



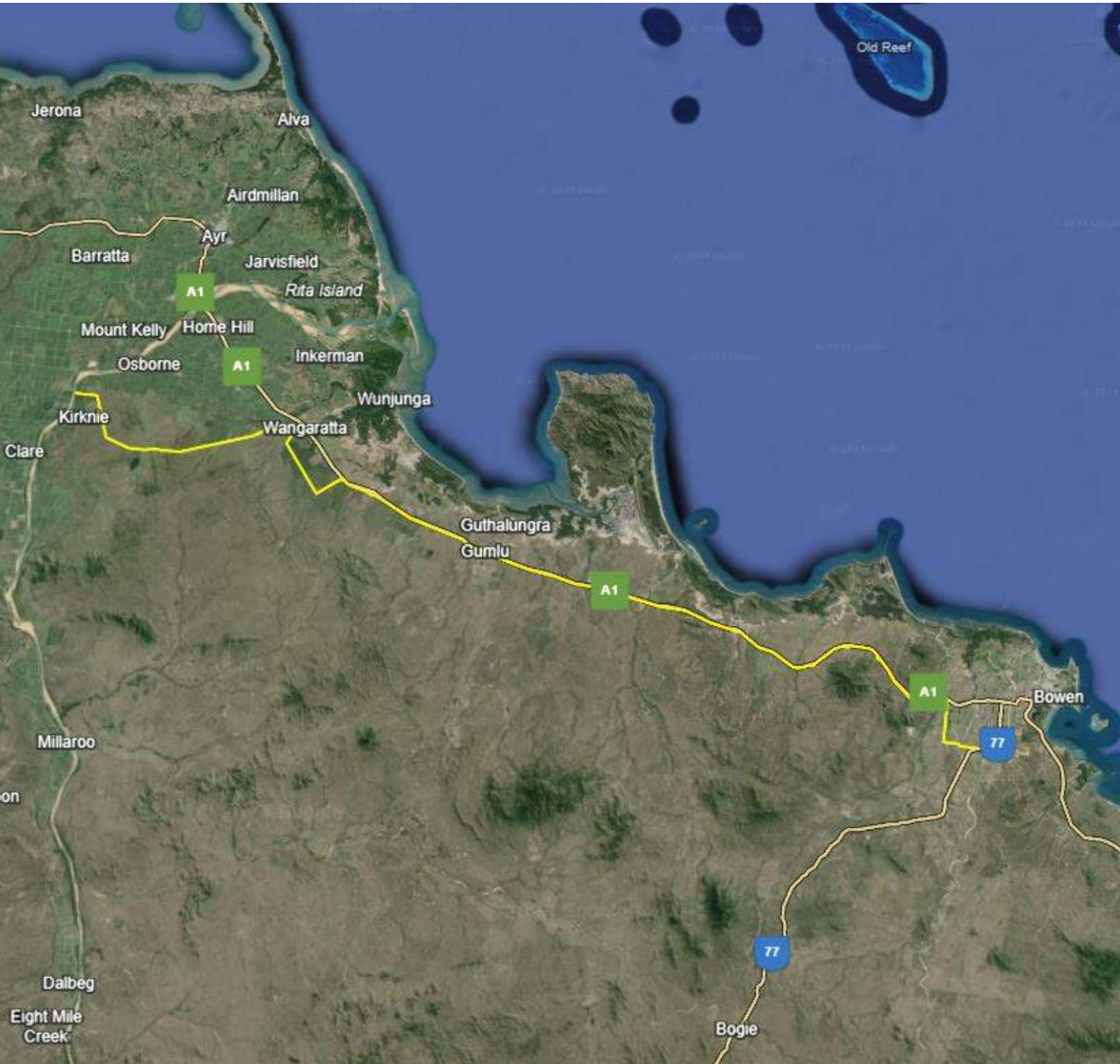
Appendix H

Flood immunity assessment



BOWEN PIPELINE PROJECT

BOWEN TO KIRKNIE FLOOD STUDY & IMMUNITY ASSESSMENT



CLIENT: BOWEN PIPELINE COMPANY

DOCUMENT NUMBER: R3280

VERSION: B

DATE: 15-03-2024

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1 INTRODUCTION

Topo were engaged by Bowen Pipeline Company to undertake a Flood Study and assess the flood immunity requirements for pump stations and infrastructure associated with the Bowen Pipeline Project. The Bowen Pipeline Project is a 116 km underground water pipeline commencing 16 km upstream from Home Hill (Burdekin River) moving south to Bowen.

1.1. GUIDELINES

This assessment has been prepared in accordance with:

- + Whitsunday Regional Council Planning Scheme (2023),
- + The Queensland Urban Drainage Manual (IPWEAQ, 2017), and
- + Australian Rainfall and Runoff (Geoscience Australia, 2019).

1.1.1. FLOOD IMMUNITY REQUIREMENTS

Reference is made to the Whitsunday Regional Council Planning Scheme – Schedule 6 – October 2023 (V4.7) and the Whitsunday Regional Council Planning Scheme – Part 8 – October 2023 (V4.7). Based on Section SC6.5.4.2, the Defined Flood Event (DFE) is the year 2100 1 % AEP critical duration event. In addition, *Table 8.2.9.3.3 Flood immunity for community infrastructure and services* identifies the 1 % AEP flood event is assumed to be the required level of immunity for this type of infrastructure.

SC6.5.4.2 Preparing a Flood hazard assessment report

(1) The Flood hazard assessment report is to include the following key elements:

- (a) assessment of the flood risk and implications up to and in excess of the defined flood event at the year 2100; the flood risk does not stop at the defined flood event so the suitability of a land use must consider the implications of larger floods, particularly in regard to the risk to people. The following should be identified:
- (i) the potential impacts of flood hazard on the development;
 - (ii) the potential impacts of the development on flood hazard;
 - (iii) the location and height of buildings, particularly habitable floor areas;
 - (iv) the location and design of plant and equipment, including electrical fittings; and
 - (v) impact of increases in rainfall intensity at 2100 in regard to safety and property damage;
 - (vi) in the case of overland flow flooding a severe storm impact assessment being provided in accordance with Queensland Urban Drainage Manual;
 - (vii) as relevant, include accurate hydrological and hydraulic modelling for the waterway network and assessment of existing flooding and flood levels of major water systems, including modelling of the 50%, 10%, 1%, 0.5% and 0.2% AEP flood events and the Probable Maximum Flood (PMF);
 - (viii) address the potential impacts of climate change, including the projected sea level rise of 0.8m; and
 - (ix) **the 1% AEP flood event at the year 2100 to inform the DFE;**

Development	Level of immunity Annual exceedance probability (AEP)
Development involving: (a) emergency/evacuation shelters; (b) the storage of valuable records or items of historic/cultural significance (e.g. libraries, galleries); (c) telecommunication facilities; (d) substations; (e) water treatment plants; (f) regional fuel storage; and (g) food storage warehouses.	0.5% AEP flood event
Development involving: (a) Sewerage treatment plants (requiring licensing as an environmentally relevant activity); (b) cemetery and crematorium (c) waste management facilities (d) sporting facility, community centre, meeting hall (where not used as an evacuation or recovery facility) (e) storage and works depots and similar facilities, including administrative facilities associated with the provision or maintenance of the community infrastructure mentioned in this part	1% AEP flood event

1.2. REVISION

VERSION	DATE	AUTHOR	REVIEWED	APPROVED
A	12/03/2024	BS	SC	SC
B	13/03/2024	BS	SC	SC

2 PROJECT OVERVIEW

The pipeline will generally run adjacent to the Bruce Highway, mainly on private land and unformed road reserves. The Project will utilise world class Australian technology for the onsite extrusion of the High-Density Polyethylene (HDPE) pipe in 100+ metre lengths. The project will allow the creation of a reliable, secure water supply to an area that produces one-fifth of Australia's vegetables and is Australia's largest winter vegetable growing area.

