	2400	38
9.85	6.71	9790	6	33.99	6.66	2310	34
9.87	6.21	10010	8	34.19	6.26	2036	161
9.9	6.89	10850	39	34.35	6.64	2280	37
9.87	6.58	10600	110	34.29	6.63	2240	72
9.84	6.8	10940	16	34.39	6.78	2360	27
9.92	6.71	10600	5	33.63	6.26	1177	616
9.94	6.75	11670	9	34.34	6.59	2420	77
10.02	6.8	10410	12	34.59	6.82	2310	60
10.07	6.78	8670	14	34.72	6.65	2170	134
10.11	6.75	10110	6	34.91	6.7	2340	74

Damaged- Blocked

30.36	3.8	3470	10	13.5	7.19	3460	21
30.4	3.32	2960	11	13.56	7.12	3300	26
30.35				13.56	7.11	3490	206
30.4	4.23	3020	374	13.15	7.15	3310	27
30.44	4.4	2780	119	13.58	7.10	3420	74
30.51	7.94	5460	13	13.62	7.8	3390	13
30.41	4.09	2310	124	13.57	7.31	3450	8
30.39	3.63	2900	342	13.58	7.38	3390	<5
30.41		*		13.65	7.47	3450	5
30.41	2.99	2440	103	13.68	6.73	3260	18
30.42	3.59	2830	639	13.73	6.86	3080	22
30.44	3.45	2820	124	13.72	6.64	3420	<5
30.41	3.21	2960	142	13.75	6.71	3510	14
30.61	3.27	2790	26	13.53	6.63	3290	10
30.51	4	2100	218	13.41	6.69	3010	<5
30.55	4.2	2440	104	13.29	6.6	3030	<5
30.52	4.2	2430	36	13.24	7.44	2740	12
30.48	4.1	2560	60	13.28	6.98	3140	16
30.48	3.55	2239	19	13.29	7.17	2970	13
30.46	3.13	2281	8	13.35	6.88	3000	18
30.46	3.02	2540	14	13.34	6.6	3180	7
30.46	2.98	2560	64	13.4	6.82	3230	28
30.38	3.06	2550	69	13.48	6.33	2560	17
30.17	3.06	3040	122	13.1	6.85	3500	11
30.35	3.17	2413	53	13.11	6.86	3460	<5
30.41	3.16	3060	72	13.2	6.71	2640	26
30.41	3.13	2920	43	13.23	6.78	3270	23
30.41	2.99	3180	55	13.26	6.72	2970	17
30.42	3.22	2800	35	13.28	7.05	3380	21
30.43	3.38	2360	28	13.26	6.84	3440	<5
30.42	3.06	2430	23	13.27	6.66	2920	8
30.41	3.04	2870	36	13.33	6.83	3330	16
30.37	3.01	2780	78	13.36	6.83	3400	7
30.41	2.9	2800	42	13.43	6.71	3410	14
30.44	2.99	2432	70	13.49	6.91	3430	8
30.36	2.77	2452	50	13.58	6.9	3350	46
30.41	2.8	2470	183	13.59	6.75	3420	24
29.53	2.99	2400	6	13.53	6.79	3170	17
30.41	2.89	2590	<5	13.45	6.82	3270	17
30.44	3.51	1910	202	13.38	6.52	2980	12
30.41	3.02	1840	26	13.31	6.42	3070	22
30.45	3	2470	34	13.32	6.88	2990	7
30.48	2.77	2600	<5	13.56	6.68	3210	9
30.44	3.28	2820	12	13.43	6.64	3310	8
30.49	2.88	2180	42	13.48	6.64	2860	6
30.44	3.29	1833	33	13.49	6.87	2620	41
30.48	4.94	2170	1680	13.57	6.95	3170	18
30.51	3.58	2360	353	13.63	6.6	3210	24
30.54	3.62	2290	96	13.67	6.91	3230	7
30.54	3.24	2120	<5	13.52	6.42	3200	<5
31.6	3.05	2100	16	13.46	7	3070	13
30.54	4.99	2330	701	13.45	6.77	3300	9
30.51	3.39	2250	54	13.42	6.71	3220	20
30.56	3.44	2260	46	13.45	6.22	3170	22
30.61	3.23	2610	50	13.47	6.64	3280	16
30.53	3.1	2790	40	13.47	6.73	3230	19
30.32	3.41	3050	48	13.45	6.78	3240	6
30.49	3.53	3230	40	13.47	6.66	3190	20
30.47	3.43	3250	45	13.48	6.74	3420	22
30.49	3.17	3100	26	13.57	6.73	3250	20
30.41	3.42	2550	25	13.64	6.58	3200	20
30.5	3.05	2810	<5	13.66	6.65	3400	<5

Bore Damaged

24.96	7.51	6430	78	20.61	5.64	1530	<5
24.96	7.47	5480	133	20.7	5.56	1560	<5
24.98	7.61	8120	531	20.66	5.74	1660	21
24.97	7.3	5260	36	20.7	5.59	1720	<5
24.93	7.43	5380	415	20.71	5.61	1770	<5
24.94	6.48	4350	#	20.73	5.67	2000	5
				20.69	5.79	1770	<5
24.93	7.33	5280	22	20.68	5.8	1810	50
24.93	7.35	6130	88	20.72	5.76	1850	<5
24.93	7.15	4910	75	20.66	5.45	1692	<5
24.98	7.06	5490	75	20.74	5.28	1910	5
24.99	6.97	5480	40	20.76	5.3	1660	<5
24.98	6.91	5890	76	20.8	5.32	1850	<5
24.97	6.68	3220	86	20.68	5.14	1656	<5
24.97	6.95	4030	27	20.53	5.33	1599	<5
25	6.92	4250	71	20.55	5.29	1553	<5
24.94	7.28	2540	94	20.49	6.23	1502	6
24.96	7.45	4780	122	20.48	5.86	1593	14
24.96	7.1	4810	62	20.5	5.31	1731	6
24.96	7.01	4040	23	20.53	5.4	1705	8
24.95	6.9	4350	17	20.5	5.26	1745	12
24.97	7.15	5290	30	20.53	5.41	1826	<5
24.94	7.03	3060	584	20.18	5.28	1841	<5
24.97	6.89	3670	20	20.09	5.45	1851	41
24.92	6.99	4410	33	20.07	5.2	1995	<5
24.95	7.13	4240	31	20.27	5.35	1827	10
24.95	6.99	4840	45	20.28	5.38	1814	10
24.96	6.99	4540	19	20.33	5.32	1807	18
24.95	7.09	5310	146	20.34	5.35	1802	<5
24.95	6.98	4200	9	20.39	5.35	1840	<5
24.95	7.06	4040	10	20.37	5.34	1873	<5
24.93	7.06	4240	18	20.48	5.3	1825	16
24.96	7.09	4200	14	20.43	5.36	1837	<5
24.93	6.98	4520	30	20.51	5.21	1877	6
24.96	7.02	4260	22	20.56	5.23	1867	20
24.95	6.87	4250	46	20.61	5.19	1852	<5
24.98	6.93	4560	42	20.67	5.12	1547	16
No access				20.58	5.18	1504	6
No access				20.6	5.4	1576	<5
No access				20.64	5.58	1550	8
No access				20.58	5.45	1622	6
No access				20.58	5.65	1597	<5
No access				20.6	5.68	1682	<5
No access				20.7	5.62	1825	<5
No access				20.73	5.04	1538	9
No access				20.68	4.39	1372	12
No access				20.77	5.37	1717	13
No access				20.84	5.67	1756	6
No access				20.89	5.37	1794	6
No access				20.9	5.18	1719	10
No access				20.97	5.35	1686	8
No access				20.96	5.05	1798	8
No access				20.95	5.25	1761	<5
No access				20.98	4.9	1721	6
No access				21.02	5.14	1768	13
No access				21.05	5.34	1775	14
No access				20.67	5.42	1783	14
No access				21	5.43	1724	14
No access				21.06	5.38	1853	14
No access				21.13	5.28	1769	<5
No access				21.16	5.51	1772	6
No access				21.23	5.29	1860	<5

10.09	6.74	12110	<5	35.16	6.84	2360	55
10.12	6.56	11870	20	35.25	6.7	1960	28
10.12	6.64	11870	15	35.24	6.77	1997	90
10.26	6.75	12003	<5	35.26	6.88	1350	26
10.48	6.57	10430	8	35.31	6.66	2080	26
10.52	6.92	11600	9	35.2	6.89	2404	23
10.56	6.87	11780	8	35.18	6.96	2370	28
10.64	6.78	12150	8	35.25	6.93	2410	18
10.65	6.78	11010	7	35.4	6.76	2210	42
10.67	5.62	925	36	34.15	No Water		
10.81	5.45	1043	13	35.13	6.76	2615	443
10.81	5.69	1202	17	34.74	6.92	2710	46
11.85	6.83	13500	11	34.85	6.88	2689	70
10.96	6.92	8330	19	35.12	5.89	188.4	75
10.94	6.75	12090	<5	35.49	5.96	275	168
10.95	5.1	847.1	26	35.65	5.77	271.9	124
11.4	6.23	1152	60	35.34	6.84	2065	627
11.11	6.43	1768	42	35.19	6.64	2391	181
11.01	4.75	468.3	14	33.82	5.88	120.3	127
10.94	4.66	519	34	35.48	6.58	2116	526
10.94	5.44	415	42	35.37	6.76	1825	164
10.88	6.83	11.79	13	34.72	6.13	138.7	126
10.5	5.26	585	76	34.94	6.03	602.2	203
10.75	5.57	430.4	21	34.32	6.71	2484	20
10.79	5.76	397.6	17	34.29	6.7	2166	81
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10.55	6.44	3630	104	34.58	6.61	2267	70
10.44	6.52	4650	65	34.58	6.61	2308	44

30.48	2.76	2630	15	13.67	6.82	3370	12
30.48	2.91	2370	16	13.67	6.7	3320	15
30.49	2.87	2480	27	13.69	6.74	3320	10
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30.53	2.94	2540	46	13.74	6.81	3300	18
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30.48	2.89	3010	7	13.79	6.82	3340	12
30.5	2.8	2380	32	13.87	6.68	3140	67
30.48	3.03	3010	24	13.86	7.09	3100	39
30.47	3	2962	31	13.78	6.9	3750	42
30.45	2.98	3080	37	13.7	7.02	3930	20
30.52	2.84	3280	12	13.68	6.98	3910	20
30.45	3.01	1876	27	13.67	6.93	2570	24
30.46	3.21	2950	33	13.62	6.92	3180	20
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30.44	2.75	3376	33	13.36	6.8	2237	21
30.46	2.91	3820	27	13.35	6.83	3640	81
30.19	2.92	2442	38	13.27	6.71	2910	169
30.47	3.12	3860	<5	13.26	6.81	4310	209
30.46	3.04	3940	44	13.18	6.63	3460	35
30.3	3.04	2900	<5	12.97	6.68	3730	25
30.42	3.12	2900	20	12.93	6.76	3320	13
30.36	3.3	3040	<5	12.84	6.85	3430	109
30.46	3.09	2930	37	12.83	6.62	3300	66
30.47	2.95	3000	14	12.88	6.62	3300	5

No access	21.25	5.18	1887	<5
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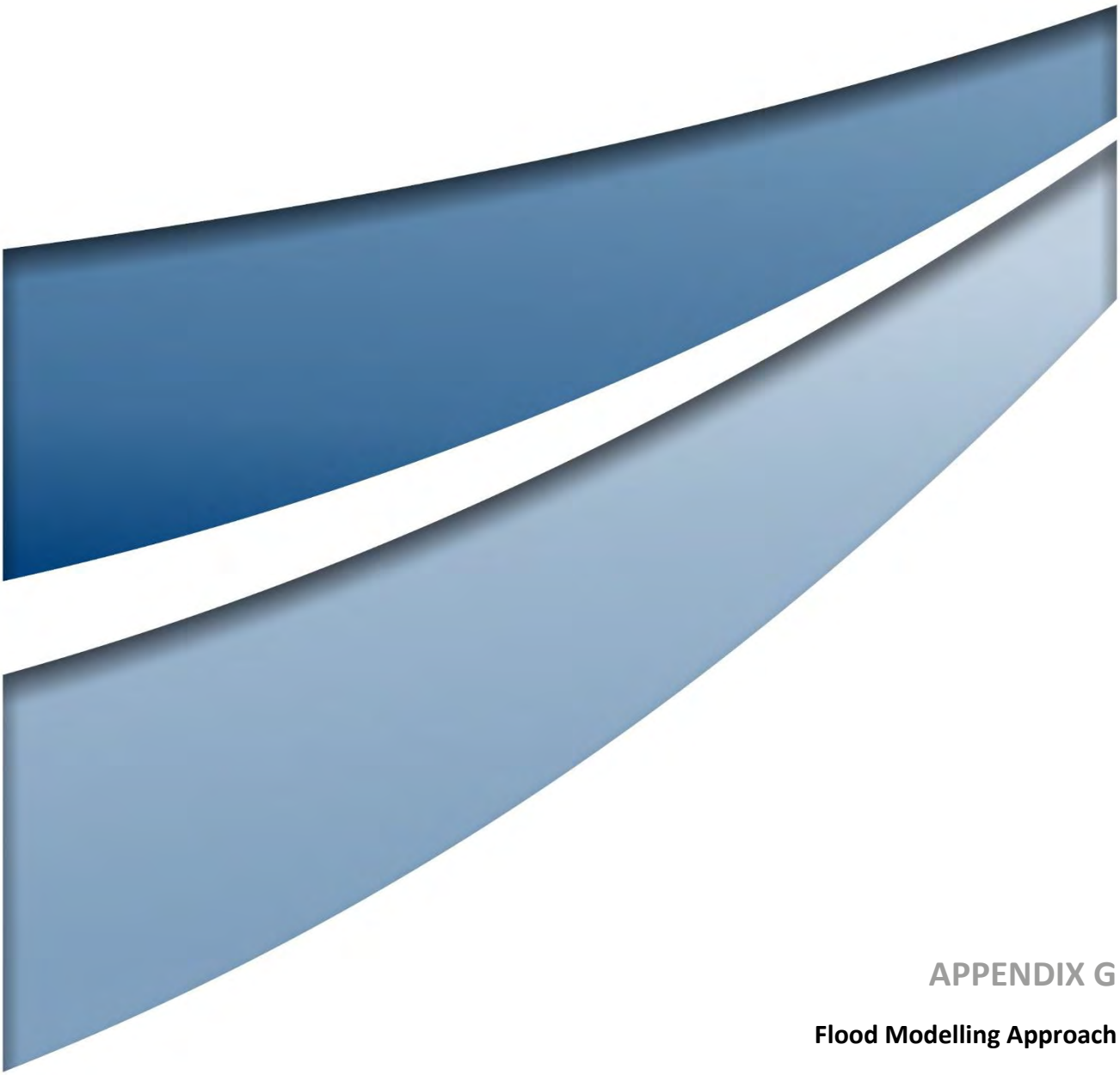


APPENDIX G

Flood Modelling Approach

Purpose of Study

A flood assessment has been undertaken to define the flood conditions within the Study Area and surrounding catchments through the establishment of appropriate numerical models. Simulation of design flood behaviour using the developed models is undertaken to estimate flood inundation extents, levels, depths and velocities across the Study Area to assess flood risk and guide the proposal planning and impact assessment.

Existing Flood Studies

Wallis and Swamp Fishery Creek Flood Study (WMAwater, 2019)

The Wallis and Swamp-Fishery Creek Flood Study was undertaken by WMAwater in 2019.

This flood study is the most recent flood study undertaken for Wallis and Swamp Fishery Creek and was prepared for Maitland City Council and Cessnock City Council. Flood modelling was undertaken in a TUFLOW two-dimensional hydraulic model to define flooding conditions due to flooding originating from the Wallis Creek, Swamp Fishery Creek, Black Waterholes Creek and other tributaries in this catchment system. Flooding from the Hunter River was not analysed in the modelling undertaken for this study, but as described in WMAwater (2010) below, the Hunter River flood level at the downstream end of Wallis Creek defines the peak flood level for the 1% AEP and PMF events at the Proposal Site as a result of backwater flooding from the Hunter River.

Hunter River Branxton to Green Rocks Flood Study (WMAwater, 2010)

The Hunter River Branxton to Green Rocks Flood Study was undertaken by WMAwater in 2010. This flood study was prepared for Maitland City Council and Cessnock City Council. Flood modelling was undertaken in a TUFLOW two-dimensional hydraulic model to define flooding conditions due to flooding originating from the Hunter River. The model extent covers the Wallis Creek pipeline crossing. The Hunter River flood level at the downstream end of Wallis Creek defines the peak flood level for events larger than the 5% AEP event at the Proposal Site at Wallis and Buttai Creek as a result of backwater flooding from the Hunter River.

Comparisons between the flood extents of the 2010 and 2019 flood studies at the Wallis Creek pipeline crossing are provided in **Figure G.1** for the 5% AEP event, **Figure G.2** for the 1% AEP event and **Figure G.3** for extreme events. The 2010 study of the Hunter River flooding did not extend upstream through Swamp Creek to the proposed crossing alignment. However, it likely that the backwater flooding conditions from Hunter River flooding will be similar at both the Swamp Creek and Wallis Creek crossings.

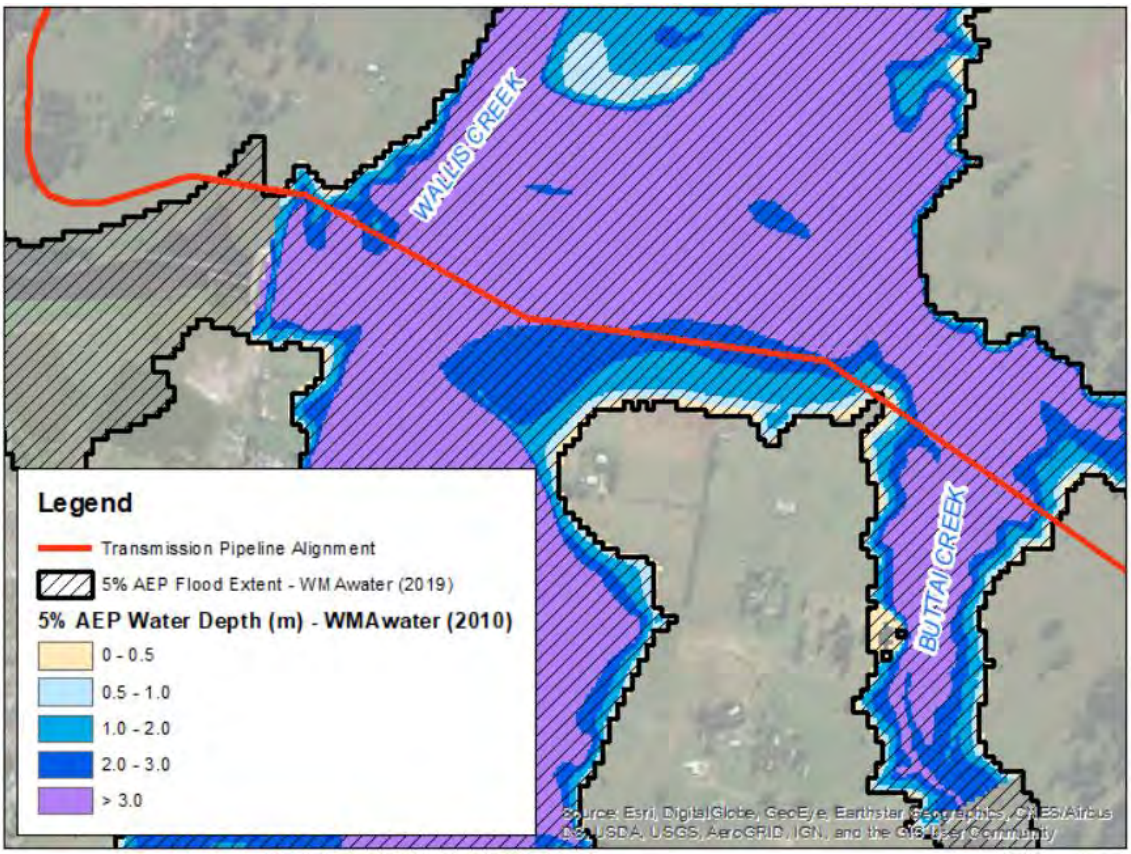


Figure G.1 Flood Extent Comparison – 5% AEP Event

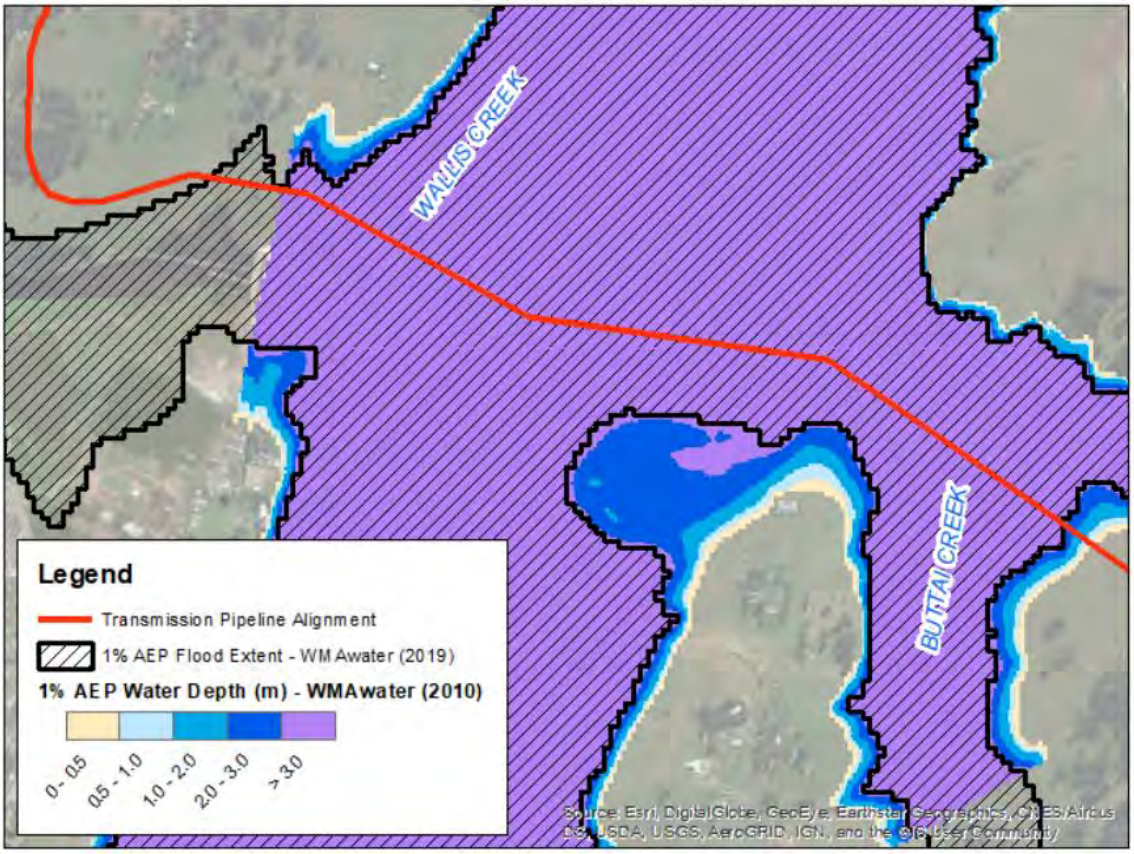


Figure G.2 Flood Extent Comparison – 1% AEP Event

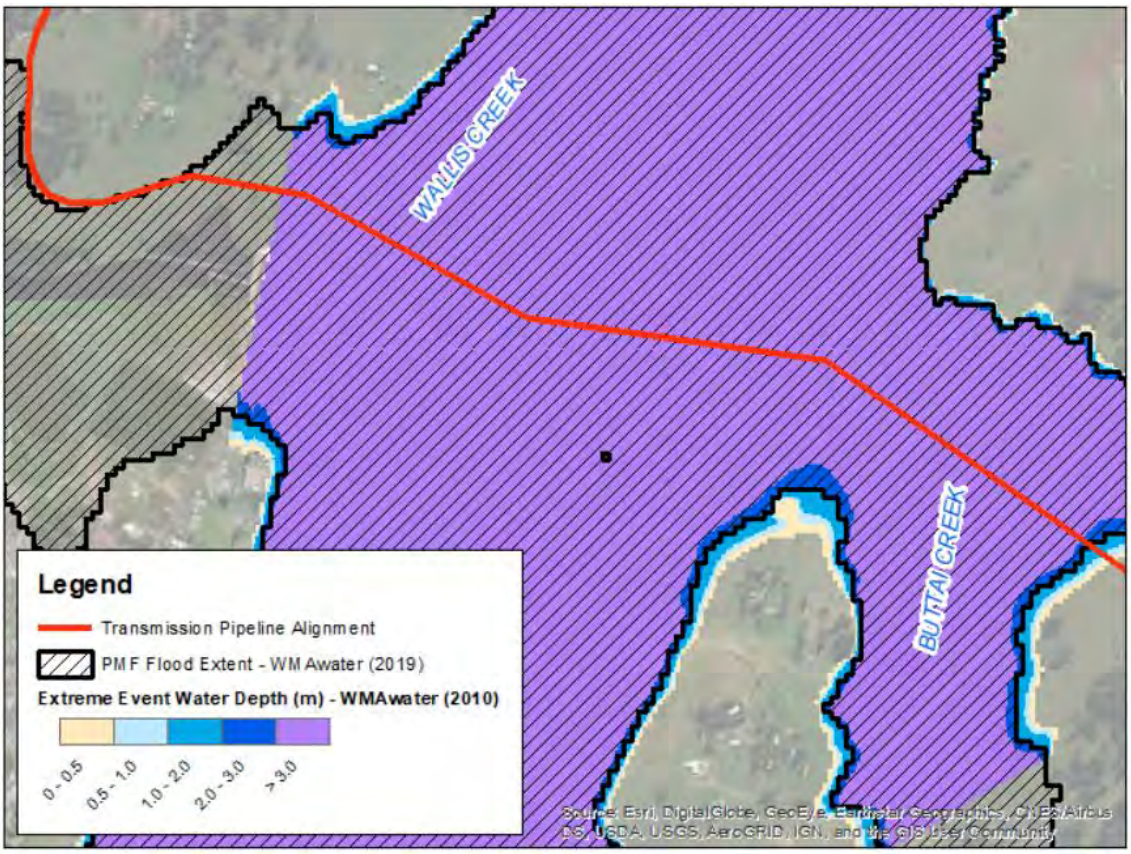


Figure G.3 Flood Extent Comparison – Extreme Events

Modelling Approach

A flood investigation was undertaken for 10%, 1%, 0.5% and 0.2% Annual Exceedance Probability (AEP) events and the Probable Maximum Flood (PMF). AEP is a measure of the likelihood a flood level or flow will be equalled or exceed in any given year. The PMF is the largest flood that could be conceivably expected to occur at a particular location, usually estimated from Probable Maximum Precipitation (PMP).

Hydraulic modelling of the Project Area was completed using a two-dimensional (2D) TUFLOW flood model. TUFLOW software is one of the most widely used hydraulic modelling software packages in Australia. The software is considered an appropriate modelling tool for modelling riverine and local overland flooding. TUFLOW allows the simulation of runoff generated from local rainfall on a grid that is representative of the site topography, known as “direct rainfall” modelling. A coarse resolution 2D TUFLOW model covering the catchment upstream of the pipeline alignment was used to determine the critical storm durations and temporal patterns. A finer resolution TUFLOW model covering the complete local catchment area draining to the Project Area was run for the critical storms and temporal patterns determined using the coarse resolution model (refer **Figure 4.1**).

The model provides estimates of flood levels, depth, velocities and flood hazard for each of the modelled design events. The hydraulic model was run for both existing and climate change conditions. Climate change modelling was undertaken using the 0.5% and 0.2% AEP year flood events as proxies for assessing sensitivity to an increase in rainfall intensity of flood producing rainfall events due to climate change.

The flood hazard was assessed in accordance with *Australian Rainfall and Runoff: A Guide to Flood Estimation* (ARR2019).

Model Domain and Topography

The catchment was delineated using LiDAR data and is shown in **Figure 4.1**. The model topography was developed from the LiDAR data available for the site. The Project Area is covered by LiDAR data flown in 2012 and 2015 (GA, 2012).

A coarse resolution model (20m grid resolution) was developed covering the catchment as well the covering the catchment. This model was used to determine critical storm durations and temporal patterns for use in the finer resolution model. The finer resolution model (5 m grid resolution) was developed and was used to estimate flood depths and flood hazard within the Project Area. The model domains for the existing Wallis and Swamp-Fishery Creek Flood Study and the new models are shown in **Figure 4.1**.

Design Rainfall Inputs

Event Duration

Design rainfall was derived for burst duration between 30 min and 24 hours, based on the expectation that the critical storm duration for the Project Area catchments would be relatively short, given their size.

Intensity-Frequency-Duration (IFD)

Rainfall burst depths for the modelled AEP events were estimated for the centroid of each sub-catchment using the 2016 ARR IFD analysis available from the BoM.

The Probable Maximum Precipitation (PMP) was estimated using the Generalised Short Duration Method (GSDM Method) BoM, 2003) for short durations.

Temporal Patterns

Temporal patterns are the distribution of the total rainfall in different periods within a given duration.

The 10 available temporal patterns were downloaded from ARR 2019 Data Hub and used to simulate the temporal distribution of burst rainfall depths during each storm duration modelled. The suite of temporal has been applied to estimate the critical design event for flood estimation in accordance with ARR 2019 procedures.

The GSDM temporal pattern was used for the PMP event.

Hydraulic Roughness and Losses

The hydraulic model used Manning's 'n' to represent the hydraulic roughness to determine the restriction caused by the range of land uses within the model area. Aerial photography was used to assign a specific Manning's 'n' roughness coefficient based on the recommendations in ARR2019, as shown in **Table G.1**. Initial and continuing losses were also applied as per land use and the adopted values are shown in **Table G.1**. The values used are typical and have been used in similar studies.

Losses were initially extracted from the ARR online datahub. The suggested losses were a 20 mm initial loss (IL) and a 2.8 mm/hr continuing loss (CL). As the site is in NSW, the continuing loss was multiplied by a factor of 0.4, reducing it to a CL value of 1.1 mm/hr.

Table G.1 Manning's Roughness and Losses used in the Developed Hydraulic Model

Manning's 'n'	IL (mm)	CL (mm/hr)	Land Use
0.04	20	1.1	Light Vegetation
0.08	20	1.1	Thick Vegetation
0.04	0	0	Waterways (minimum vegetation)
0.06	0	0	Waterways (medium vegetation)
0.08	0	0	Waterways (thick vegetation)
0.05	20	1.1	Lots
0.02	0	0	Paved Area
0.04	20	1.1	Railway
0.05	20	1.1	Wetland

Hydraulic Structures

Given the high-level risk assessment being undertaken, only a simplified representation of road and rail cross drainage was incorporated in the hydraulic model. Detailed data on culvert configurations and dimensions was not acquired for the study, and were estimated where aerial photography, LIDAR data and observed on site.

No additional hydraulic loss parameters were applied to structures. It is noted that the principal inclusion of the structures in the model is to provide flow continuity across road embankment structures, rather than a detailed analysis of structure performance.

Model Scenarios

Critical Storm Duration and Temporal Patterns

A range of storm duration and temporal patterns (as discussed above) were simulated (using ARR2019 inputs) to identify the rainfall profiles providing for the critical flood conditions (design peak water levels) across the Project Area. A coarse grid (20 m resolution) TUFLOW model was used to determine the critical storm duration and temporal patterns. These scenarios were modelled in the finer 5m grid hydraulic model.

Flood Model Results

The flood model results provide the distribution of peak flood level, depth, velocity and hazard across the Project Area for each modelled design magnitude flood event. Note that areas where the modelled flood depths are less than 100 mm have been filtered from the results.

The flood mapping is provided in **Appendix H**, **Appendix I** and **Appendix J** for flood depth, flood velocity and flood hazard respectively for each design as outlined below:

1. 10% AEP event
2. 1% AEP event - represents the principal flood planning event
3. 0.5% and 0.2% AEP events representative of indicative climate change impacts
4. PMF event

Flood Hazard Classifications

The flood hazard of the site was assessed in accordance with ARR 2019, which defines six hazard categories as presented in **Table G.2**. The combined flood hazard curves are presented in **Figure G.4**.

Table G.2 Hazard Classification (ARR, 2016)

Hazard Vulnerability Classification	Classification Limit (D and V in combination)	Limiting Still Water Depth (D)	Limiting Velocity (V)	Description
H1	D*V ≤ 0.3	0.3	2.0	Generally safe for vehicles, people and buildings.
H2	D*V ≤ 0.6	0.5	2.0	Unsafe for small vehicles.
H3	D*V ≤ 0.6	1.2	2.0	Unsafe for vehicles, children and the elderly.
H4	D*V ≤ 1.0	2.0	2.0	Unsafe for vehicles and people.
H5	D*V ≤ 4.0	4.0	4.0	Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
H6	D*V ≥ 4.0	-	-	Unsafe for vehicles and people. All building types considered vulnerable to failure.

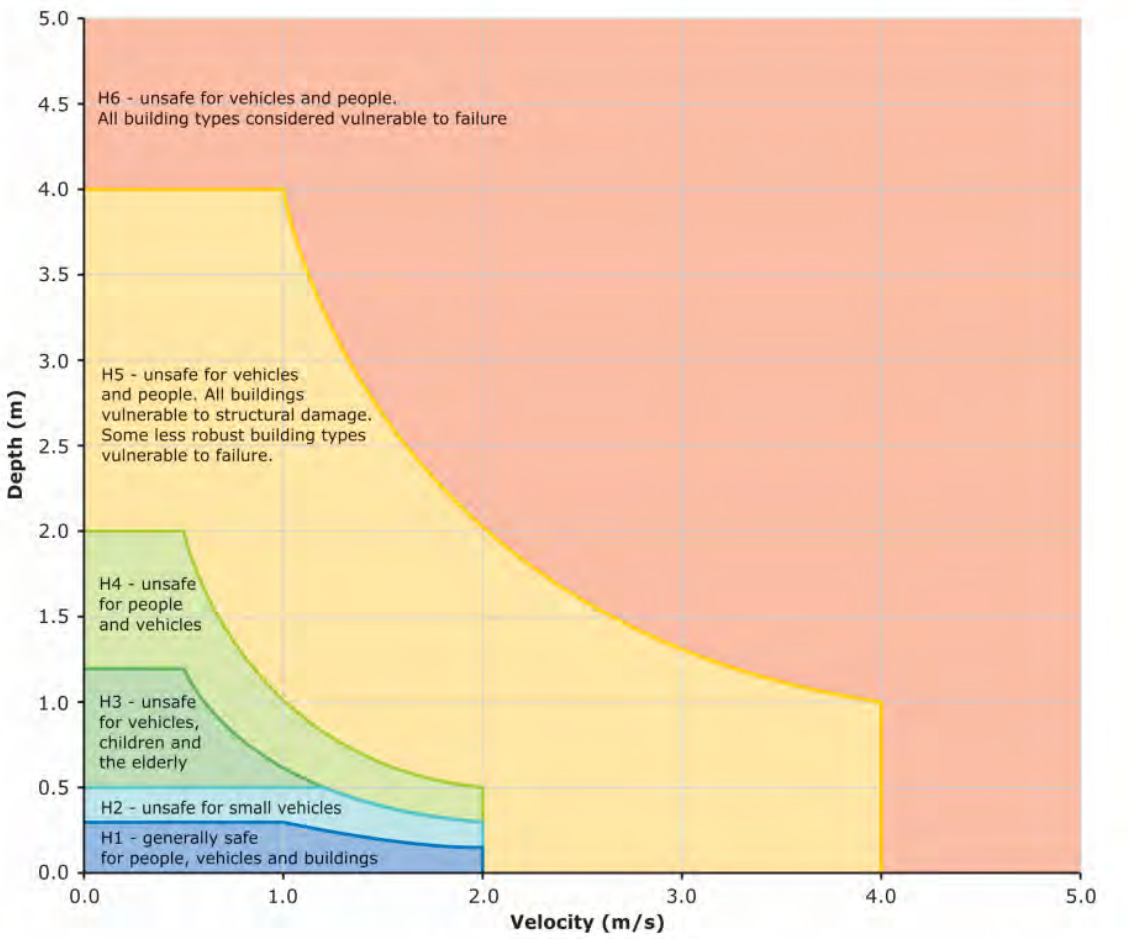
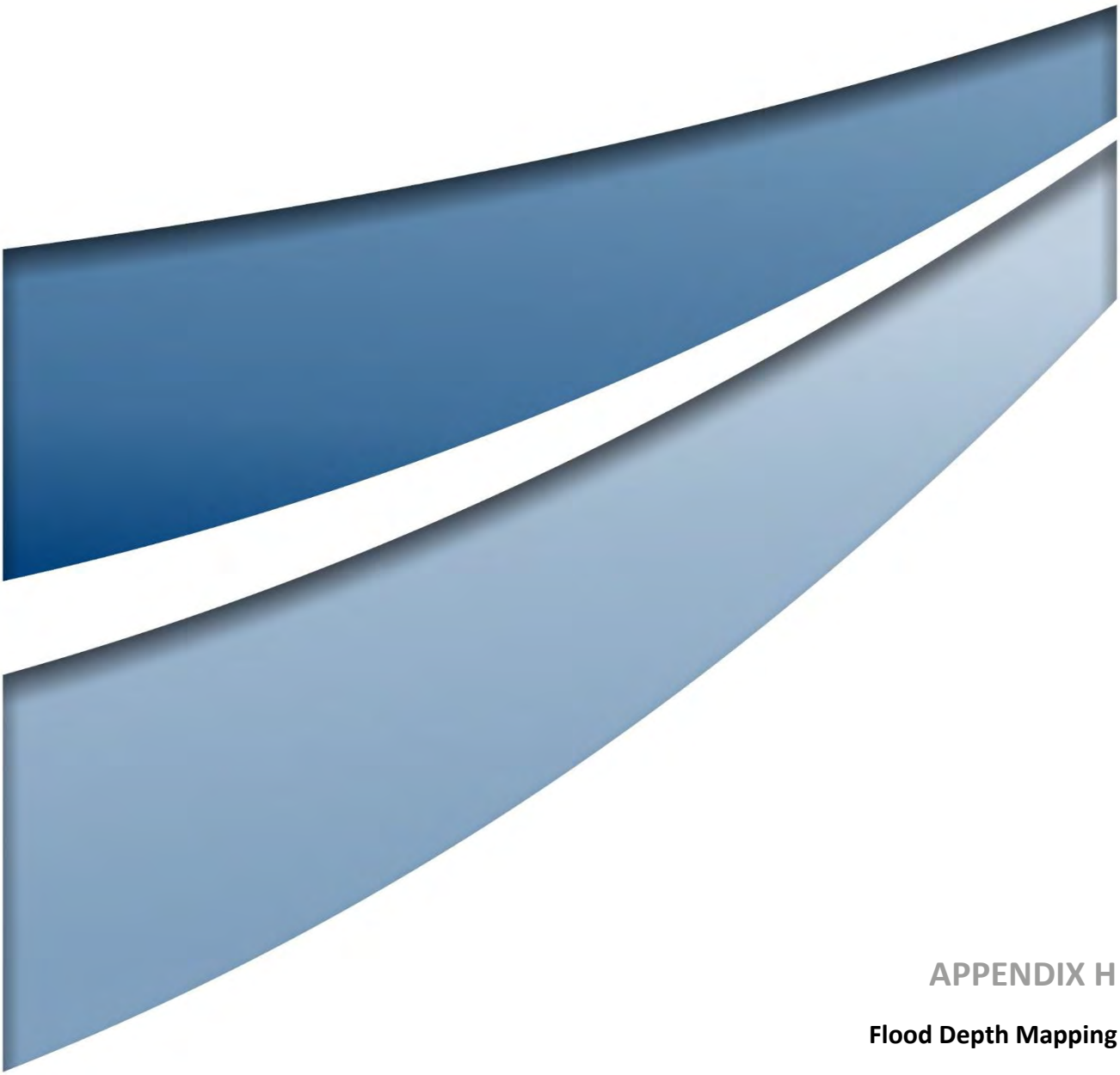


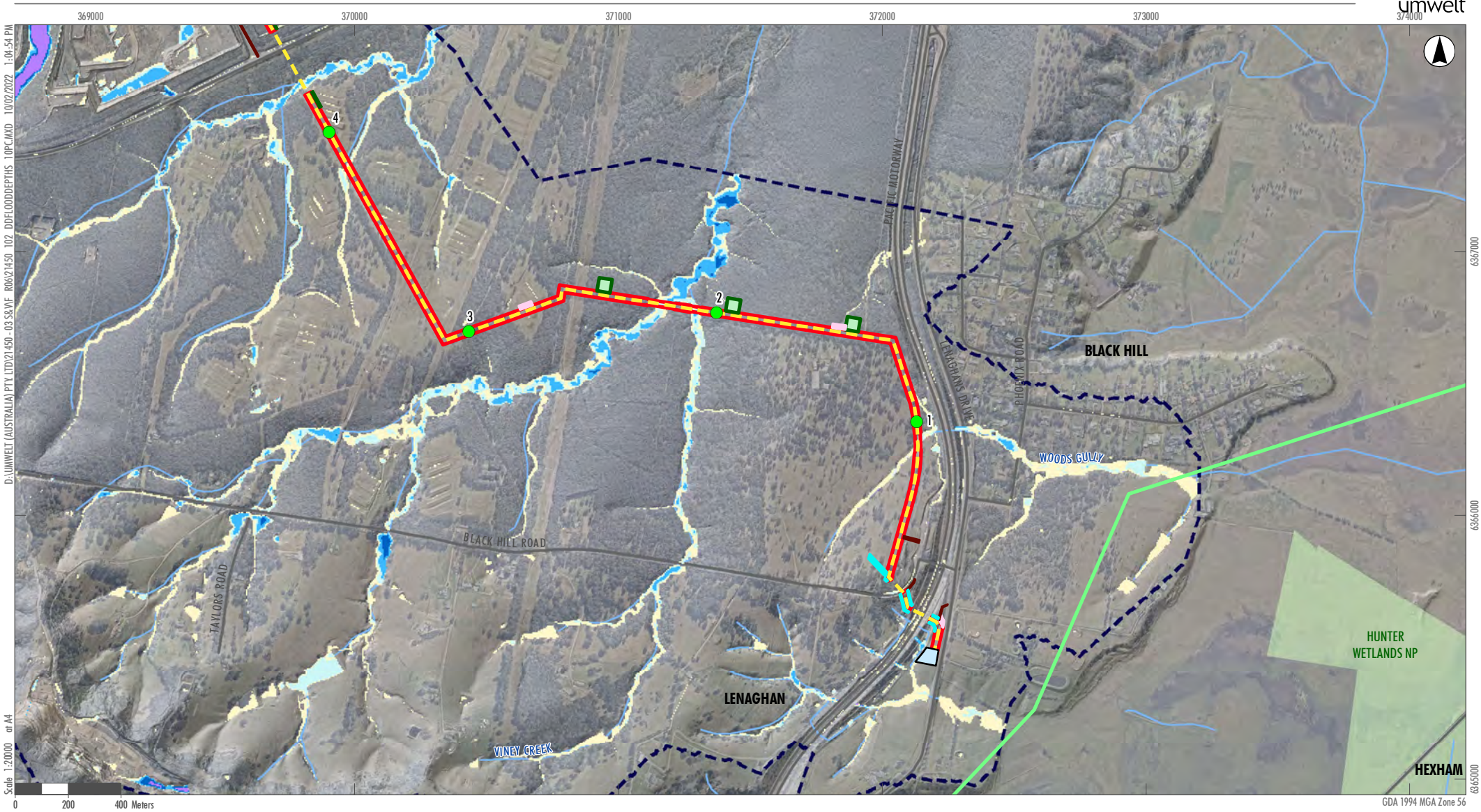
Figure G.4 Combined Flood Hazard Curves

(Smith et al. 2014)



APPENDIX H

Flood Depth Mapping



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- Sydney to Newcastle Pipeline (JGN Northern Trunk)
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- JGN Offtake Facility
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

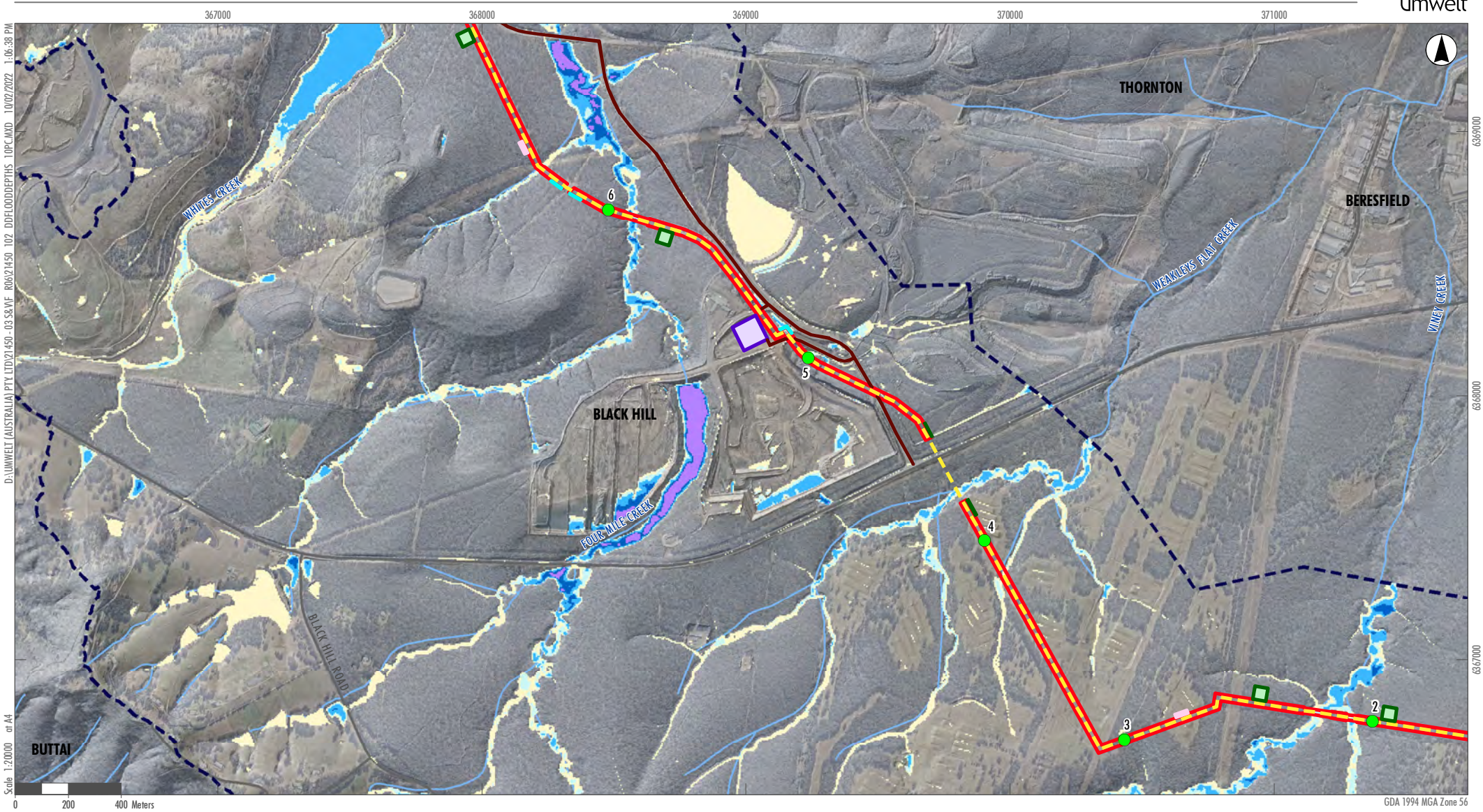
Water Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)