Figure 1 presents the project alignment and location of key infrastructure.



Figure 1 – Concept Alignment Layout Plan (Extract from Drawing No. 8704 E BP001 Sheet 00 Rev I)

2.1. KEY INFRASTRUCTURE LOCATIONS

This flood assessment is focussed on five (5) key infrastructure areas, these being:

1. Kirknie Intake,
2. Inkerman Pump Station,
3. Guthalunga Pump Station & Tank,
4. Salisbury Plains Pump Station & Tank, and
5. Delta Pump Station & Tank.

2.2. CLIMATE DATA

The Bowen Airport gauging station (Station 033257) provides 27 years of climate data, reporting an annual average rainfall depth of 895 mm (for years between 1987 and 2015). Based on the historic climate data, the region is subject to a distinct wet season between January and February, with 60 % of annual rainfall typically occurring in this 3 month period. Rainfall is reduced through the remainder of the year, with significantly lower monthly averages observed from June to October. The maximum Mean Monthly Rainfall was 221 mm in February, while the lowest Mean Monthly Rainfall is typically observed in September, with only 1.2 % of the annual average rainfall occurring.

The maximum Mean Maximum Temperature is 31.5 °C historically occurs in January while the lowest Mean Minimum Temperature is 13.4 °C, historically occurring in July. Further details are provided in Table 1 and plotted as Figure 2 and Figure 3.

Table 1 – Historical Climate Statistics

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Mean rainfall (mm)	179	221.1	118.5	62.2	41.1	23.3	19.6	23	10.6	12.1	52	141.4
Median rainfall (mm)	127.1	159.8	60.4	19.8	18.7	14.6	3.7	4.4	2.3	3.9	22	89.2
Mean maximum temperature (°C)	31.5	31.3	30.8	29.3	27.1	24.9	24.5	25.4	27.4	29.2	30.4	31.3
Mean minimum temperature (°C)	23.8	23.8	22.8	20.8	17.8	15	13.4	14.2	16.5	19.8	22.2	23.4

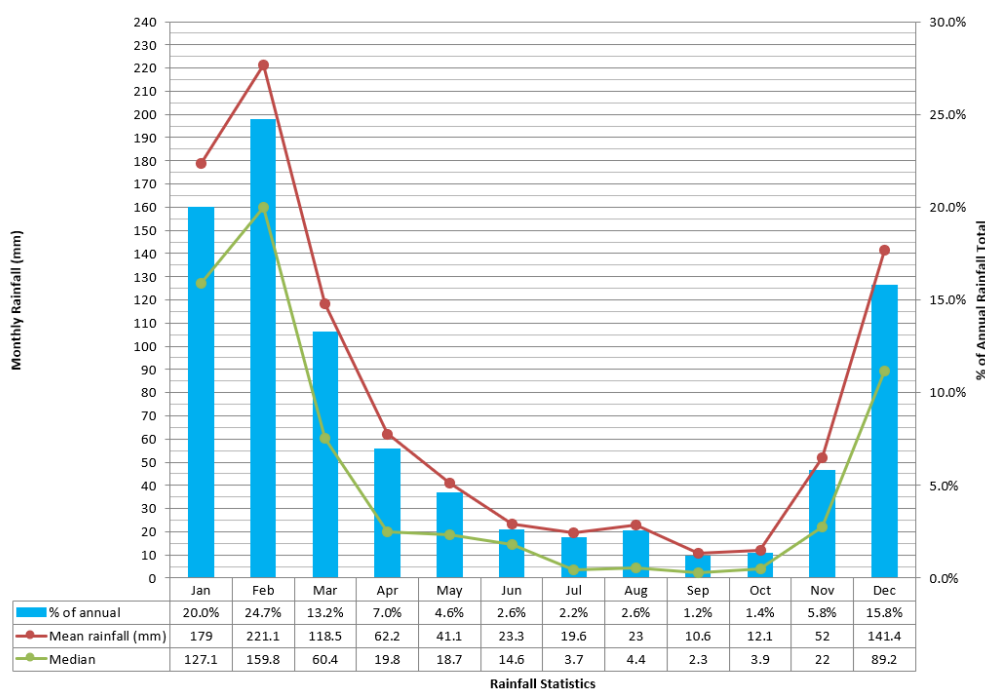


Figure 2 – Historic rainfall data for Bowen Airport – Station 033257 (Source: BoM)

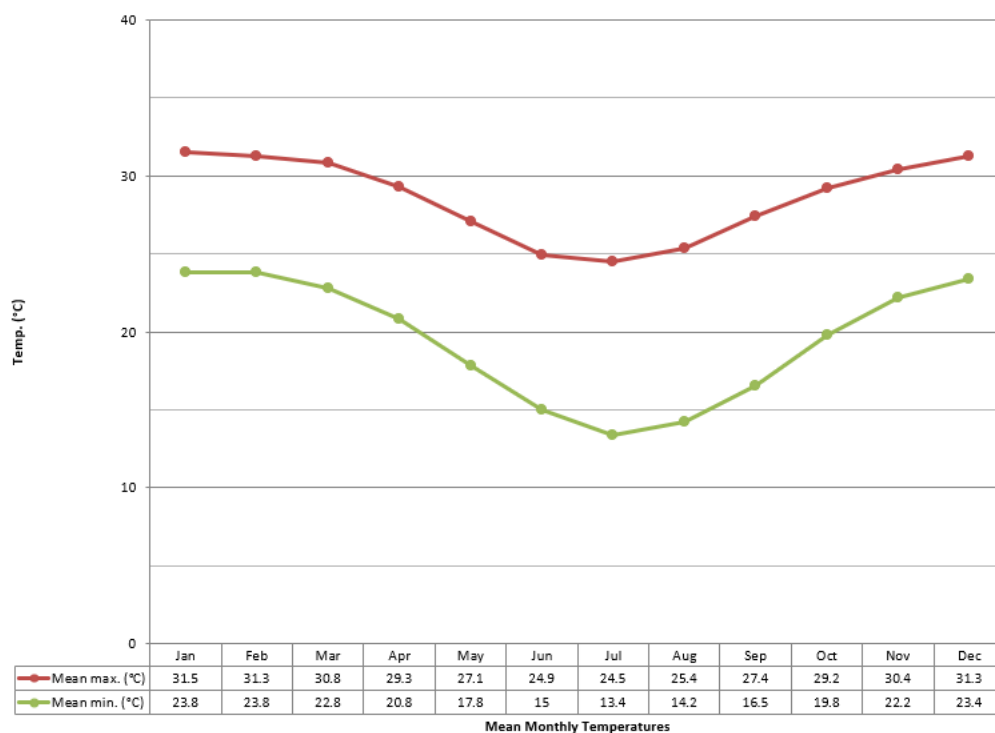


Figure 3 – Historic temperature data for Bowen Airport – Station 033257 (Source: BoM)

3 DEFINED FLOOD LEVELS

The peak water level associated with the 1 % Annual Exceedance Probability (AEP) event is classified as the Defined Flood Level (DFL). Flood searches were undertaken for the key infrastructure locations, with the DFL found to be available from both Whitsunday Regional Council (WRC) and the Burdekin Shire Council (BSC) Interactive mapping/Flood Mapping websites and purchased flood searches. The DFL was freely available from WRC for the Delta and the Guthalungra Pump Station & Tank. An additional a flood search was purchased from BSC for the Kirknie Intake. Details of the flood searches and assumptions made in relation to determining the DFL for each location are presented in Section 3.1 to 3.3.