APPENDIX H-1A

10% AEP Flood Depths for Existing Conditions

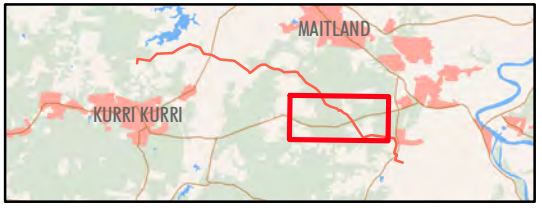


Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Pipe Laydown Areas
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

Water Depth (m)

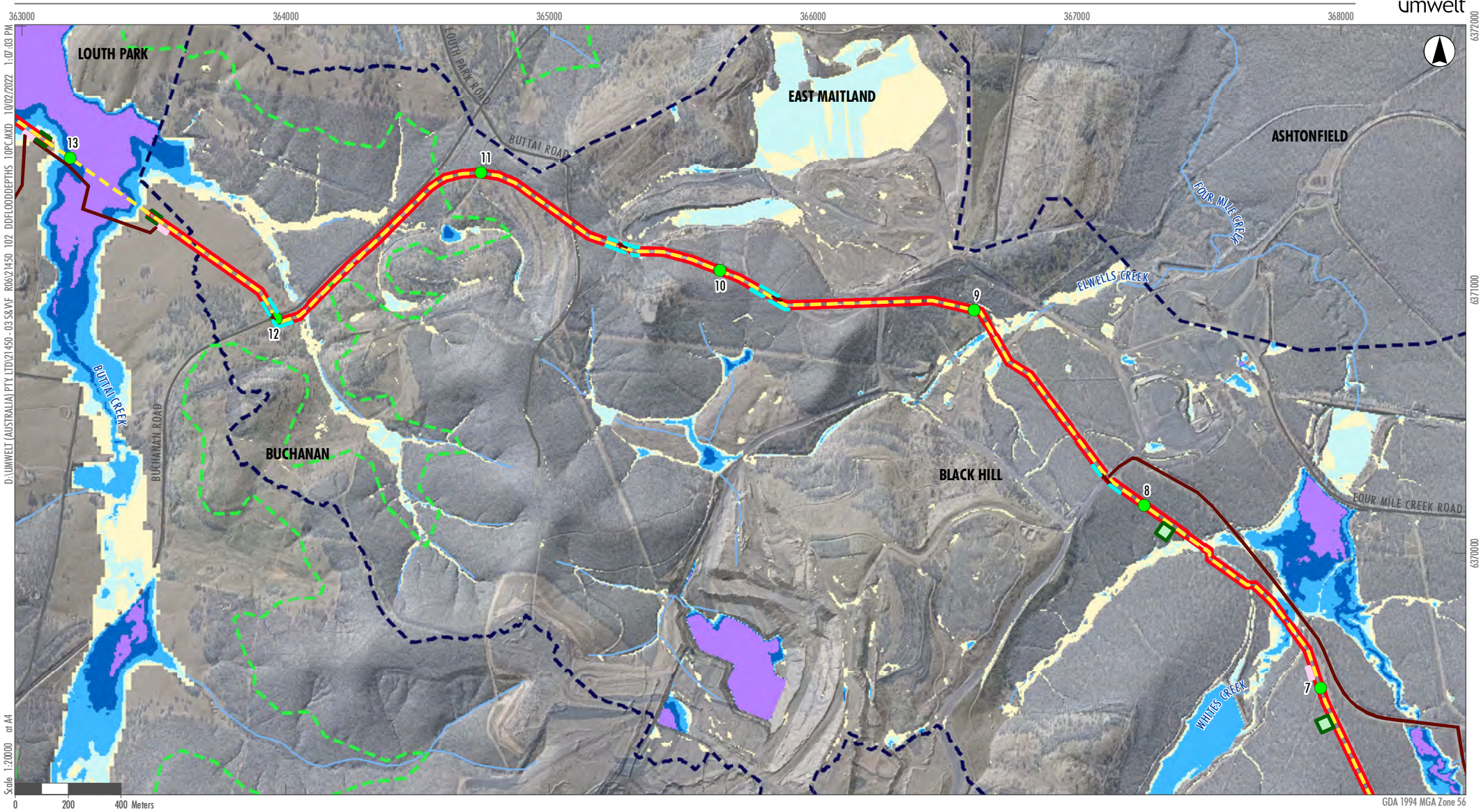
- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0



APPENDIX H-1B

10% AEP Flood Depths for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

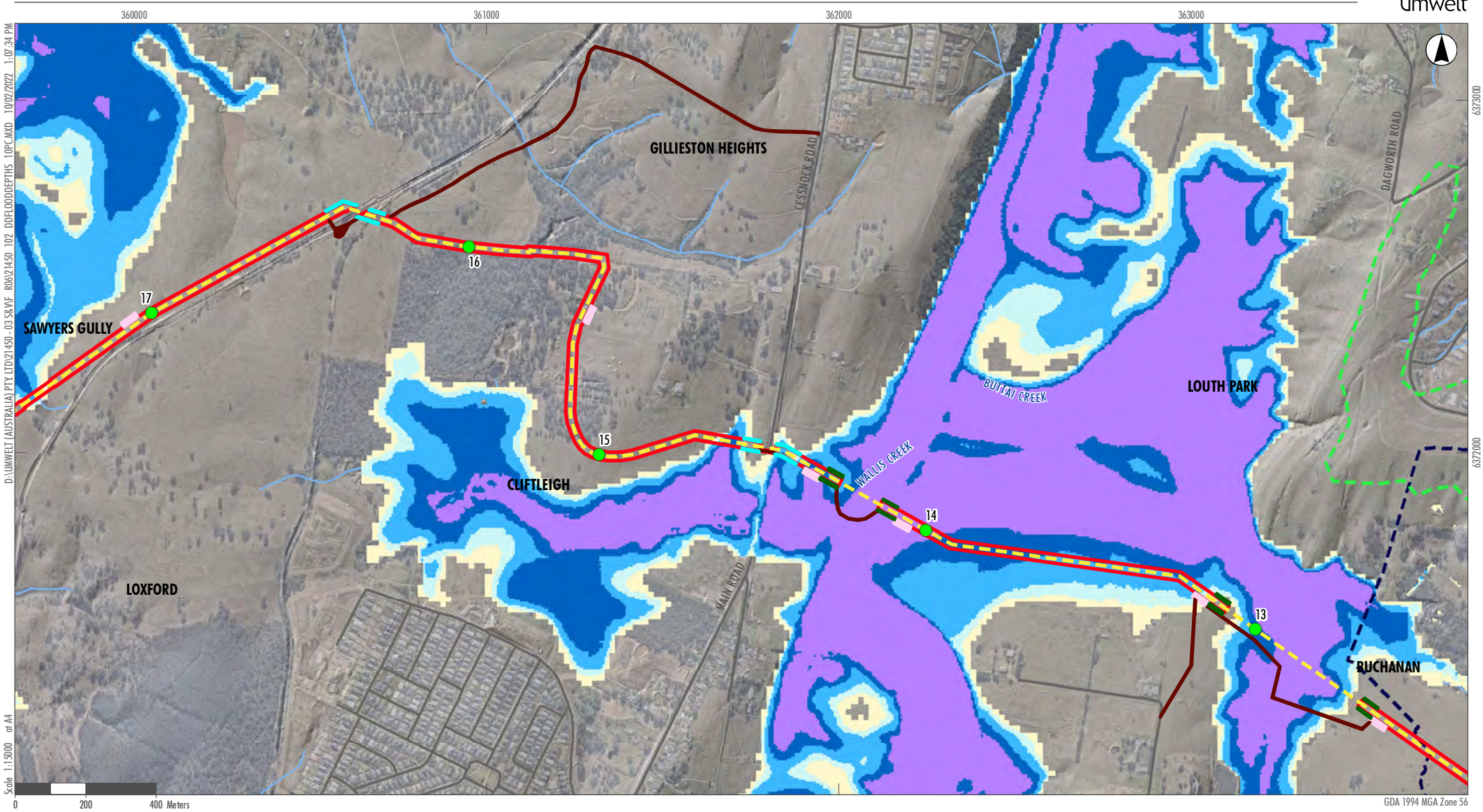
Water Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)

APPENDIX H-1C

10% AEP Flood Depths for Existing Conditions



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Access Tracks
- Roads
- Watercourses

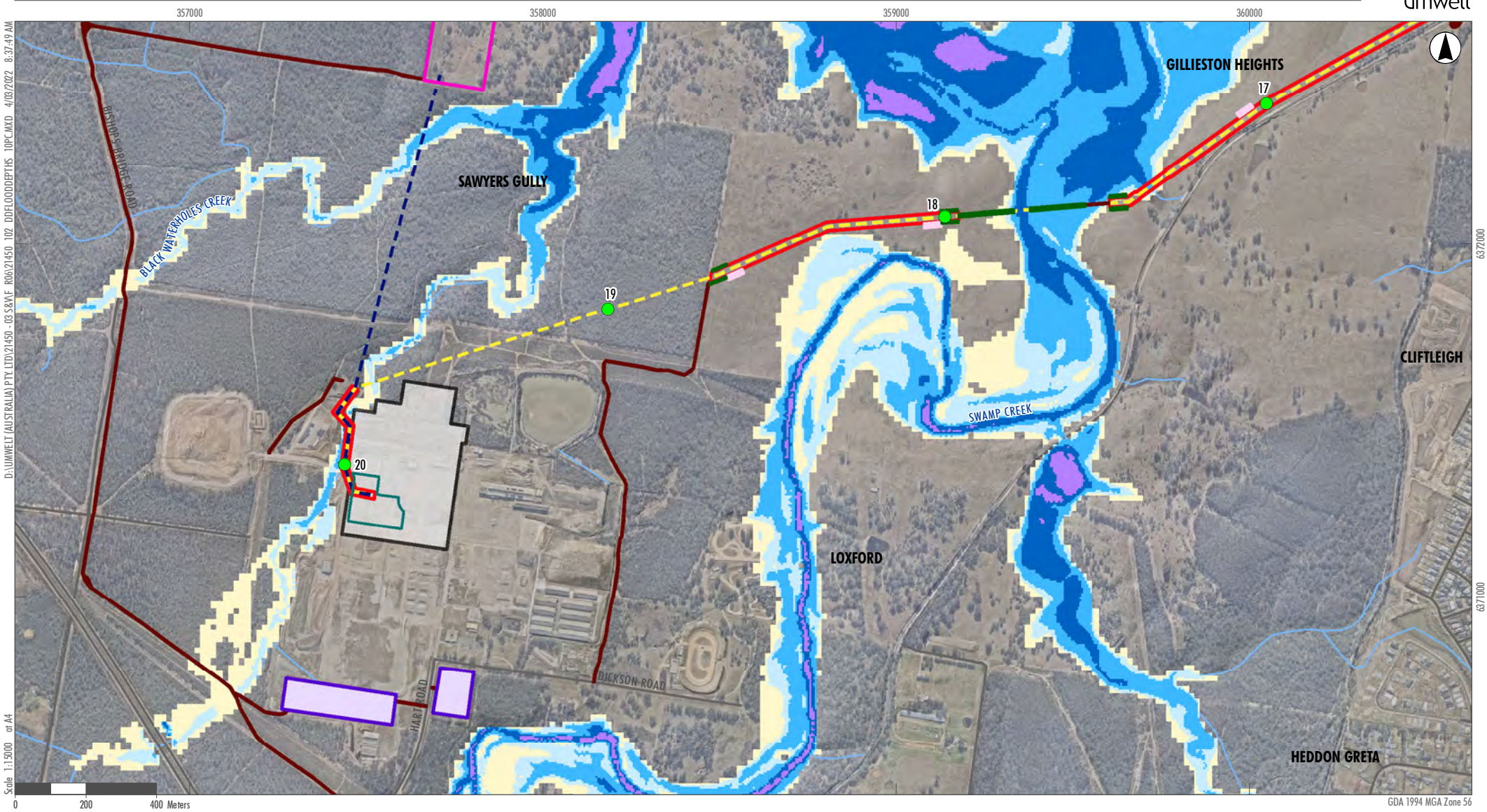
Water Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

APPENDIX H-1D

10% AEP Flood Depths for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Access Tracks
- Roads
- Watercourses

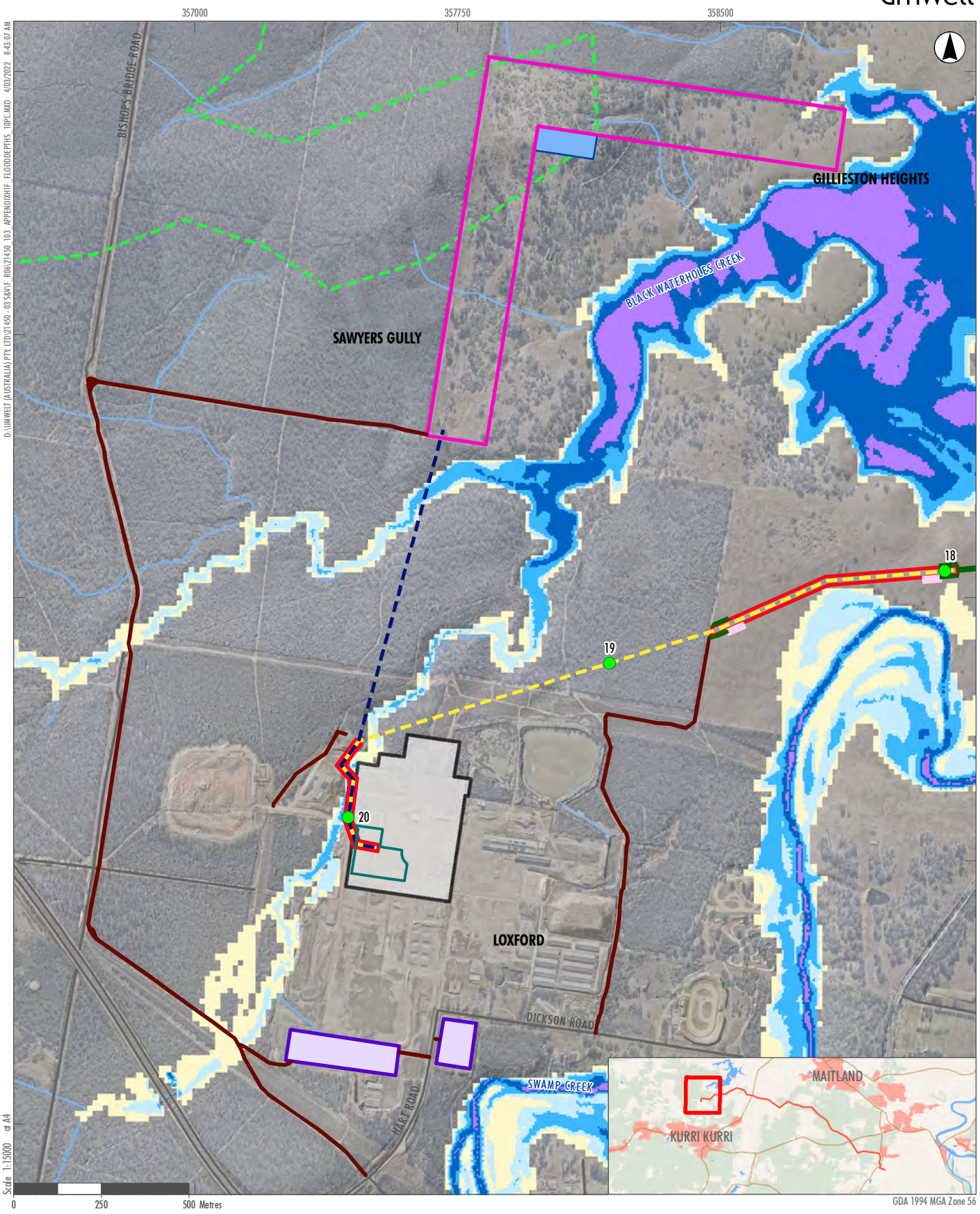
Water Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)

APPENDIX H-1E

10% AEP Flood Depths for Existing Conditions



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Turkey Nest Dam
- Access Tracks
- Roads
- Watercourses

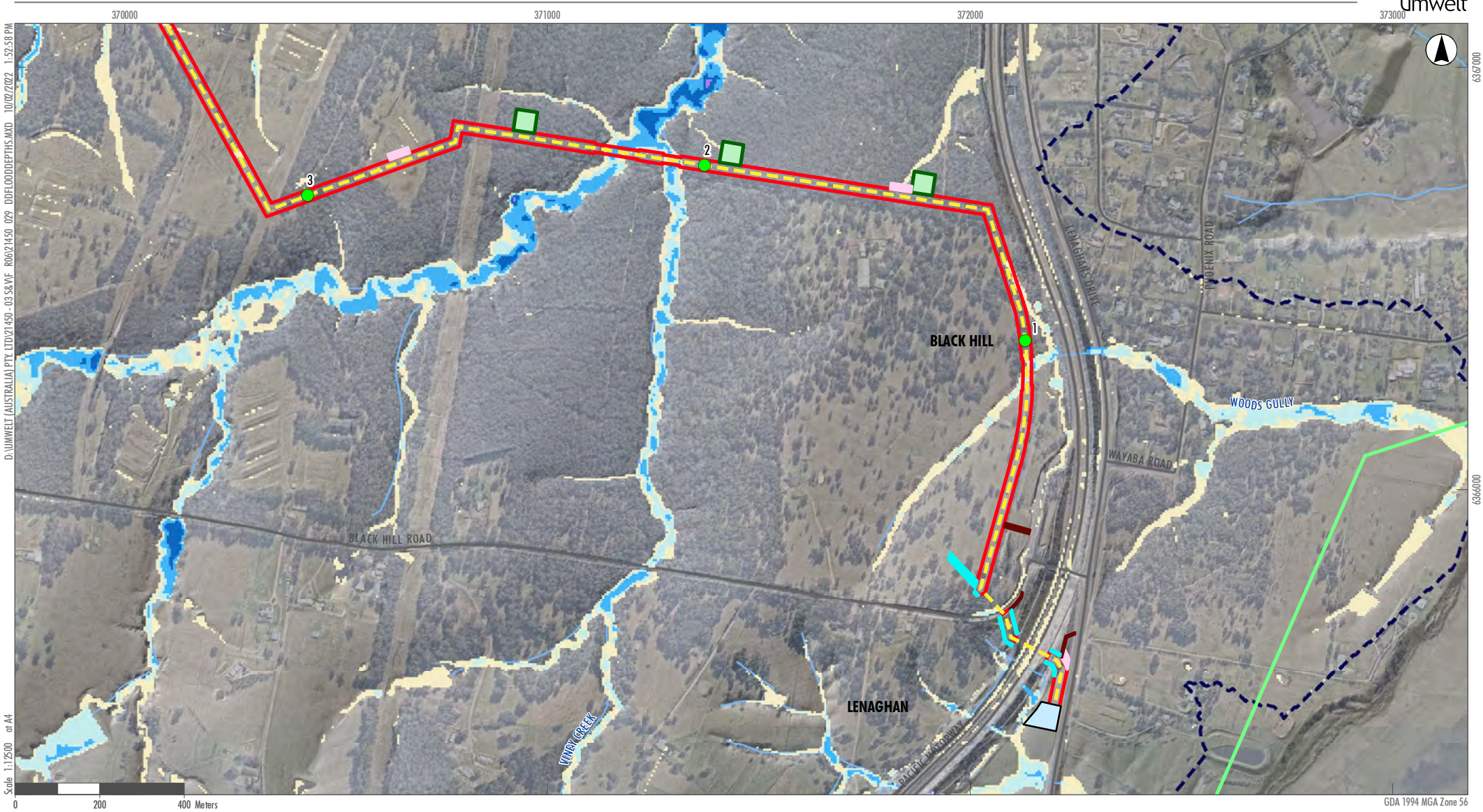
Water Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

Image Source: Nearmap (October 2021) Data source: NSW LPI (2020;2021)

APPENDIX H-1F

10% AEP Flood Depths for Existing Conditions



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- Sydney to Newcastle Pipeline (JGN Northern Trunk)
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- JGN Offtake Facility
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

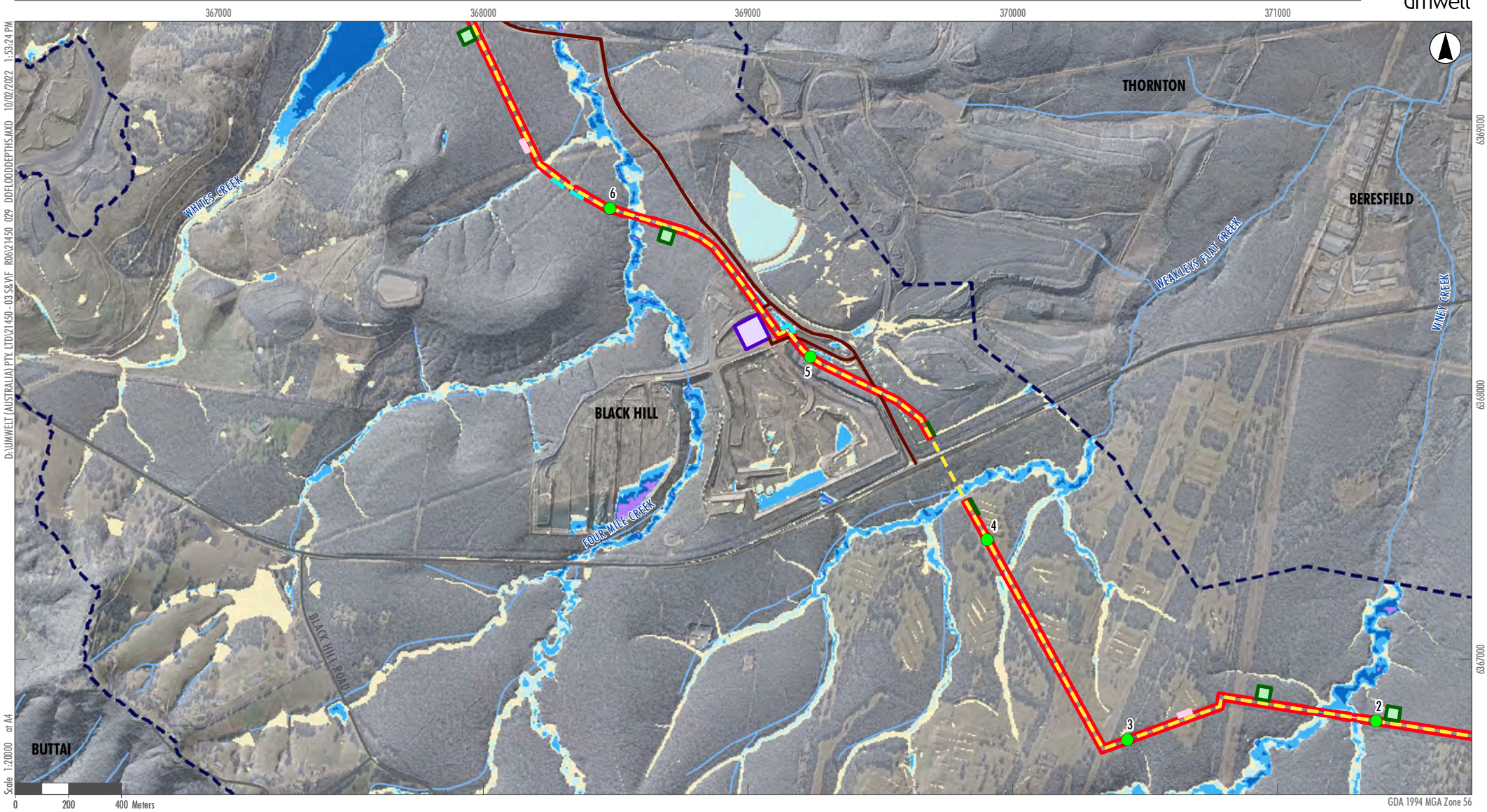
Water Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)

APPENDIX H-2A

1% AEP Flood Depths for Existing Conditions

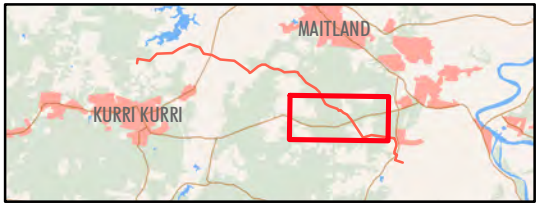


Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Pipe Laydown Areas
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

Water Depth (m)

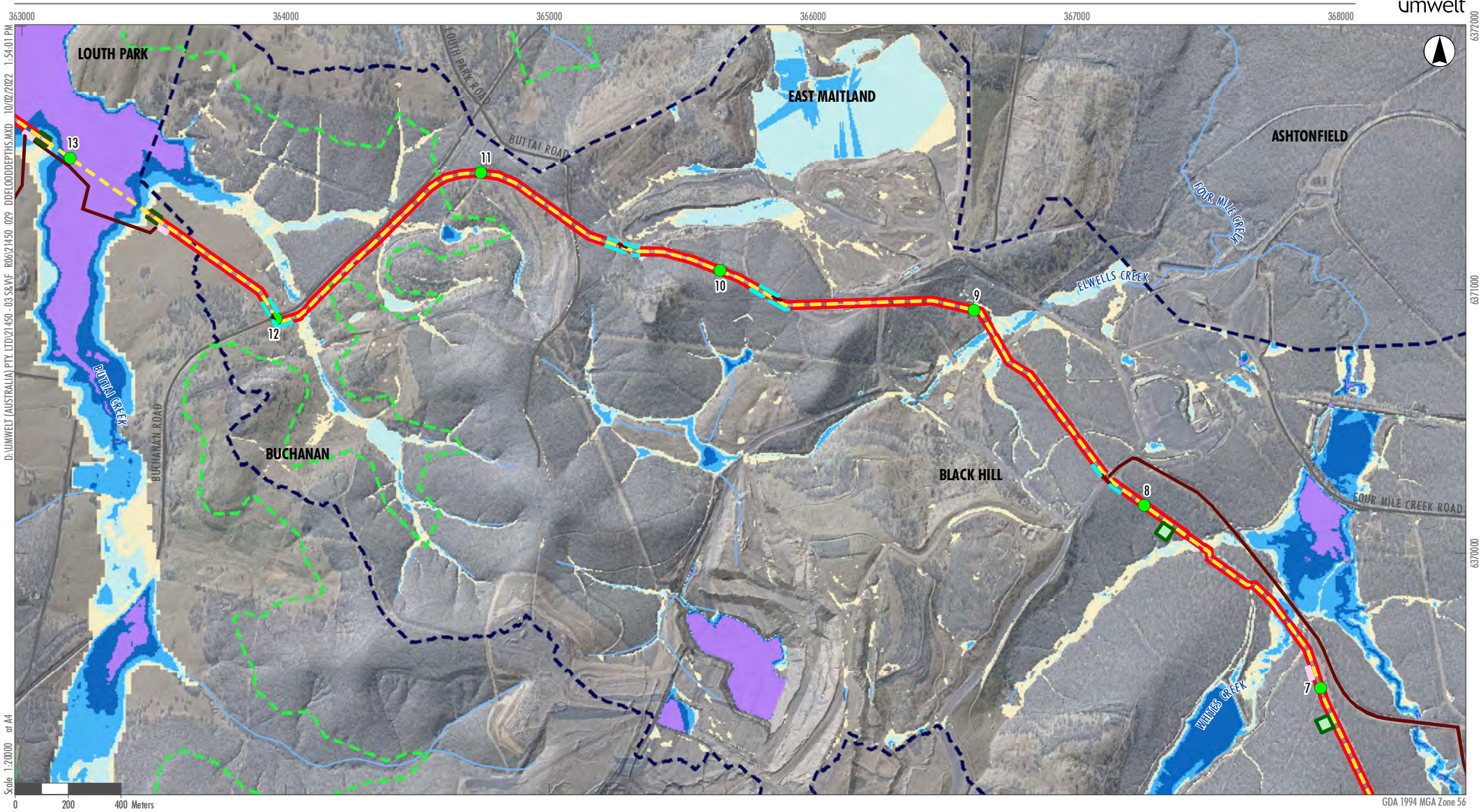
- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0



APPENDIX H-2B

1% AEP Flood Depths for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

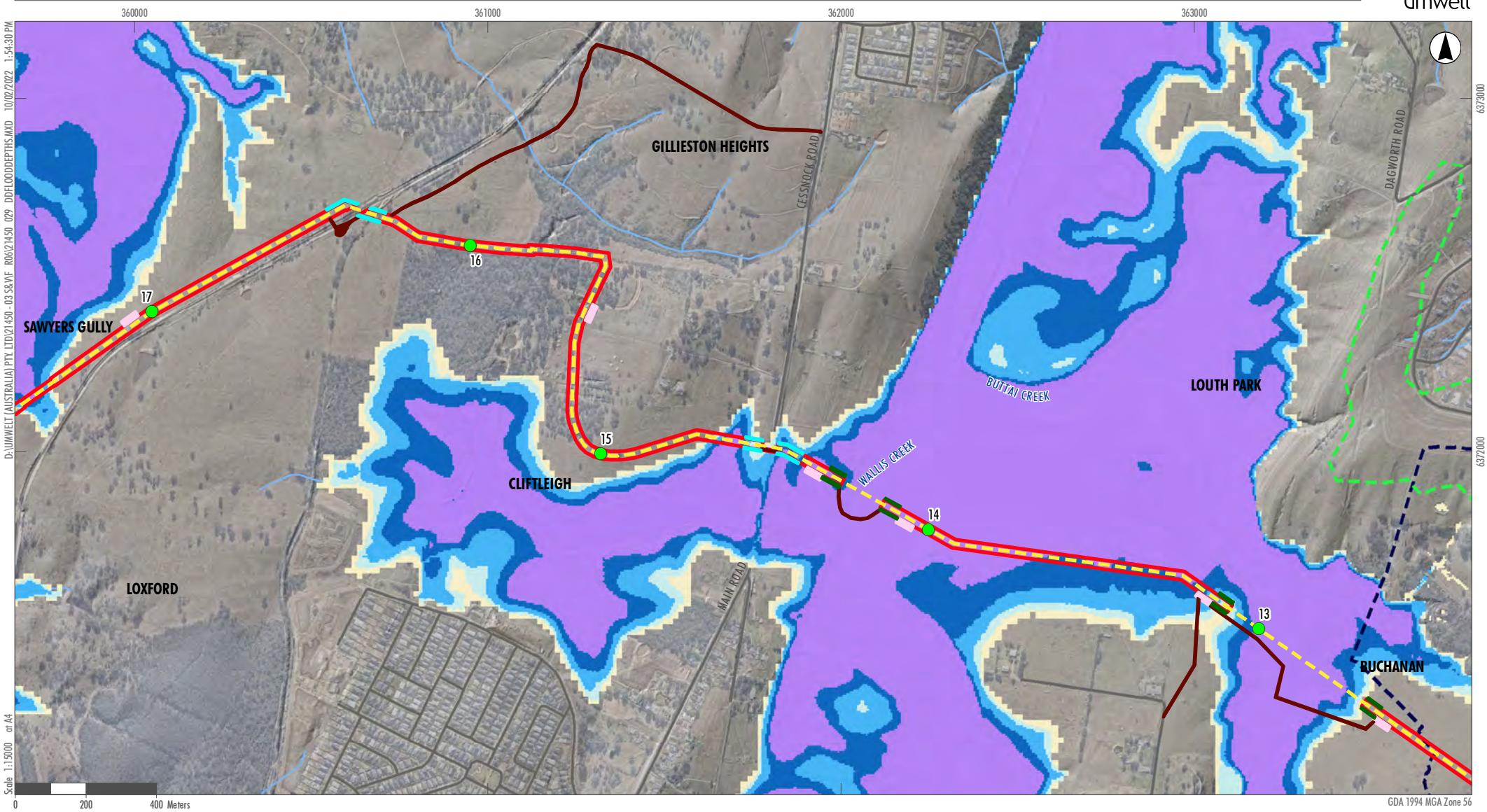
Water Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)

APPENDIX H-2C

1% AEP Flood Depths for Existing Conditions



D:\UMWELT (AUSTRALIA) PTY. LTD\21450 - 03 S&WF R06\21450_029_DDFLOODDEPTHS.MXD 10/02/2022 1:54:30 PM

Scale 1:15000 at A4

GDA 1994 MGA Zone 56

Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Access Tracks
- Roads
- Watercourses

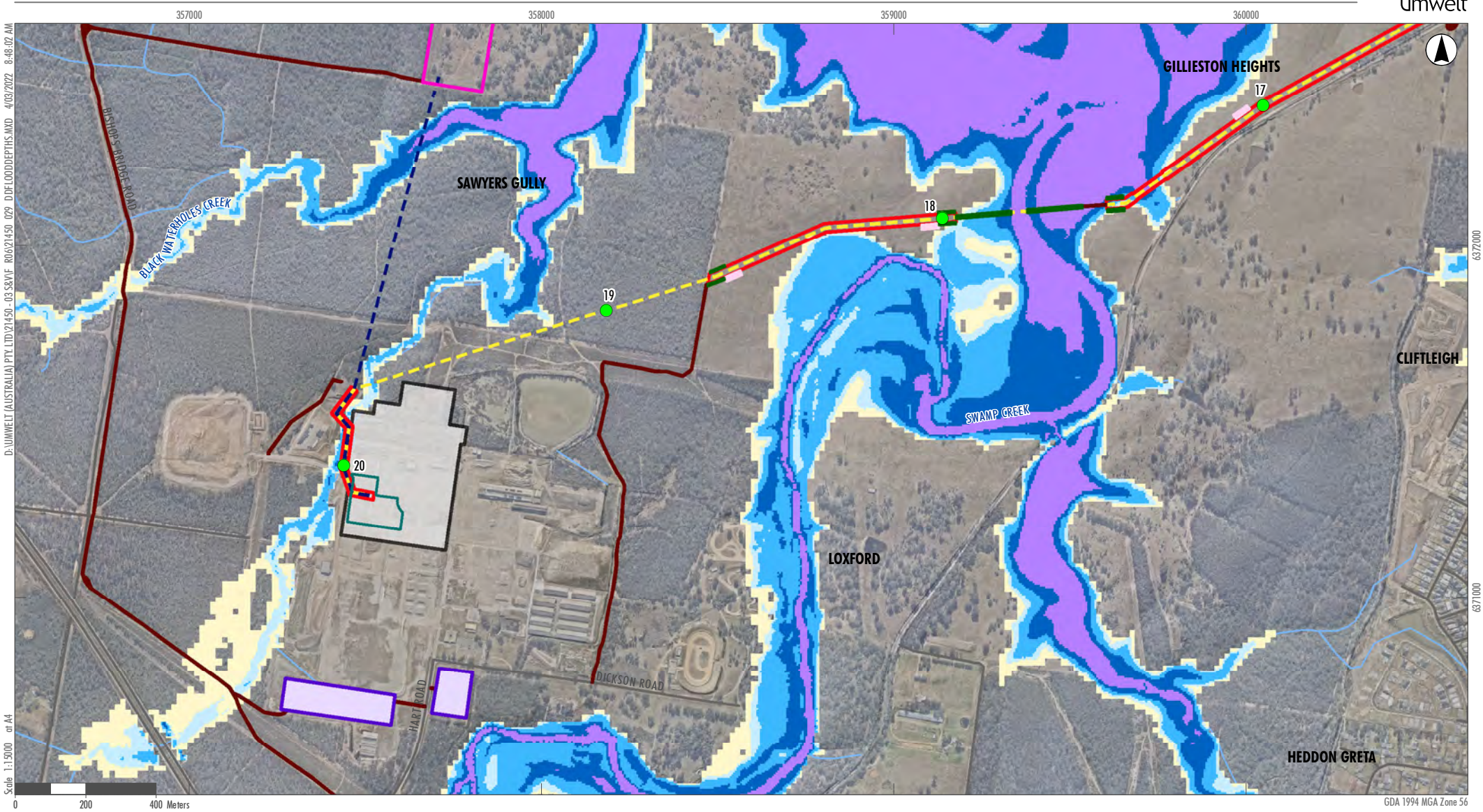
Water Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)

APPENDIX H-2D

1% AEP Flood Depths for Existing Conditions



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Access Tracks
- Roads
- Watercourses

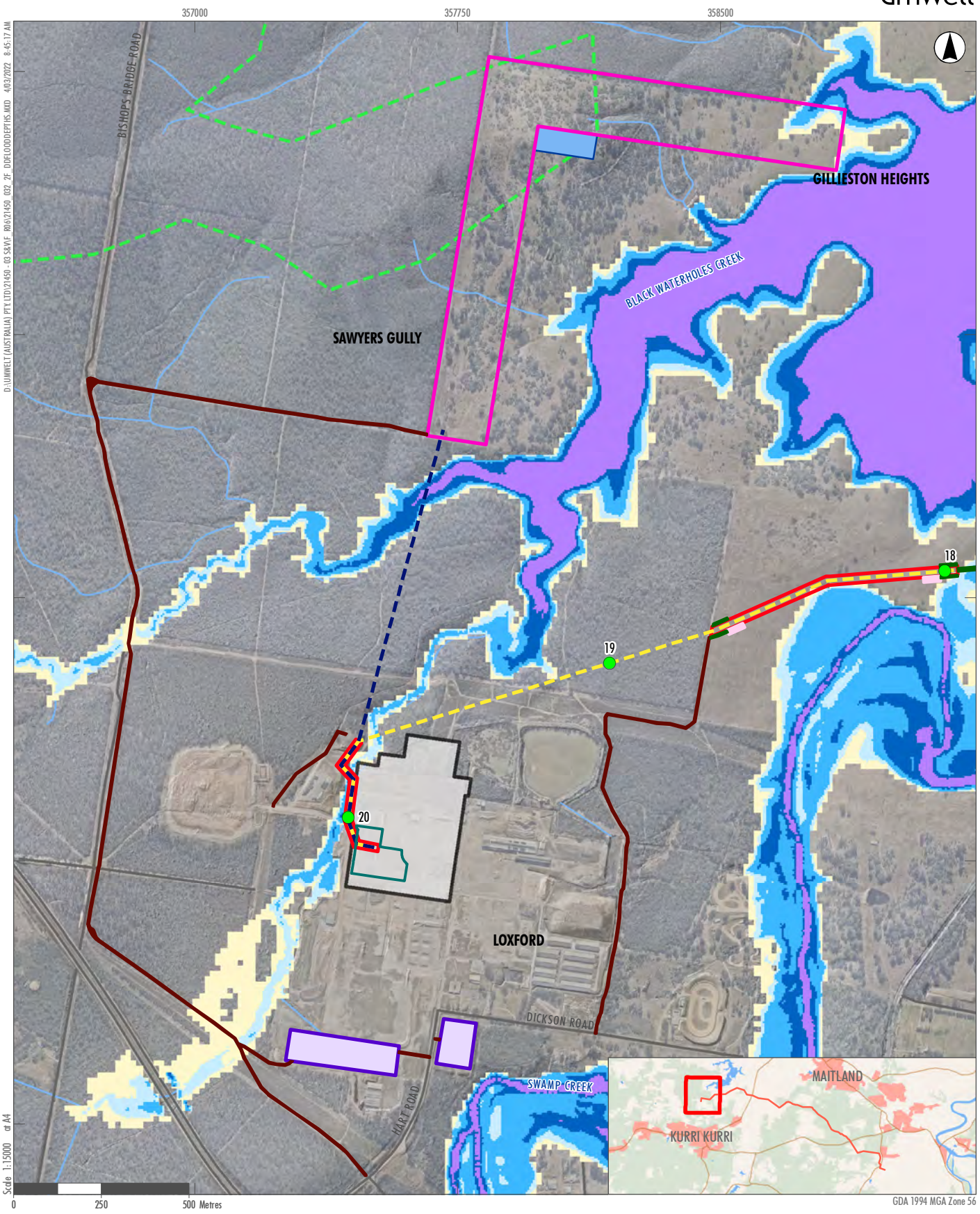
Water Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)

APPENDIX H-2E

1% AEP Flood Depths for Existing Conditions



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Turkey Nest Dam
- Access Tracks
- Roads
- Watercourses

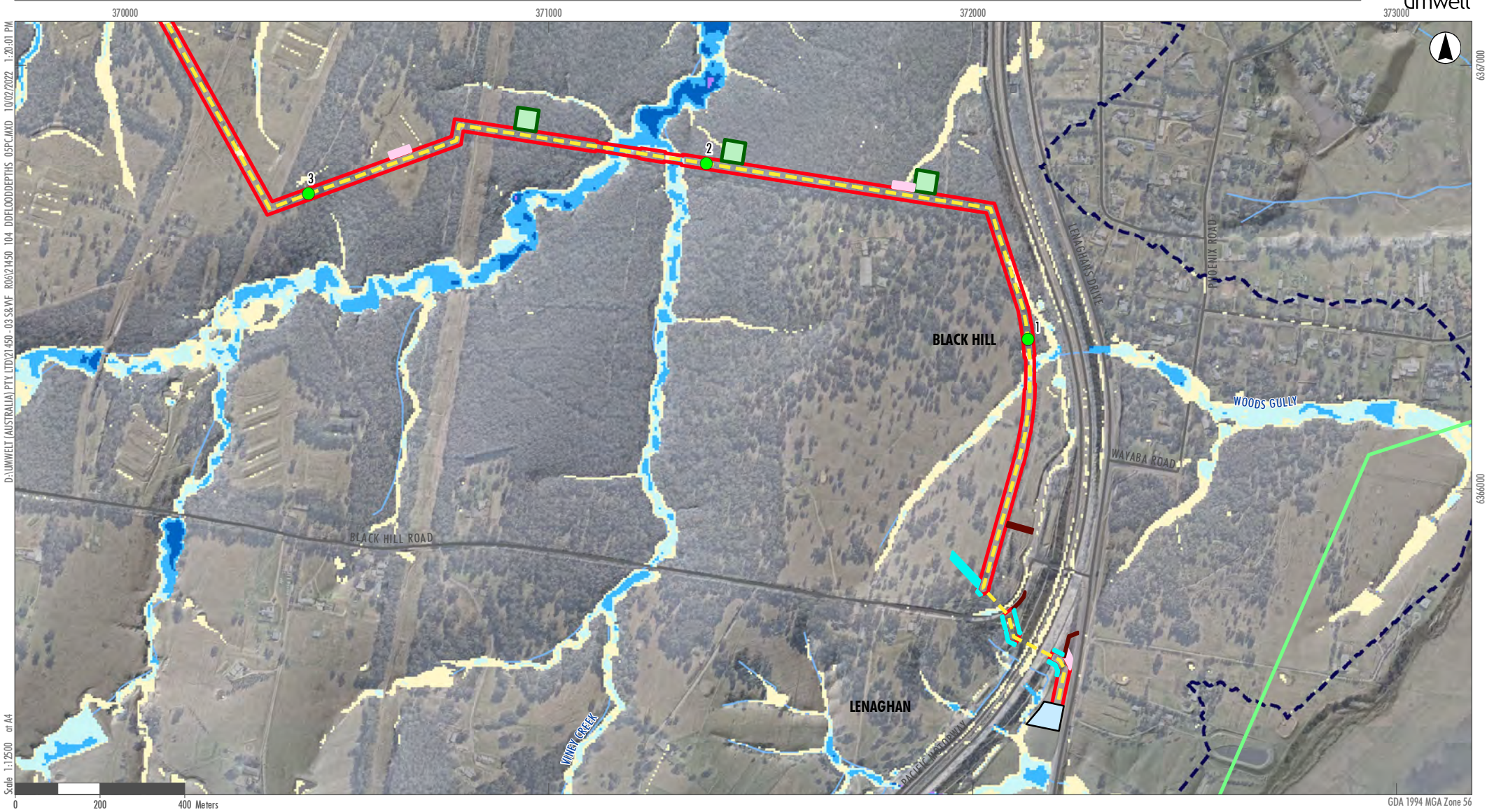
Water Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)

APPENDIX H-2F

1% AEP Flood Depths for Existing Conditions



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- Sydney to Newcastle Pipeline (JGN Northern Trunk)
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- JGN Offtake Facility
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

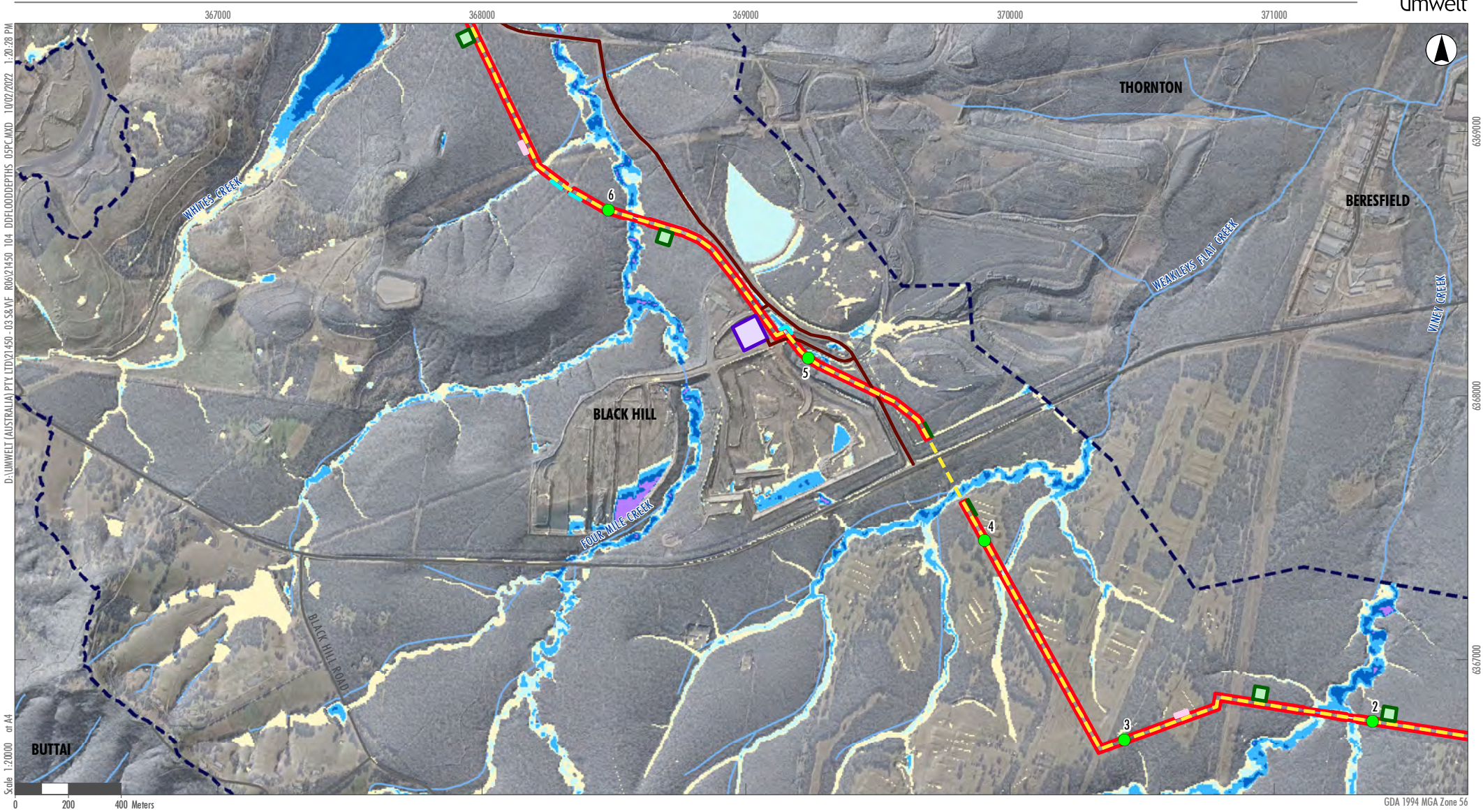
Water Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)

APPENDIX H-3A

0.5% AEP Flood Depths for Existing Conditions

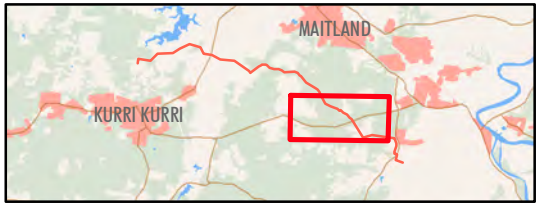


Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Pipe Laydown Areas
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

Water Depth (m)

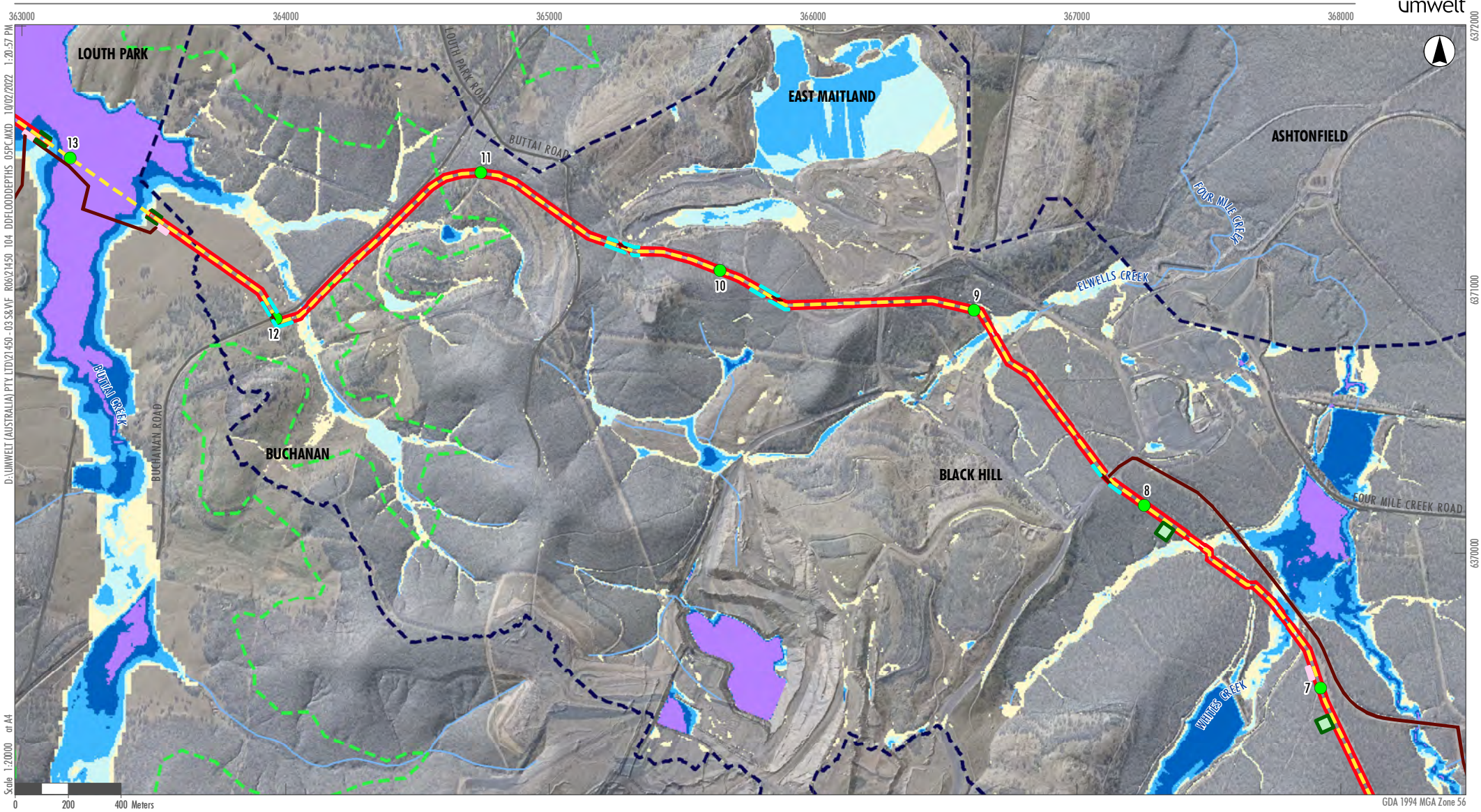
- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0



APPENDIX H-3B

0.5% AEP Flood Depths for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

Water Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

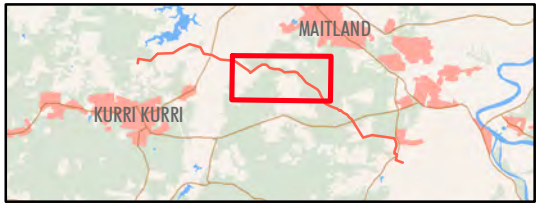
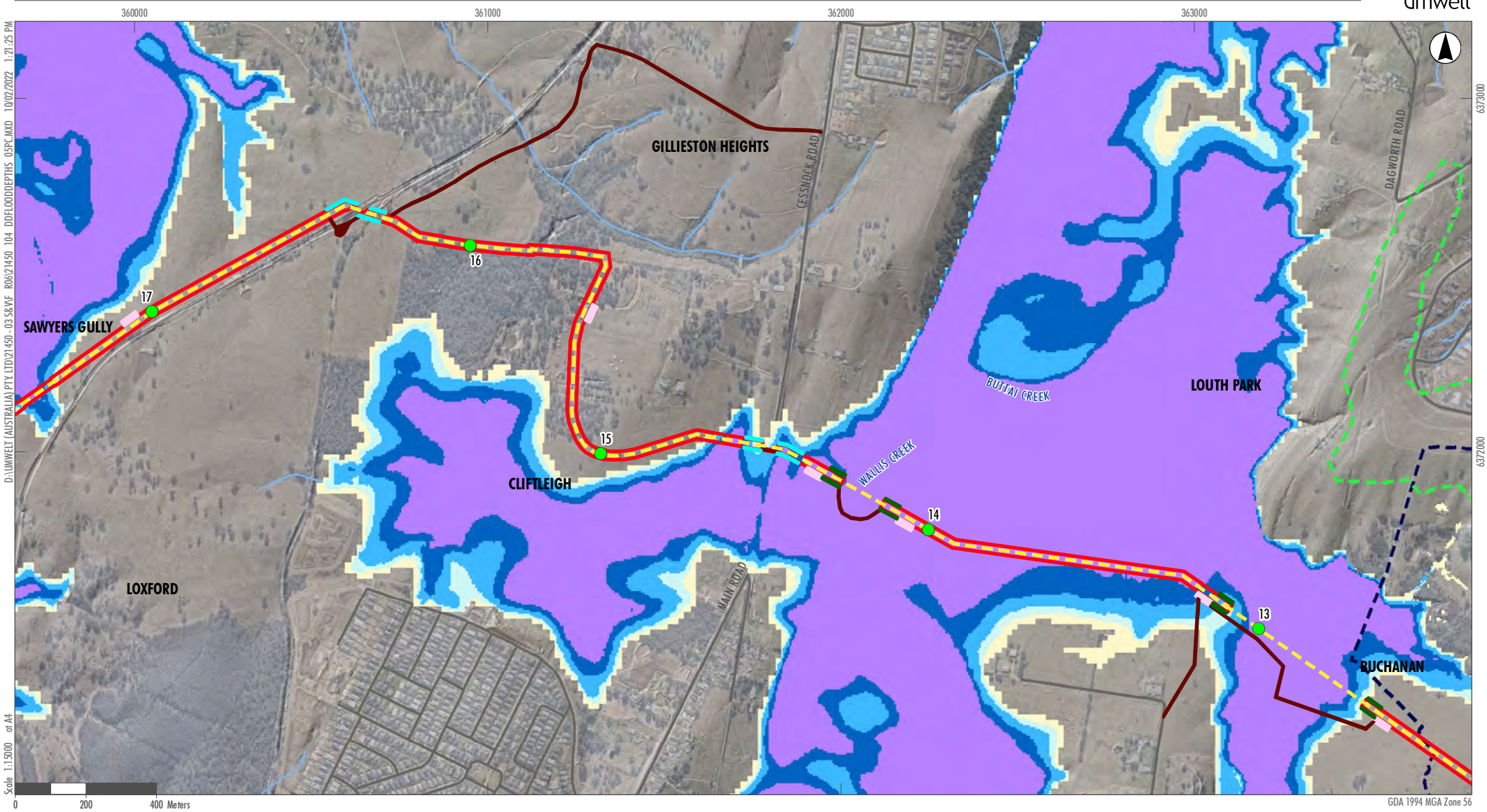


Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)

APPENDIX H-3C

0.5% AEP Flood Depths for Existing Conditions



D:\UMWELT (AUSTRALIA) PTY LTD\21450 - 03 S&V\F R06\21450_104_DDFLOODDEPTHS_05PC.MXD 10/02/2022 1:21:25 PM

Scale 1:15000 at A4

Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Access Tracks
- Roads
- Watercourses

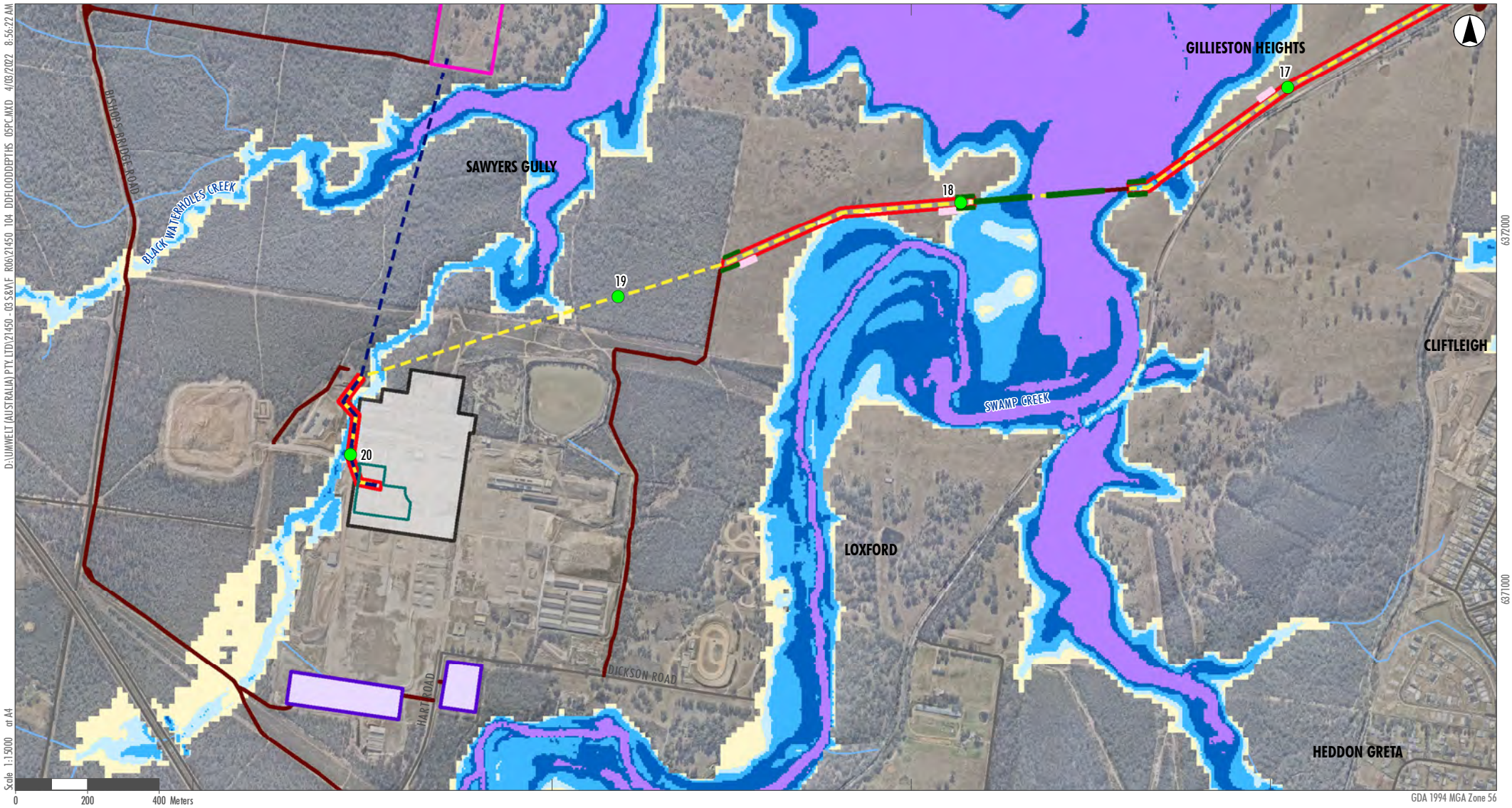
Water Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

APPENDIX H-3D

0.5% AEP Flood Depths for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Access Tracks
- Roads
- Watercourses

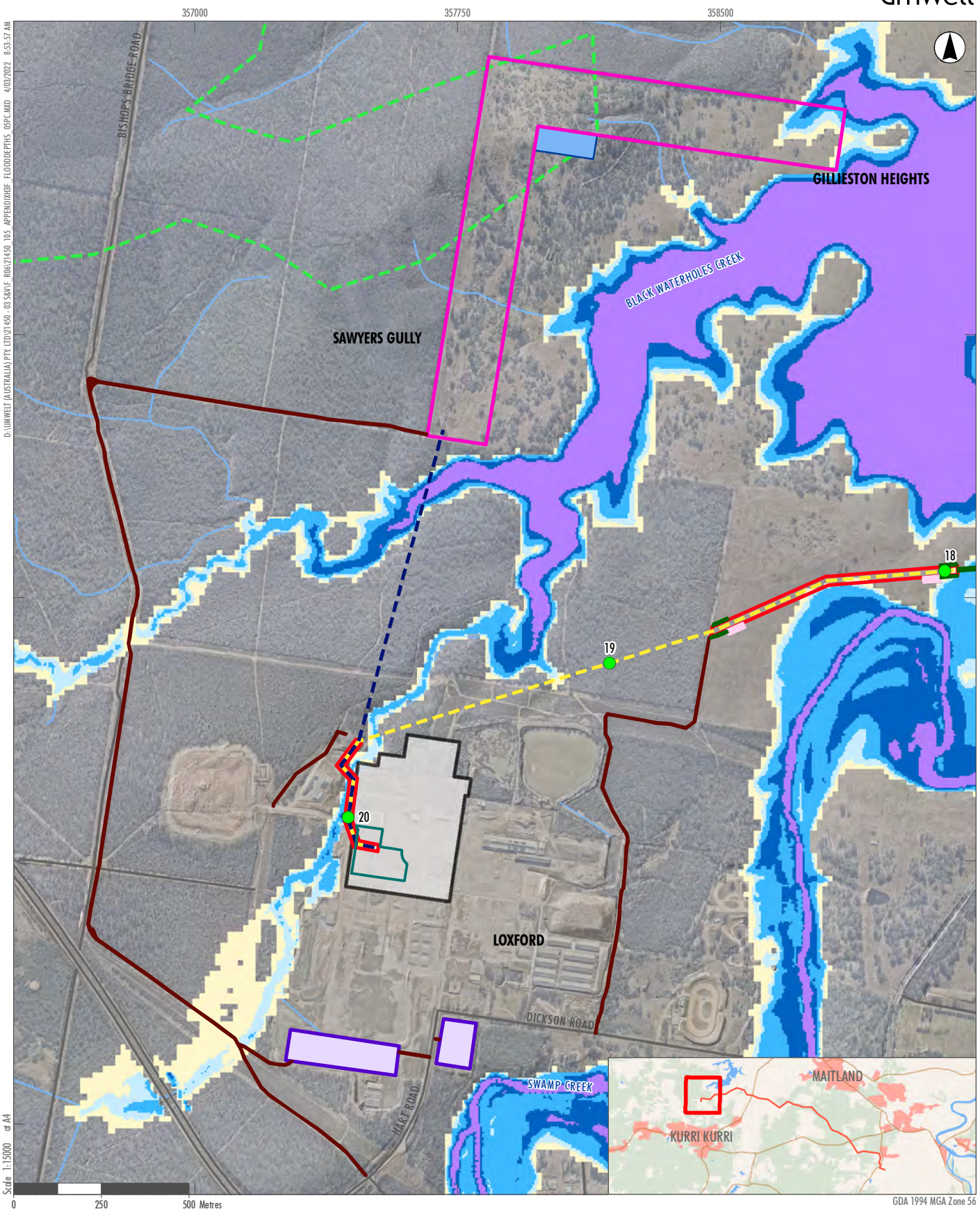
Water Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)

APPENDIX H-3E

0.5% AEP Flood Depths for Existing Conditions



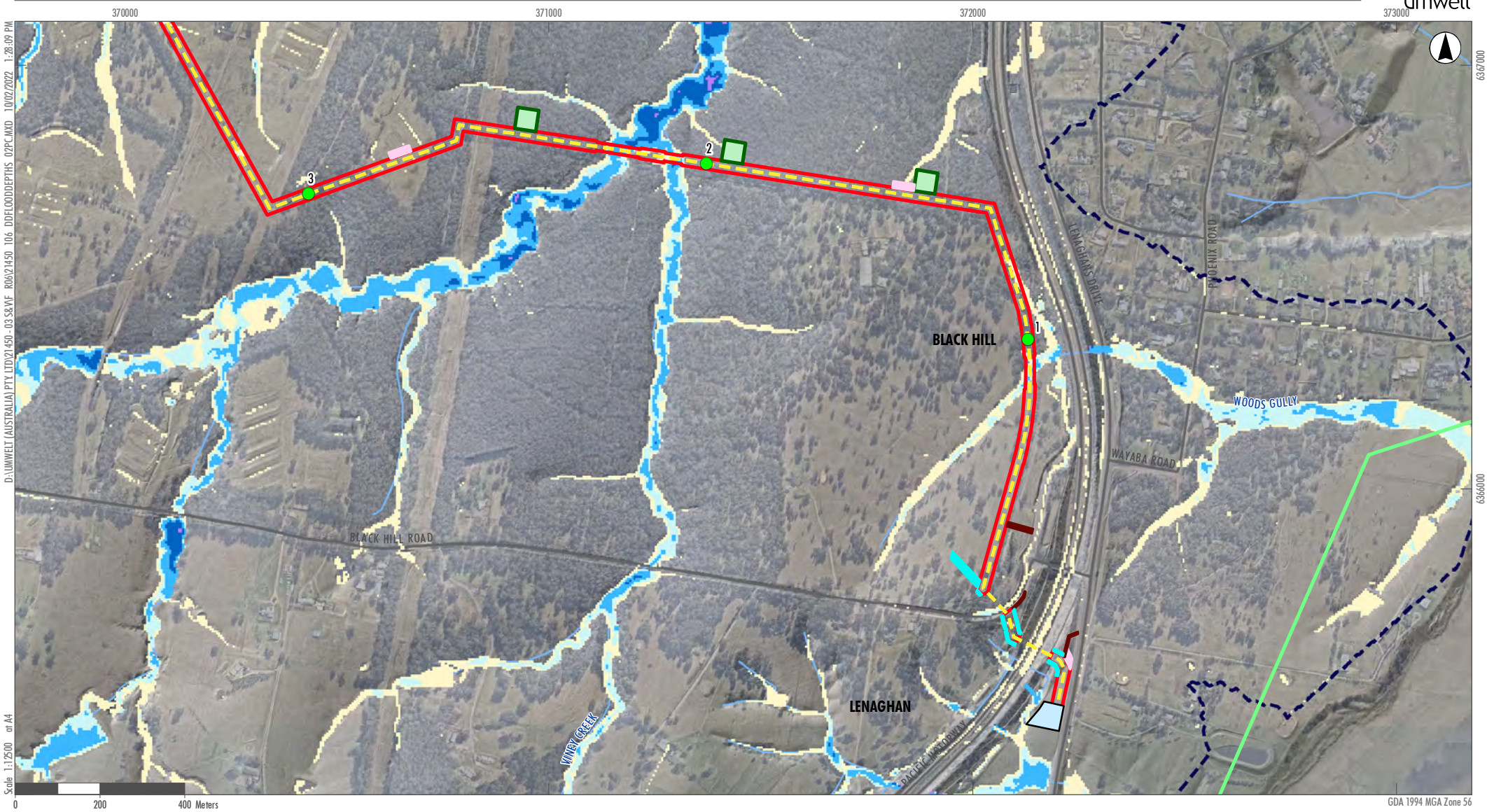
Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Turkey Nest Dam
- Access Tracks
- Roads
- Watercourses

APPENDIX H-3F

0.5% AEP Flood Depths for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- Sydney to Newcastle Pipeline (JGN Northern Trunk)
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- JGN Offtake Facility
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

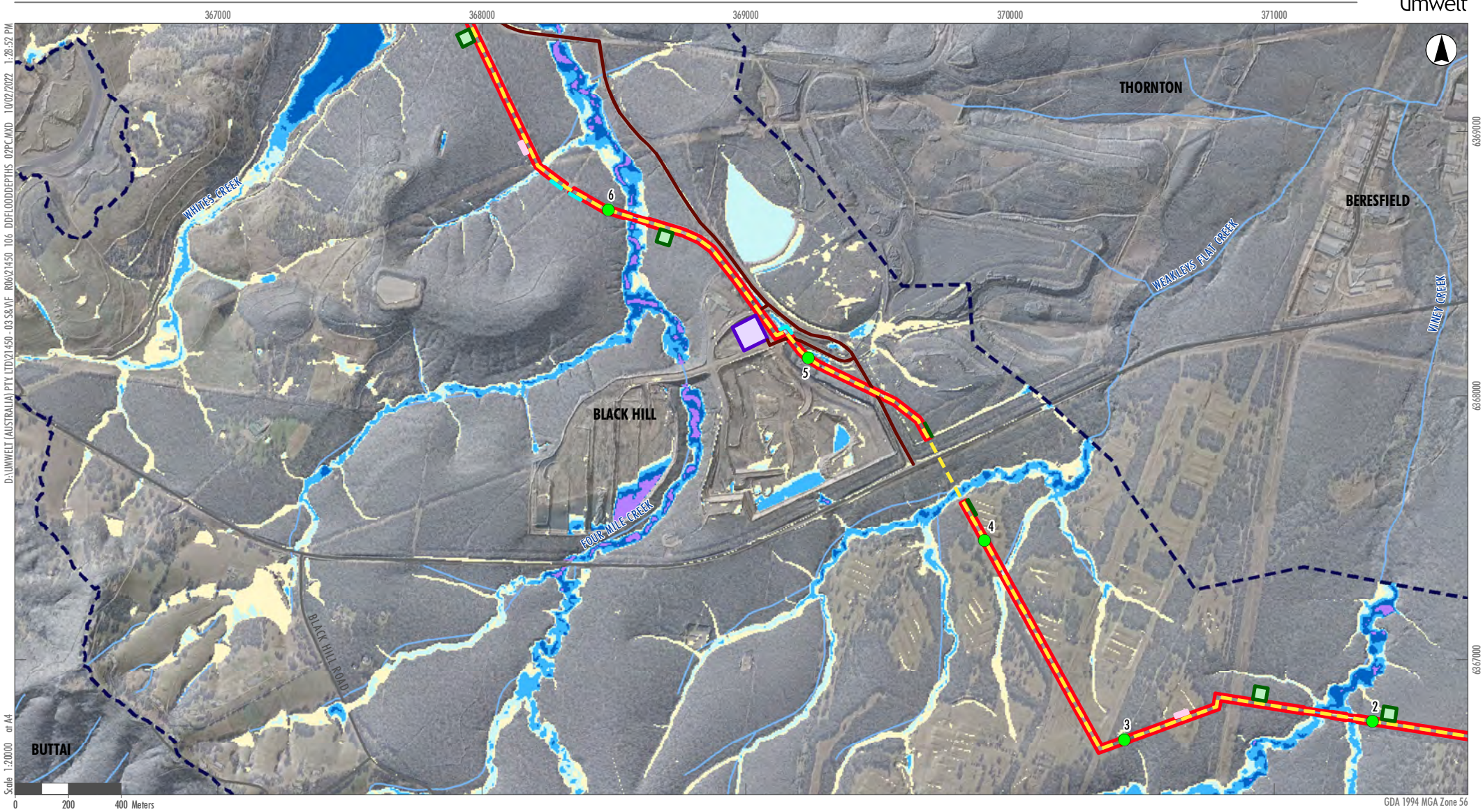
Water Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)

APPENDIX H-4A

0.2% AEP Flood Depths for Existing Conditions

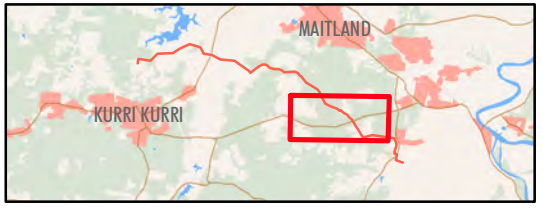


Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Pipe Laydown Areas
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

Water Depth (m)

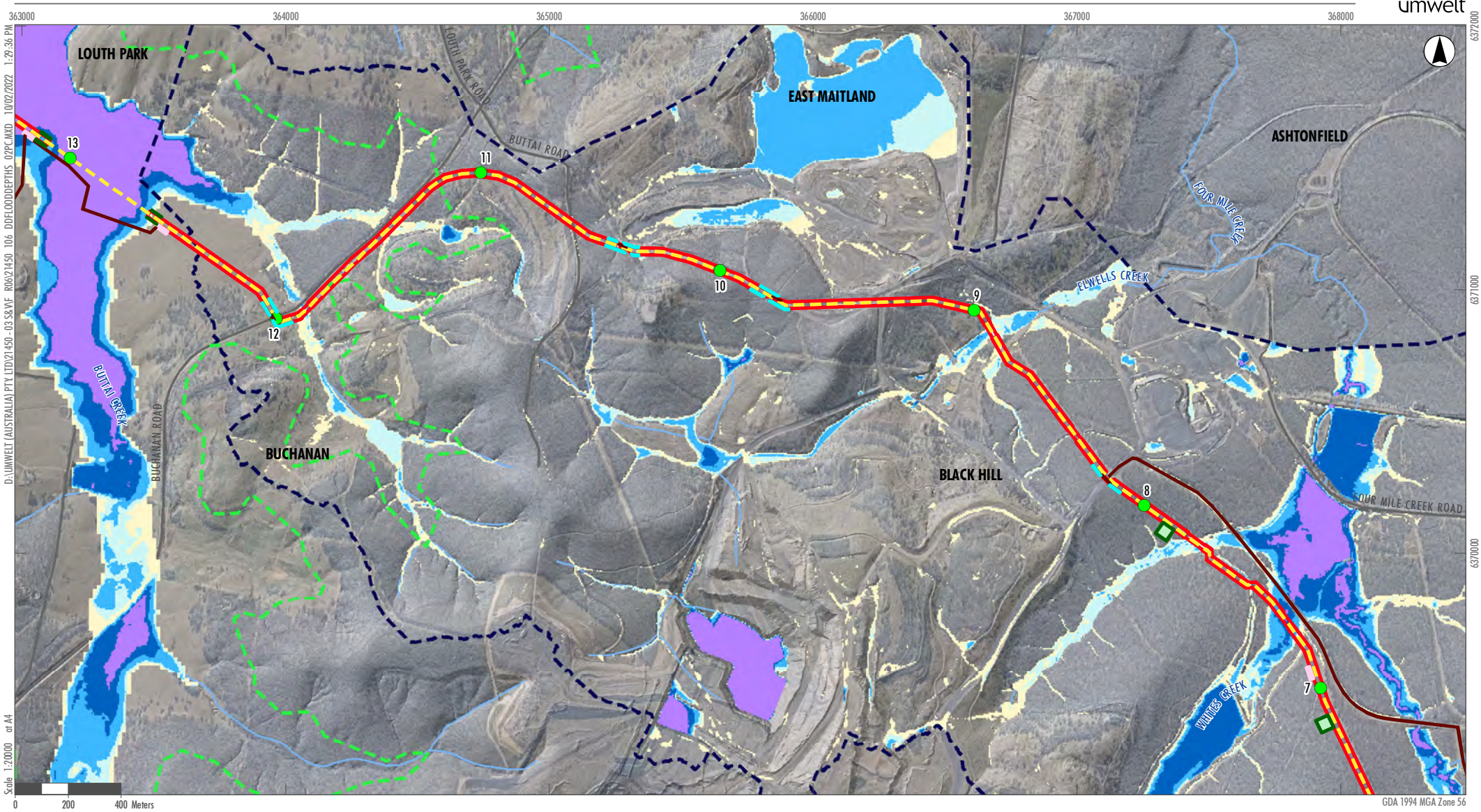
- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0



APPENDIX H-4B

0.2% AEP Flood Depths for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

Water Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

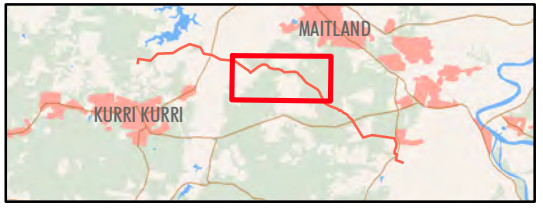
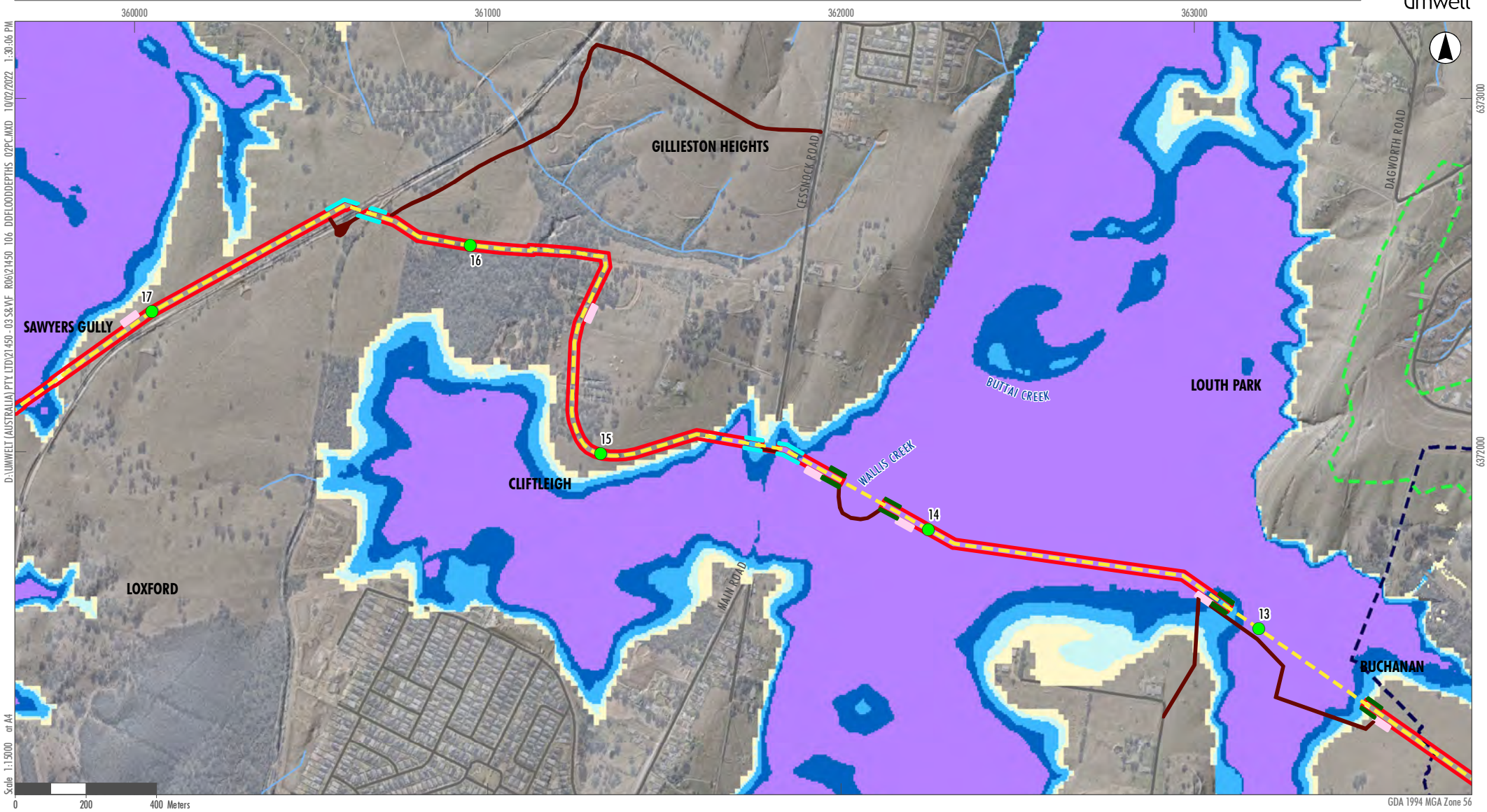


Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)

APPENDIX H-4C

0.2% AEP Flood Depths for Existing Conditions



D:\UMWELT (AUSTRALIA) PTY LTD\21450 - 03 S&VF R06\21450_106_DDFLOODDEPTHS_02PC.MXD 10/02/2022 1:30:06 PM

Scale 1:15000 at A4

Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Access Tracks
- Roads
- Watercourses

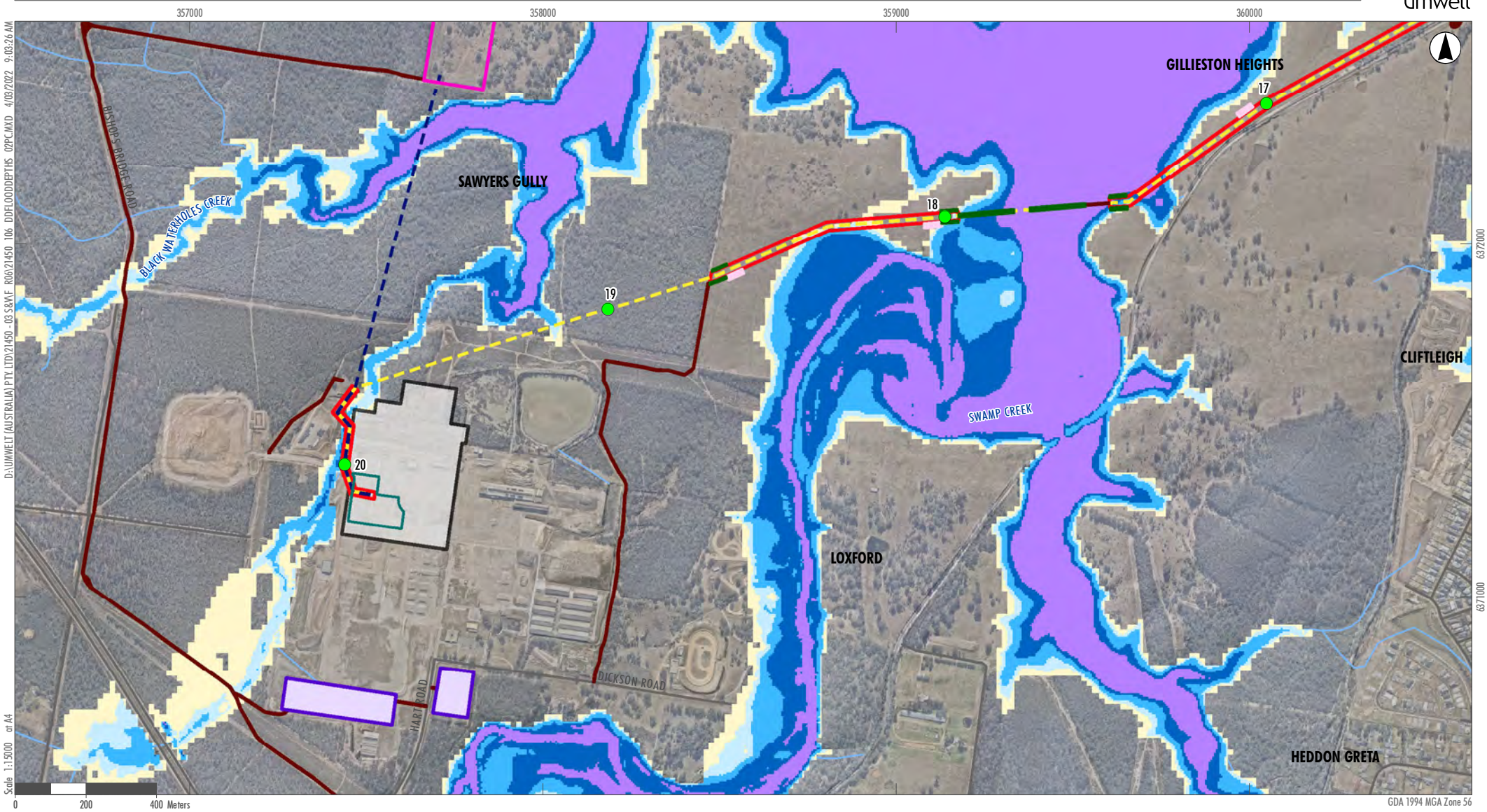
Water Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

APPENDIX H-4D

0.2% AEP Flood Depths for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Access Tracks
- Roads
- Watercourses

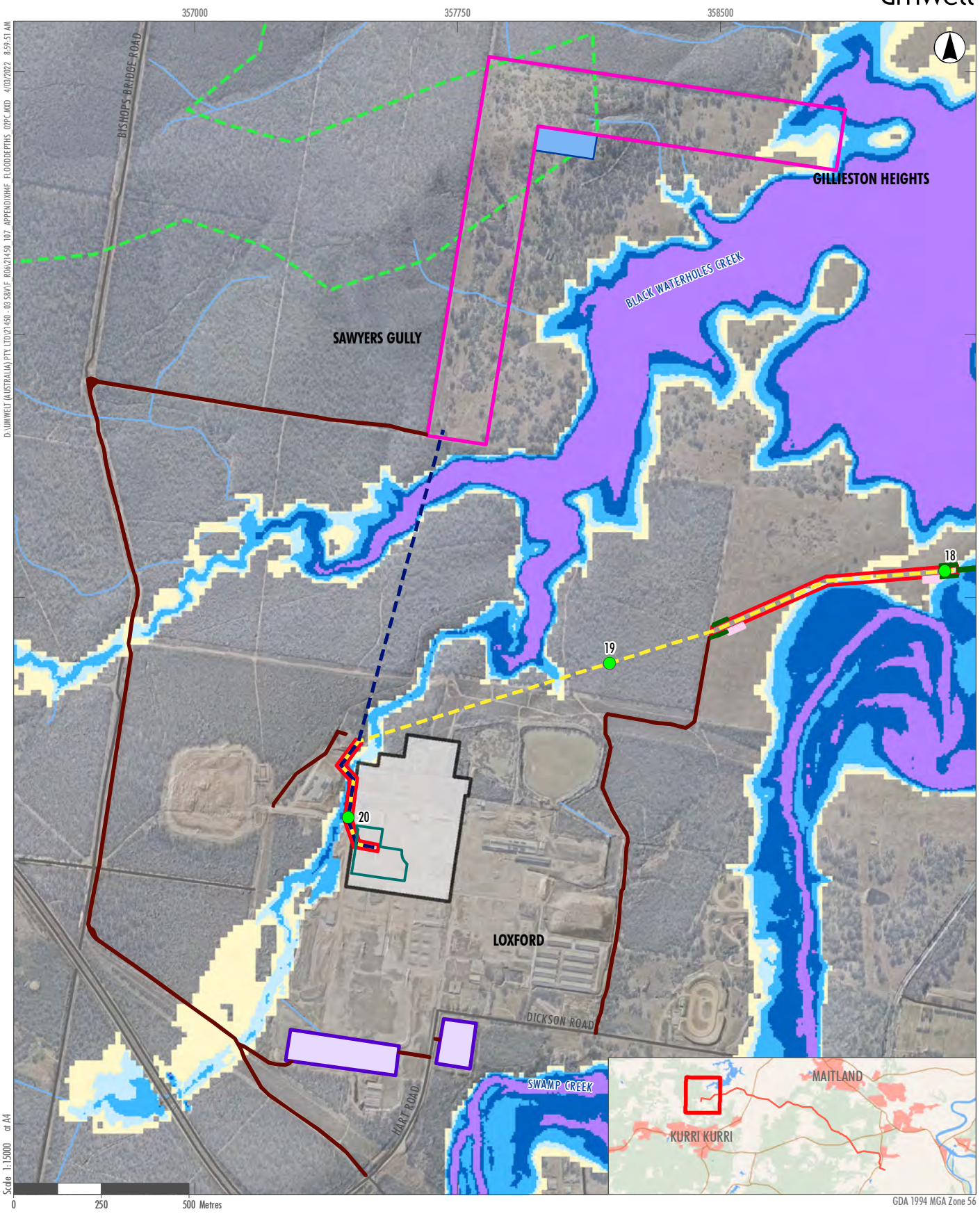
Water Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)

APPENDIX H-4E

0.2% AEP Flood Depths for Existing Conditions



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Turkey Nest Dam
- Access Tracks
- Roads
- Watercourses

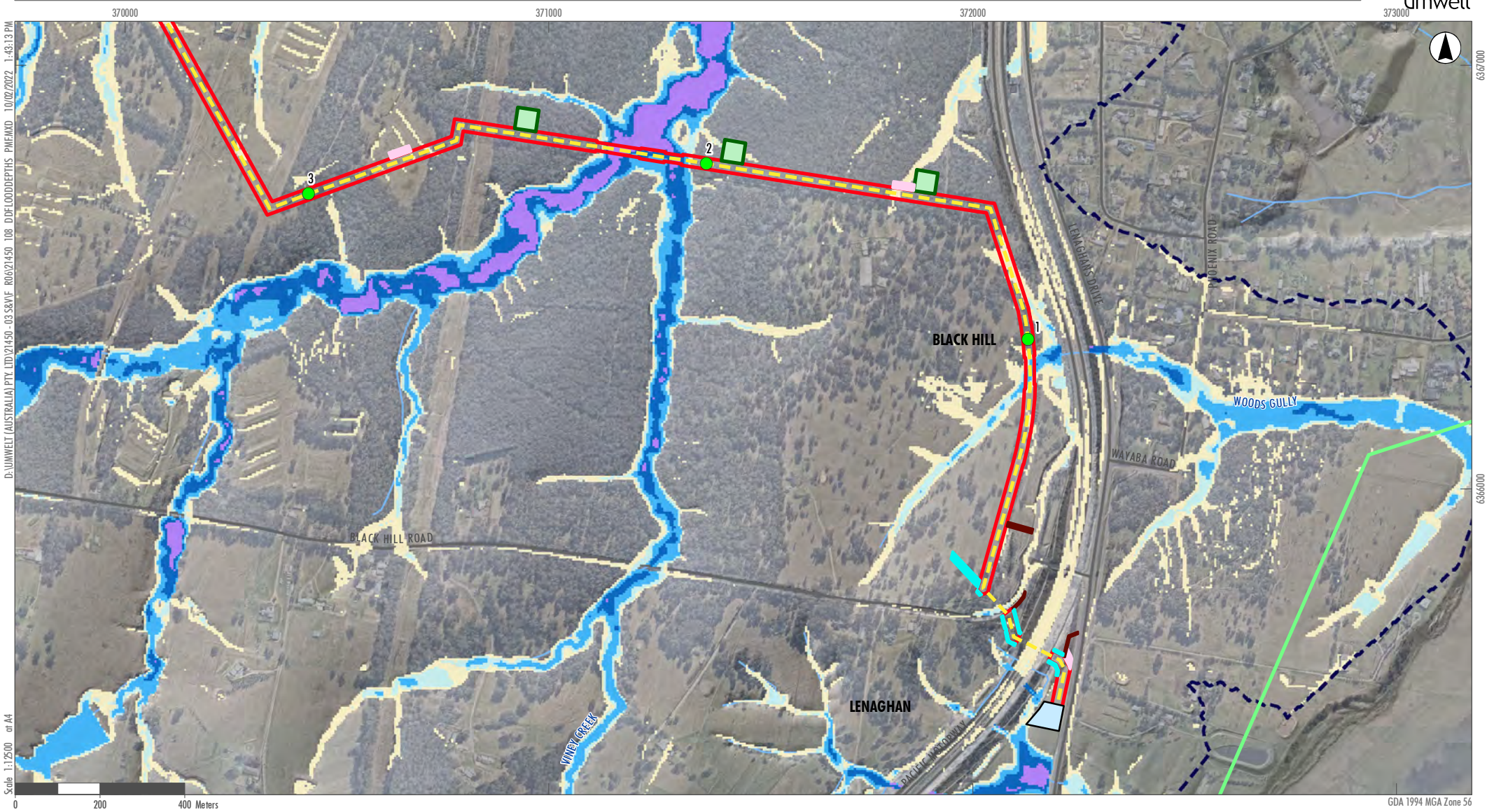
Water Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

APPENDIX H-4F

0.2% AEP Flood Depths for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



D:\UMWELT (AUSTRALIA) PTY. LTD\21450 - 03 S&WF R06\21450_108_DDFLOODDEPTHS_PMF.MXD 10/02/2022 1:43:13 PM

Scale 1:12500 at A4

Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- Sydney to Newcastle Pipeline (JGN Northern Trunk)
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- JGN Offtake Facility
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