For the remaining infrastructure locations (i.e. the Inkerman Pump Station and Salisbury Plains Pump Station & Tank) flood search data was not available and flood modelling was undertaken to assess the DFL for these locations. Refer to Section 4 for details in relation to the hydrologic and hydraulic modelling undertaken at each of these locations.

3.1. DELTA PUMP STATION & TANK

The Delta pump station and tank is to be constructed at 700 Bowen Developmental Road (Lot 94 on HR1038). Flood mapping for this property, reproduced as Figure 4, indicates the full site is subject to inundation during the 1 % AEP event. The flood search from the WRC mapping service identifies the DFL, or 1 % AEP peak water level 25.0 m AHD. This presents the maximum flood level on the site.

Review of the property extents and topography reveals the maximum elevation of Lot 94 is located on the southern boundary near the minor watercourse, with the remainder of the lot falling in a north-north-westerly direction. Figure 5 illustrates the location of the maximum elevation of 24.91 m AHD, along with 0.25 m contours generated from LIDAR data across the site. At the location of the proposed Delta Pump Station and Tank, the ground level is approximately 20.7 m AHD.

However, given the DFL of 25.0 m AHD for the lot is provided as the maximum water level, it is concluded this occurs at the point of maximum elevation, in this case representing a flood depth of approximately 0.1 m. The flooding is assumed to be associated with overtopping of the banks of the minor waterway south of the site. To gain a greater understanding of the flow regime, flood searches were undertaken for the adjacent properties. The details of these flood searches are provided in Appendix A, as well as being summarised in below:

+ Lot 2 on RP714956	26.50 m AHD
+ Lot 1 on RP714956	25.75 m AHD
+ Lot 24 on K12437	25.50 m AHD
+ Lot 94 on HR1038	25.00 m AHD
+ Lot 159 on HR1290	22.50 m AHD
+ Lot 150 on HR1222	21.25 m AHD
+ Lot 31 on SP22001	19.25 m AHD
+ Lot 2 on RR739183	17.25 m AHD
+ Lot 3 on RR742540	17.75 m AHD

Using GIS, these DFLs were mapped to create the water surface profile across the site and adjacent properties. The results of this mapping are presented as Figure 6, along with the longitudinal profile of the site and the re-created water surface. Based on this assessment, the DFL at the location of the proposed Delta Pump Station and Tank is 21.9 m AHD.

The ground level at this location is approximately 20.7 m AHD. Therefore, for the 1 % AEP event, flood depths of approximately 1.2 m could be expected through the site of the proposed infrastructure and will need to be factored into the design and floor levels for control rooms etc.



Figure 4 – WRC Flood Mapping Extract



Figure 5 – Lot 94 HR1038 Maximum Elevation

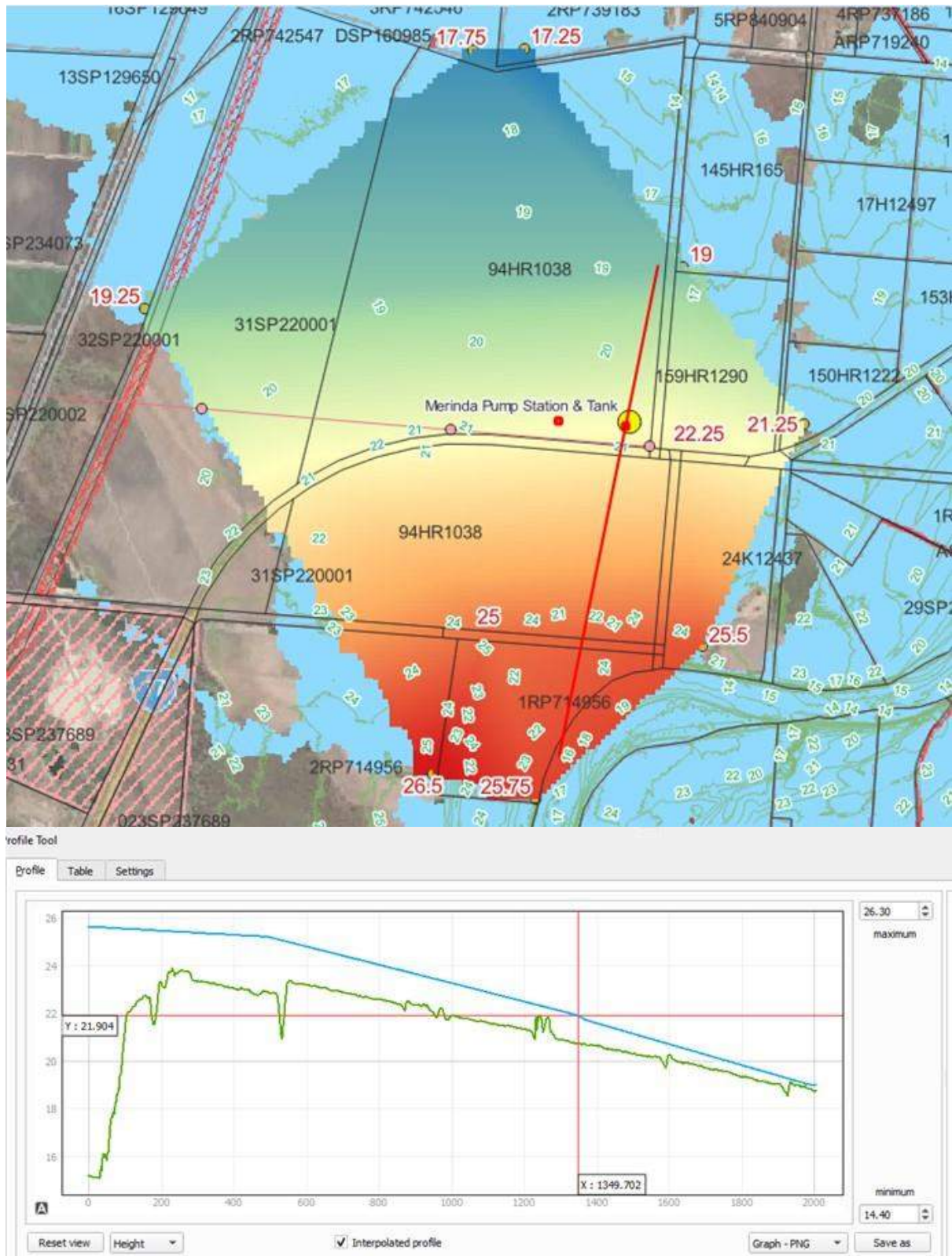


Figure 6 – Lot 94 Inundation Mapping & Longitudinal Profile

3.2. GUTHALUNGRA PUMP STATION & TANK

The flood search from WRC mapping service identifies the DFL, or 1 % AEP peak water level for Lot 38 on SB445 (the closest flood affected property) as being 14.25 m AHD. Figure 7 presents an extract of the flood search.

Review of topographic data along the eastern boundary of Lot 38 indicates levels range from approximately 15 m AHD in the south to approximately 8.5 m AHD in the north. The pump station and associated infrastructure at Guthalungra are proposed at elevation of approximately 13.1 m AHD on Lot 28 SB505, west of Nevada Road. While this is lower than the reported DFL for Lot 38, review of LIDAR data reveals a gully between Nevada Road and the Elliot River. In the event of flooding associated with storms greater than the 1 % AEP event that overtop the banks of the Elliot River, this gully will convey these over-bank flows in a northerly direction towards the Nevada Road/Bruce Highway intersection and Bruce Highway culvert crossing. It is therefore concluded there is no risk for the proposed Guthalungra infrastructure from flood waters associated with the Elliot River, up to the Defined Flood Event.