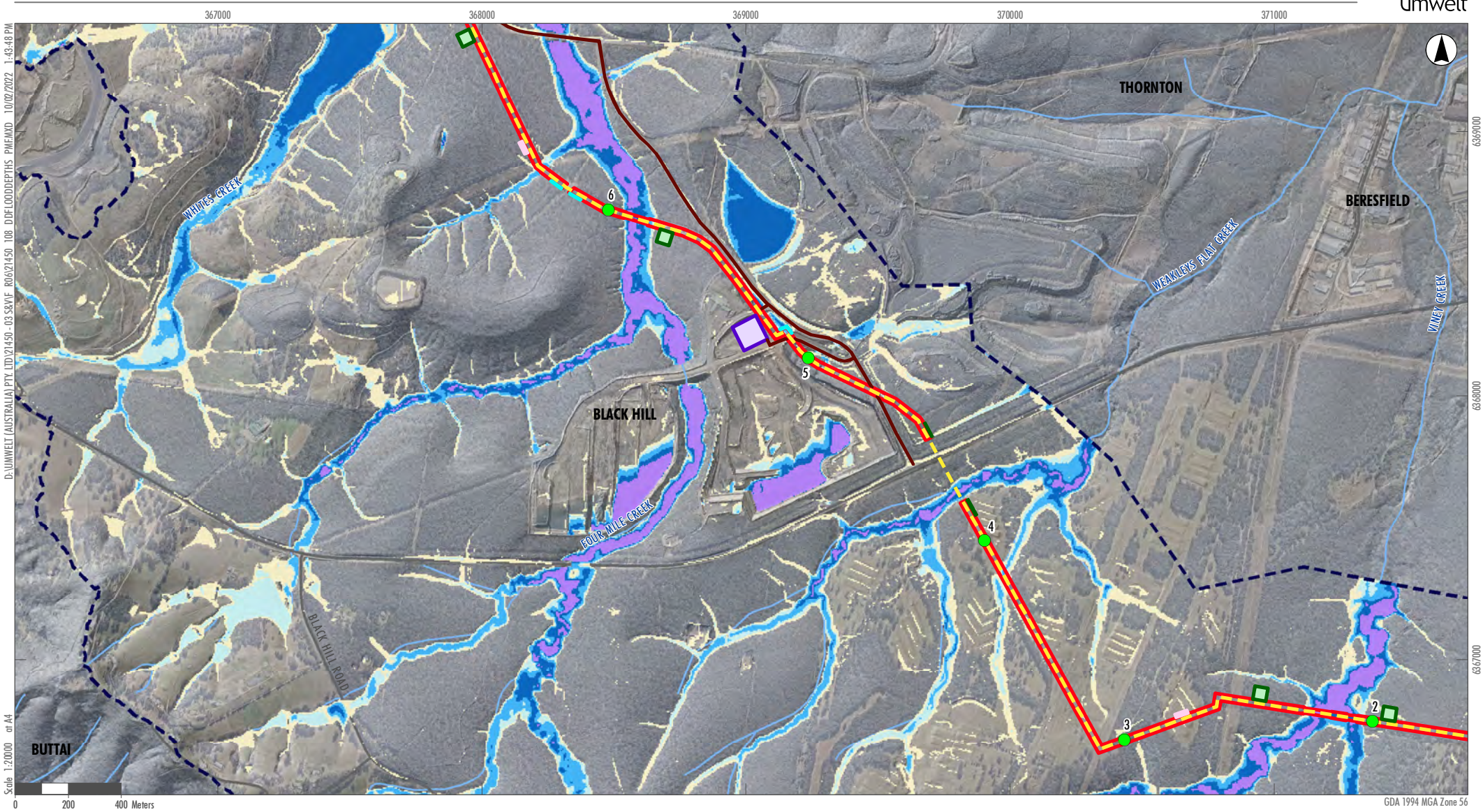
Water Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

Image Source: Nearmap (October 2021) Data source: NSW LPI (2020;2021)

APPENDIX H-5A

PMF Flood Depths for Existing Conditions

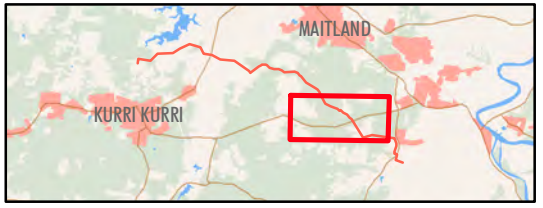


Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Pipe Laydown Areas
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

Water Depth (m)

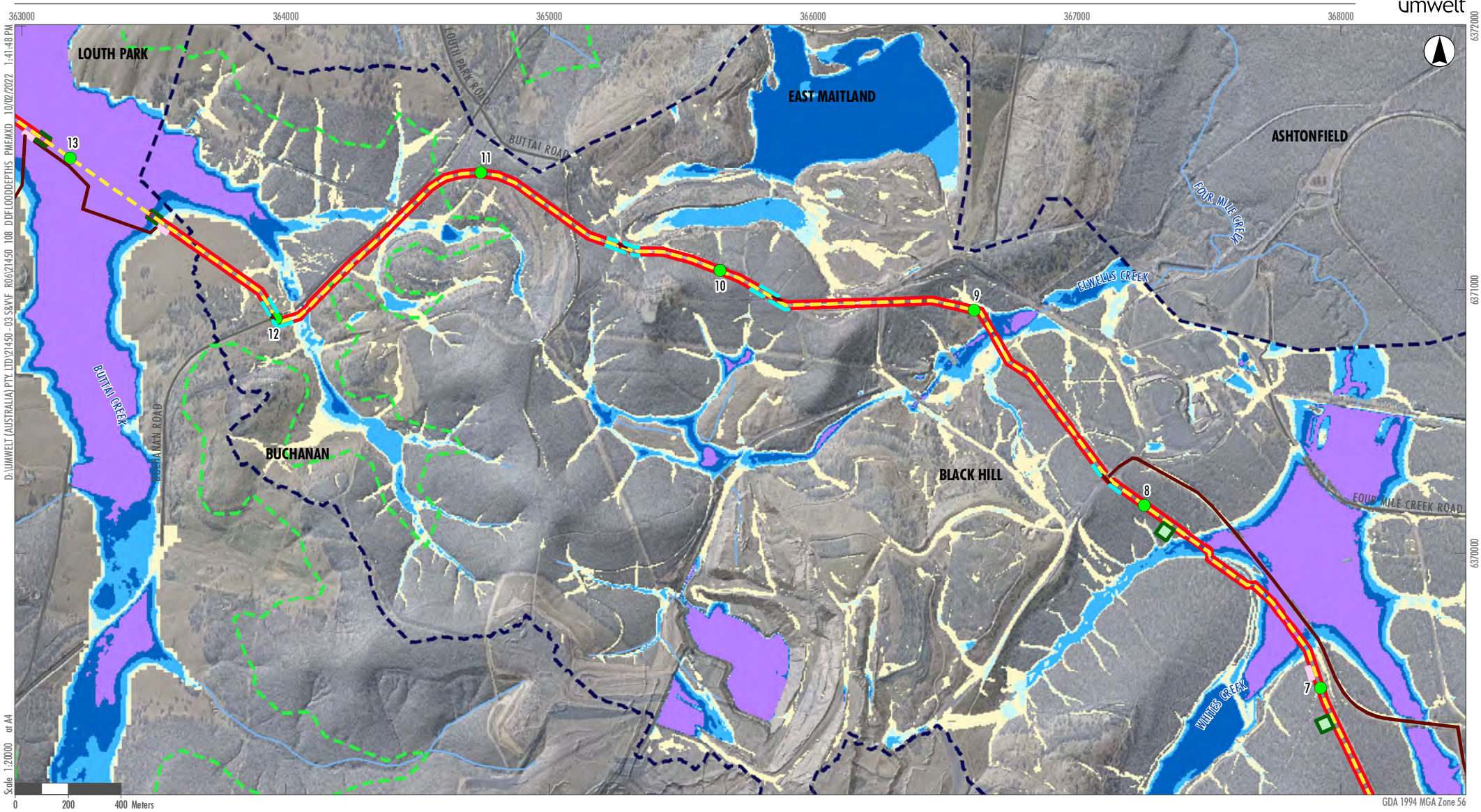
- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0



APPENDIX H-5B

PMF Flood Depths for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

Water Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

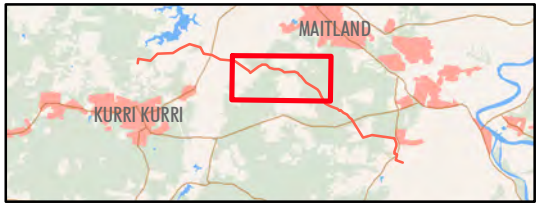
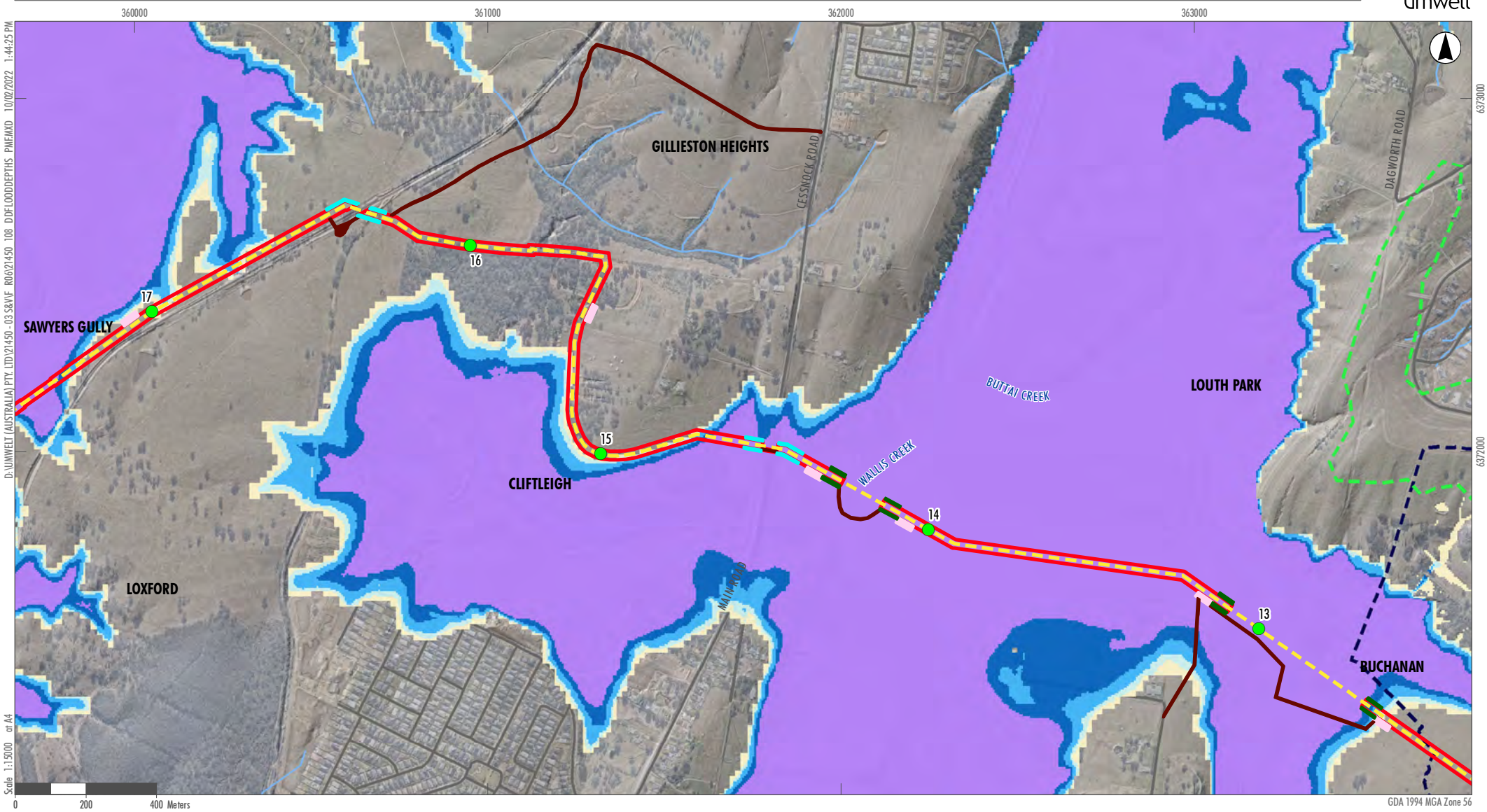


Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)

APPENDIX H-5C

PMF Flood Depths for Existing Conditions



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Access Tracks
- Roads
- Watercourses

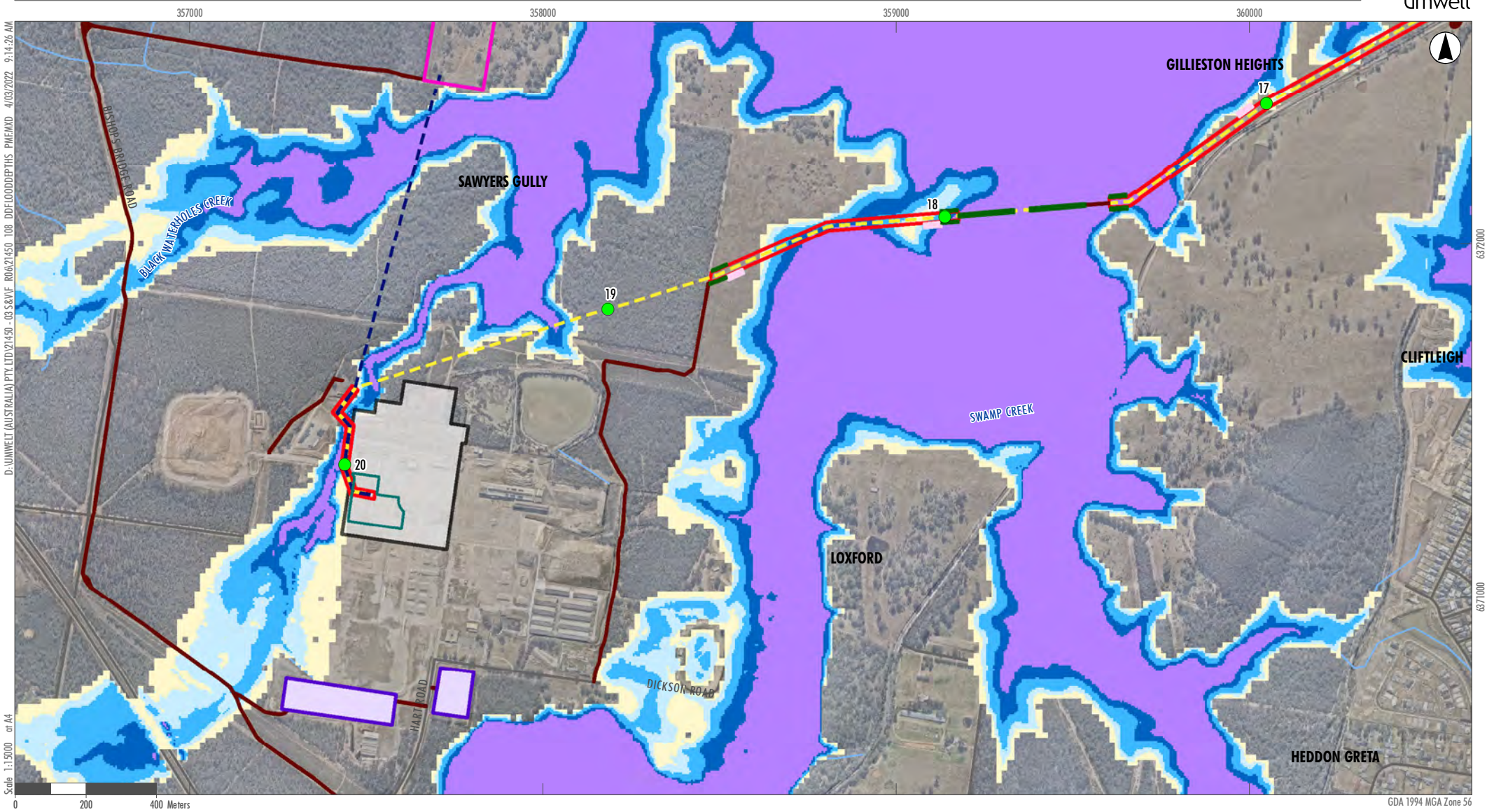
Water Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

APPENDIX H-5D

PMF Flood Depths for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Access Tracks
- Roads
- Watercourses

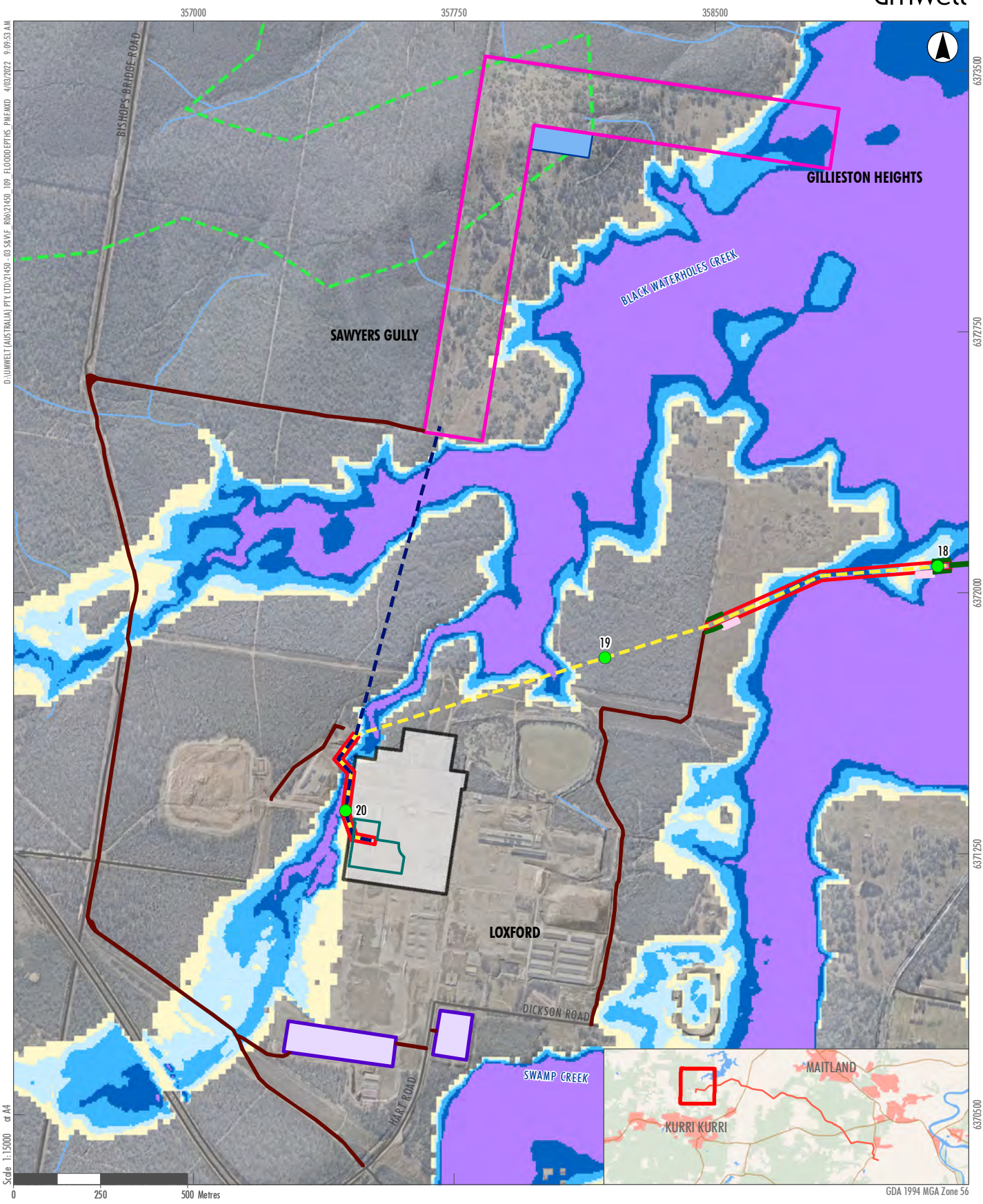
Water Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

APPENDIX H-5E

PMF Flood Depths for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Turkey Nest Dam
- Access Tracks
- Roads
- Watercourses

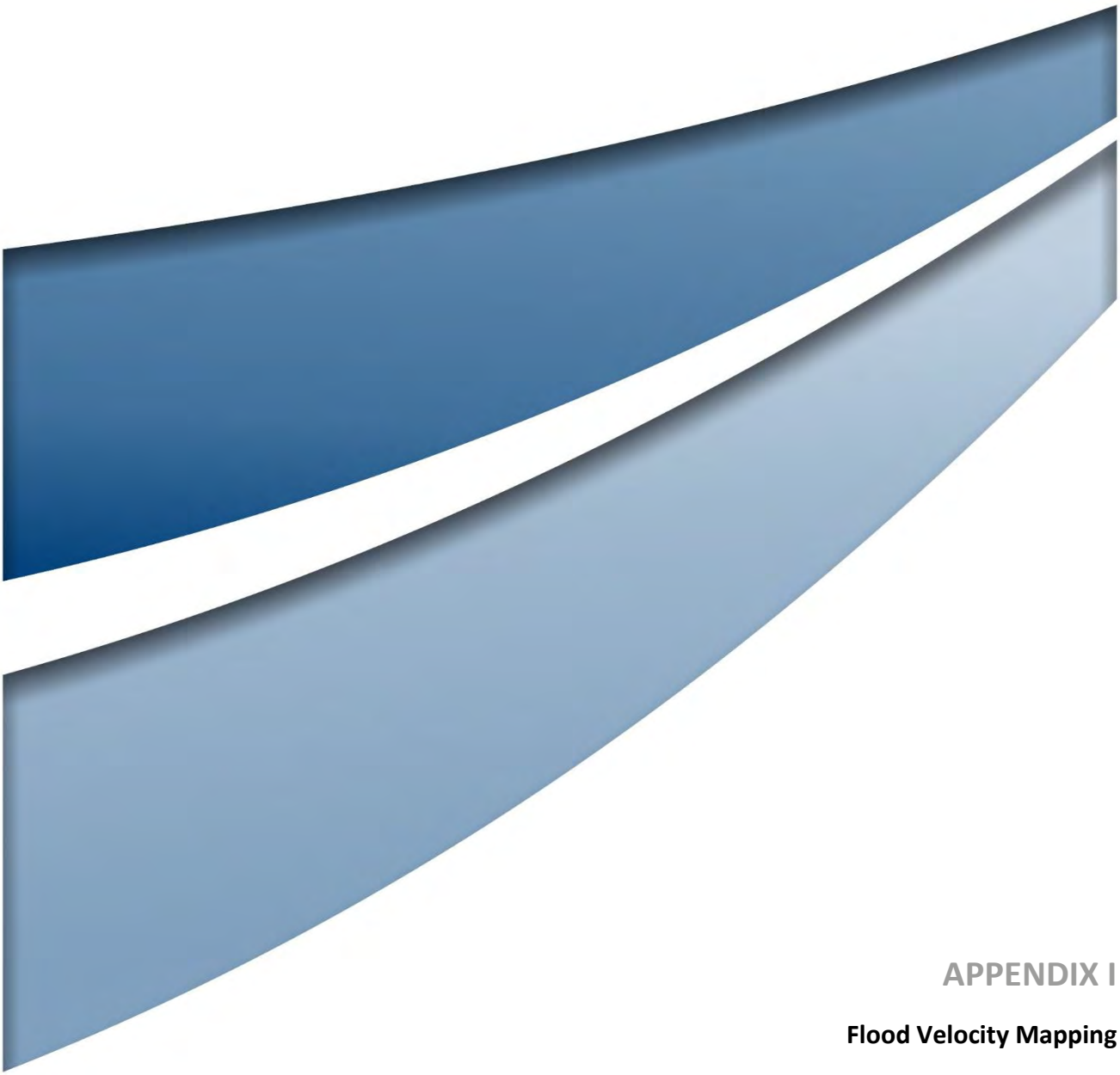
Water Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

APPENDIX H-5F

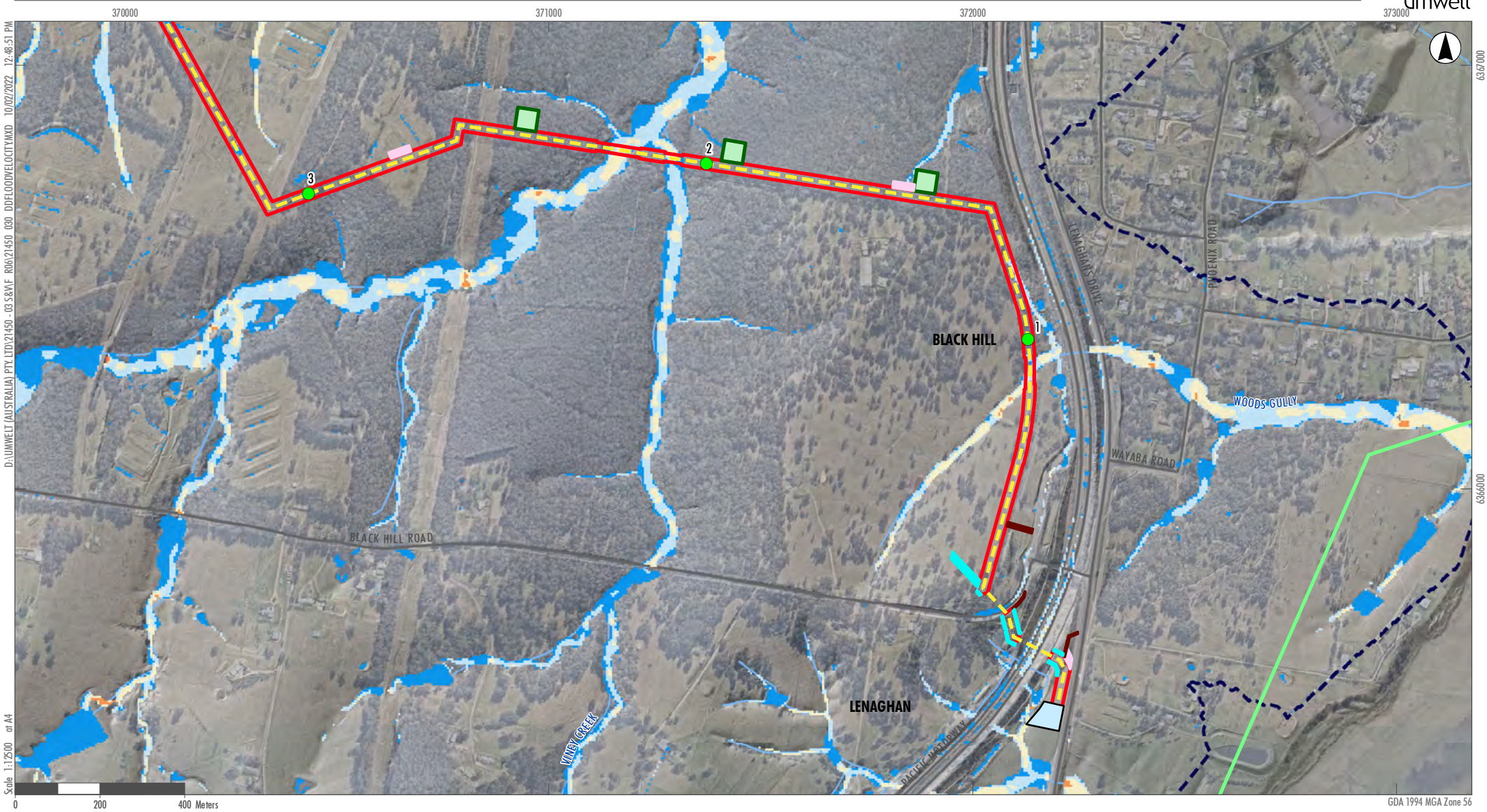
PMF Flood Depths for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



APPENDIX I

Flood Velocity Mapping



D:\UMWELT (AUSTRALIA) PTY LTD\21450 - 03 S&WF R06\21450_030_DDFLOODVELOCITY.MXD 10/02/2022 12:48:51 PM

Scale 1:12500 at A4

Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Sydney to Newcastle Pipeline (JGN Northern Trunk)
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- JGN Offtake Facility
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

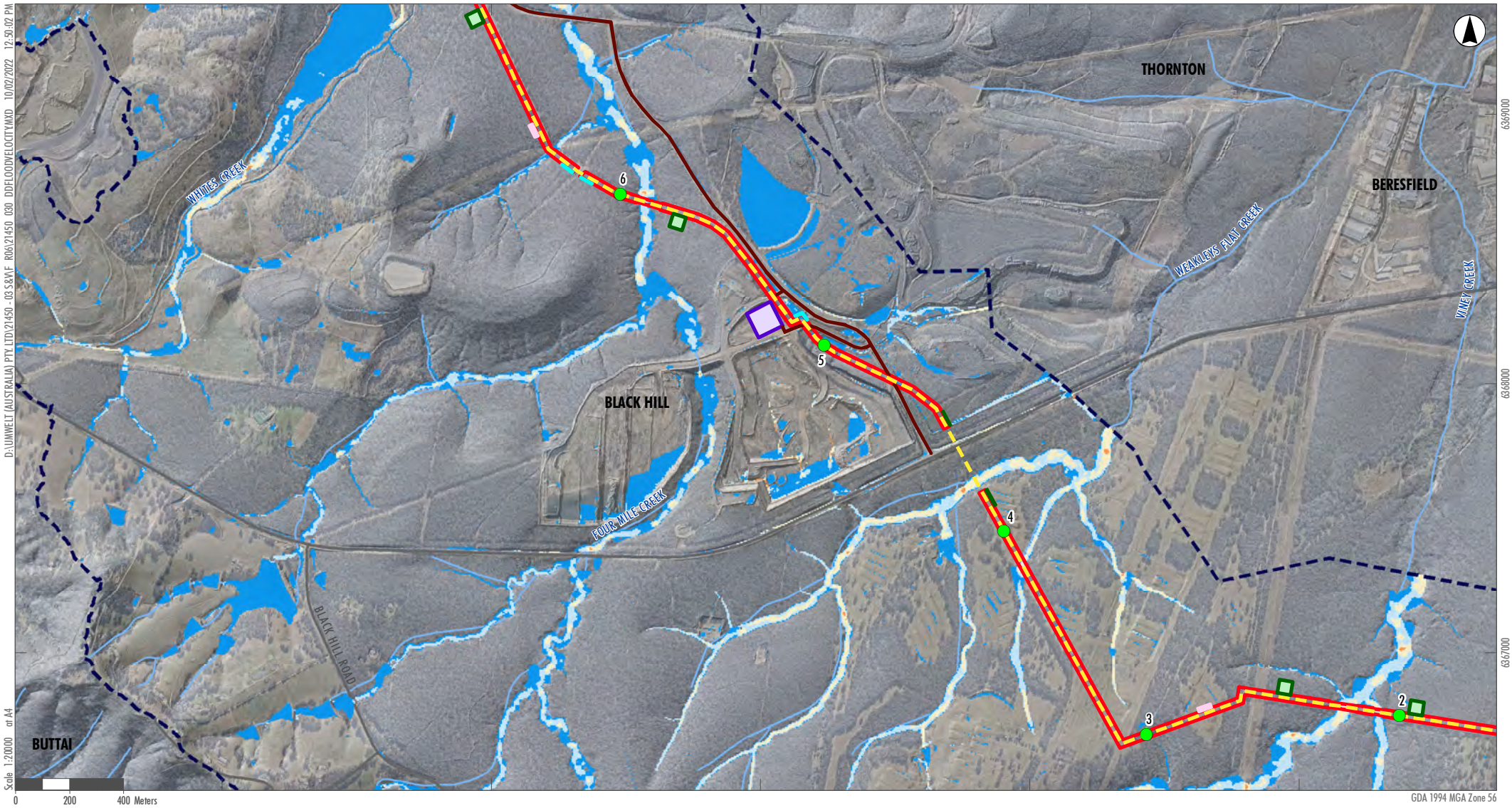
Water Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)

APPENDIX I-2A

1% AEP Flood Velocities for Existing Conditions

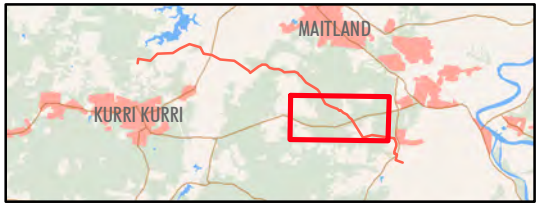


Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Pipe Laydown Areas
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

Water Velocity (m/s)

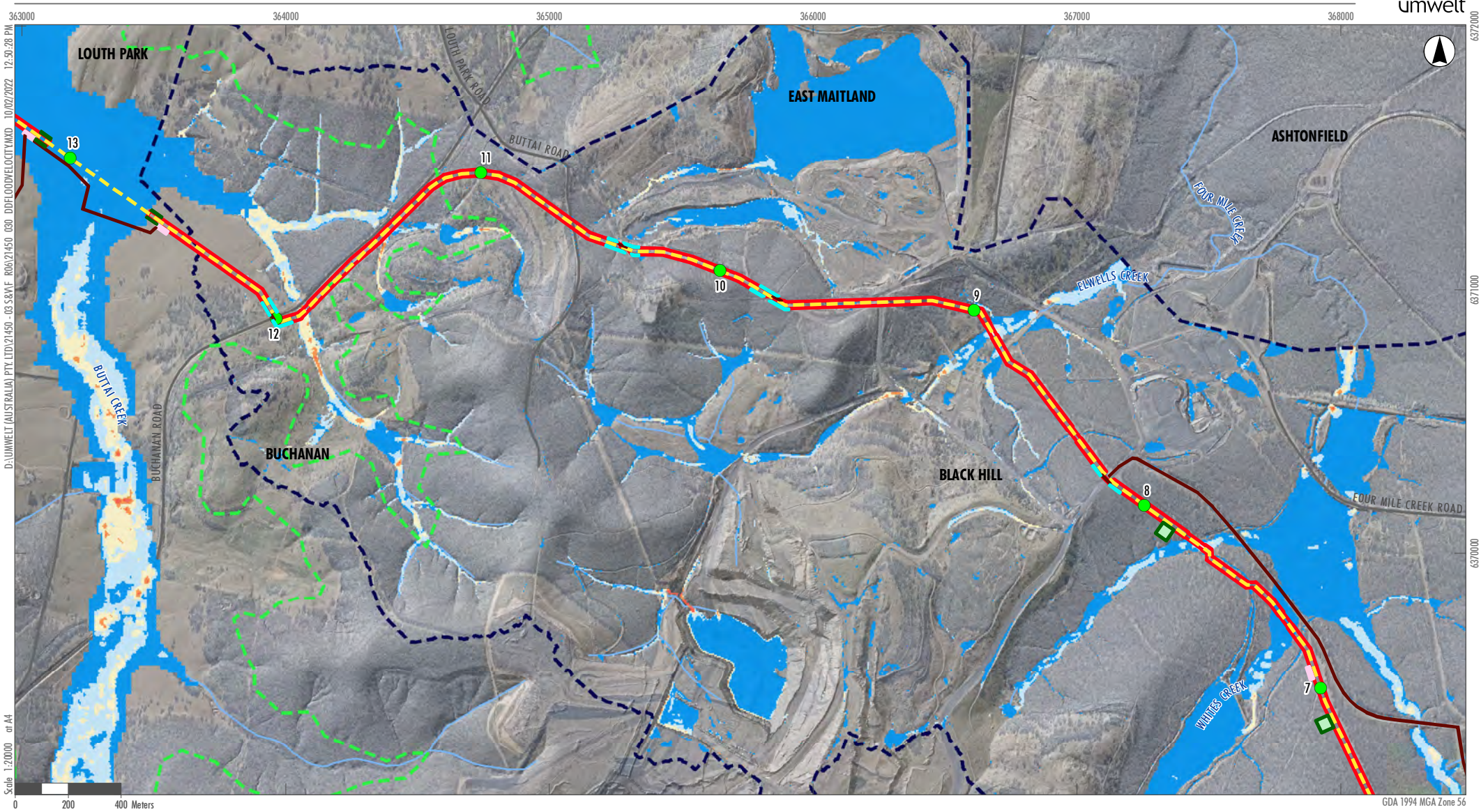
- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0



APPENDIX I-2B

1% AEP Flood Velocities for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)

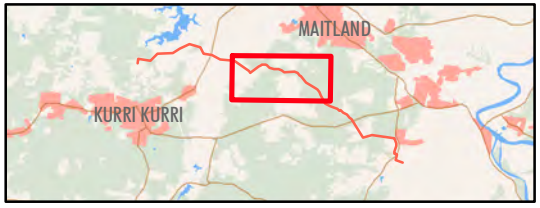


Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

Water Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0



APPENDIX I-2C

1% AEP Flood Velocities for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)

Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Access Tracks
- Roads
- Watercourses

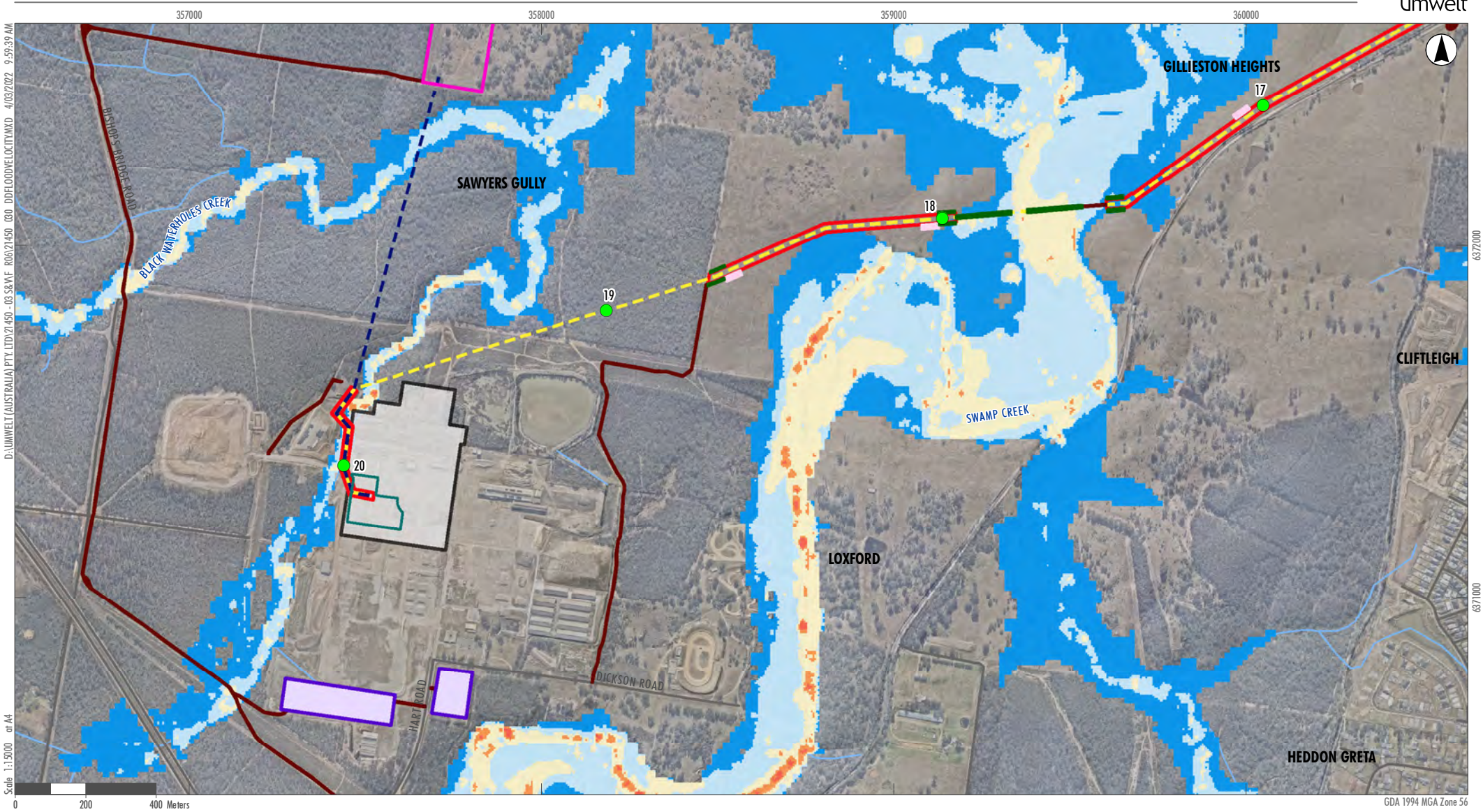
Water Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

APPENDIX I-2D

1% AEP Flood Velocities for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Access Tracks
- Roads
- Watercourses

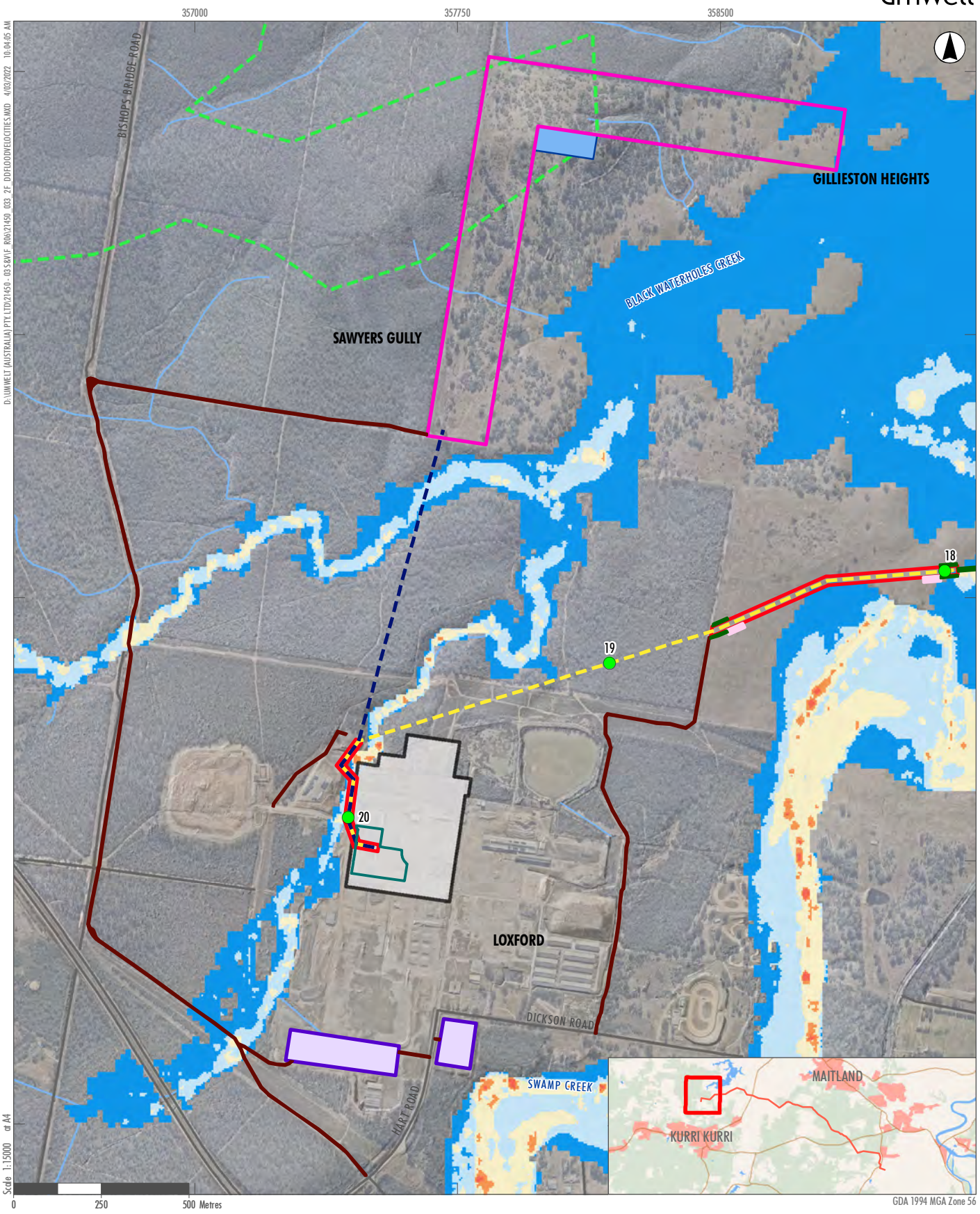
Water Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0- 2.0
- 2.0 - 3.0
- > 3.0

APPENDIX I-2E

1% AEP Flood Velocities for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Turkey Nest Dam
- Access Tracks
- Roads
- Watercourses

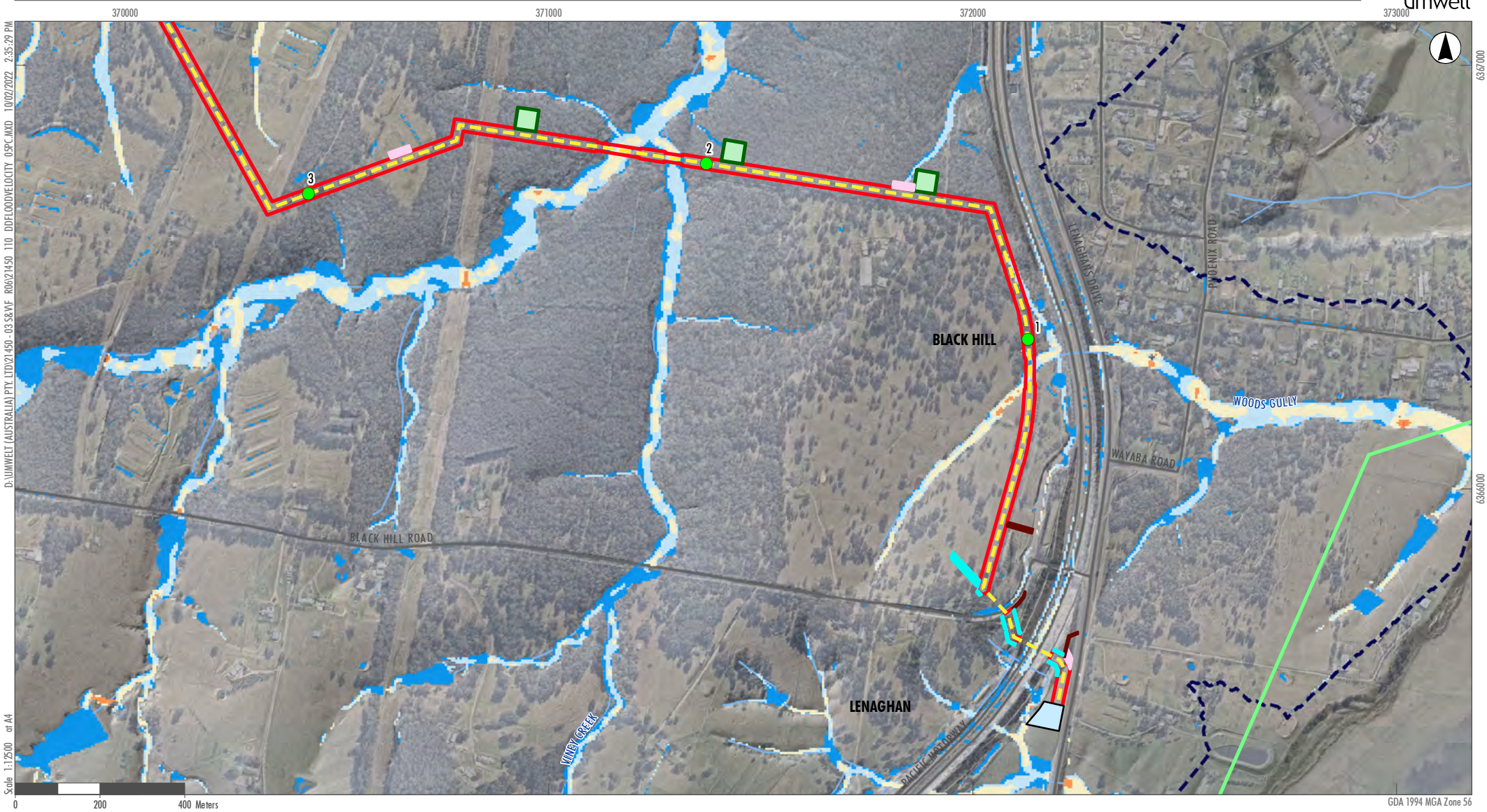
Water Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0- 2.0
- 2.0 - 3.0
- > 3.0