An extract from the WRC flood mapping (Planning Scheme Interactive Mapping) has been provided as Figure 8 to illustrate the separation of the Elliot River flood waters and the proposed infrastructure at Guthalungra (Lot 28 SB505).

Review of LIDAR data for Lot 28 in the vicinity of the proposed pump station indicates it is in a catchment of approximately 170 ha that directs runoff to culverts under the railway line and Bruce Highway. The invert level of the railway line culvert is approximately 10.9 m AHD, and the ground level of the western boundary of the existing residential lots is approximately 13.1 to 13.4 m AHD. Figure 9 provides further details in relation to these levels and the catchment. Given the ground level of the proposed pump station (18.5 m AHD) provides approximately 5 m freeboard to the residential lots, it is concluded the works provide at least 5 m freeboard to the 1 % AEP event and are therefore suitably located.

Property Information

Lot Plan(s): 38SB445

Address:

Lot size: 40.671ha

Zoning: Rural

Flood and or Coastal hazard information

Local Studies (Flood Levels available 1% AEP)

Risk rating(s): Identified Flood Hazard Area

Max Flood Height: 14.25m (AHD)

Max flood velocity: No Council flood study identifying velocity for this premises. Further assessment by Registered Professional Engineer Queensland (RPEQ) may be required.

Min habitable floor level: 14.55m (AHD)

Source: Elliot River Flood Model

Molongle Creek Catchment Flood Study
2006 (updated 2013)



Legend

 Selected Property

 DNRME Restrictions and Covenants

 Easement

 Flood Studies

Flood Hazard

 Low Risk Flood Hazard Area

 Medium Risk Flood Hazard Area

 High Risk Flood Hazard Area

 Identified Flood Hazard Area

Coastal Hazard - Storm Tide

 Inundation Area

 Wave-Run Up Area

Figure 7 – Flood Search Extract for Guthalungra Pump Station & Tank

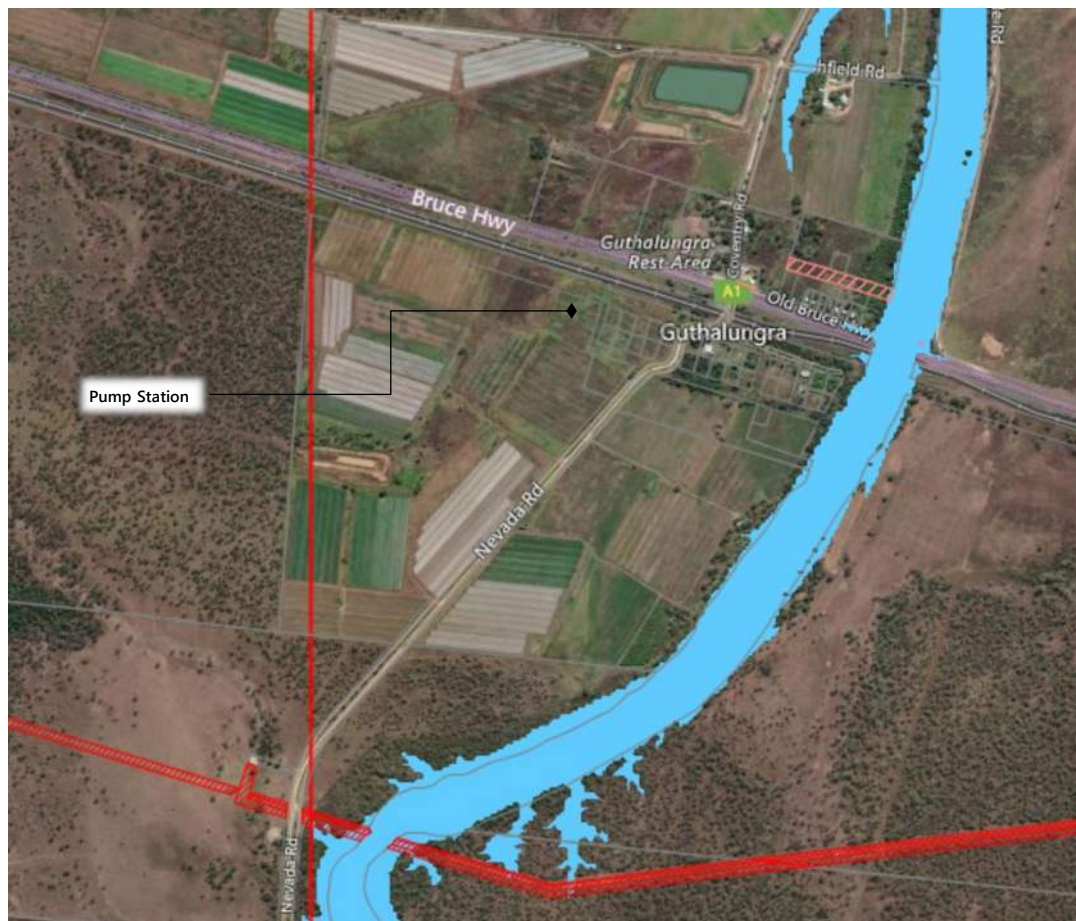


Figure 8 – Whitsunday Regional Council Interactive Mapping – Guthalungra

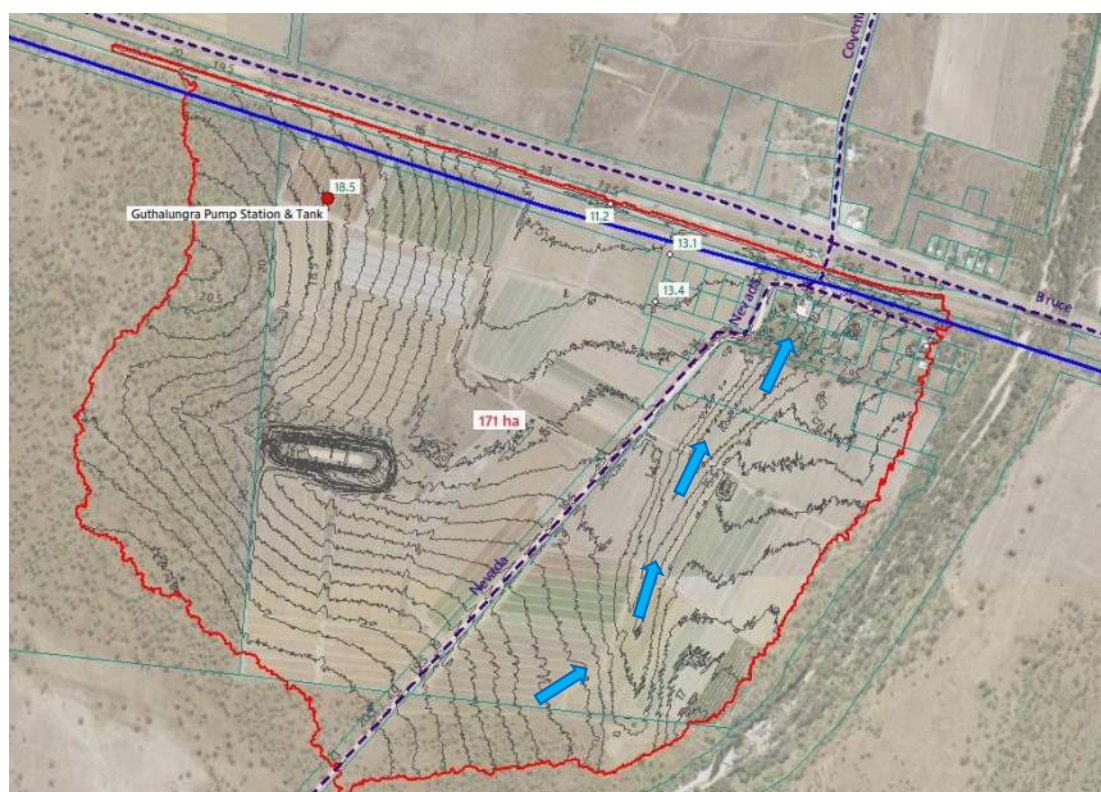


Figure 9 – Guthalungra Site Levels & Catchment Analysis -

3.3. KIRKNIE INTAKE LOCATION

A flood search for the Lot 7 SP250556 was purchased from the BSC to determine the DFL for the Kirknie Intake. The provided flood search was for Lot 8 on RP908773 to the north. The DFL for Lot 8 on RP908773 is reported to be 23.2 m AHD, and again this represents the maximum flood level on the site. A copy of the BSC Flood Certificate is included as Appendix B.

Further discussion with council officers and review of the Burdekin Shire Planning Scheme Flood Hazard Overlay Map (a) revealed the flood modelling for the Burdekin River from which the DFLs are extracted does not cover the site. Two separate models have been developed for the river, but neither cover the location of the proposed Kirknie Intake. The extents of the models and intake location are illustrated in Figure 10. It is therefore not possible to obtain the DFL for the proposed works from flood searches.

3.3.1. LIDAR ASSESSMENT

3.3.1.1. BURDEKIN 2009

The Burdekin 2 km LIDAR tiles (2009) were analysed to provide an indication of the Hydraulic Grade Line (HGL) along the river between the intake and the location of the flood search provided for Lot 8. The LIDAR data suggests a longitudinal grade (assumed to be consistent with the HGL under flood conditions) of 0.01 %.

3.3.1.2. BURDEKIN 2011

The Burdekin 1 km LIDAR tiles (2011), in conjunction with the Burdekin Shire Planning Scheme Flood Hazard Overlay Map (a) were analysed to estimate the peak water level at the extents of the modelling undertaken for the Burdekin River upstream of the intake. For the Extreme Flood Hazard, the estimated peak water level is 26.4 m AHD. This location is approximately 1,460 m upstream of the proposed intake location, so assuming the hydraulic grade line under flood conditions of 0.01 % (as per Section 3.2.1.1), the estimated flood level is 26.2 m AHD.

3.3.2. SUNWATER & LOWER BURDEKIN WATER INFRASTRUCTURE

Further advice from BSC provided the following details:

"...the original Sunwater pump station site on Barry Road is 25.5m AHD" (per email dated 12 December 2023).

It is understood works undertaken by Lower Burdekin Water in 2023 to upgrade the pump station involved raising the control room floor level to 26 m AHD. As part of the works proposed for the Kirknie Intake, the flood level is assumed to be 26.0 m AHD and the control room floor will provide freeboard to this. Refer to Figure 11 for further details.

This is considered appropriate to demonstrate an acceptable level of flood immunity for the proposed infrastructure, and further assessment of the flood regime will be undertaken (if required) during the detailed design phase of the project.

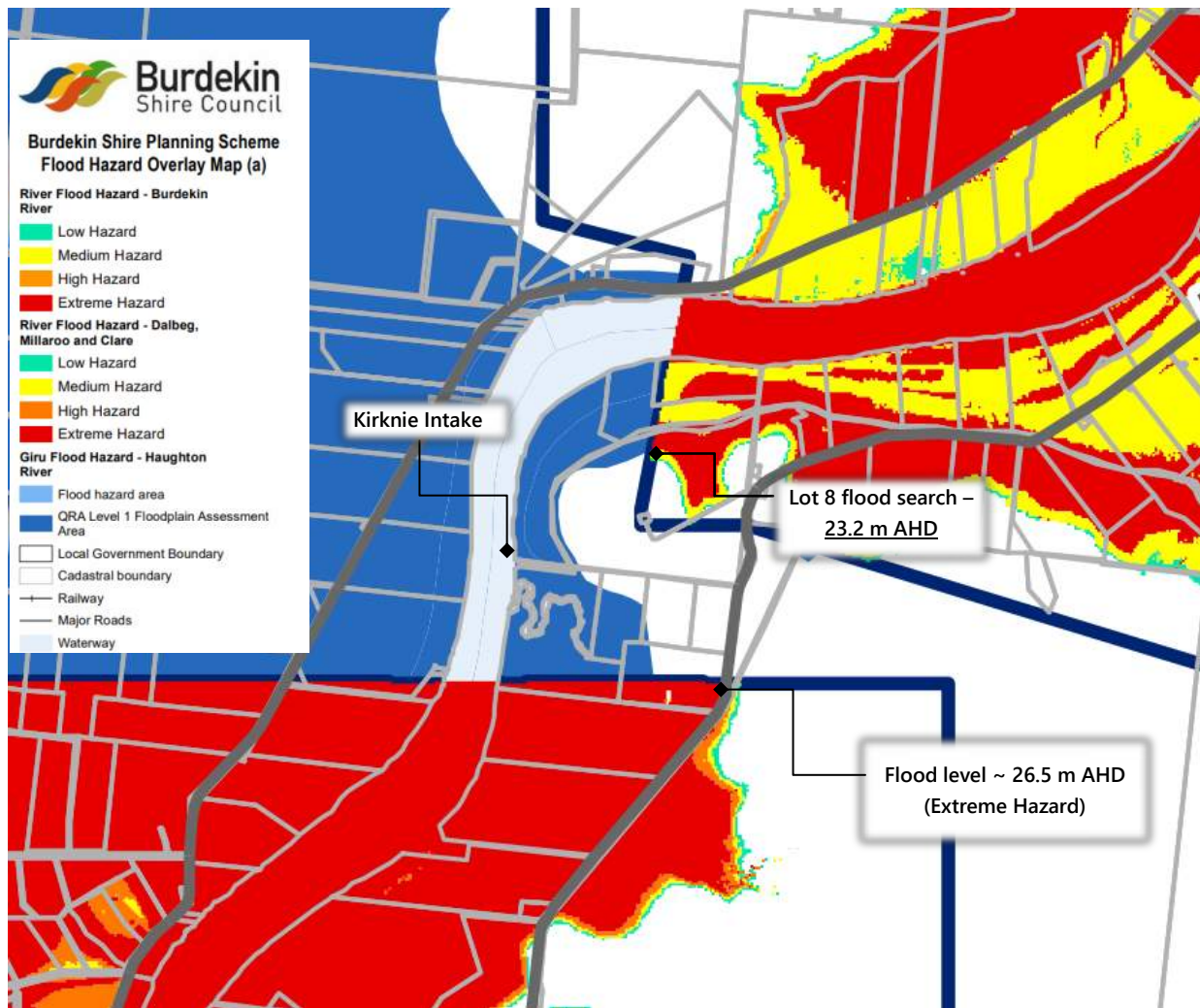


Figure 10 – BSC Flood Hazard Overlay – Data gap (Burdekin Shire Planning Scheme Flood Hazard Overlay Map (a))