APPENDIX I-2F

1% AEP Flood Velocities for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



D:\UMWELT (AUSTRALIA) PTY LTD\21450 - 03 S&WF R06\21450 110 DDFLOODVELOCITY 05PC.MXD 10/02/2022 2:35:29 PM

Scale 1:12500 at A4

Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Sydney to Newcastle Pipeline (JGN Northern Trunk)
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- JGN Offtake Facility
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

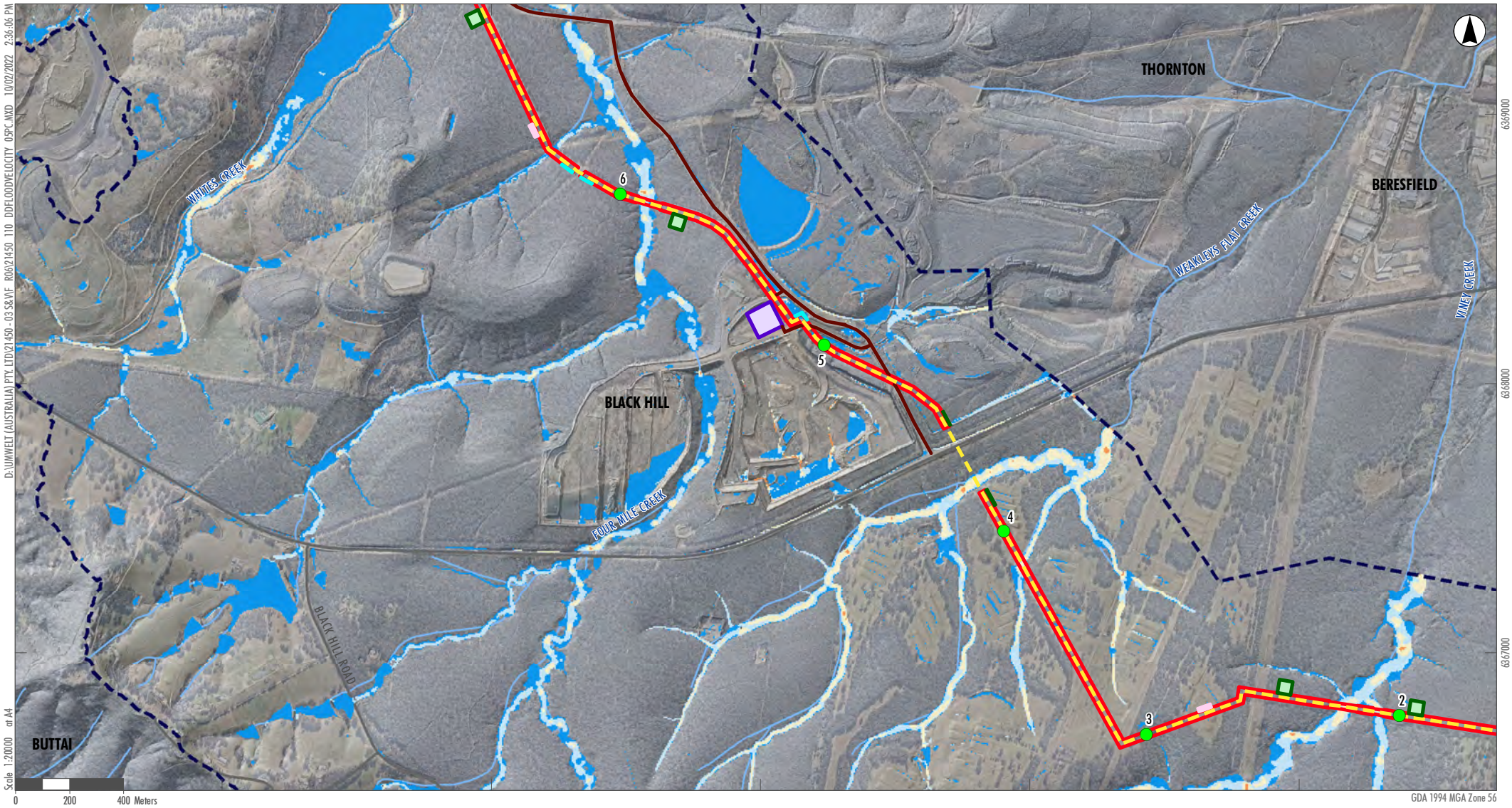
Water Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)

APPENDIX I-3A

0.5% AEP Flood Velocities for Existing Conditions

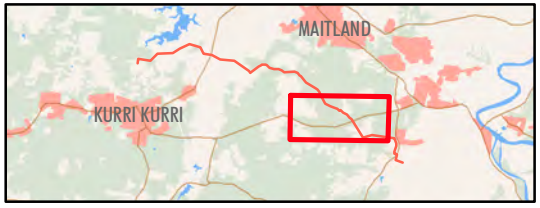


Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Pipe Laydown Areas
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

Water Velocity (m/s)

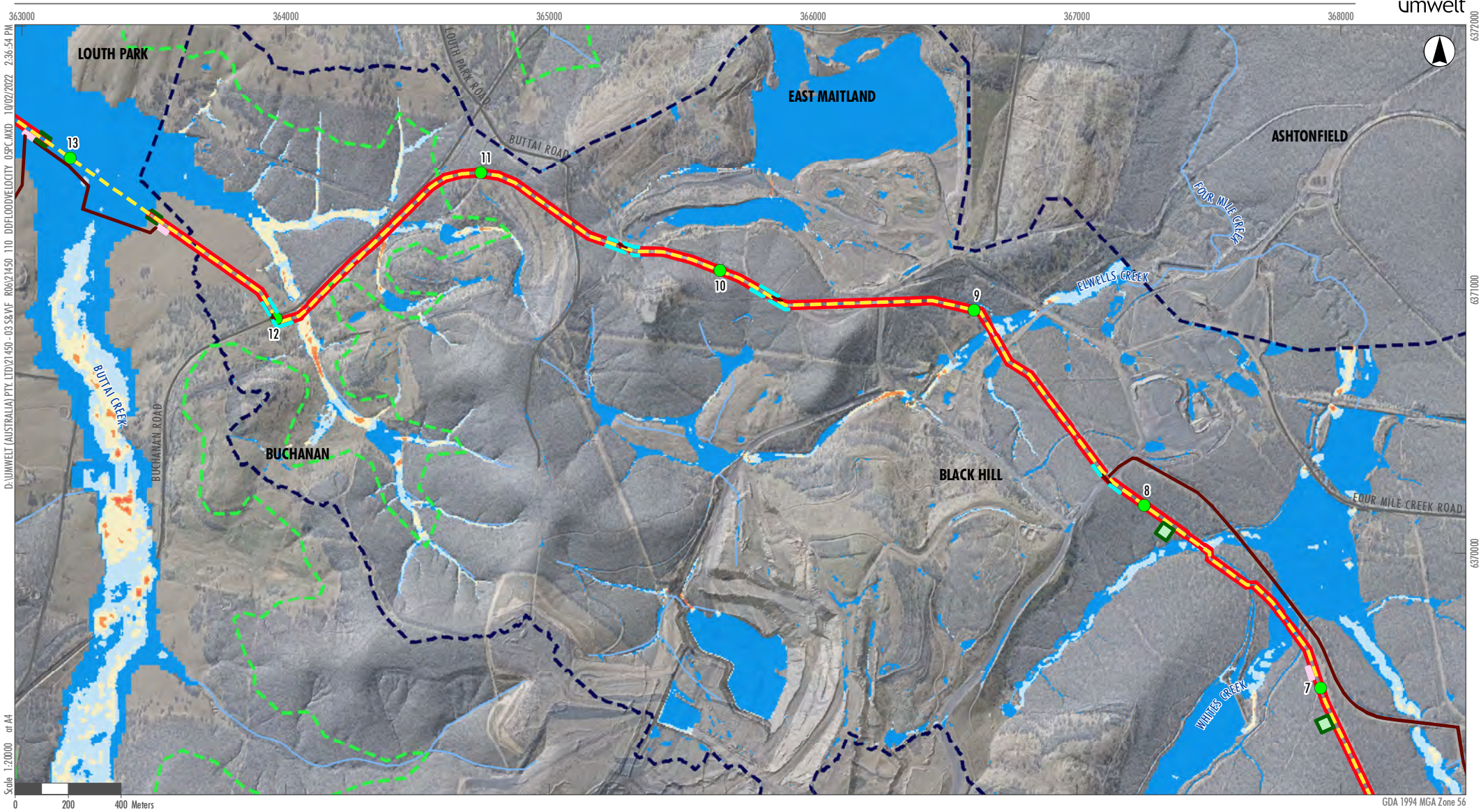
- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0



APPENDIX I-3B

0.5% AEP Flood Velocities for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)

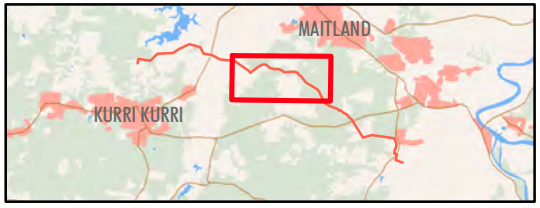


Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

Water Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0



APPENDIX I-3C

0.5% AEP Flood Velocities for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)

D:\UMWELT (AUSTRALIA) PTY LTD\21450 - 03 S&WF R06\21450 110 DDFLOODVELOCITY 05PC.MXD 10/02/2022 2:37:37 PM

Scale 1:15000 at A4

Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Access Tracks
- Roads
- Watercourses

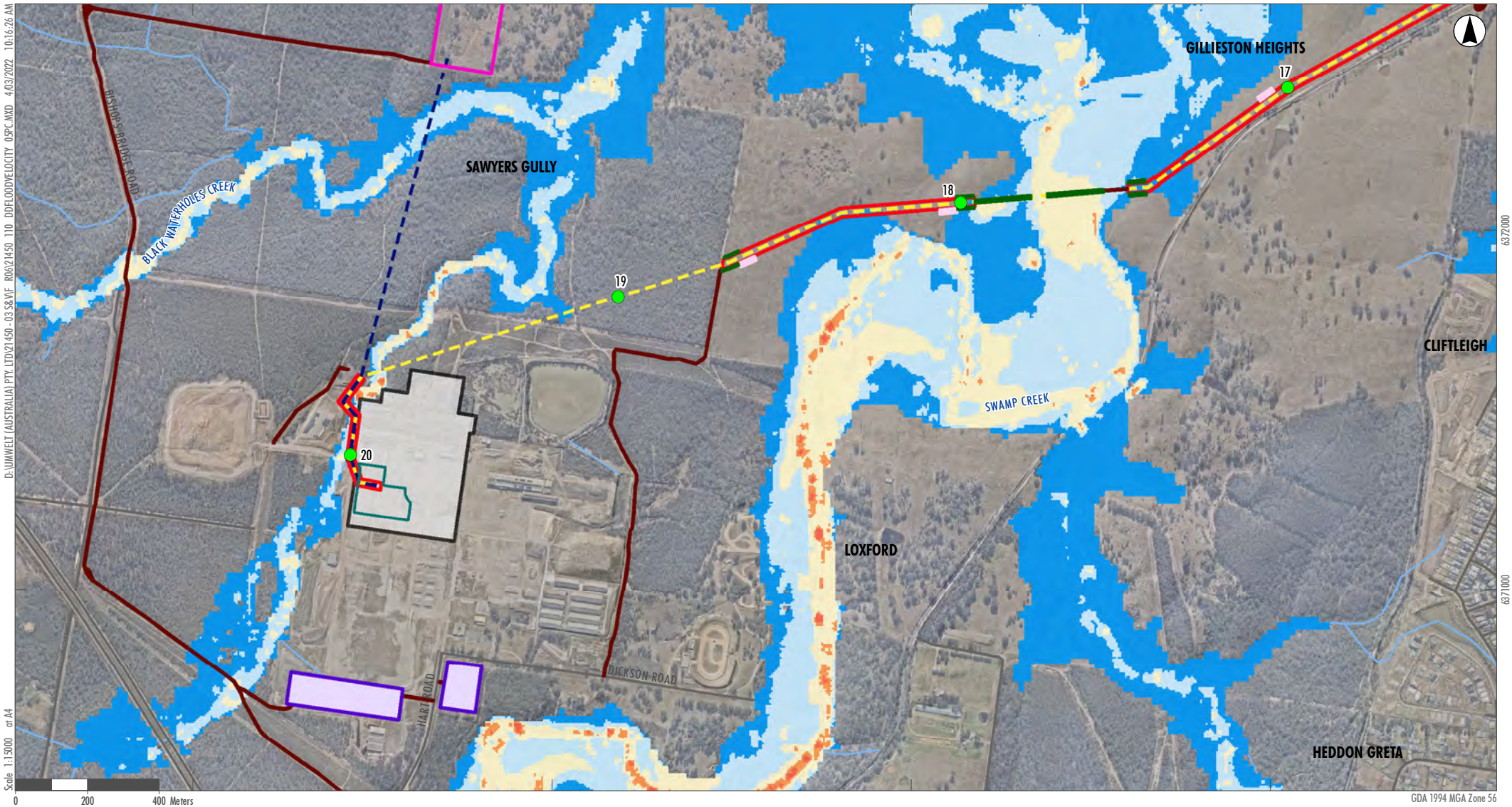
Water Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

APPENDIX I-3D

0.5% AEP Flood Velocities for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Access Tracks
- Roads
- Watercourses

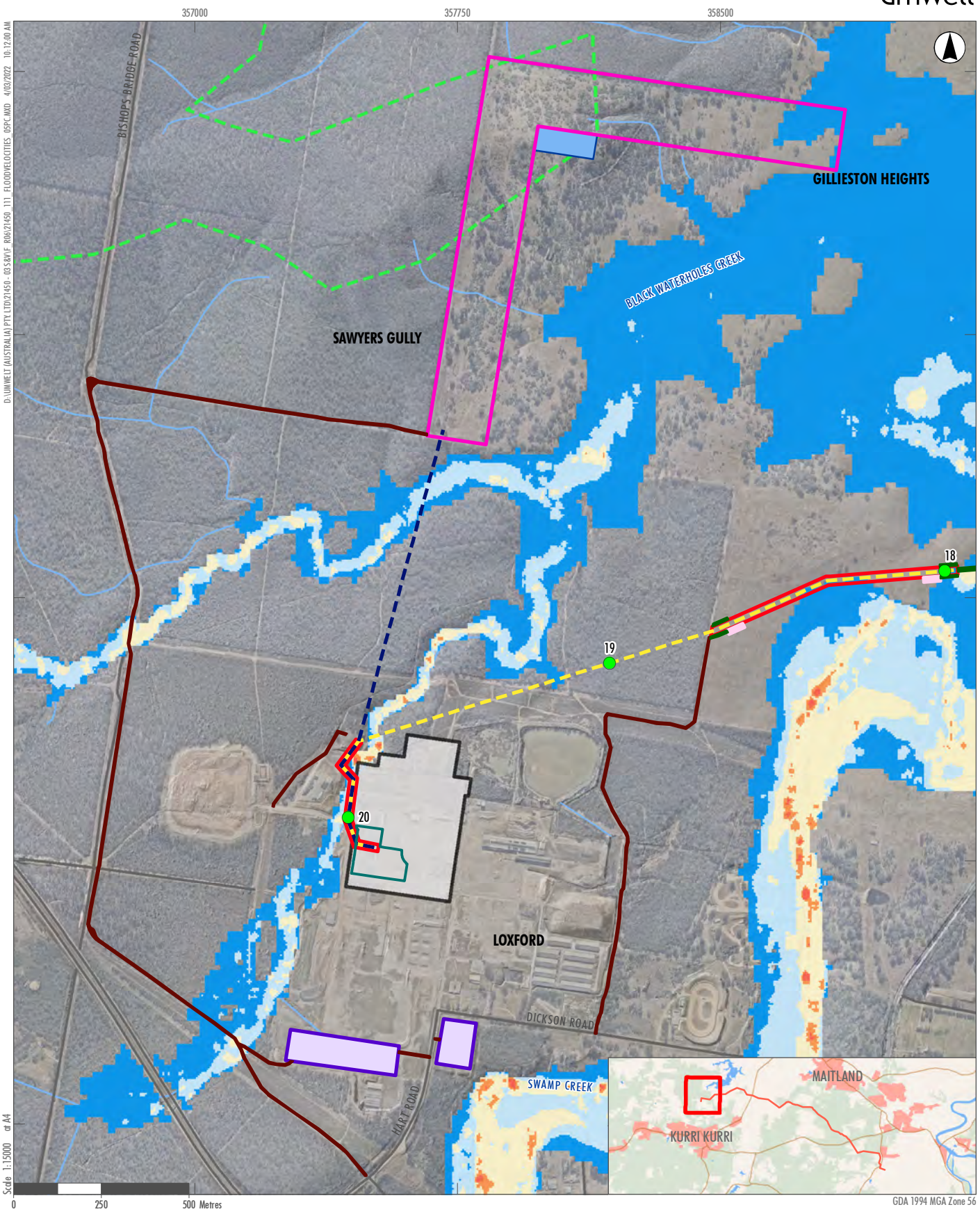
Water Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

APPENDIX I-3E

0.5% AEP Flood Velocities for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Turkey Nest Dam
- Access Tracks
- Roads
- Watercourses

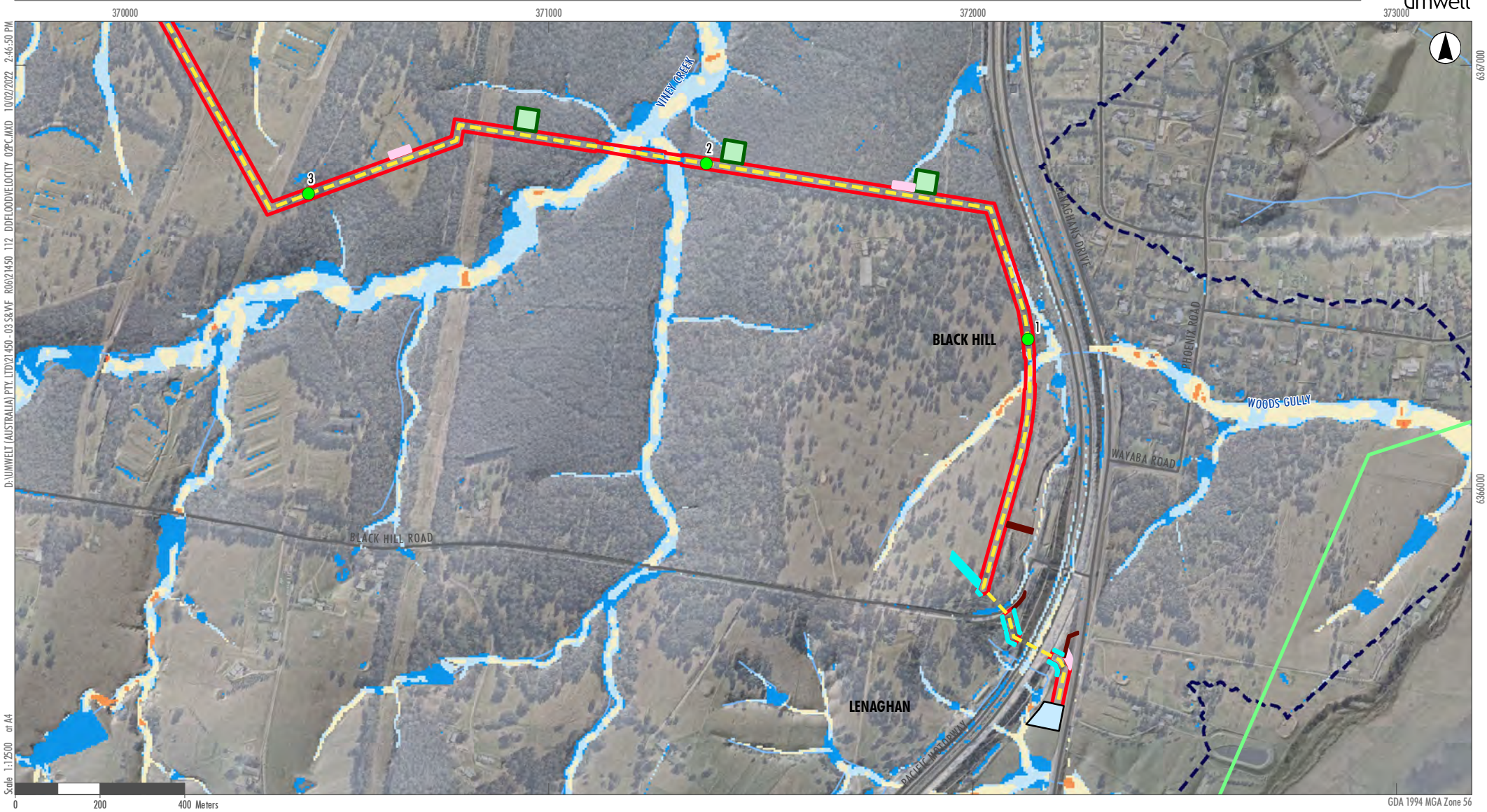
Water Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

APPENDIX I-3F

0.5% AEP Flood Velocities for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Sydney to Newcastle Pipeline (JGN Northern Trunk)
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- JGN Offtake Facility
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

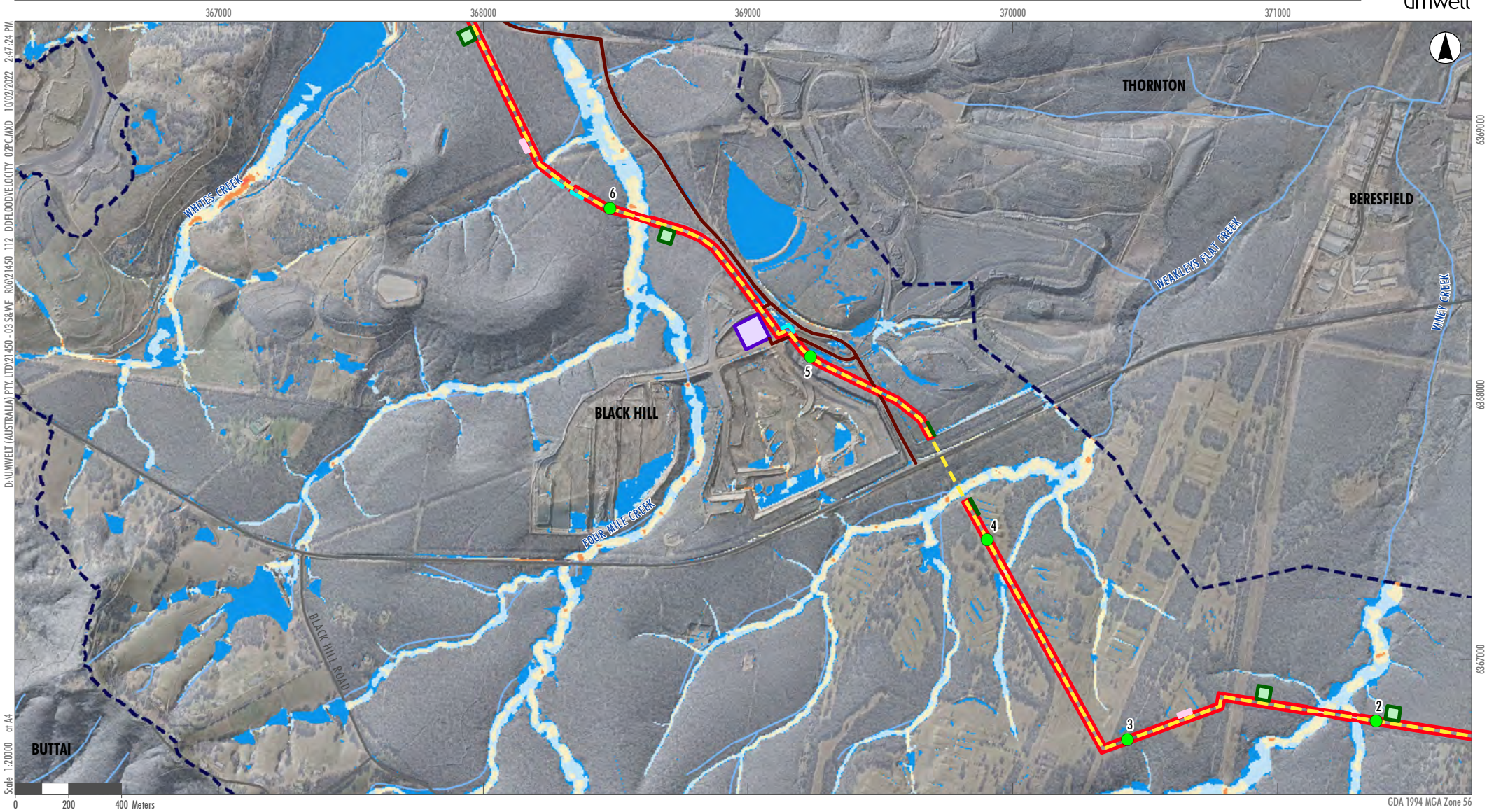
Water Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)

APPENDIX I-4A

0.2% AEP Flood Velocities for Existing Conditions



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Pipe Laydown Areas
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

Water Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

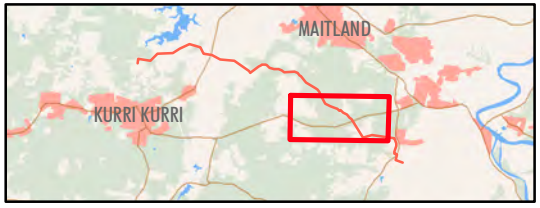
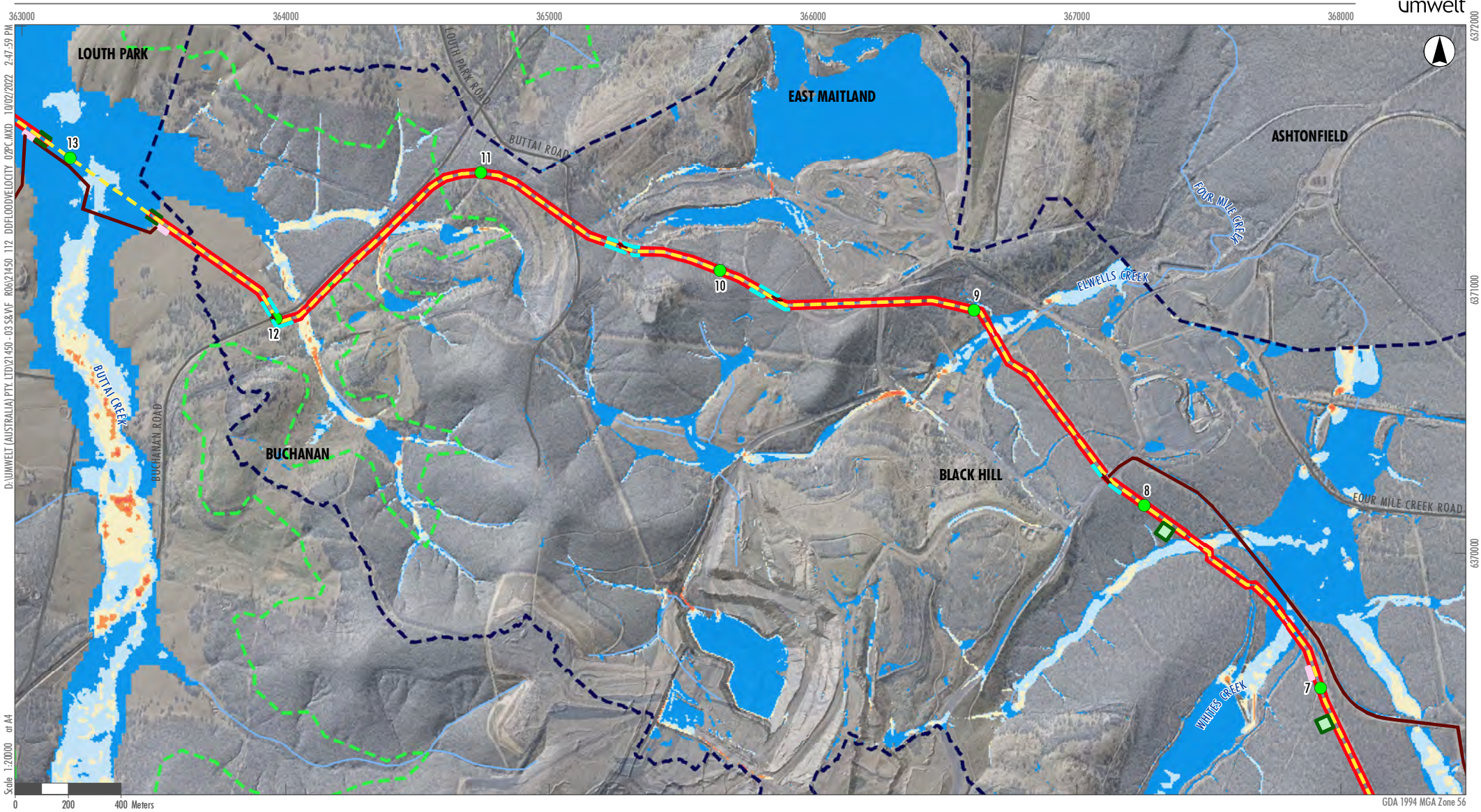


Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)

APPENDIX I-4B

0.2% AEP Flood Velocities for Existing Conditions



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

Water Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

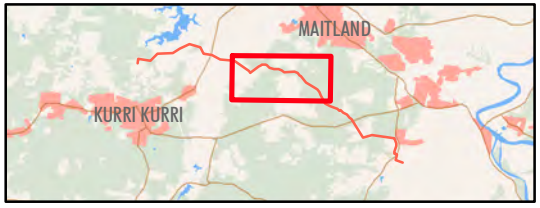
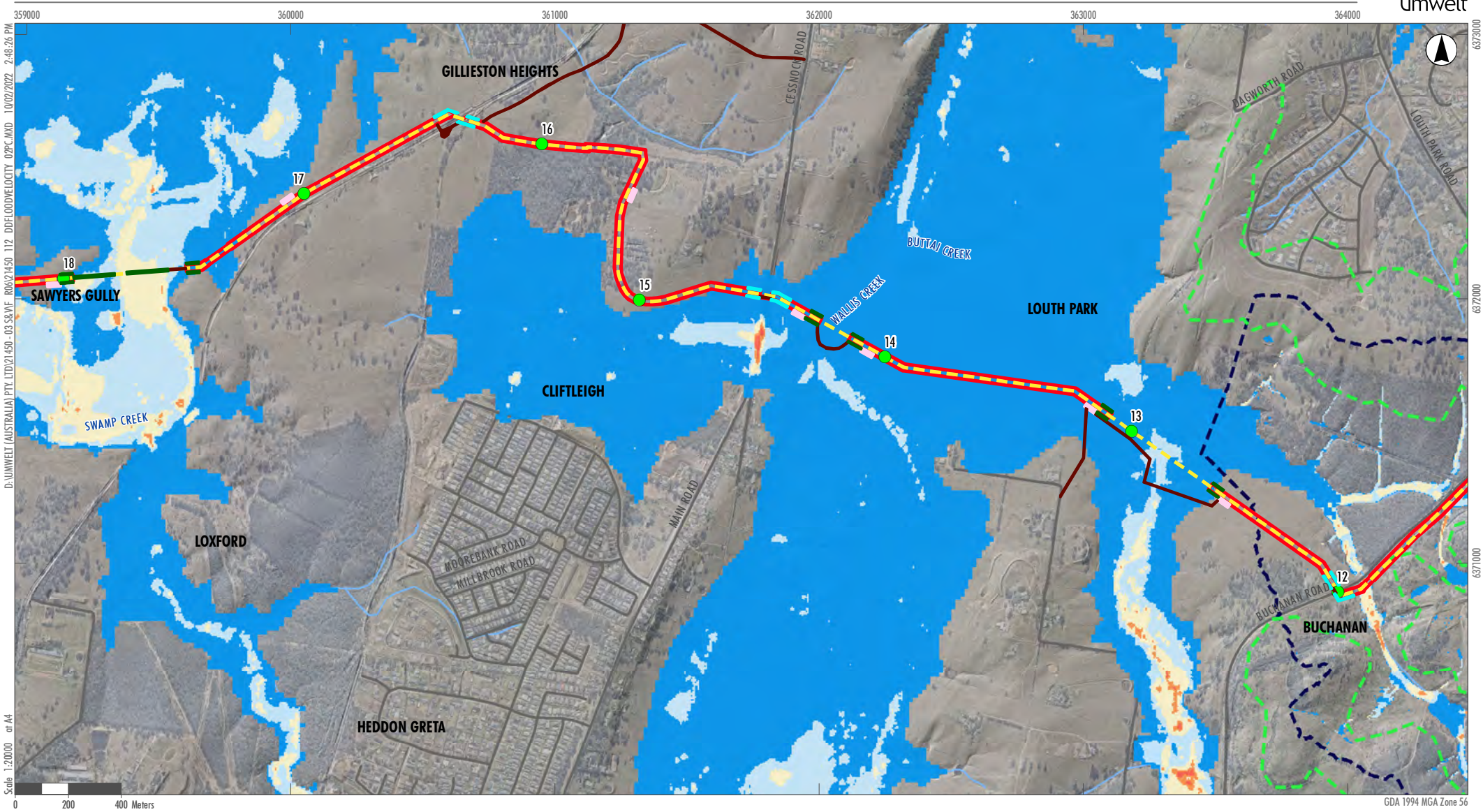


Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)

APPENDIX I-4C

0.2% AEP Flood Velocities for Existing Conditions



D:\UMWELT (AUSTRALIA) PTY LTD\21450 - 03 S&WF R06\21450 112 DDFLOODVELOCITY 02PC.MXD 10/02/2022 2:48:26 PM

Scale 1:20000 at A4

Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Access Tracks
- Roads
- Watercourses

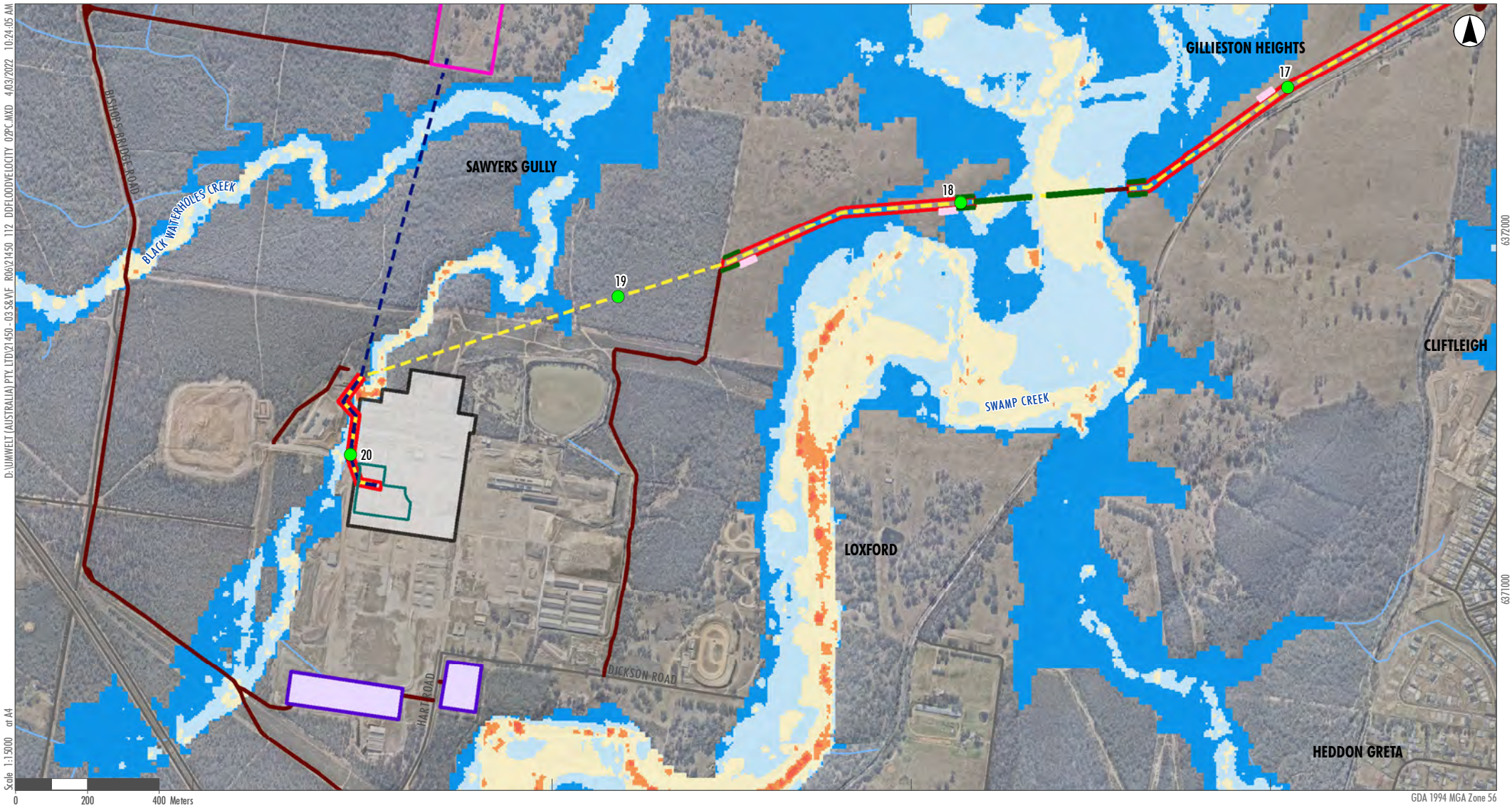
Water Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

APPENDIX I-4D

0.2% AEP Flood Velocities for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Access Tracks
- Roads
- Watercourses

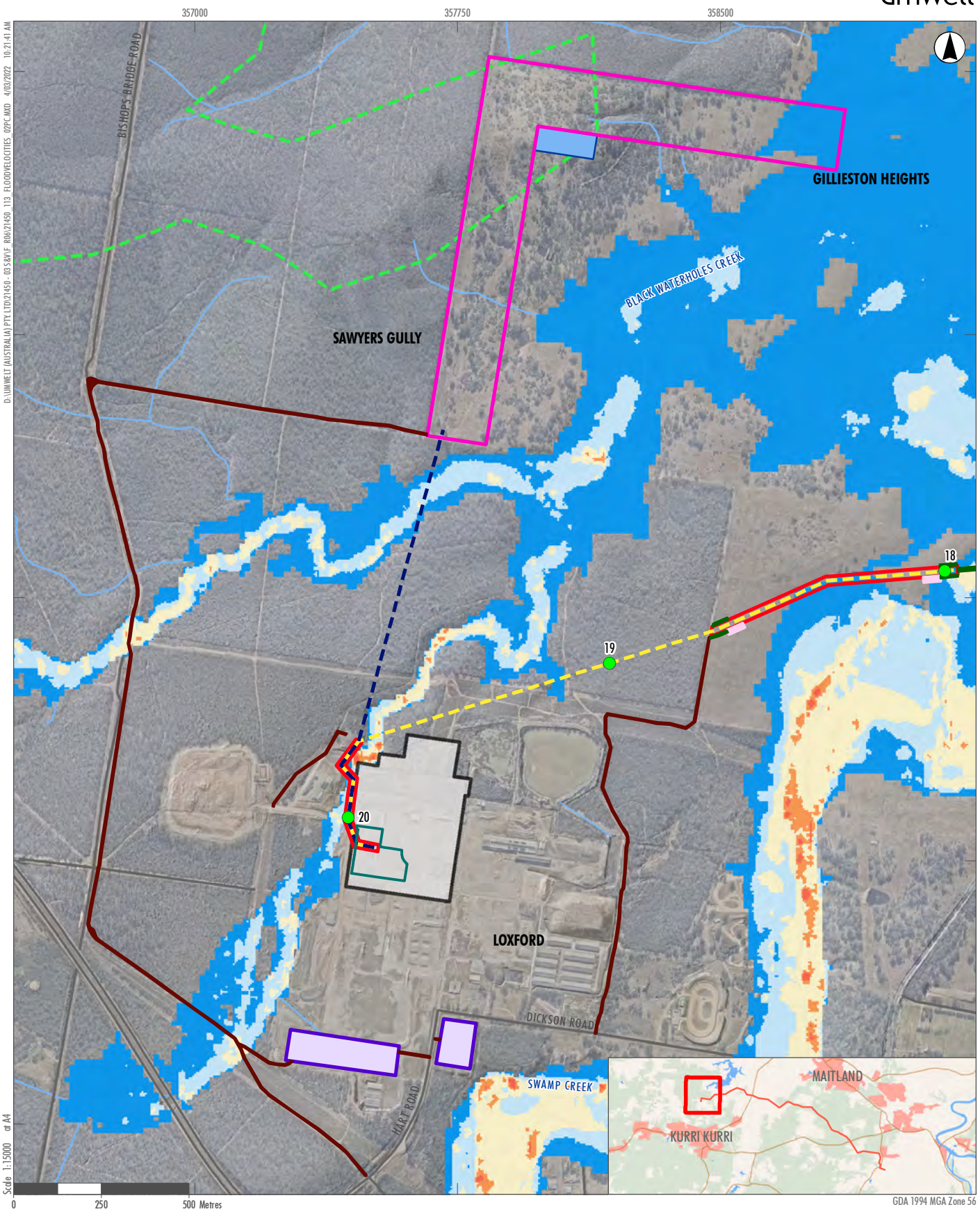
Water Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

APPENDIX I-4E

0.2% AEP Flood Velocities for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Turkey Nest Dam
- Access Tracks
- Roads
- Watercourses

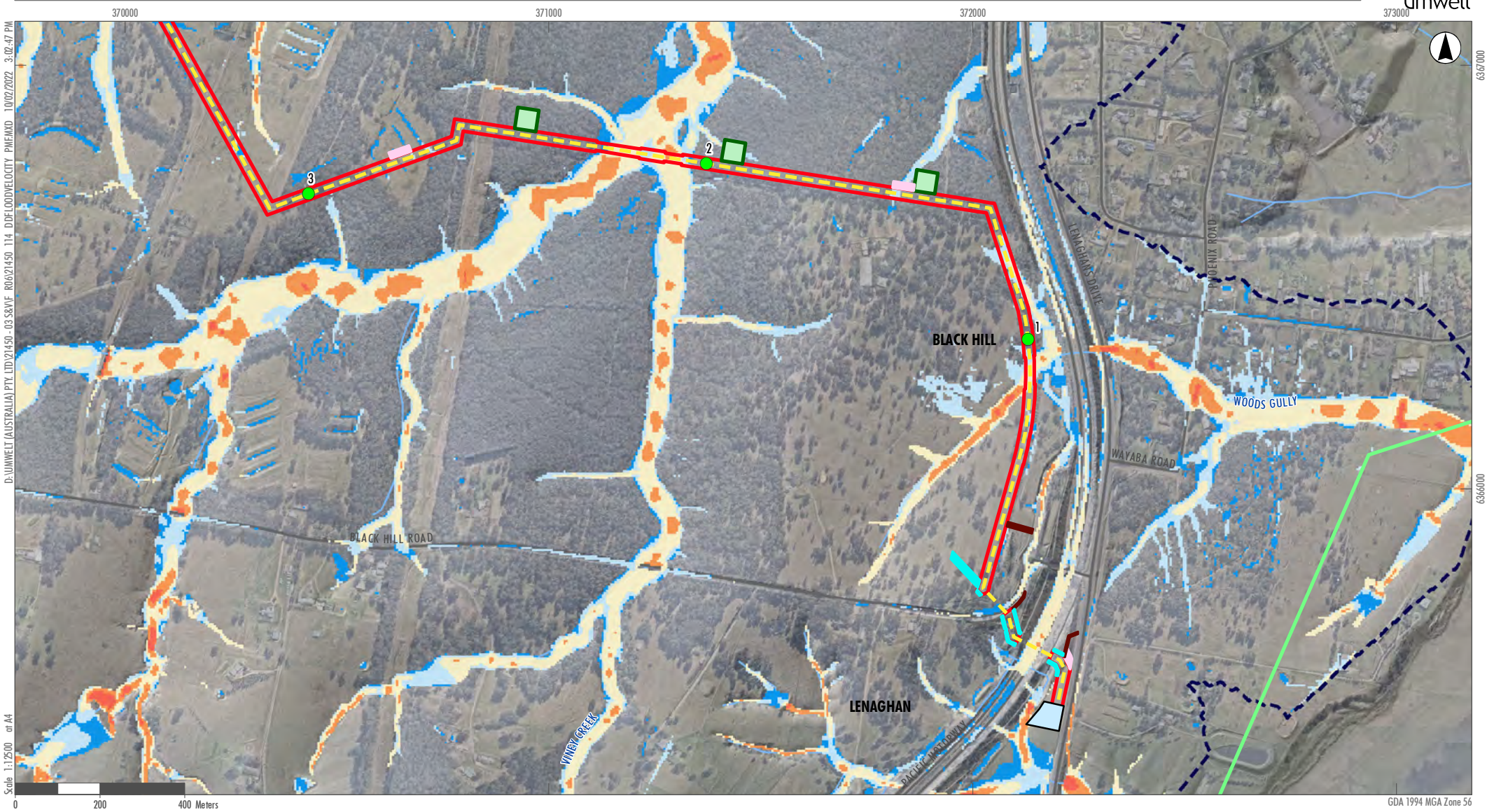
Water Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

APPENDIX I-4F

0.2% AEP Flood Velocities for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Sydney to Newcastle Pipeline (JGN Northern Trunk)
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- JGN Offtake Facility
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