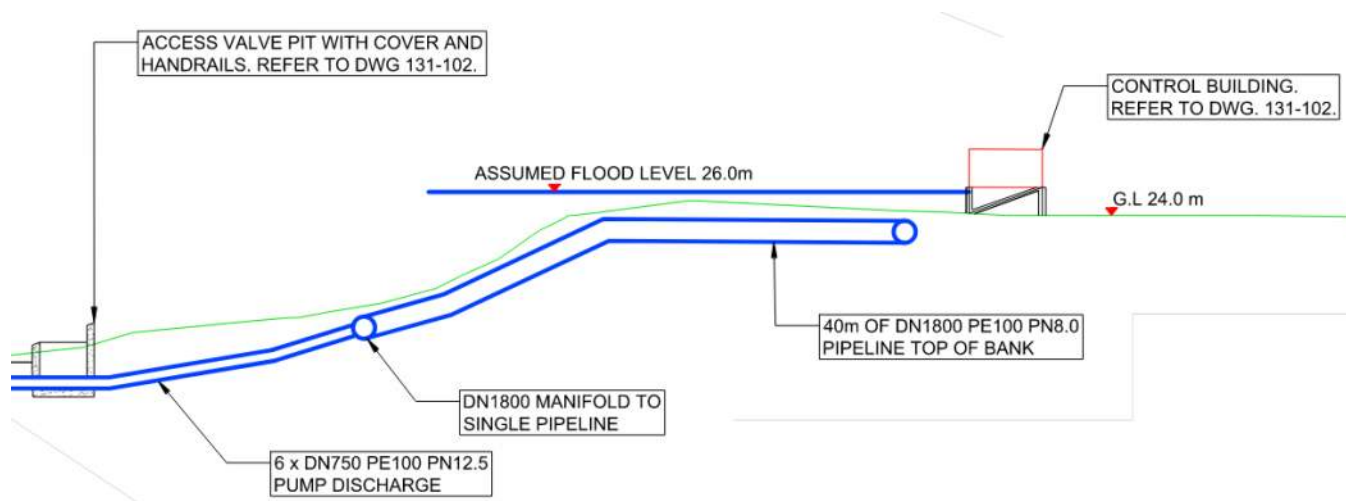


Figure 11 –Kirknie Intake Structure Arrangement (Extract Pinion Drawing No. 121-003 Sheet 3 of 3, Rev 03)

4 HYDROLOGIC & HYDRAULIC MODELLING

As previously noted, no flood search records are available for the sites at Inkerman and Salisbury Plains. For these locations, hydrologic and hydraulic modelling was undertaken to assess the flow regime and determine the DFL (i.e. the 1 % AEP peak water levels) in the vicinity of the proposed infrastructure.

Details of the modelling undertaken are provided as:

- + Appendix C for Inkerman, and
- + Appendix D for Salisbury Plains

4.1. INKERMANS DFL

Review of LIDAR data indicates the ground level of the proposed pump station is approximately 15.3 m AHD. This location is located approximately 200 m north-west of the nearest flood waters associated with the 1 % AEP event. An extract from the peak water level map for the site is provided as Figure 12. Based on the modelling undertaken, the 1 % AEP peak water level and therefore the DFL is nominated as 12.51 m AHD.

The pump station and control room provide approximately 2.8 m freeboard to the DFL.

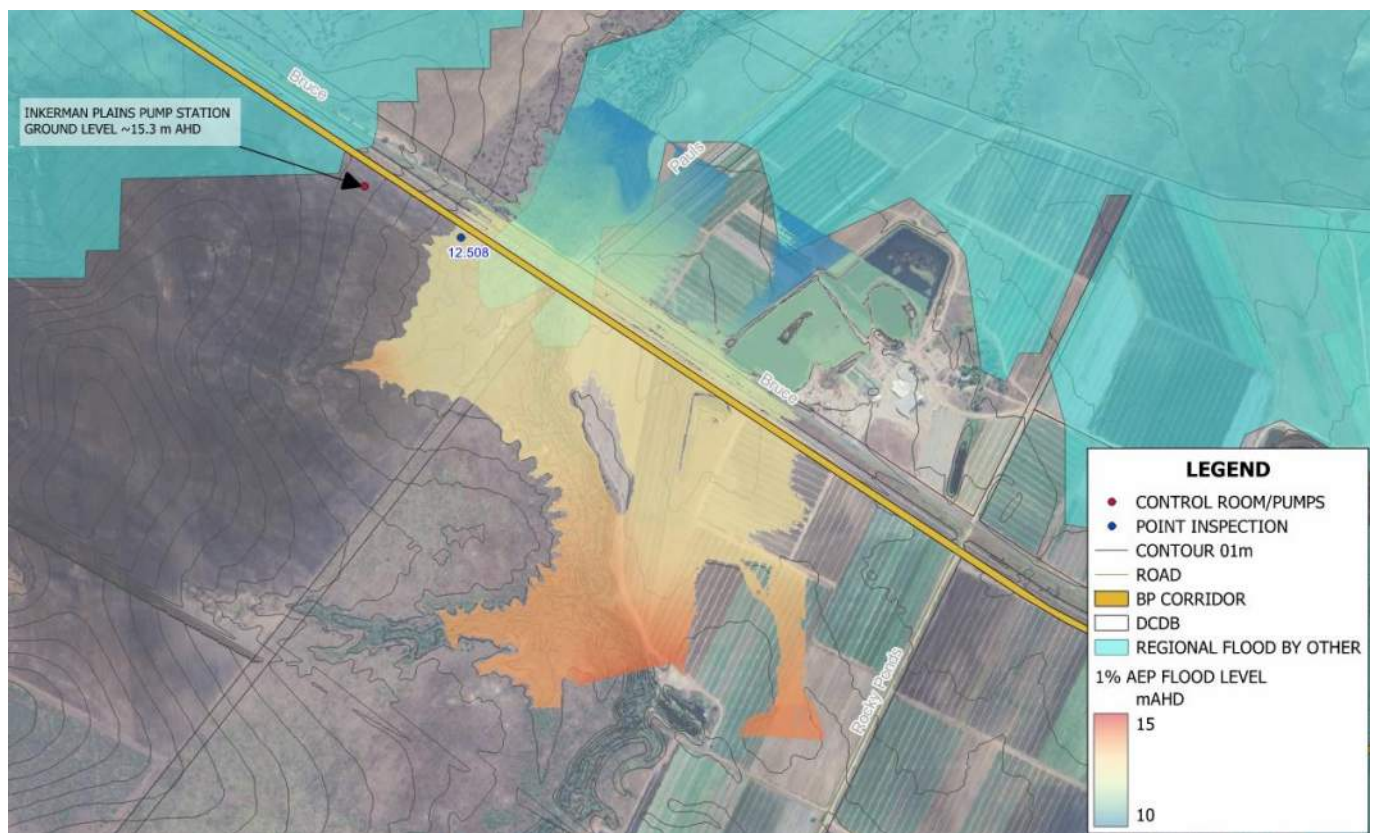


Figure 12 – Inkerman 1 % AEP Peak Water Level

4.2. SALISBURY PLAINS

Review of LIDAR data indicates the proposed pump station is proposed between two drainage lines at a ground level of approximately 27.1 m AHD. An extract from the peak water level map for the site is provided as Figure 12.

Based on the modelling undertaken, the 1 % AEP peak water level for the flowpath to the west is 26.91 m AHD, while for the flow path to the east the 1 % AEP peak water level is 26.86 m AHD. Therefore, the DFL is nominated as 26.91 m AHD.

At ground level, the pump station and control room provide approximately 0.2 m freeboard to the DFL.

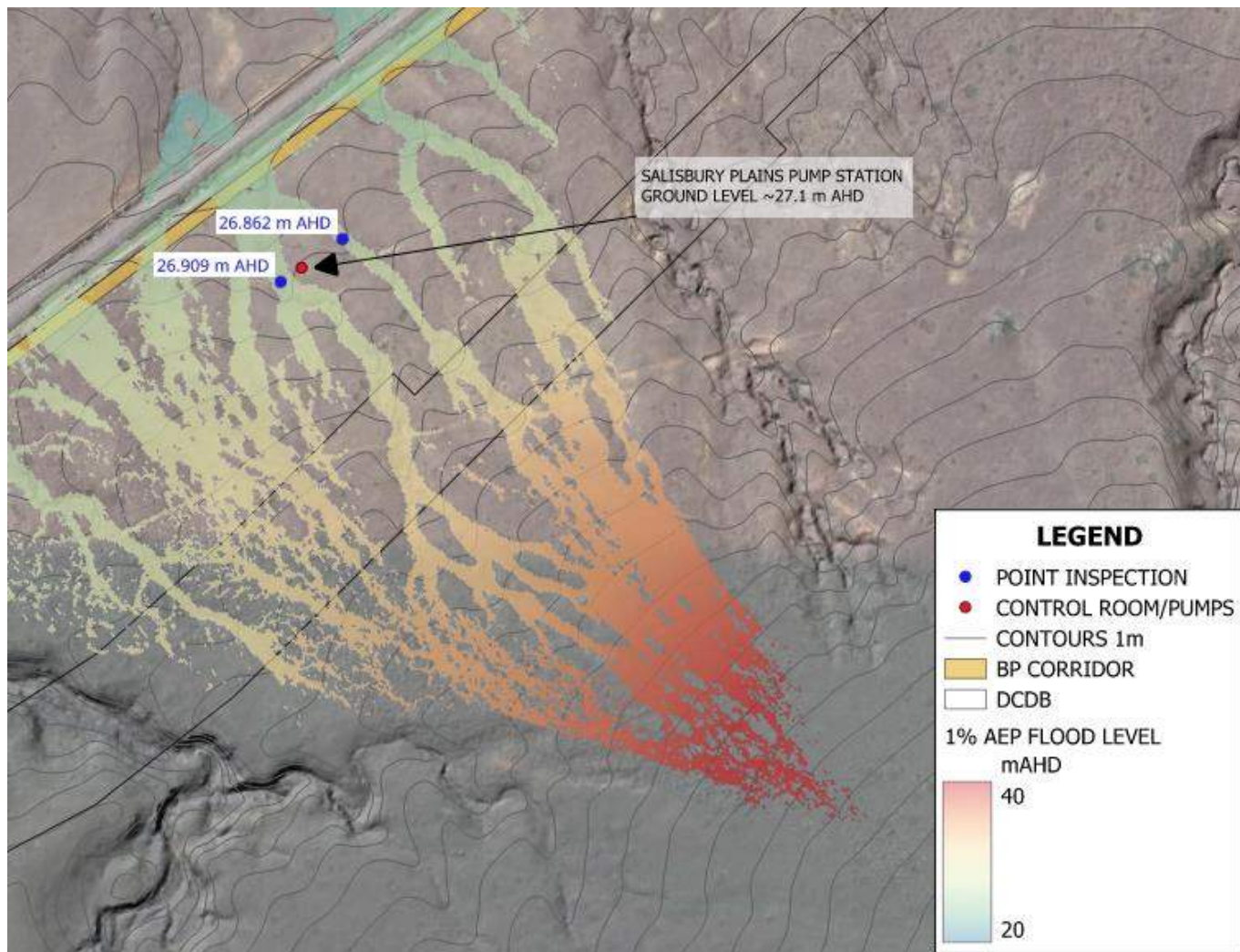


Figure 13 – Salisbury Plains 1 % AEP Peak Water Level

5 SUMMARY

Based on the modelling undertaken as part of this assessment and flood search details provided herein, the Defined Flood Levels summarised in Table 2 are proposed for the locations under consideration. It has been shown that all locations either:

- + Provide flood immunity to the DFL/1 % AEP event, or
- + Can easily be constructed to achieve the required level of immunity without loss of floodplain storage, or adverse impacts being caused for adjoining properties, roadway or rail infrastructure.

Table 2 – Defined Flood Level Summary

LOCATION	DFL (m AHD)	SOURCE
Kirknie Intake	26.0	Flood Search, interpolation and adjacent infrastructure
Inkerman Pump Station	12.51	Flood modelling
Guthalungra Pump Station & Tank	n/a -infrastructure provides at least 5 m freeboard to the residential lots	Flood Search, review of topography & cadastral boundaries
Salisbury Plains Pump Station & Tank	26.91	Flood modelling
Delta Pump Station & Tank	21.9	Flood Search & interpolation

6 RECOMMENDATIONS

While all proposed infrastructure associated with the Delta is considered to be capable of providing flood immunity through the structures being raised off the ground, locating the works further west to a higher point within the property has the potential to reduce the flood depths by approximately 0.5 m. It is recommended during the detailed design phase that this location be assessed and if possible, works moved to the west by approximately 250 m.

7 CERTIFICATION

This report and associated modelling have been prepared by Steven Chamberlain of Topo (RPEQ 15,545).

Signature: 

Date: 15-03-2024



APPENDIX A

- DELTA FLOOD SEARCHES





Property Information

Lot Plan(s): [32SP220001](#)
Address: [751 Bowen Developmental Road](#)
Lot size: 58.28ha
Zoning: Rural

Flood and or Coastal hazard information

Local Studies (Flood Levels available 1% AEP)

Risk rating(s): Identified Flood Hazard Area
Max Flood Height: 19.25m (AHD)
Max flood velocity: No Council flood study identifying velocity for this premises. Further assessment by Registered Professional Engineer Queensland (RPEQ) may be required.
Min habitable floor level: 19.55m (AHD)
Source: Bowen Local Catchment Study 2015
Don River Flood Risk and Mitigation Study 2014



Legend

	Selected Property
	DNRME Restrictions and Covenants
	Easement
	Flood Studies
Flood Hazard	
	Low Risk Flood Hazard Area
	Medium Risk Flood Hazard Area
	High Risk Flood Hazard Area
	Identified Flood Hazard Area
Coastal Hazard - Storm Tide	
	Inundation Area
	Wave-Run Up Area

Property Information

Lot Plan(s): [24K12437](#)
Address: [565 Bowen Developmental Road](#)
Lot size: 33.589ha
Zoning: Rural

Flood and or Coastal hazard information

Local Studies (Flood Levels available 1% AEP)

Risk rating(s): Identified Flood Hazard Area
Max Flood Height: 25.50m (AHD)
Max flood velocity: No Council flood study identifying velocity for this premises. Further assessment by Registered Professional Engineer Queensland (RPEQ) may be required.
Min habitable floor level: 25.80m (AHD)
Source: Bowen Local Catchment Study 2015
Don River Flood Risk and Mitigation Study 2014



Legend

	Selected Property
	DNRME Restrictions and Covenants
	Easement
	Flood Studies
Flood Hazard	
	Low Risk Flood Hazard Area
	Medium Risk Flood Hazard Area
	High Risk Flood Hazard Area
	Identified Flood Hazard Area
Coastal Hazard - Storm Tide	
	Inundation Area
	Wave-Run Up Area

Property Information

Lot Plan(s): [151H12497](#)
Address: [454 Bowen Developmental Road](#)
Lot size: 16.187ha
Zoning: Rural

Flood and or Coastal hazard information

Local Studies (Flood Levels available 1% AEP)

Risk rating(s): Identified Flood Hazard Area
Max Flood Height: 20.00m (AHD)
Max flood velocity: No Council flood study identifying velocity for this premises. Further assessment by Registered Professional Engineer Queensland (RPEQ) may be required.