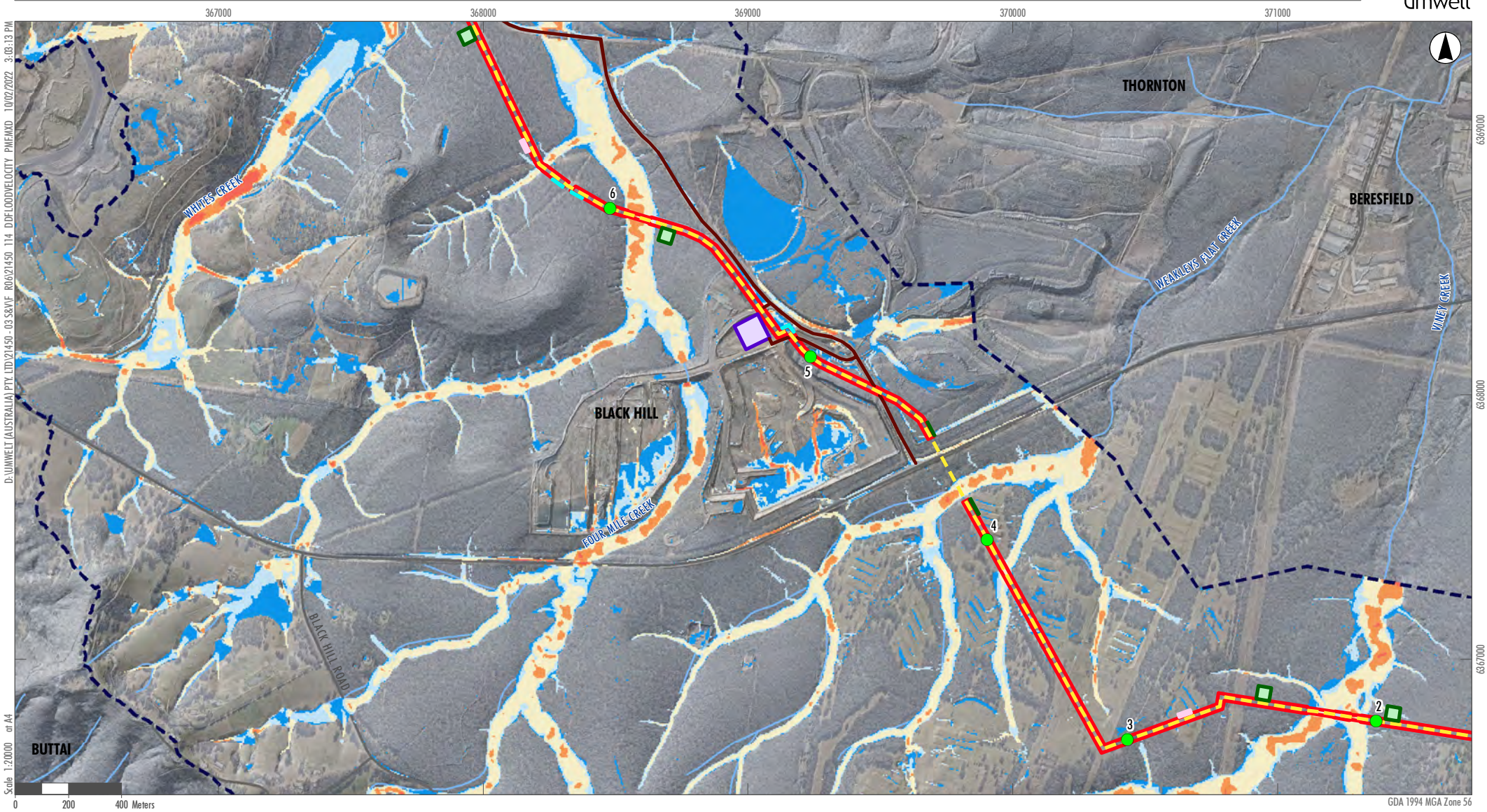
Water Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

APPENDIX I-5A

PMF Flood Velocities for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)

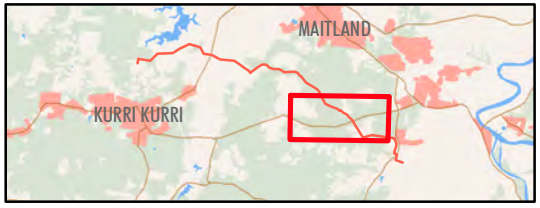


Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Pipe Laydown Areas
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

Water Velocity (m/s)

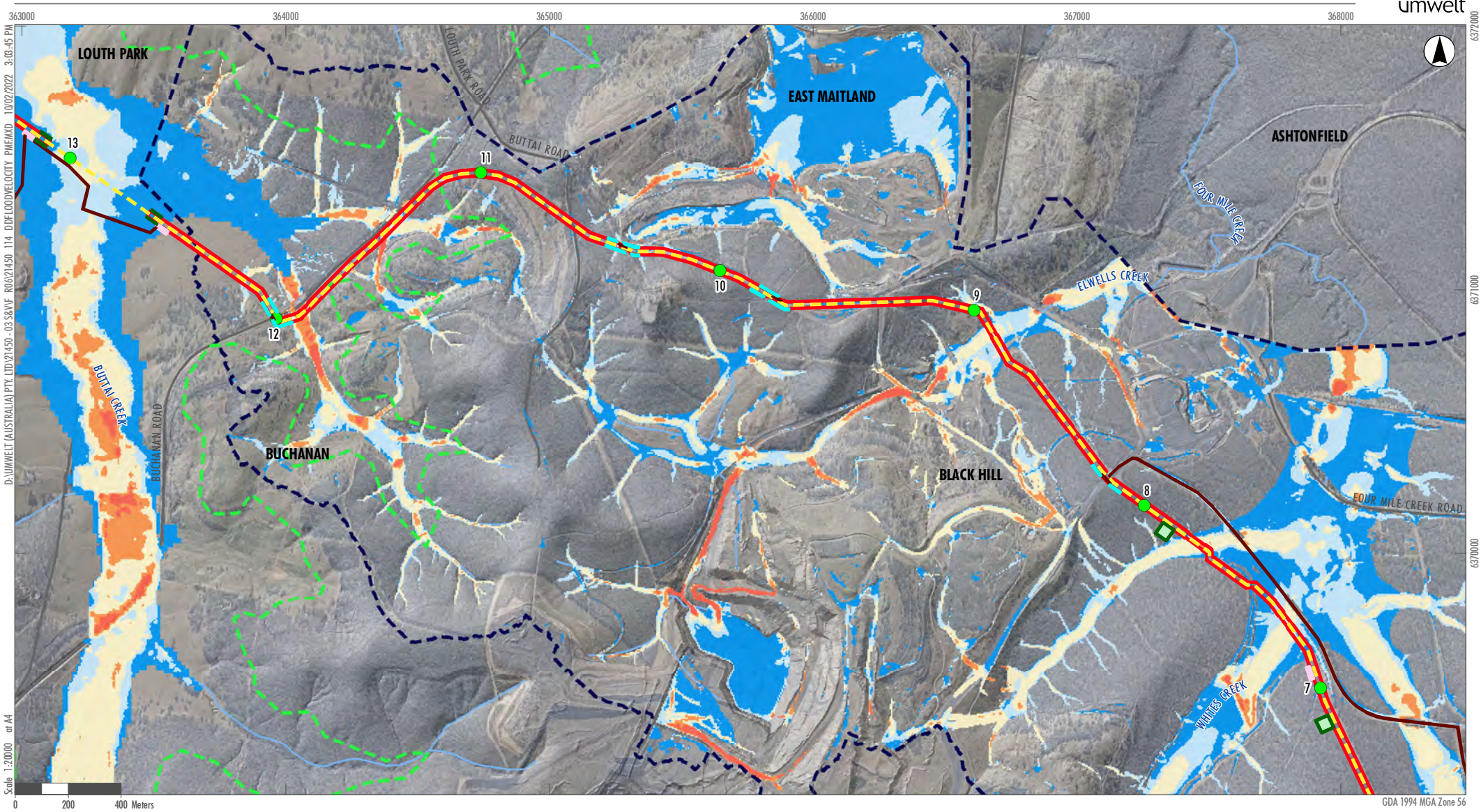
- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0



APPENDIX I-5B

PMF Flood Velocities for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)

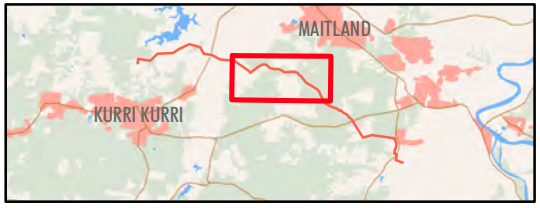


Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

Water Velocity (m/s)

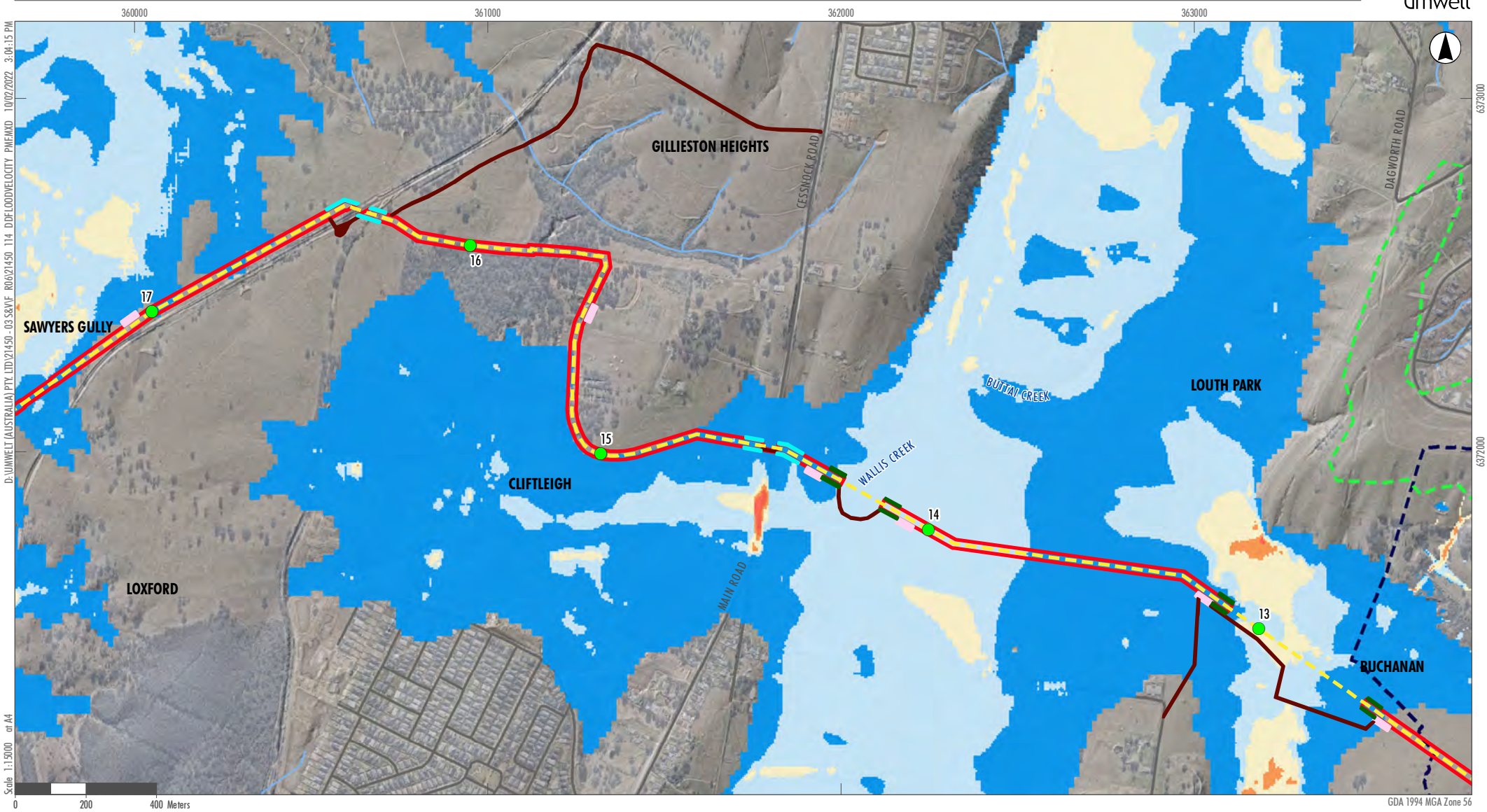
- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0



APPENDIX I-5C

PMF Flood Velocities for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)



D:\UMWELT (AUSTRALIA) PTY. LTD\21450 - 03 S&VF R06\21450_114_DDFLOODVELOCITY_PME.MXD 10/02/2022 3:04:15 PM

Scale 1:15000 at A4

Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Access Tracks
- Roads
- Watercourses

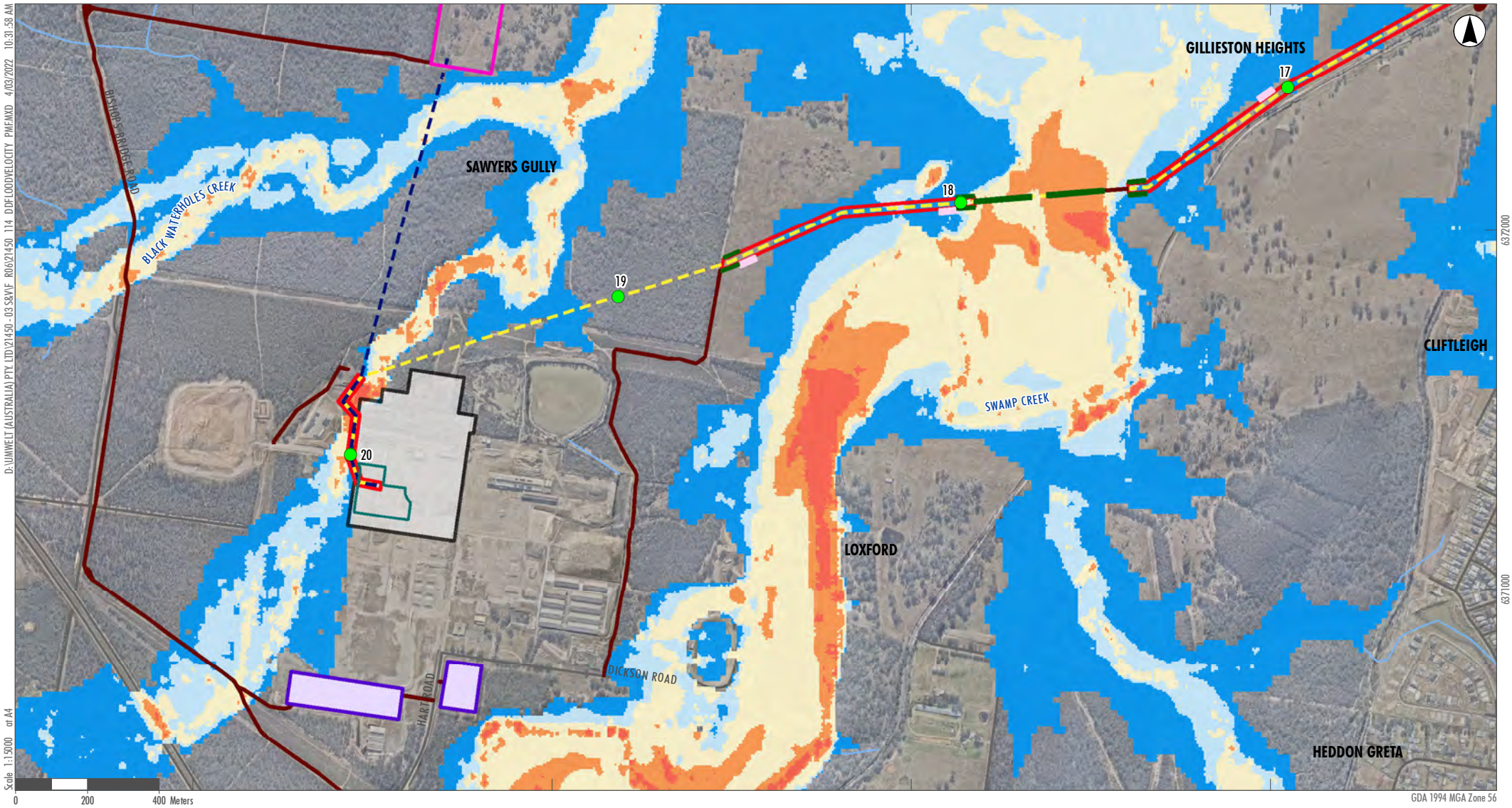
Water Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

APPENDIX I-5D

PMF Flood Velocities for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Access Tracks
- Roads
- Watercourses

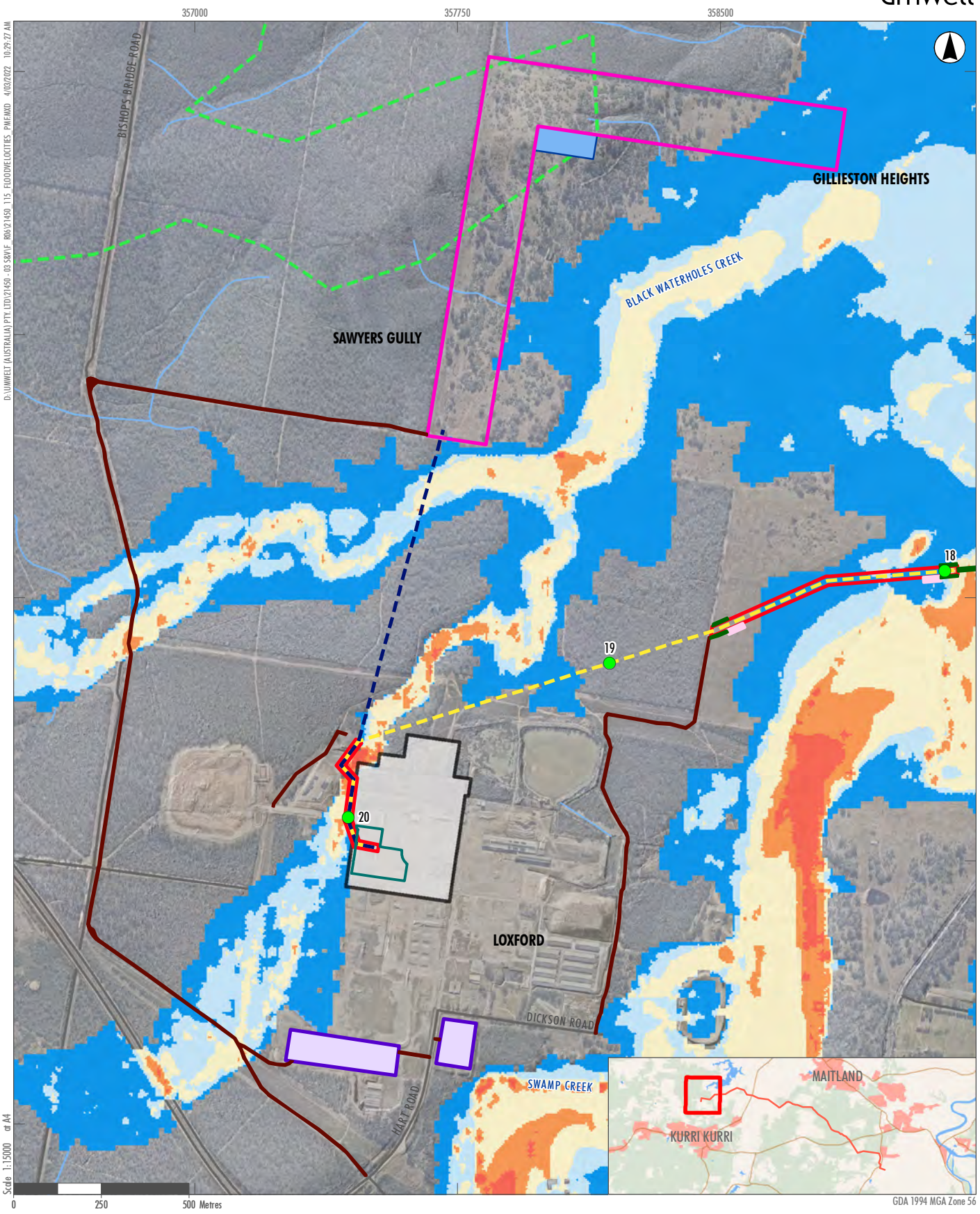
Water Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

APPENDIX I-5E

PMF Flood Velocities for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Turkey Nest Dam
- Access Tracks
- Roads
- Watercourses

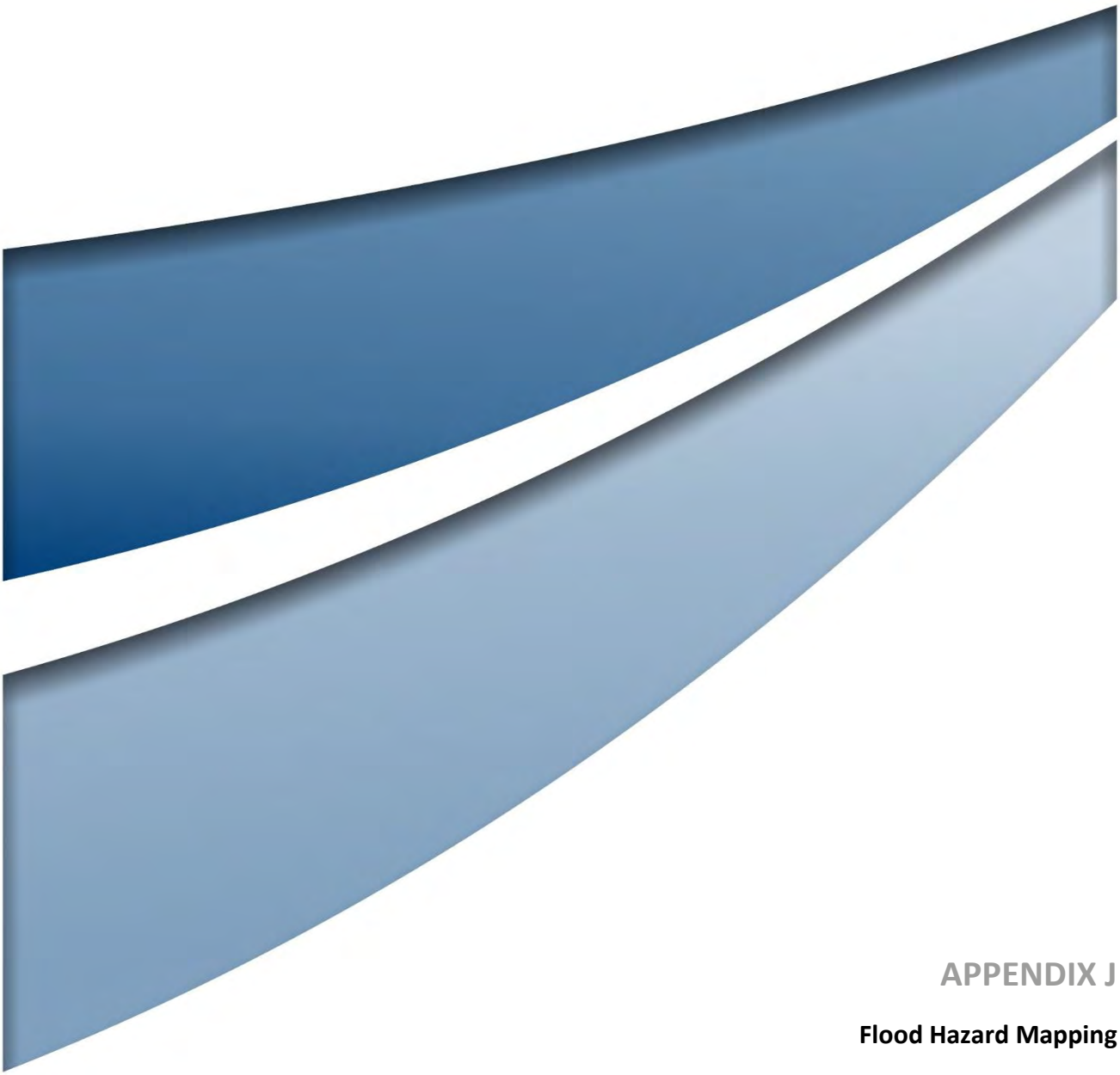
Water Velocity (m/s)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 3.0
- > 3.0

APPENDIX I-5F

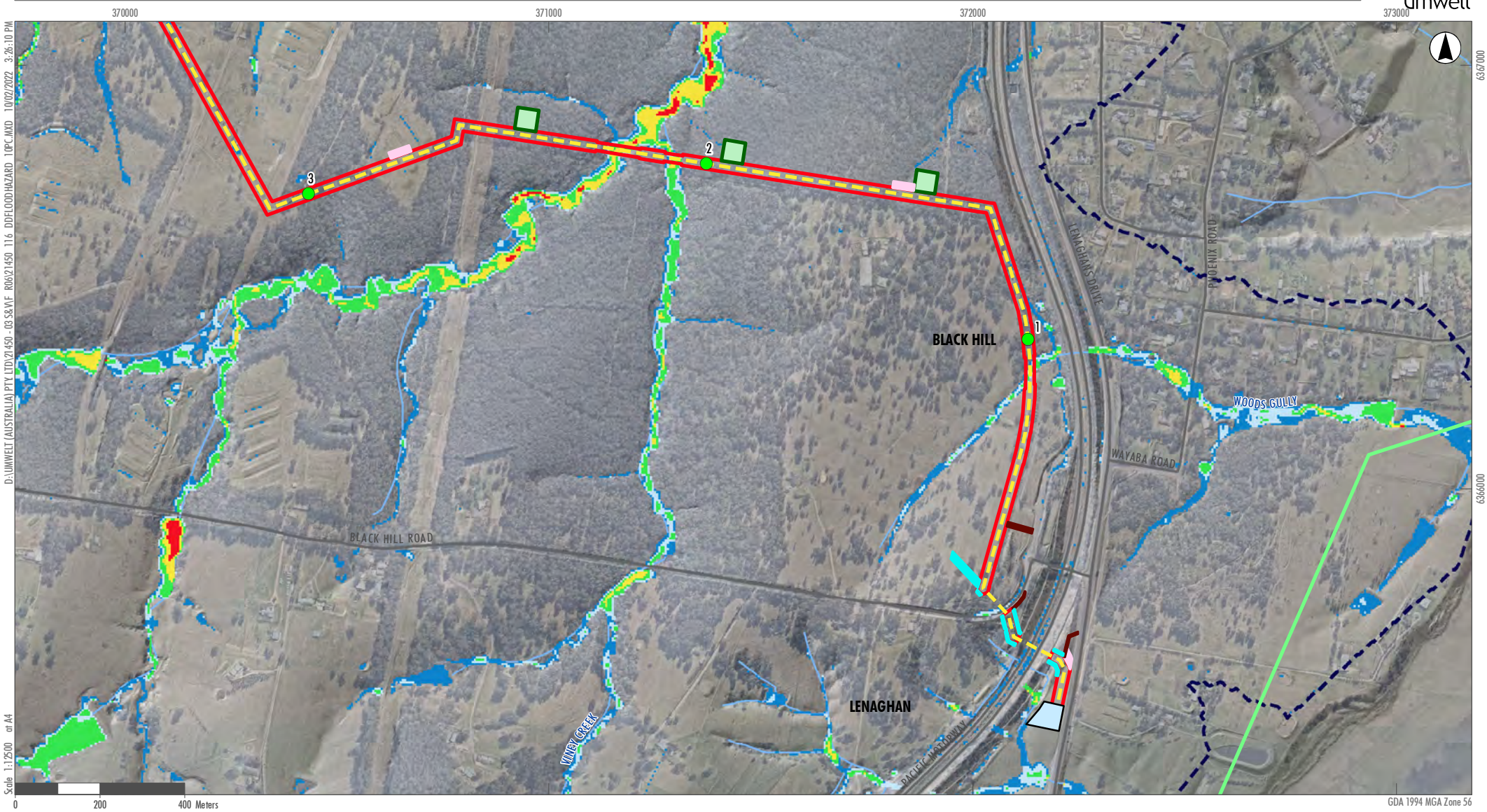
PMF Flood Velocities for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



APPENDIX J

Flood Hazard Mapping



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Sydney to Newcastle Pipeline (JGN Northern Trunk)
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- JGN Offtake Facility
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

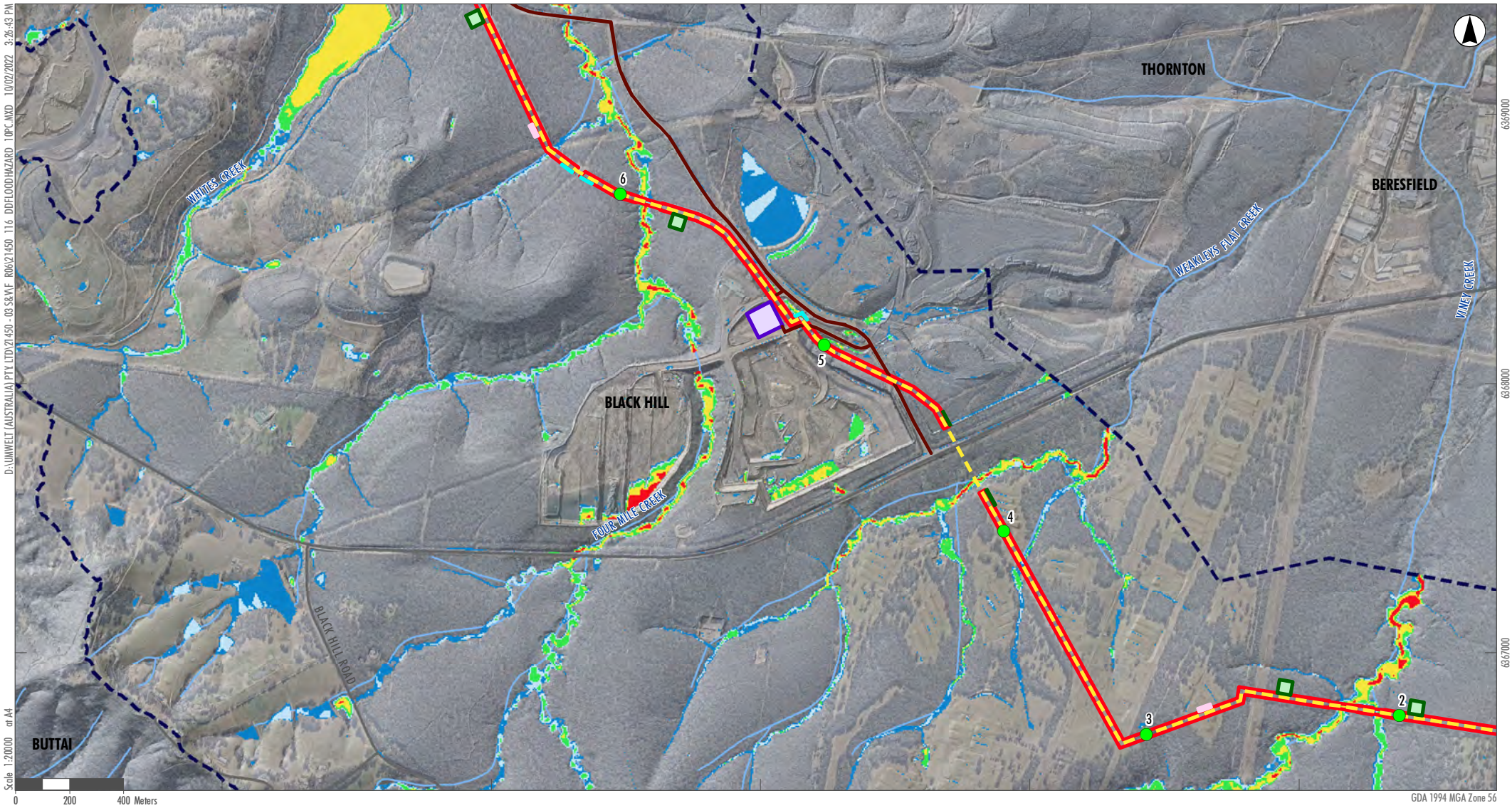
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX J-1A

10% AEP Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)

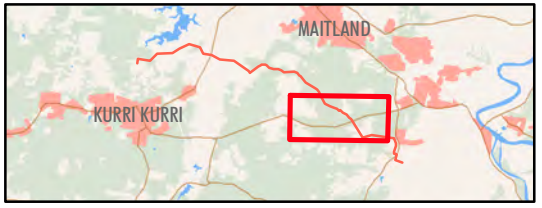


Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Pipe Laydown Areas
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

Hazard Category

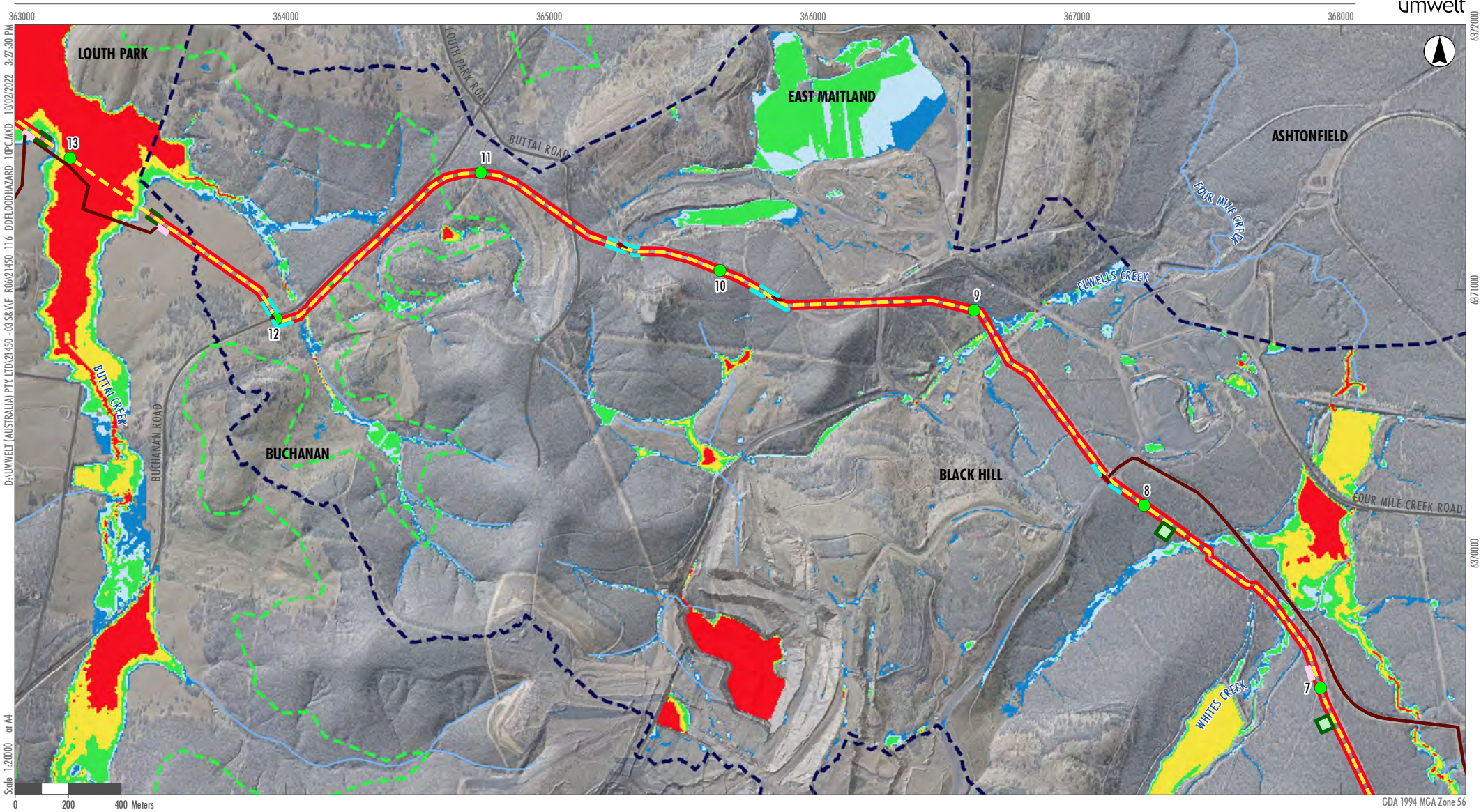
- H1
- H2
- H3
- H4
- H5
- H6



APPENDIX J-1B

10% AEP Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

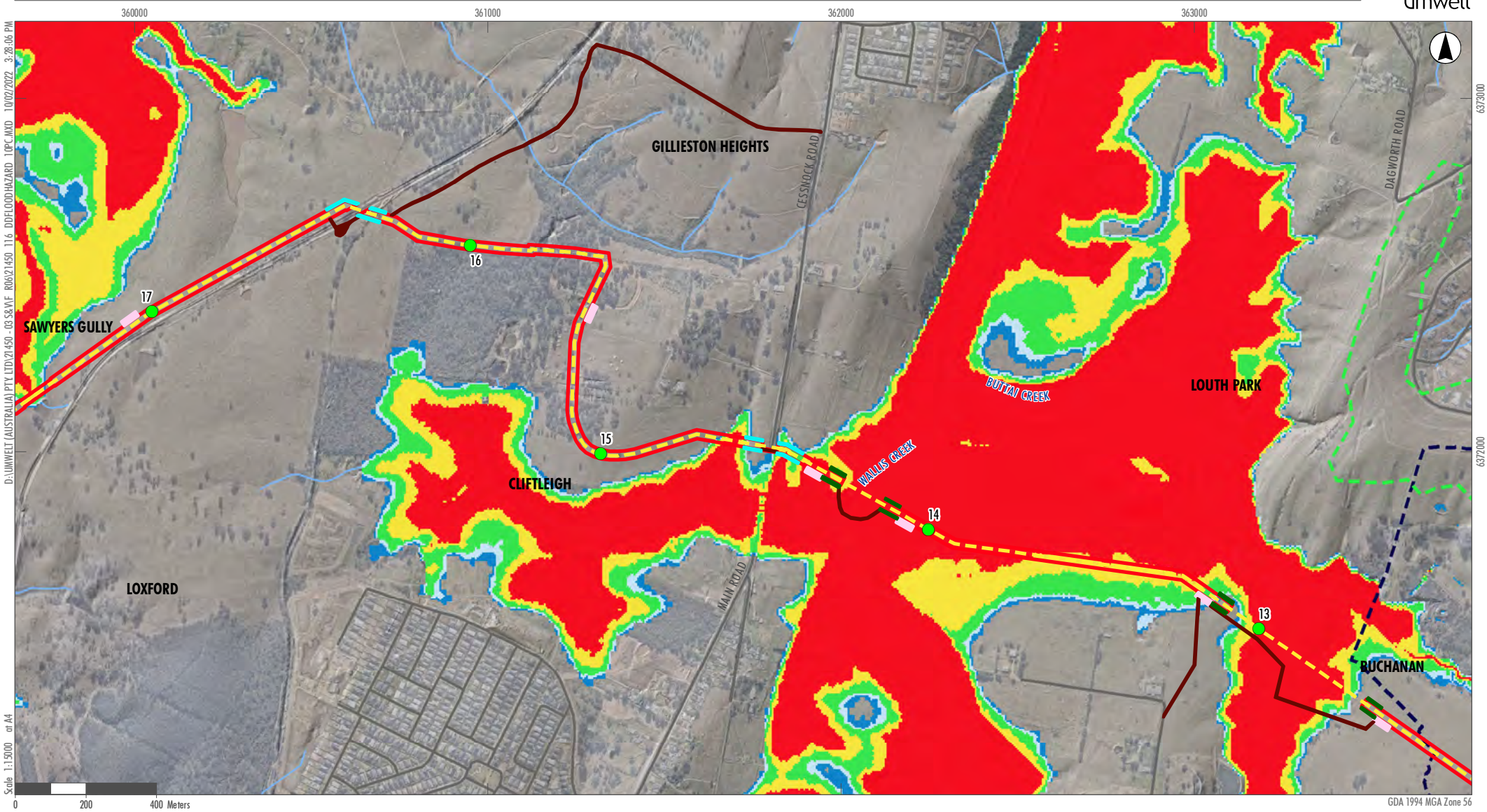
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX J-1C

10% AEP Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Access Tracks
- Roads
- Watercourses

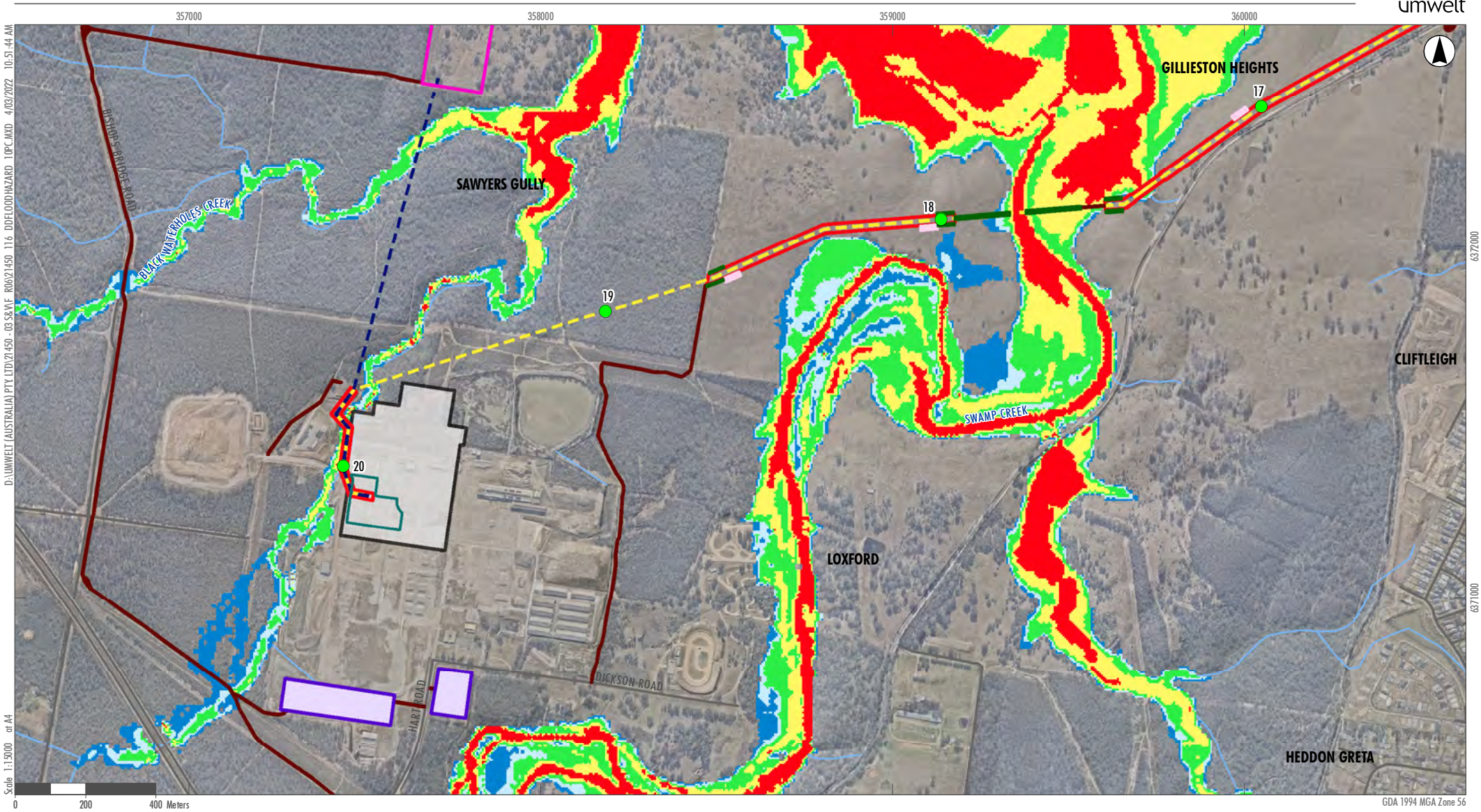
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX J-1D

10% AEP Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Access Tracks
- Roads
- Watercourses

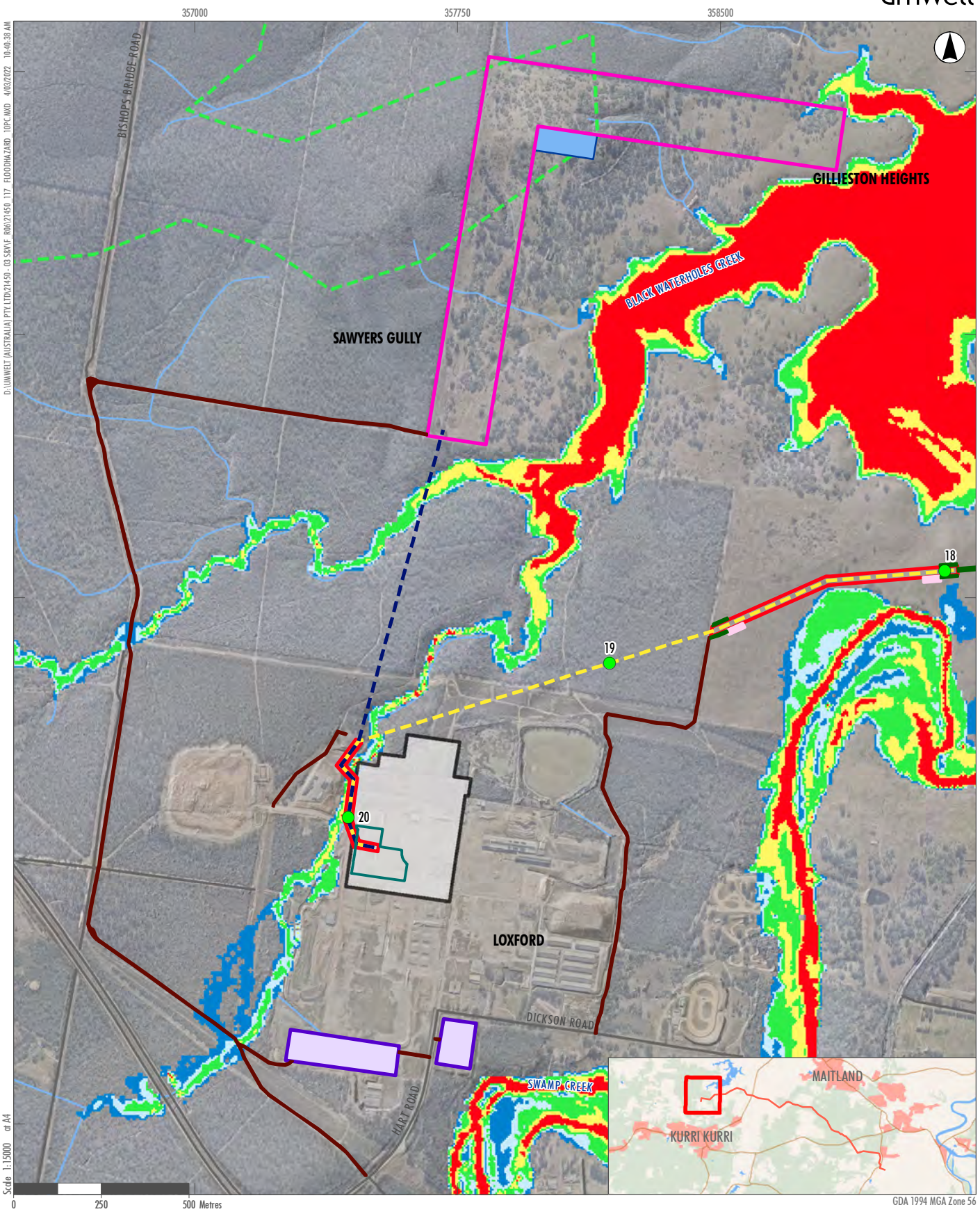
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX J-1E

10% AEP Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Turkey Nest Dam
- Access Tracks
- Roads
- Watercourses

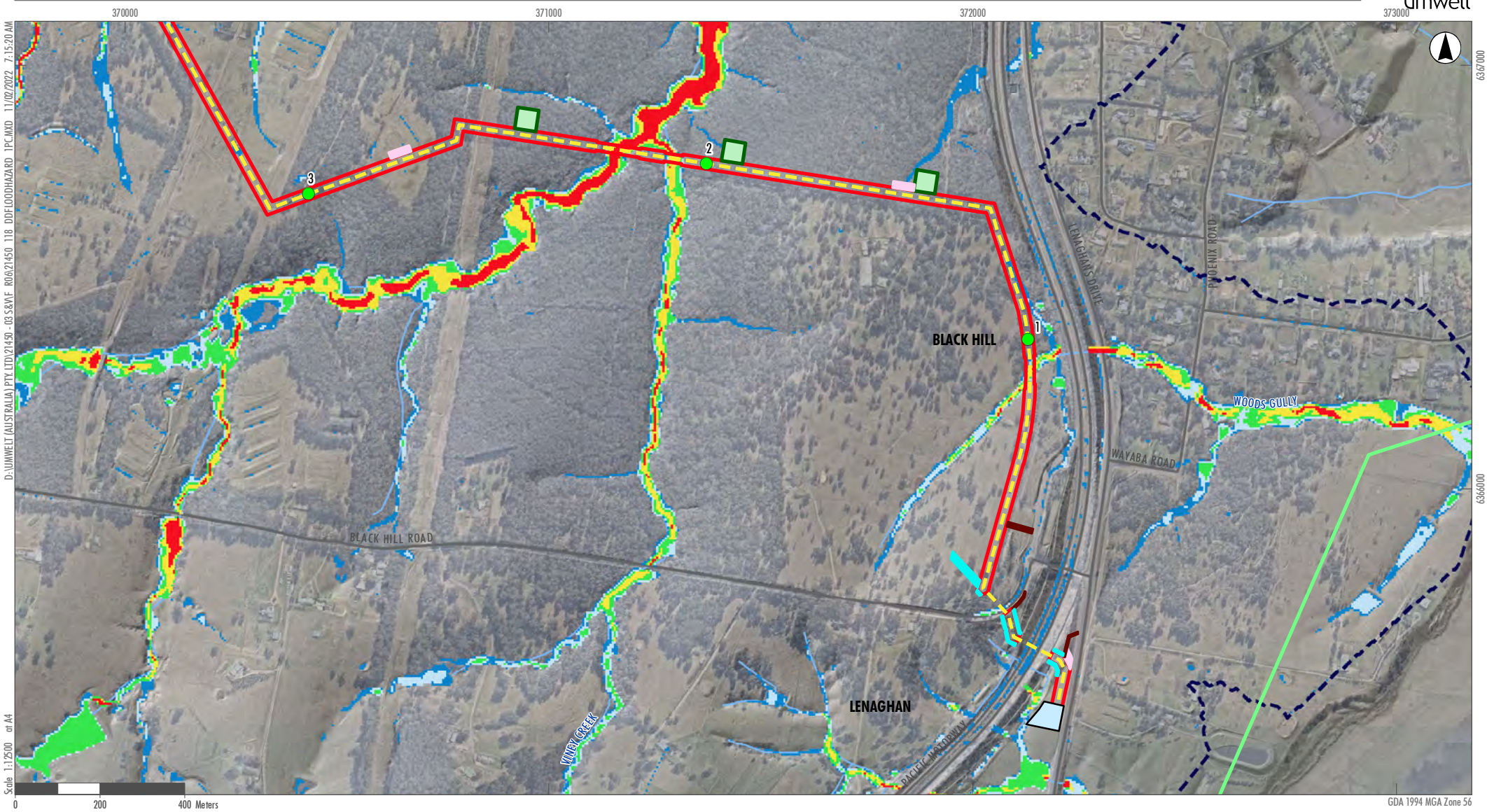
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX J-1F

10% AEP Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Sydney to Newcastle Pipeline (JGN Northern Trunk)
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- JGN Offtake Facility
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

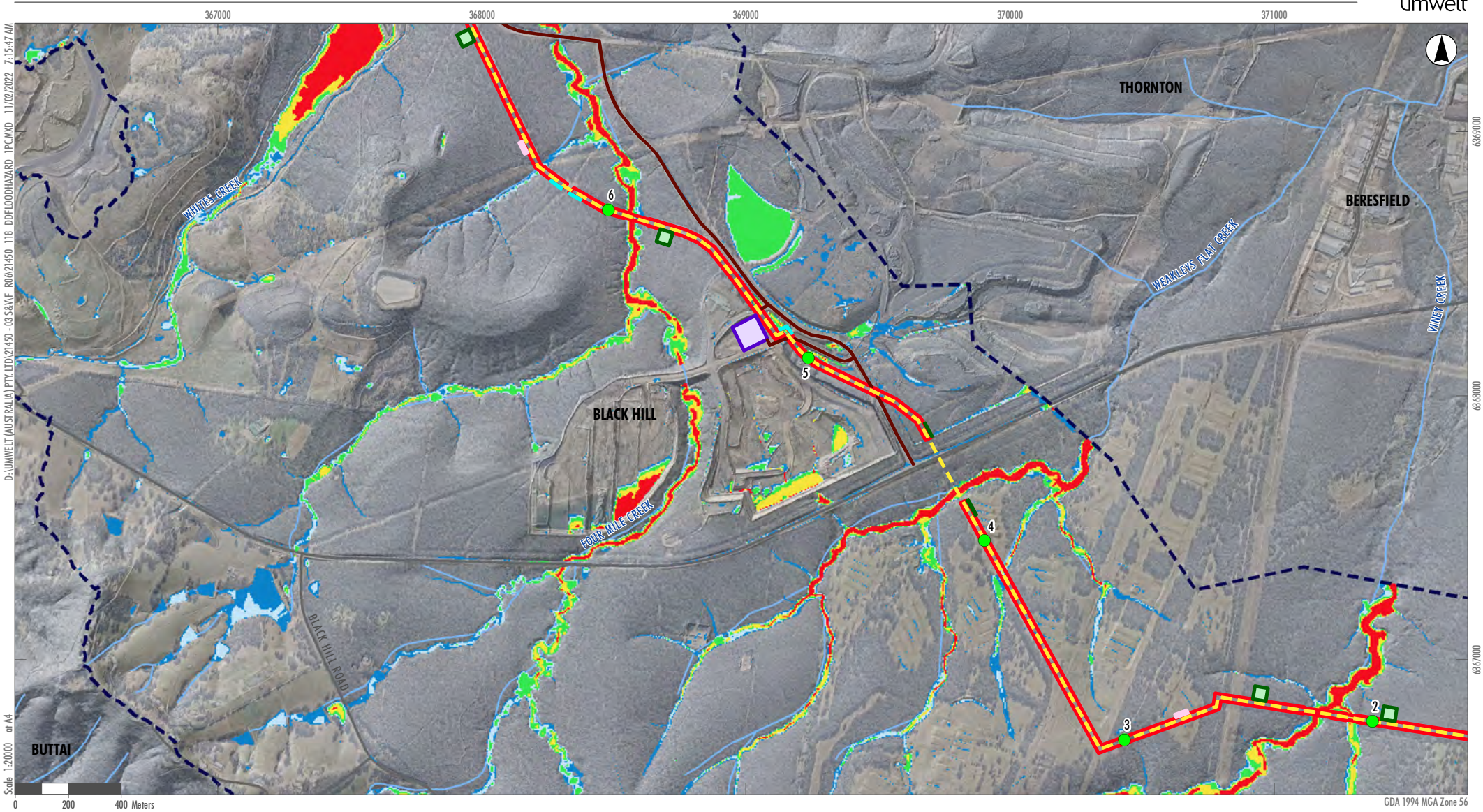
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX J-2A

1% AEP Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)

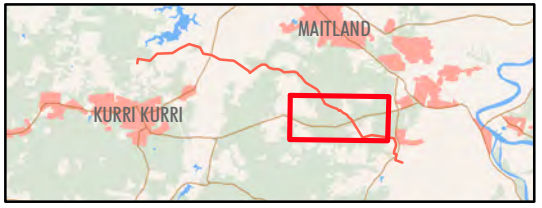


Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Pipe Laydown Areas
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

Hazard Category

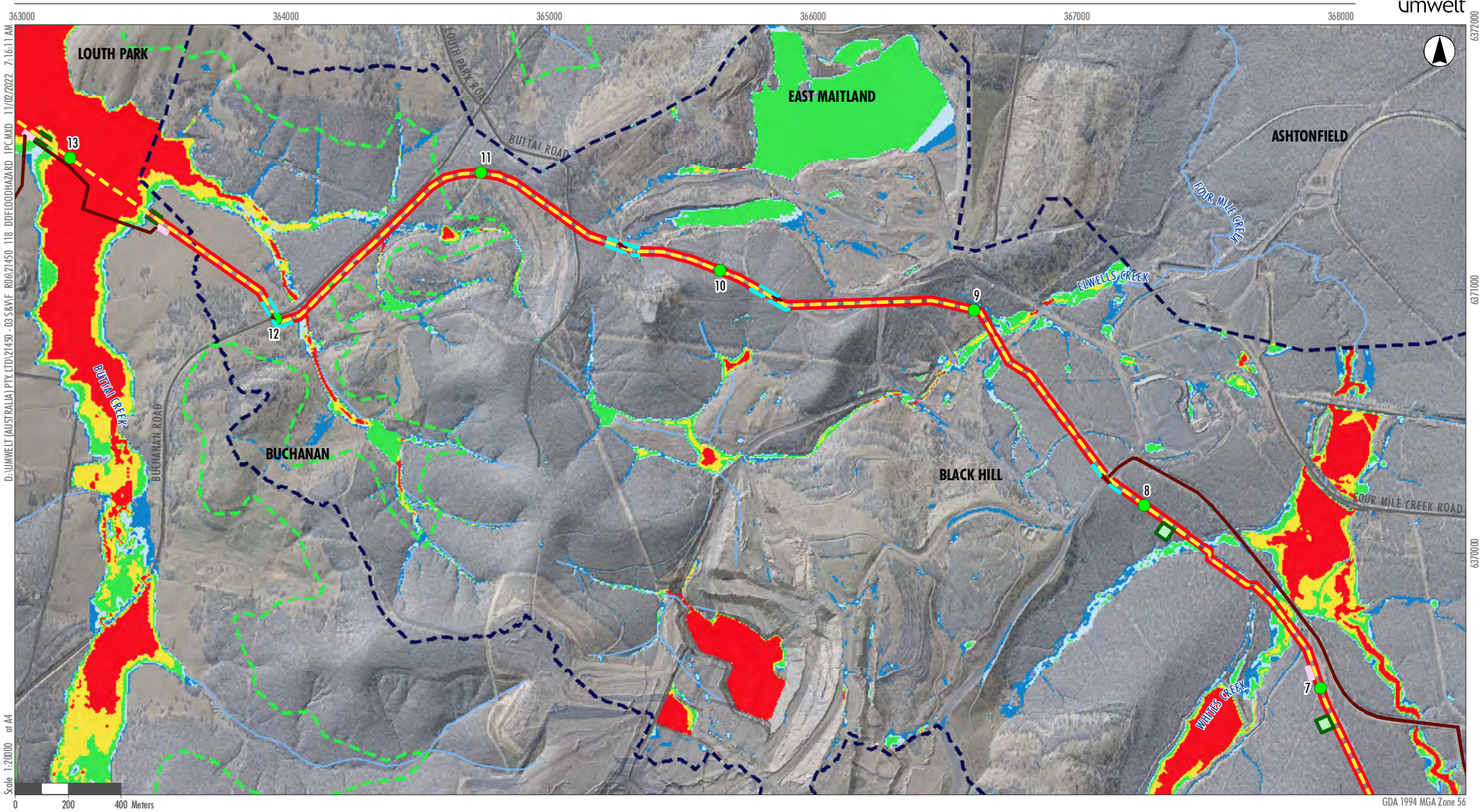
- H1
- H2
- H3
- H4
- H5
- H6



APPENDIX J-2B

1% AEP Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

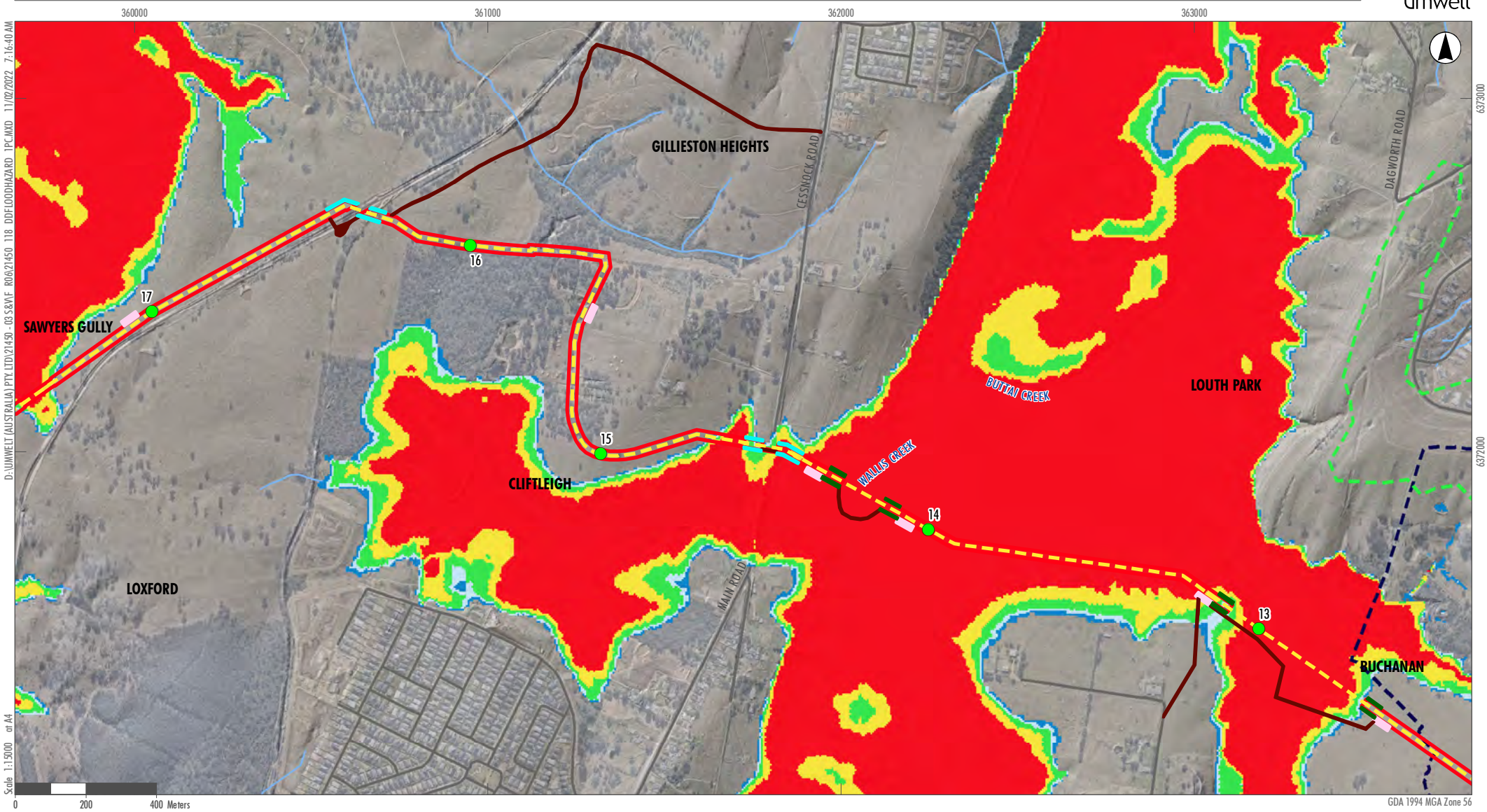
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX J-2C

1% AEP Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)



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Scale 1:15000 at A4

Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Access Tracks
- Roads
- Watercourses

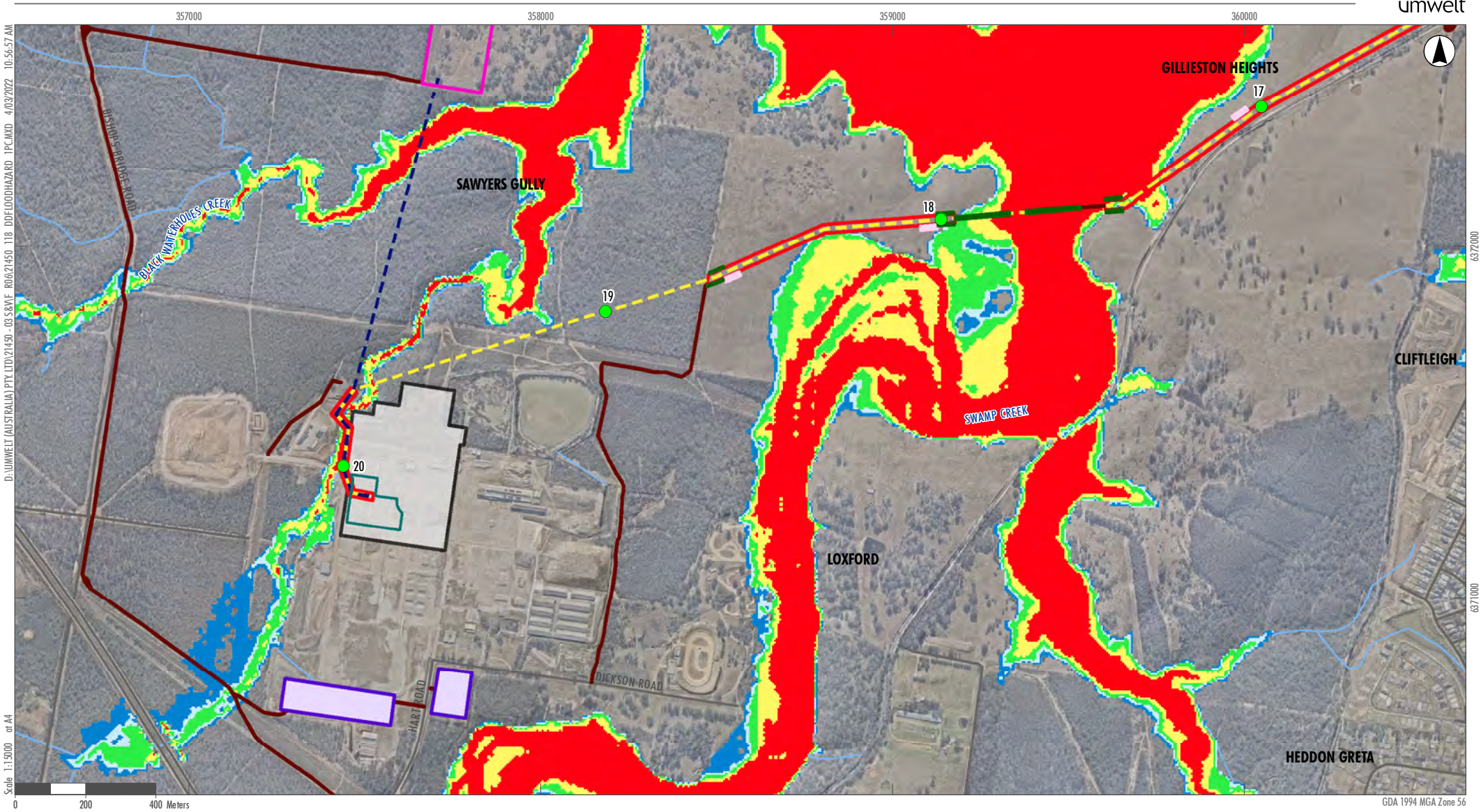
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX J-2D

1% AEP Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Access Tracks
- Roads
- Watercourses

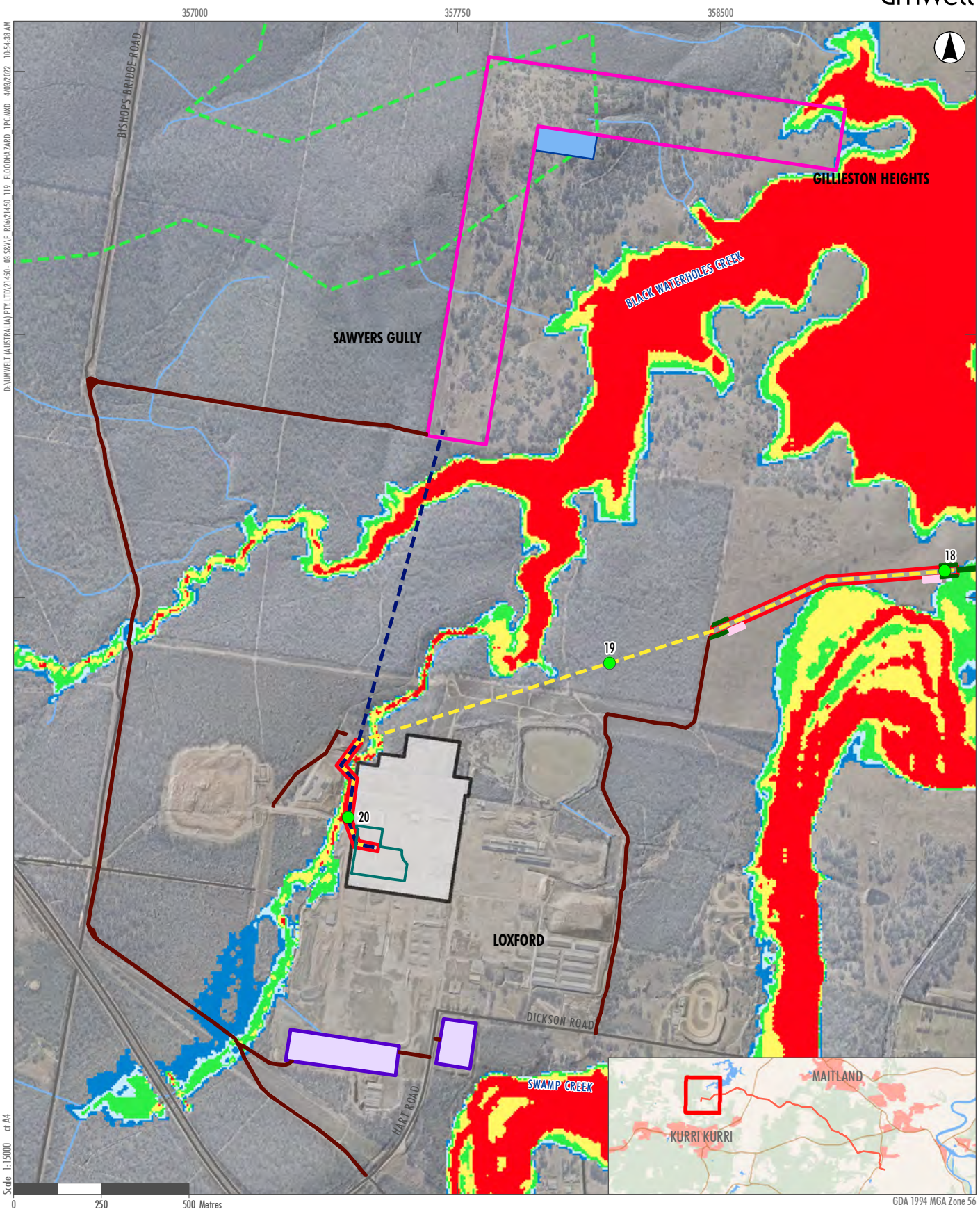
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX J-2E

1% AEP Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Turkey Nest Dam
- Access Tracks
- Roads
- Watercourses

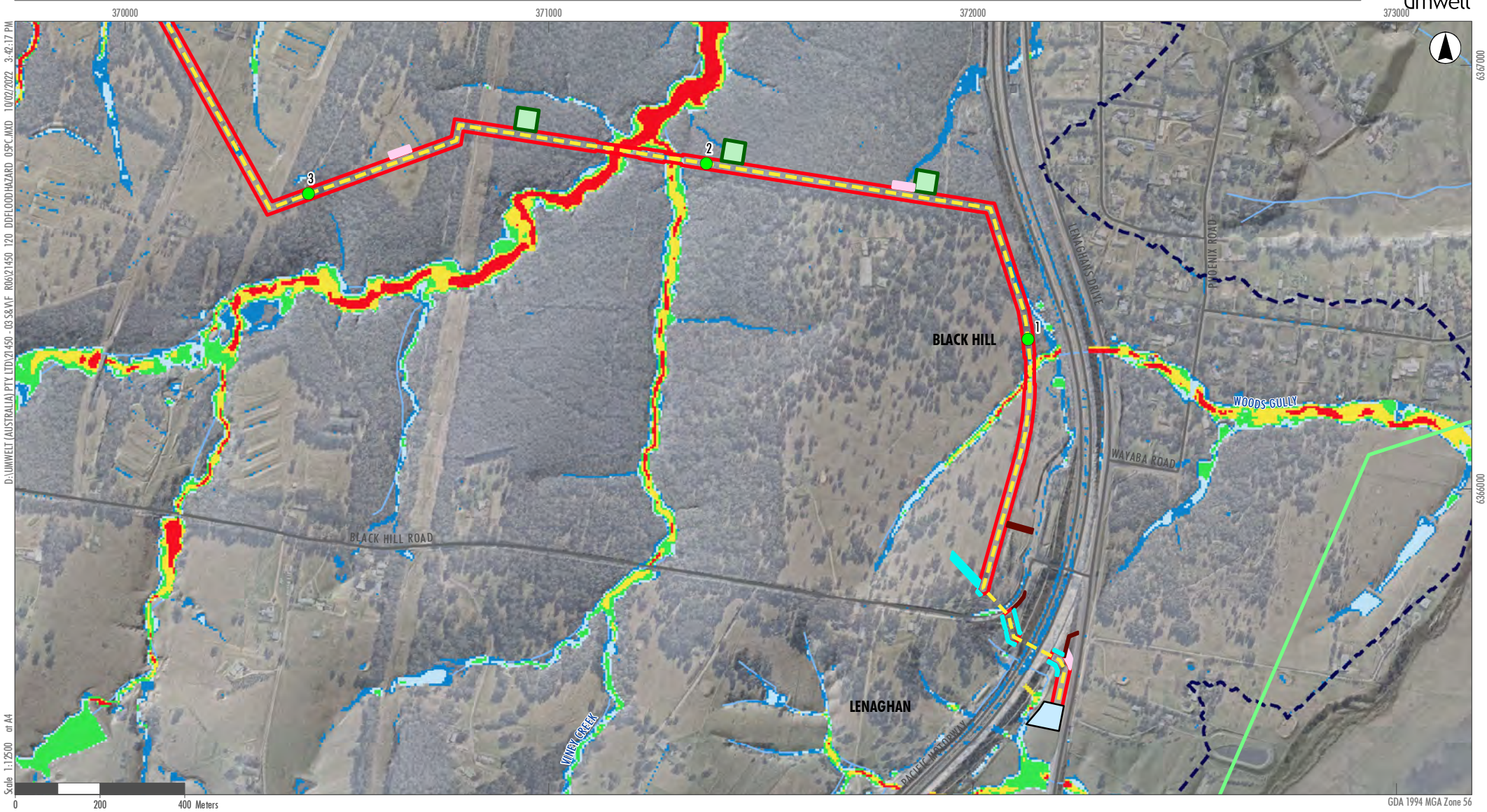
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX J-2F

1% AEP Flood Hazard for Existing Conditions

Image Source: Nearmap (October 2021) Data source: NSW LPI (2020;2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Sydney to Newcastle Pipeline (JGN Northern Trunk)
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- JGN Offtake Facility
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

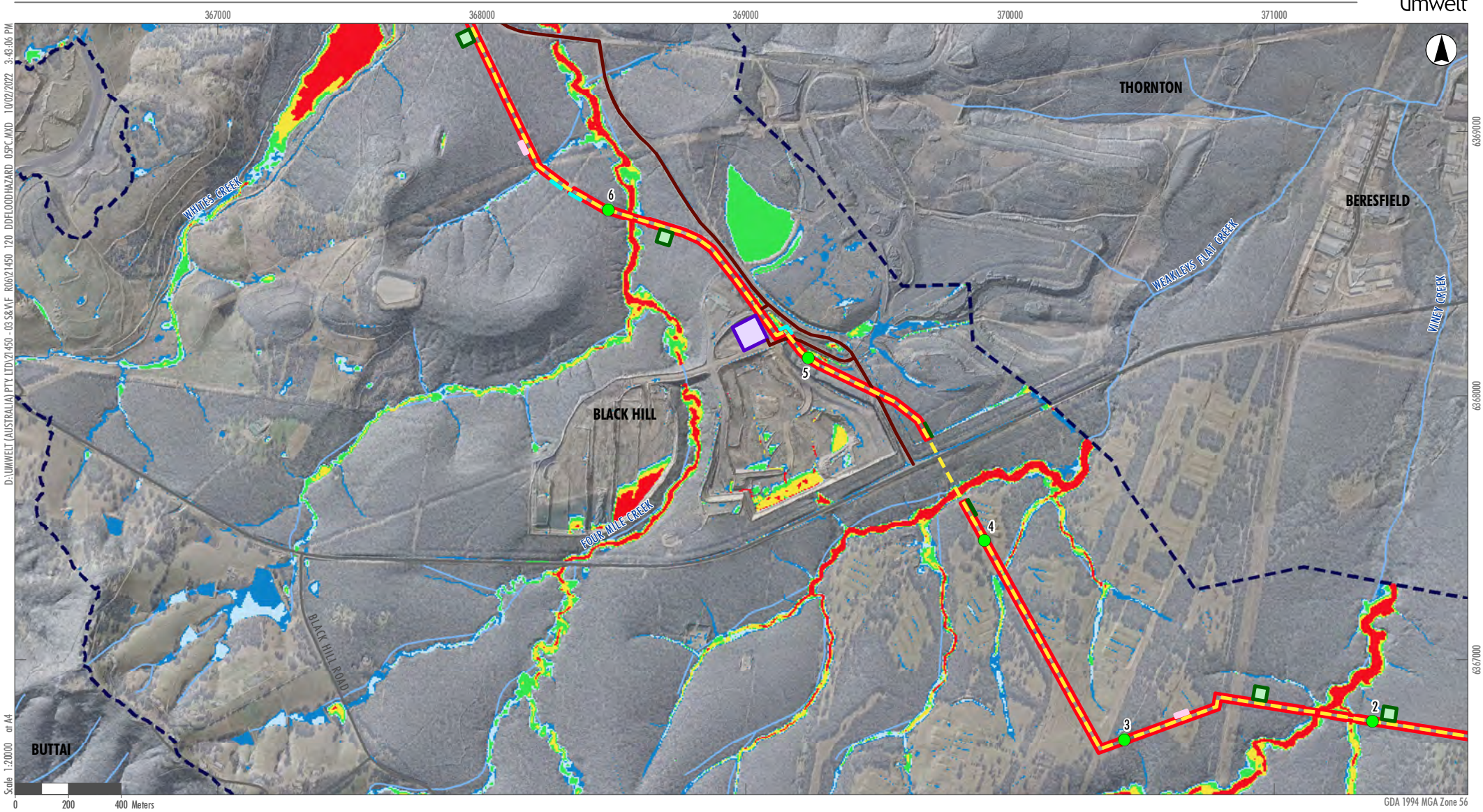
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX J-3A

0.5% AEP Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)

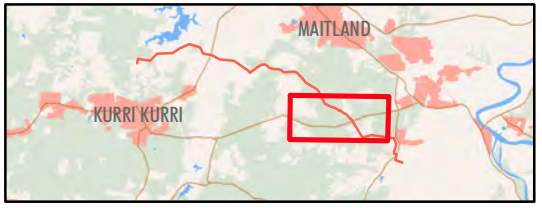


Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Pipe Laydown Areas
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

Hazard Category

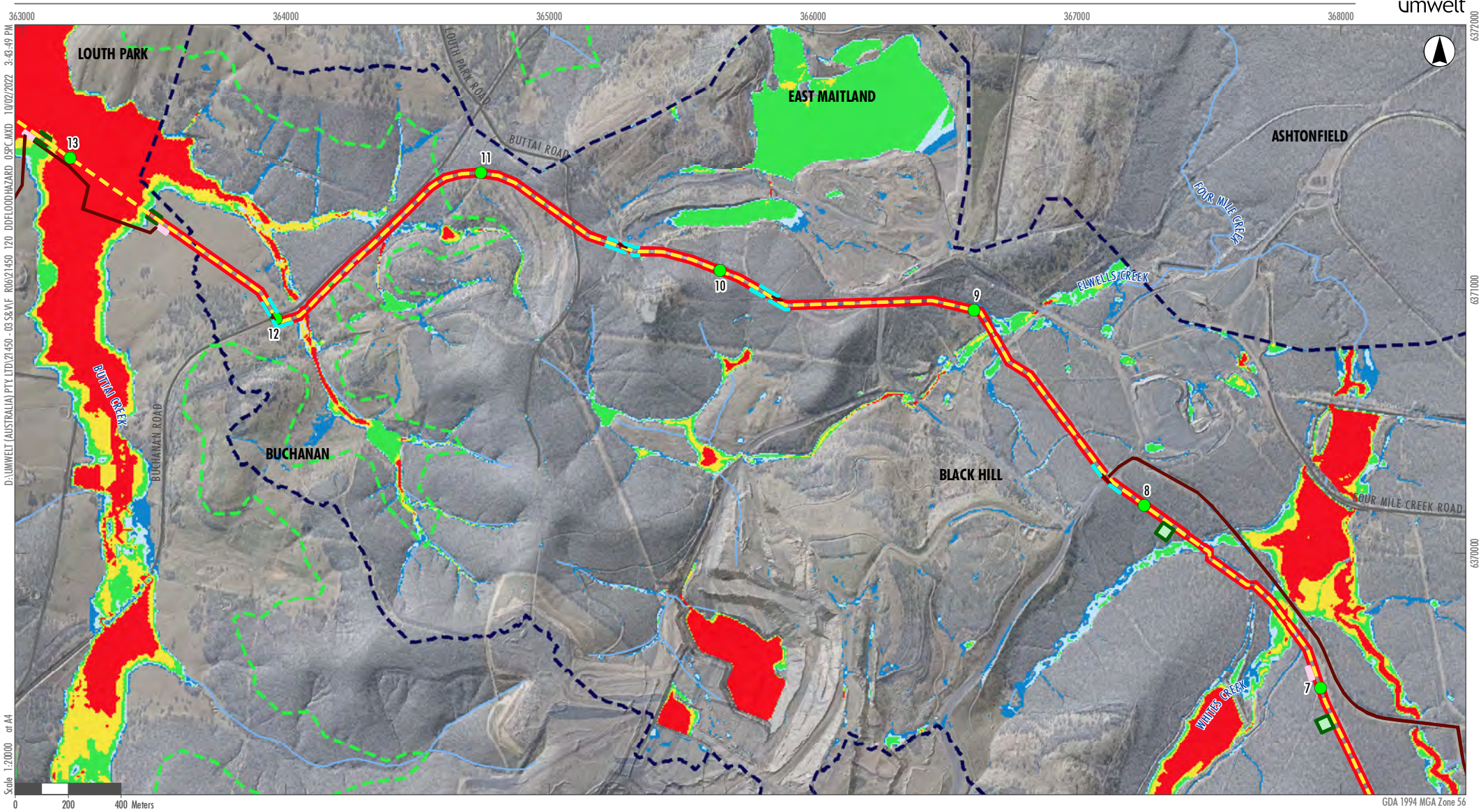
- H1
- H2
- H3
- H4
- H5
- H6



APPENDIX J-3B

0.5% AEP Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

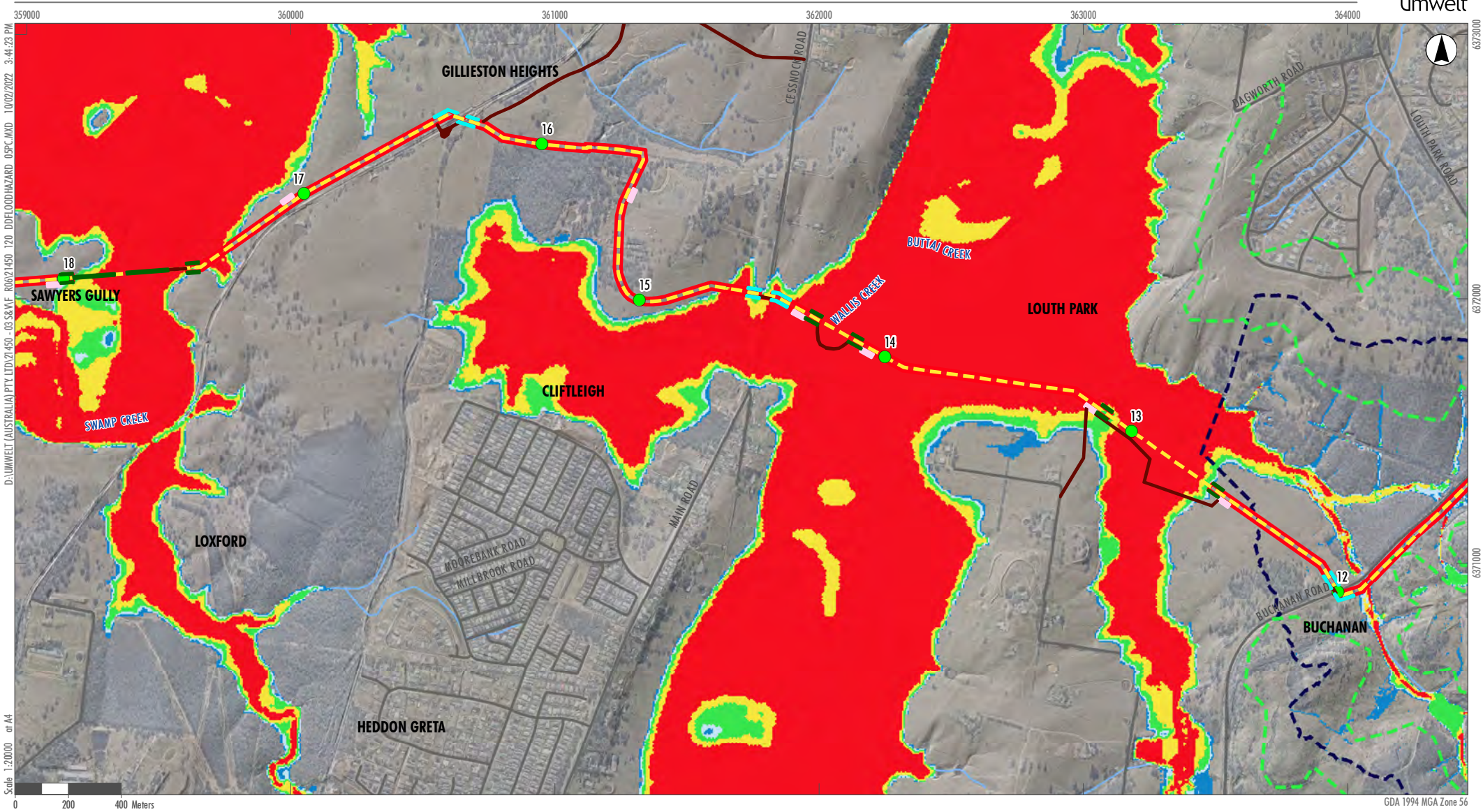
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX J-3C

0.5% AEP Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Access Tracks
- Roads
- Watercourses

Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

Scale 1:20000 at A4

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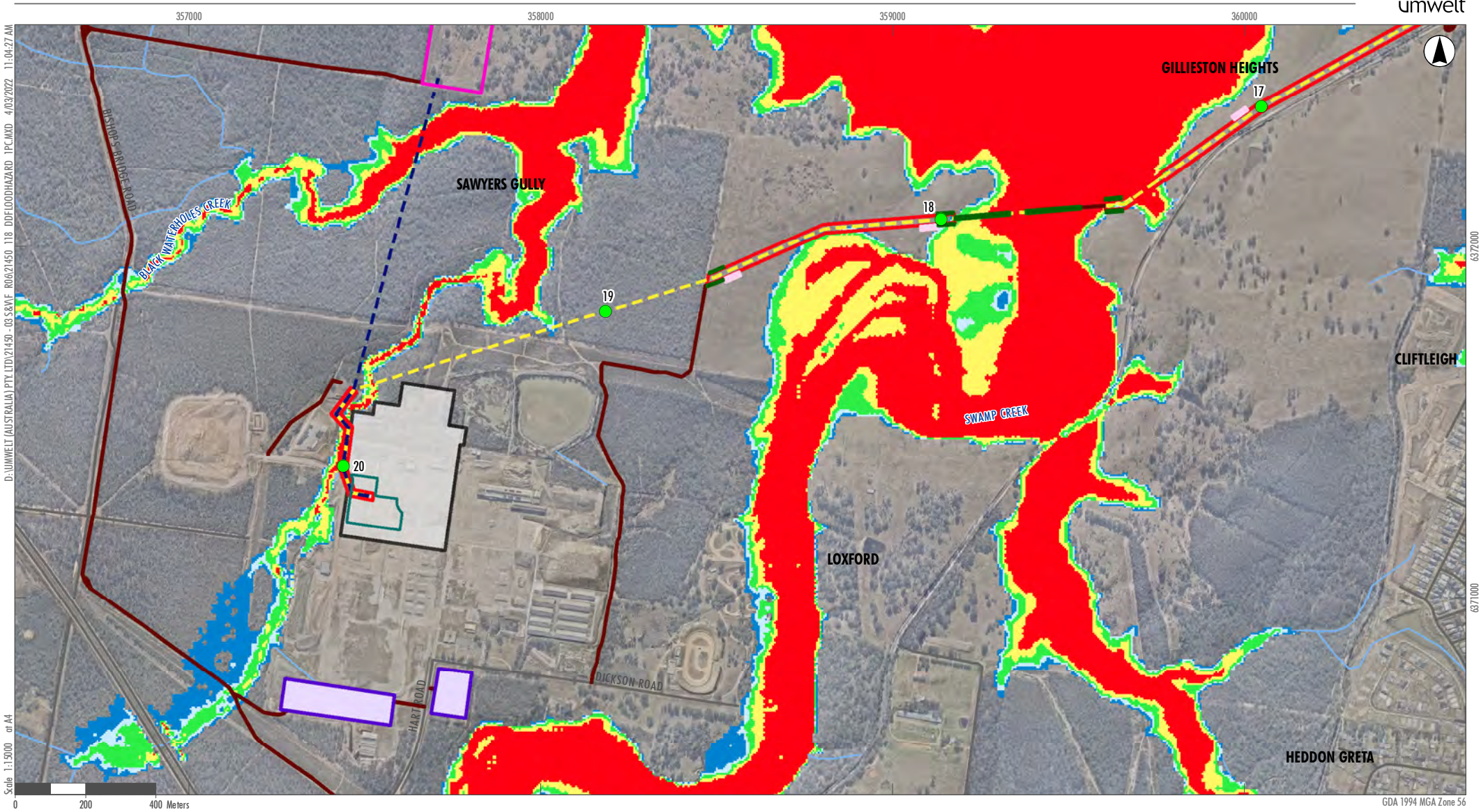
Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)

APPENDIX J-3D

0.5% AEP Flood Hazard for Existing Conditions



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Access Tracks
- Roads
- Watercourses

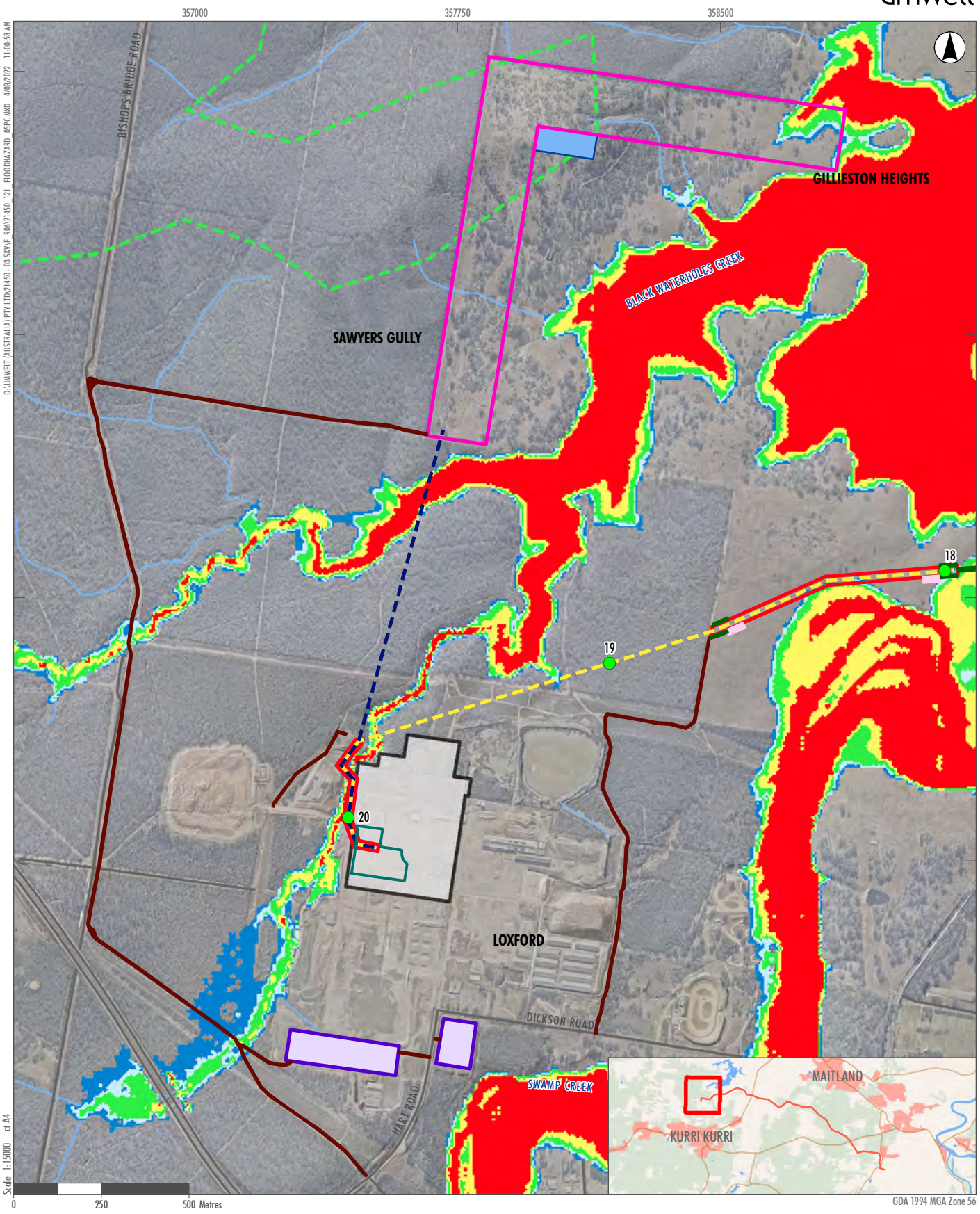
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX J-3E

0.5% AEP Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



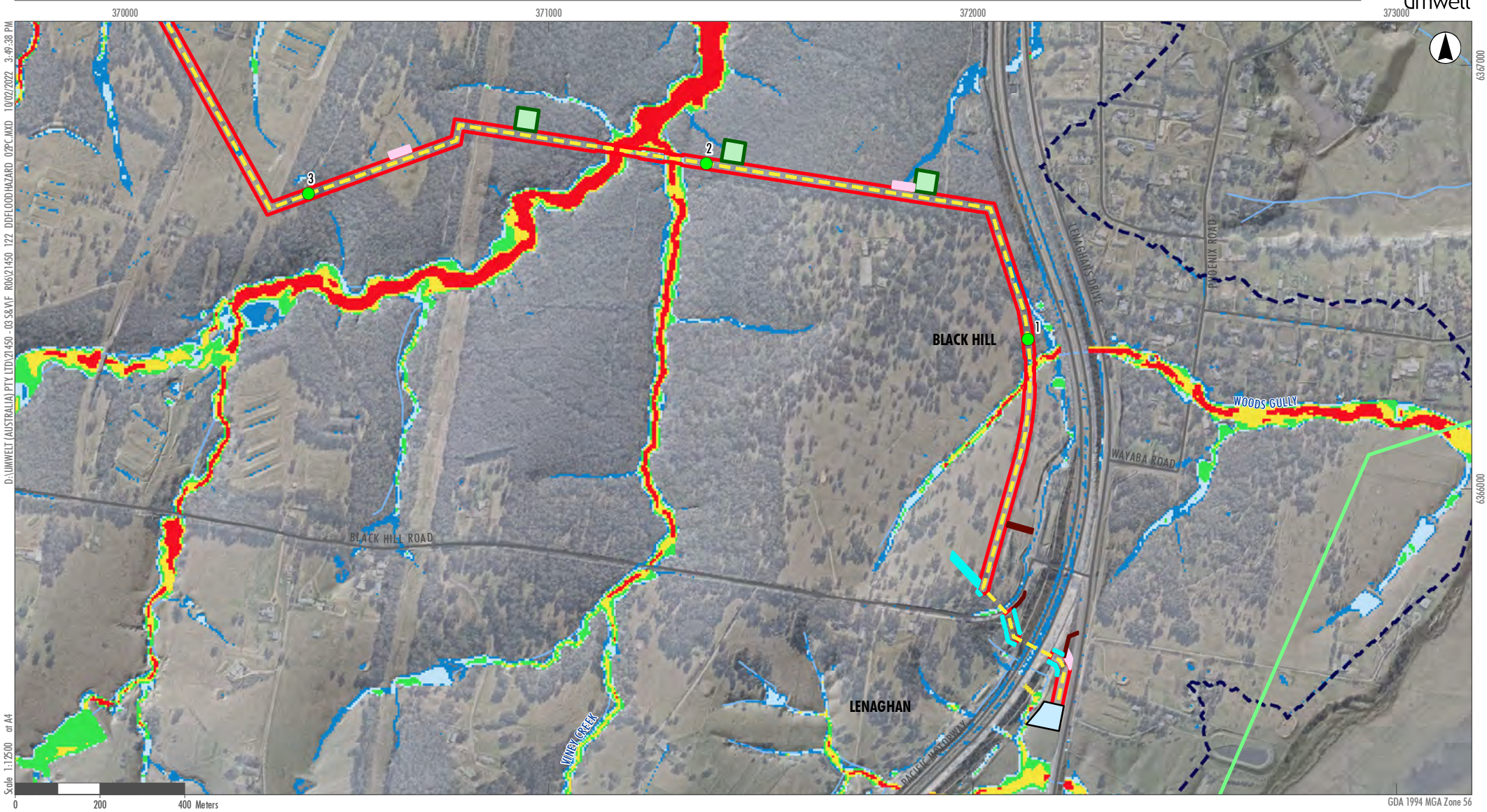
Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Turkey Nest Dam
- Access Tracks
- Roads
- Watercourses

APPENDIX J-3F

0.5% AEP Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



D:\UMWELT (AUSTRALIA) PTY LTD\21450 - 03 S&V\F R06\21450_122_DDFLOODHAZARD_02PC.MXD 10/02/2022 3:49:38 PM

Scale 1:12500 at A4

Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Sydney to Newcastle Pipeline (JGN Northern Trunk)
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- JGN Offtake Facility
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

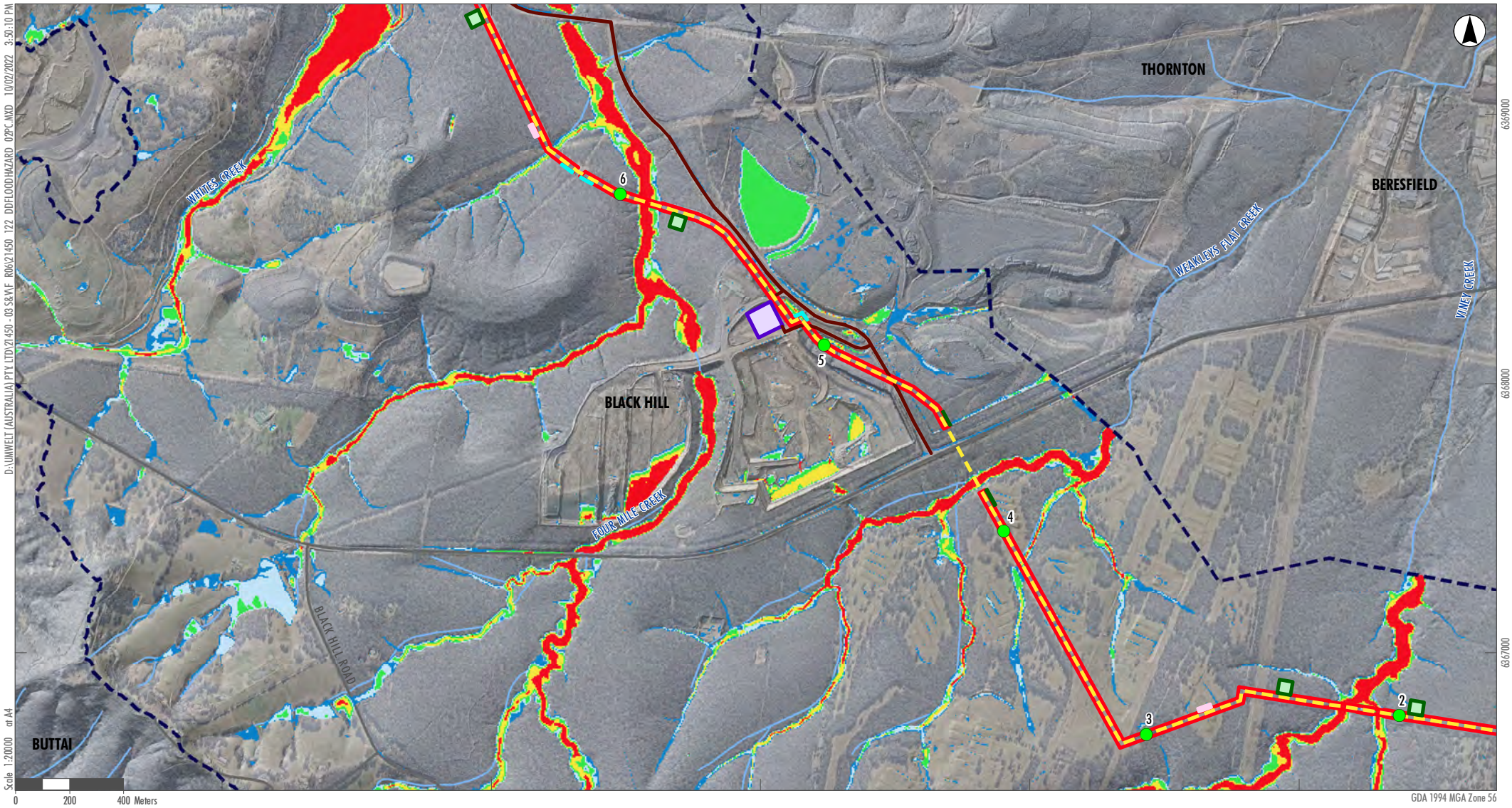
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX J-4A

0.2% AEP Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)

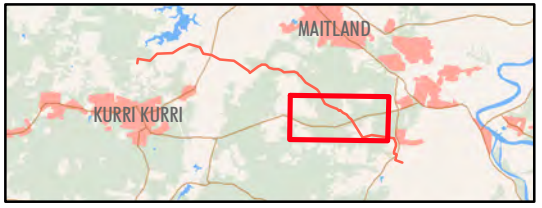


Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Pipe Laydown Areas
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

Hazard Category

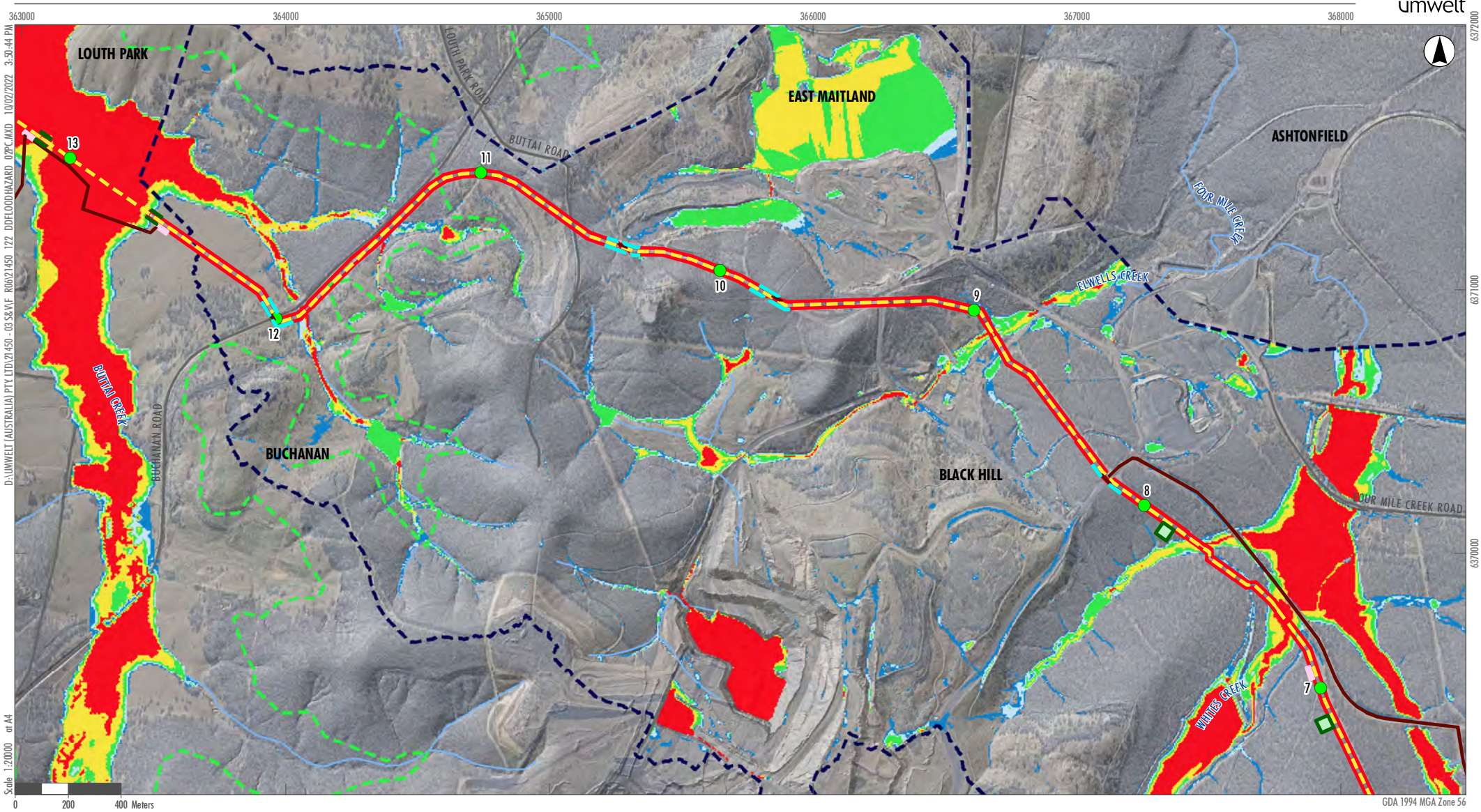
- H1
- H2
- H3
- H4
- H5
- H6



APPENDIX J-4B

0.2% AEP Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

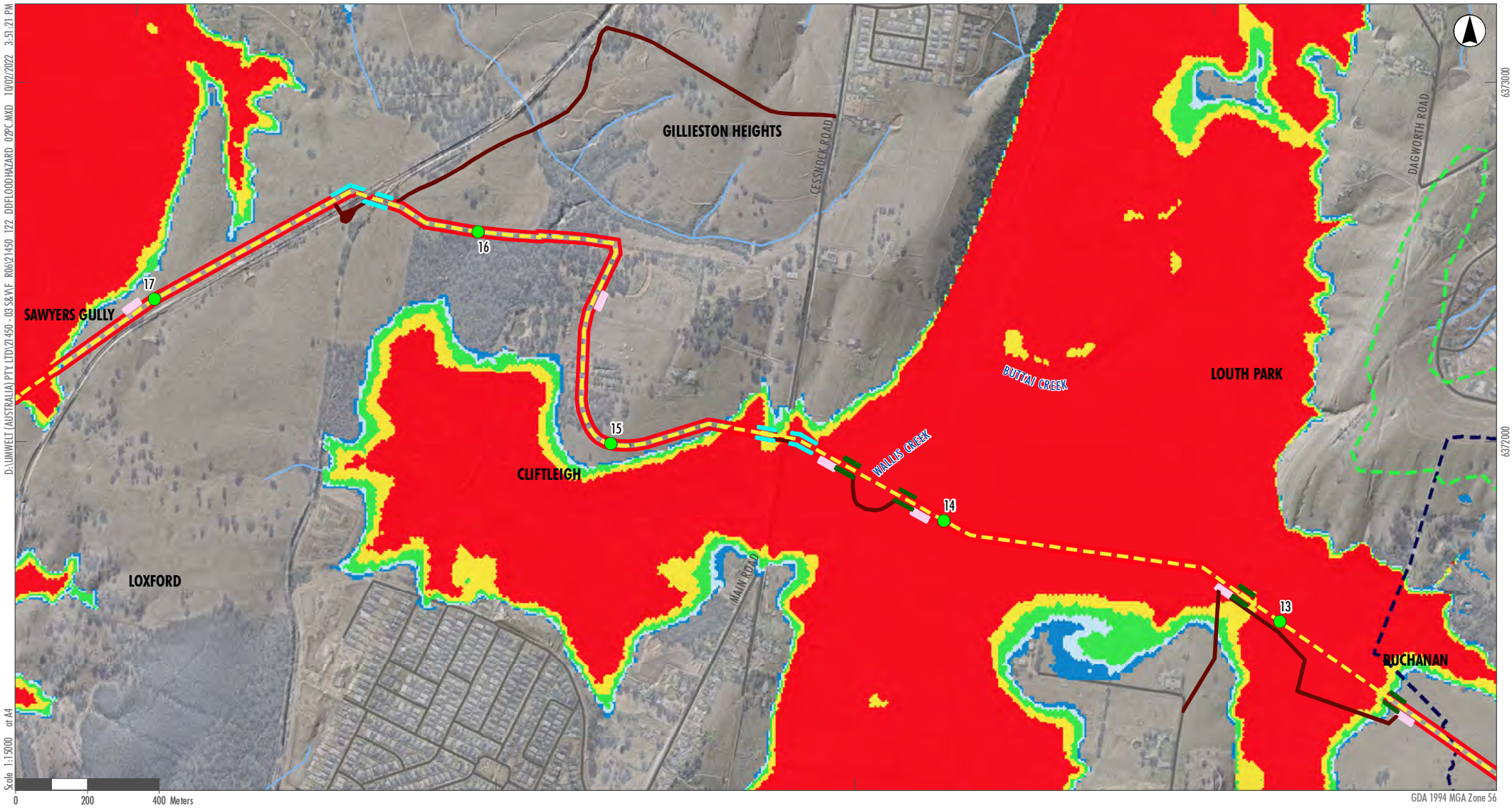
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX J-4C

0.2% AEP Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)



D:\UMWELT (AUSTRALIA) PTY LTD\21450 - 03 S&WF R06\21450_122_DDFLOODHAZARD_02PC.MXD 10/02/2022 3:51:21 PM

Scale 1:15000 at A4

GDA 1994 MGA Zone 56

Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Access Tracks
- Roads
- Watercourses

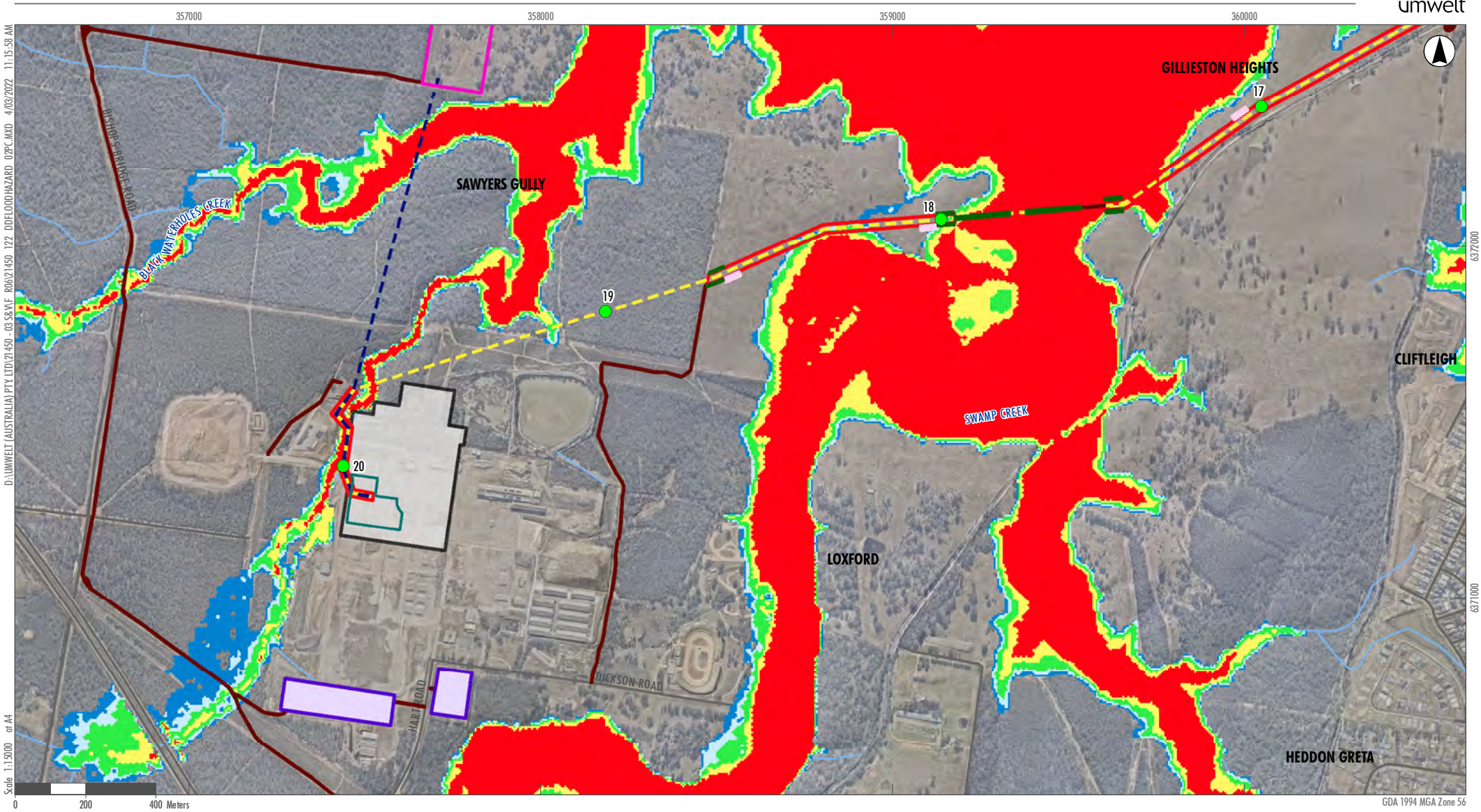
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX J-4D

0.2% AEP Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Access Tracks
- Roads
- Watercourses

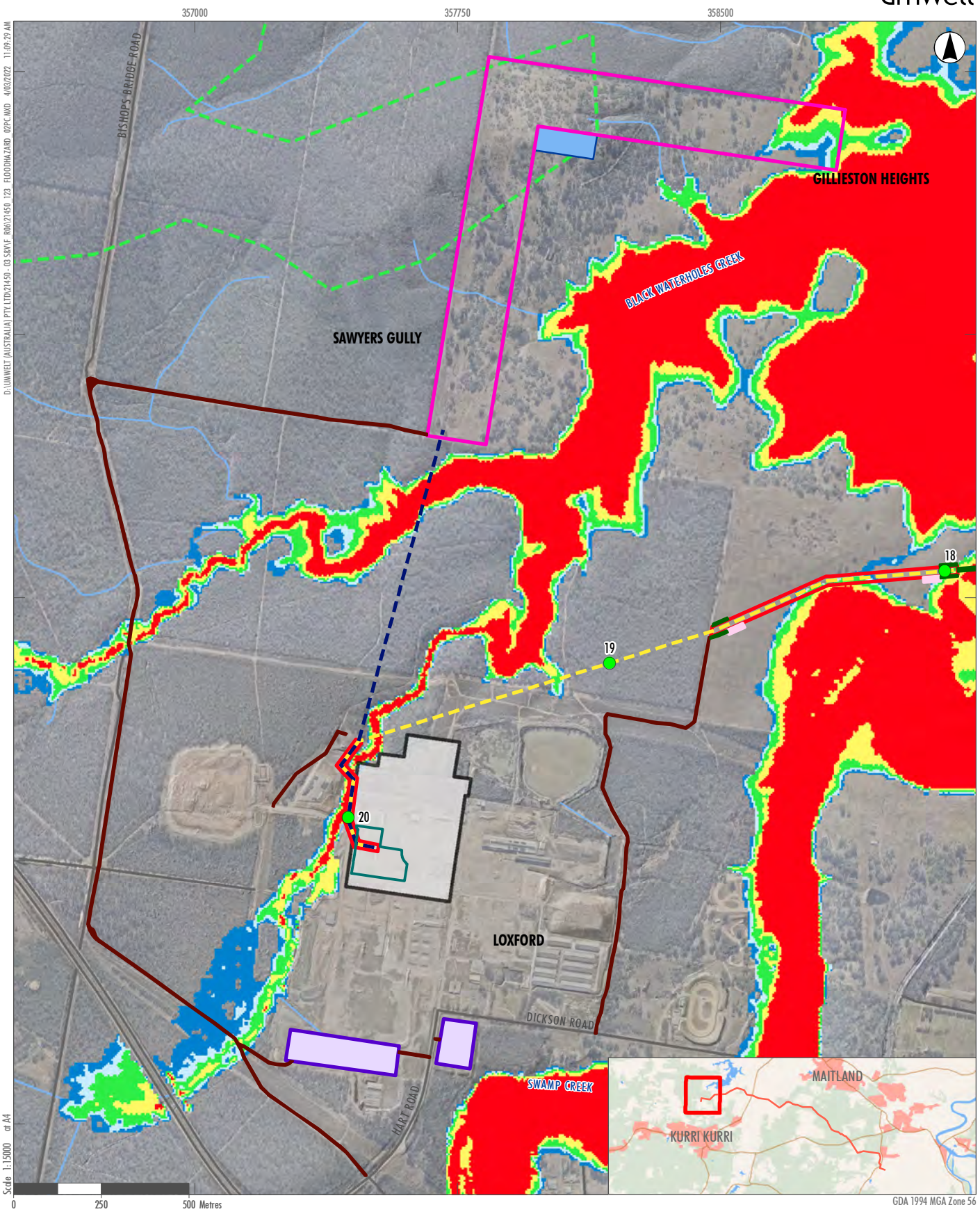
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX J-4E

0.2% AEP Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Turkey Nest Dam
- Access Tracks
- Roads
- Watercourses

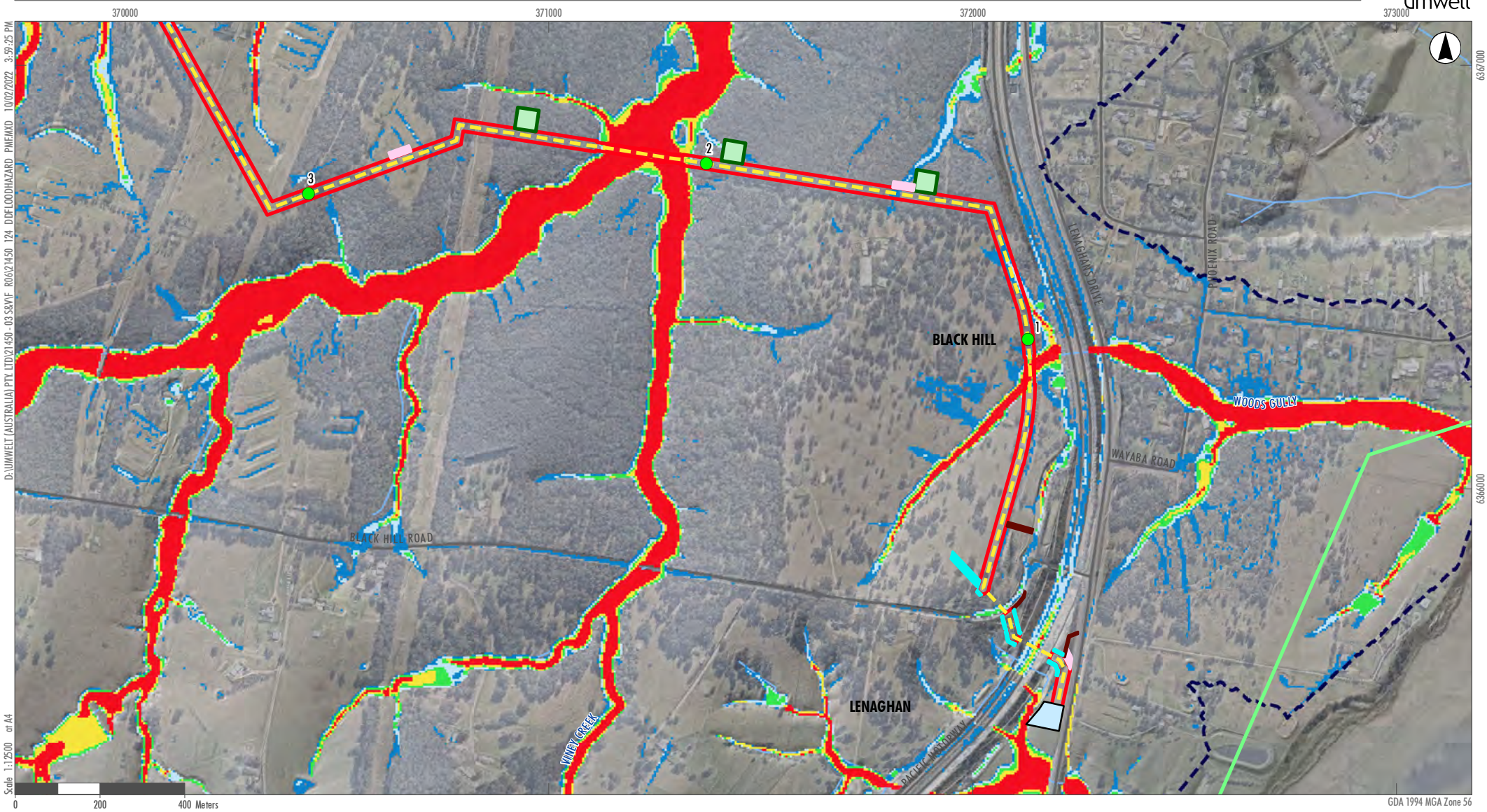
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX J-4F

0.2% AEP Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Sydney to Newcastle Pipeline (JGN Northern Trunk)
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- JGN Offtake Facility
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

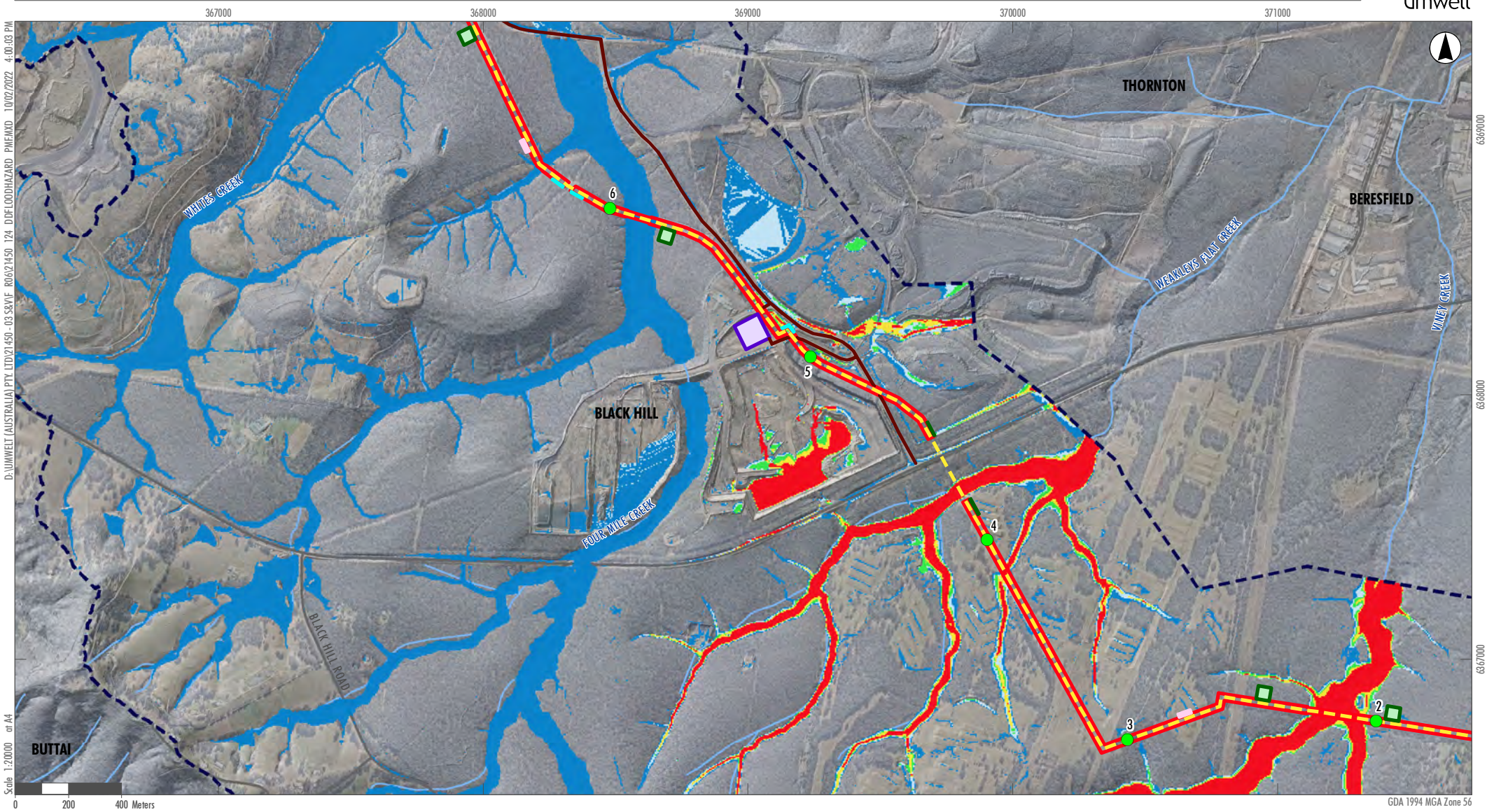
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX J-5A

PMF Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)



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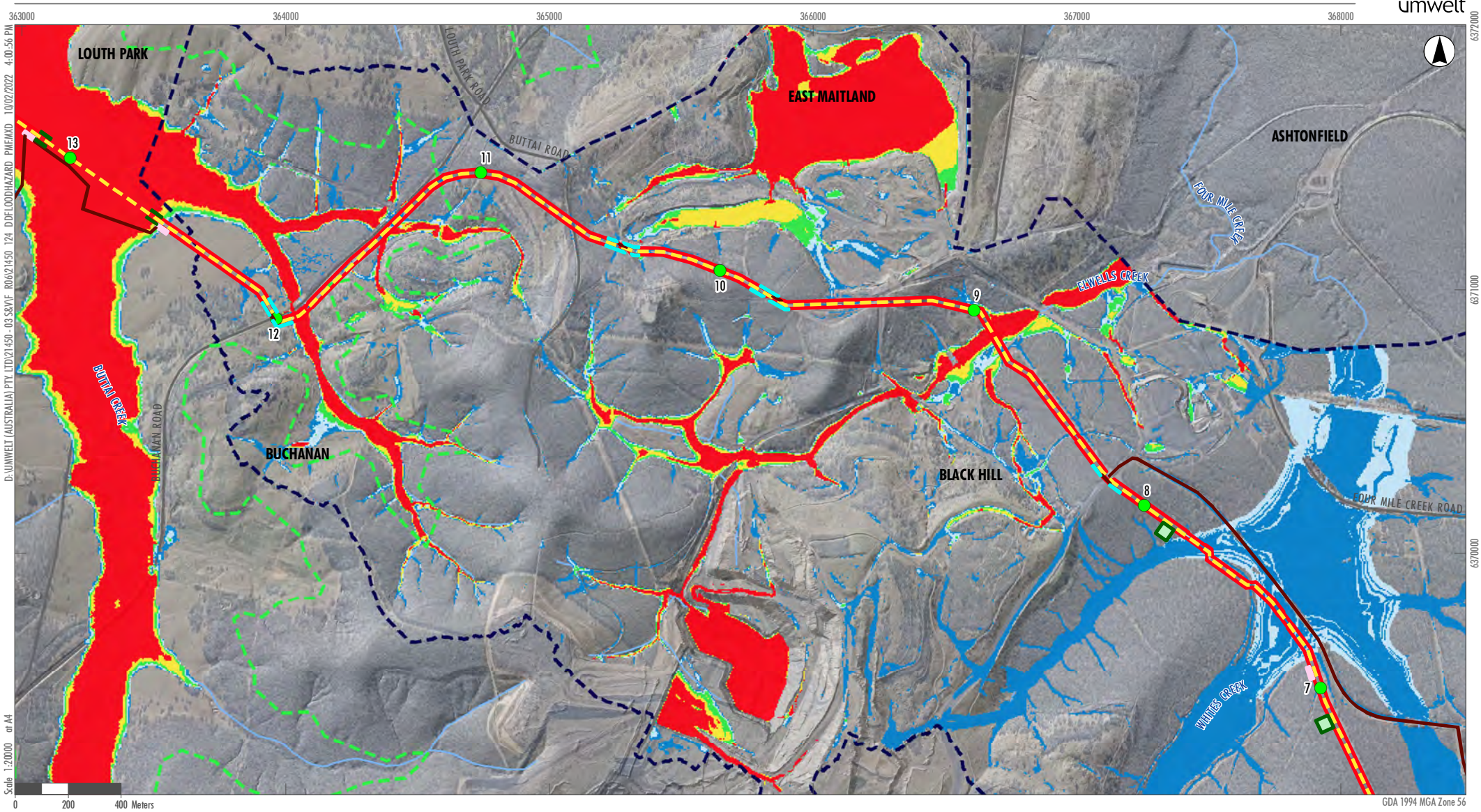
Scale 1:20000 at A4

APPENDIX J-5B

PMF Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Vegetation EWS
- Access Tracks
- Roads
- Watercourses

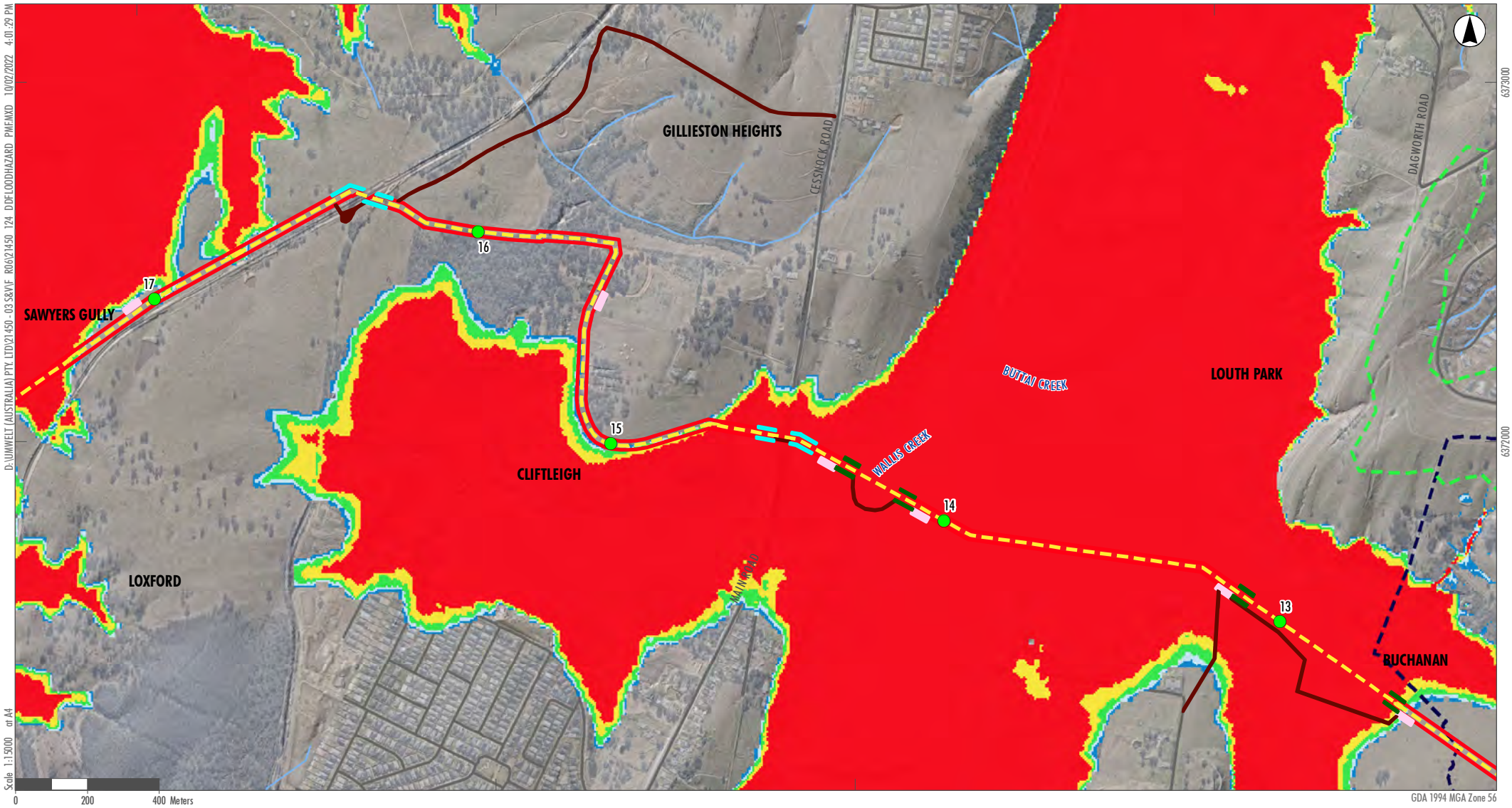
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX J-5C

PMF Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)



D:\UMWELT (AUSTRALIA) PTY LTD\21450 - 03 S&YF RG\21450_124_DDFLOODHAZARD_PME.MXD 10/02/2022 4:01:29 PM

Scale 1:15000 at A4

GDA 1994 MGA Zone 56

Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Kilometre Point
- HDD Workspace
- Horizontal Bore Workspace
- Umwelt Model Domain
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Truck Turnarounds
- Access Tracks
- Roads
- Watercourses

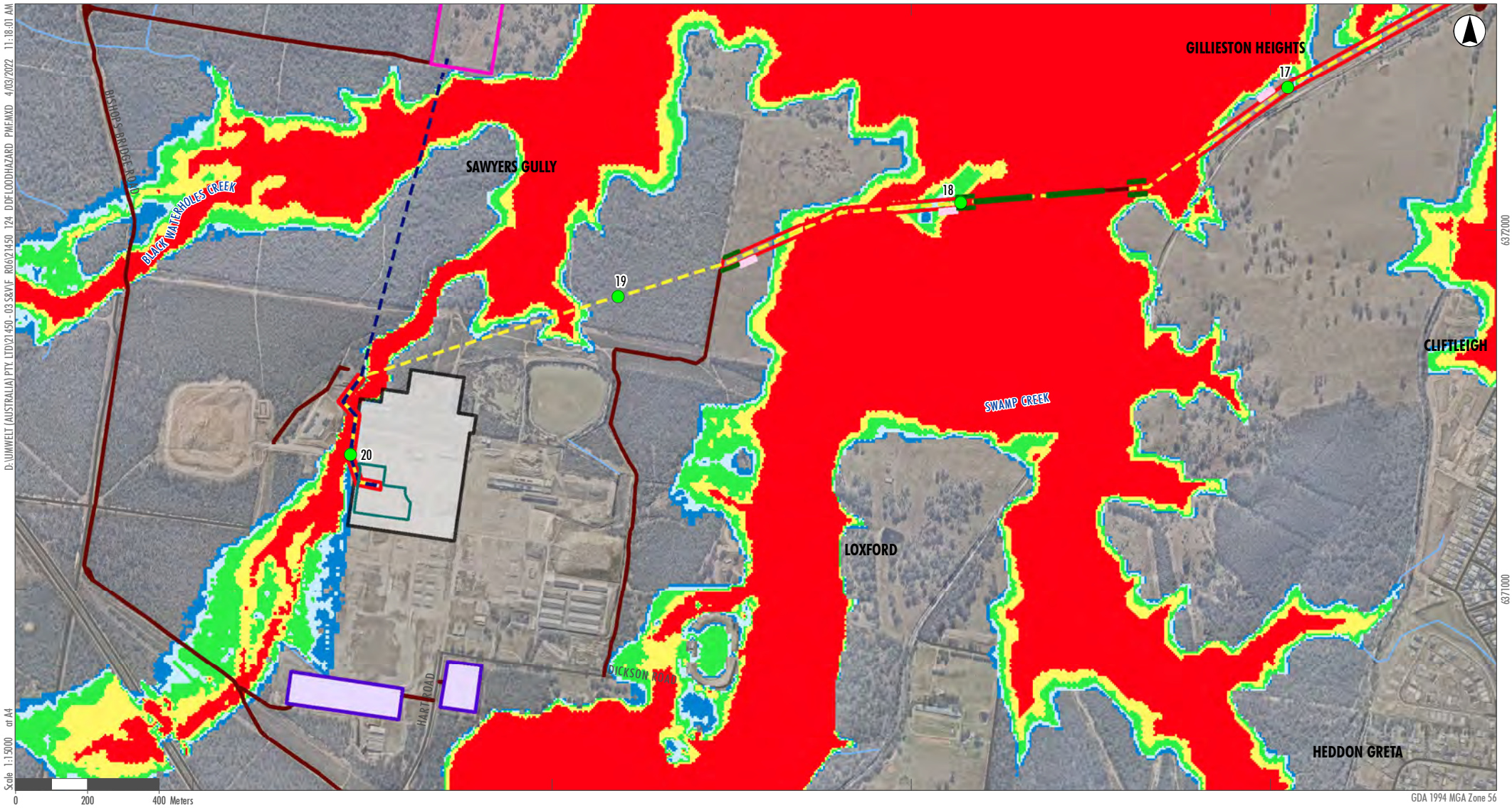
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX J-5D

PMF Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020; 2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Access Tracks
- Roads
- Watercourses

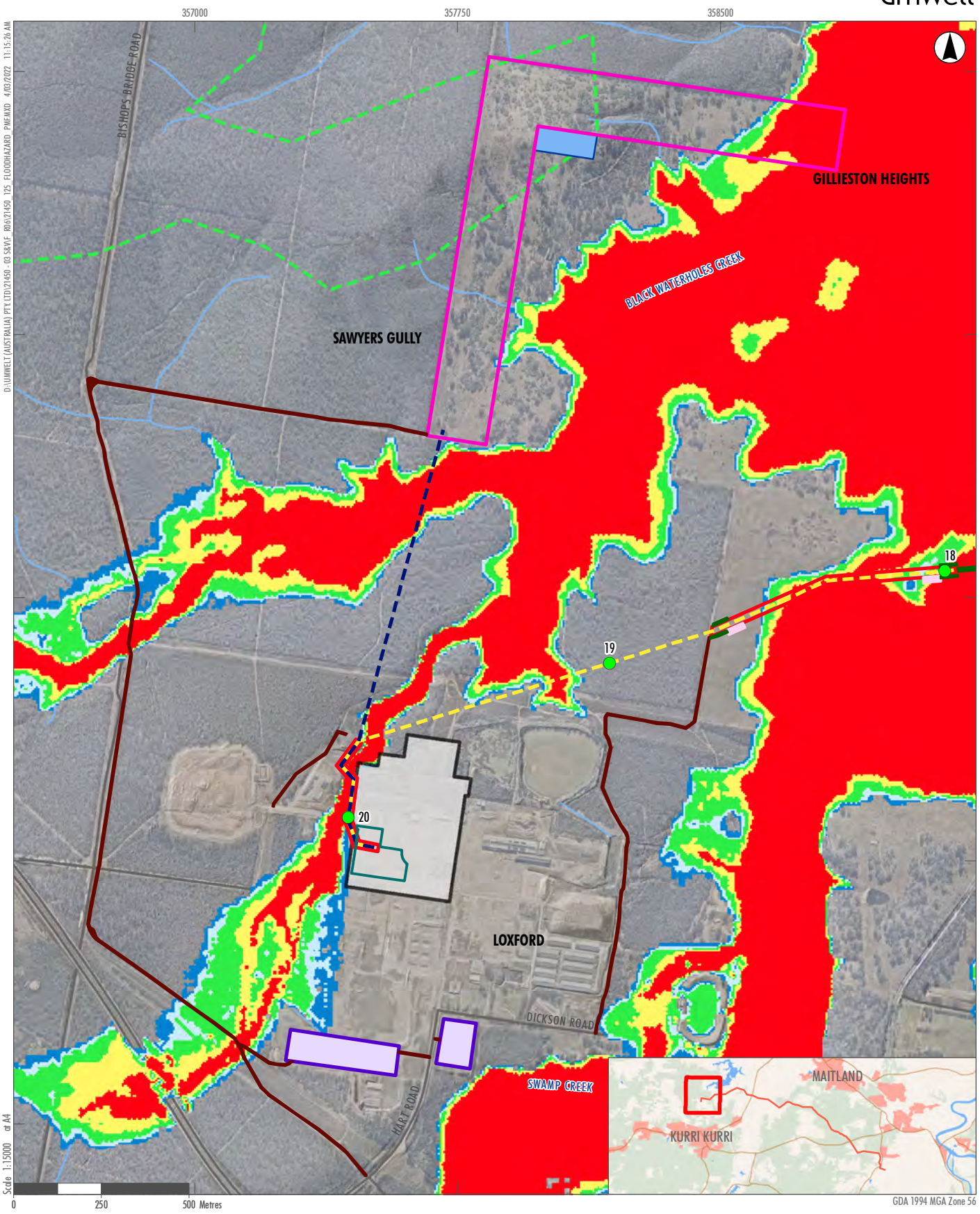
Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX J-5E

PMF Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)



Legend

- Transmission Pipeline Construction Footprint
- Transmission Pipeline Alignment
- Interconnect Pipeline
- Wallis and Swamp-Fishery Creek Flood Study Model Domain
- Kilometre Point
- HDD Workspace
- Compressor and Delivery Station
- HPP Proposal Site
- Pipe Laydown Areas
- Truck Turnarounds
- Storage Pipeline
- Turkey Nest Dam
- Access Tracks
- Roads
- Watercourses

Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

APPENDIX J-5F

PMF Flood Hazard for Existing Conditions

Image Source: Neamap (October 2021) Data source: NSW LPI (2020;2021)

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