Min habitable floor level: 20.30m (AHD)

Source: Bowen Local Catchment Study 2015
Don River Flood Risk and Mitigation Study 2014



Legend

	Selected Property
	DNRME Restrictions and Covenants
	Easement
	Flood Studies
Flood Hazard	
	Low Risk Flood Hazard Area
	Medium Risk Flood Hazard Area
	High Risk Flood Hazard Area
	Identified Flood Hazard Area
Coastal Hazard - Storm Tide	
	Inundation Area
	Wave-Run Up Area

Property Information

Lot Plan(s): [150HR1222](#)
Address:
Lot size: 13.245ha
Zoning: Rural

Flood and or Coastal hazard information

Local Studies (Flood Levels available 1% AEP)

Risk rating(s): Identified Flood Hazard Area
Max Flood Height: 21.25m (AHD)
Max flood velocity: No Council flood study identifying velocity for this premises. Further assessment by Registered Professional Engineer Queensland (RPEQ) may be required.
Min habitable floor level: 21.55m (AHD)
Source: Bowen Local Catchment Study 2015
Don River Flood Risk and Mitigation Study 2014



Legend

	Selected Property
	DNRME Restrictions and Covenants
	Easement
	Flood Studies
Flood Hazard	
	Low Risk Flood Hazard Area
	Medium Risk Flood Hazard Area
	High Risk Flood Hazard Area
	Identified Flood Hazard Area
Coastal Hazard - Storm Tide	
	Inundation Area
	Wave-Run Up Area

Property Information

Lot Plan(s): [1RP714956](#)
Address: [99 Burnfoot Road](#)
Lot size: 34.322ha
Zoning: Rural

Flood and or Coastal hazard information

Local Studies (Flood Levels available 1% AEP)

Risk rating(s): Identified Flood Hazard Area
Max Flood Height: 25.75m (AHD)
Max flood velocity: No Council flood study identifying velocity for this premises. Further assessment by Registered Professional Engineer Queensland (RPEQ) may be required.
Min habitable floor level: **26.05m (AHD)**
Source: Bowen Local Catchment Study 2015
Don River Flood Risk and Mitigation Study 2014



Legend

	Selected Property
	DNRME Restrictions and Covenants
	Easement
	Flood Studies
Flood Hazard	
	Low Risk Flood Hazard Area
	Medium Risk Flood Hazard Area
	High Risk Flood Hazard Area
	Identified Flood Hazard Area
Coastal Hazard - Storm Tide	
	Inundation Area
	Wave-Run Up Area

Property Information

Lot Plan(s): [3RP742546](#)

Address:

Lot size: 126.736ha

Zoning: Rural

Flood and or Coastal hazard information

Local Studies (Flood Levels available 1% AEP)

Risk rating(s): Identified Flood Hazard Area

Max Flood Height: 17.75m (AHD)

Max flood velocity: No Council flood study identifying velocity for this premises. Further assessment by Registered Professional Engineer Queensland (RPEQ) may be required.

Min habitable floor level: 18.05m (AHD)

Source: Bowen Local Catchment Study 2015
Don River Flood Risk and Mitigation Study 2014



Legend

Selected Property

DNRME Restrictions and Covenants

Easement

Flood Studies

Flood Hazard

Low Risk Flood Hazard Area

Medium Risk Flood Hazard Area

High Risk Flood Hazard Area

Identified Flood Hazard Area

Coastal Hazard - Storm Tide

Inundation Area

Wave-Run Up Area

Property Information

Lot Plan(s): [2RP739183](#)
Address: [127 Hermans Road](#)
Lot size: 128.6ha
Zoning: Rural

Flood and or Coastal hazard information

Local Studies (Flood Levels available 1% AEP)

Risk rating(s): Identified Flood Hazard Area
Max Flood Height: 17.25m (AHD)
Max flood velocity: No Council flood study identifying velocity for this premises. Further assessment by Registered Professional Engineer Queensland (RPEQ) may be required.
Min habitable floor level: 17.55m (AHD)
Source: Bowen Local Catchment Study 2015
Don River Flood Risk and Mitigation Study 2014



Legend

 Selected Property	
 DNRME Restrictions and Covenants	
 Easement	 Flood Studies
Flood Hazard	
 Low Risk Flood Hazard Area	 Medium Risk Flood Hazard Area
 High Risk Flood Hazard Area	 Identified Flood Hazard Area
Coastal Hazard - Storm Tide	
 Inundation Area	 Wave-Run Up Area

Property Information

Lot Plan(s): [145HR165](#)
Address:
Lot size: 39.093ha
Zoning: Rural

Flood and or Coastal hazard information

Local Studies (Flood Levels available 1% AEP)

Risk rating(s): Identified Flood Hazard Area
Max Flood Height: 19.00m (AHD)
Max flood velocity: No Council flood study identifying velocity for this premises. Further assessment by Registered Professional Engineer Queensland (RPEQ) may be required.
Min habitable floor level: 19.30m (AHD)
Source: Bowen Local Catchment Study 2015
Don River Flood Risk and Mitigation Study 2014



Legend

	Selected Property
	DNRME Restrictions and Covenants
	Easement
	Flood Studies
Flood Hazard	
	Low Risk Flood Hazard Area
	Medium Risk Flood Hazard Area
	High Risk Flood Hazard Area
	Identified Flood Hazard Area
Coastal Hazard - Storm Tide	
	Inundation Area
	Wave-Run Up Area

Property Information

Lot Plan(s): [159HR1290](#)
Address: [536 Bowen Developmental Road](#)
Lot size: 32.331ha
Zoning: Rural

Flood and or Coastal hazard information

Local Studies (Flood Levels available 1% AEP)

Risk rating(s): Identified Flood Hazard Area
Max Flood Height: 22.25m (AHD)
Max flood velocity: No Council flood study identifying velocity for this premises. Further assessment by Registered Professional Engineer Queensland (RPEQ) may be required.
Min habitable floor level: **22.55m (AHD)**
Source: Bowen Local Catchment Study 2015
Don River Flood Risk and Mitigation Study 2014



Legend

	Selected Property
	DNRME Restrictions and Covenants
	Easement
	Flood Studies
Flood Hazard	
	Low Risk Flood Hazard Area
	Medium Risk Flood Hazard Area
	High Risk Flood Hazard Area
	Identified Flood Hazard Area
Coastal Hazard - Storm Tide	
	Inundation Area
	Wave-Run Up Area

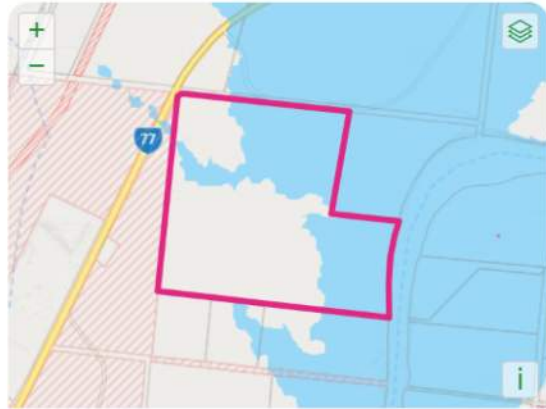
Property Information

Lot Plan(s): [2RP714956](#)
Address: [113 Burnfoot Road](#)
Lot size: 151.808ha
Zoning: Rural

Flood and or Coastal hazard information

Local Studies (Flood Levels available 1% AEP)

Risk rating(s): Identified Flood Hazard Area
Max Flood Height: 26.50m (AHD)
Max flood velocity: No Council flood study identifying velocity for this premises. Further assessment by Registered Professional Engineer Queensland (RPEQ) may be required.
Min habitable floor level: 26.80m (AHD)
Source: Bowen Local Catchment Study 2015
Don River Flood Risk and Mitigation Study 2014



Legend

	Selected Property
	DNRME Restrictions and Covenants
	Easement
	Flood Studies
Flood Hazard	
	Low Risk Flood Hazard Area
	Medium Risk Flood Hazard Area
	High Risk Flood Hazard Area
	Identified Flood Hazard Area
Coastal Hazard - Storm Tide	
	Inundation Area
	Wave-Run Up Area

Property Information

Lot Plan(s): [159HR1290](#)
Address: [536 Bowen Developmental Road](#)
Lot size: 32.331ha
Zoning: Rural

Flood and or Coastal hazard information

Local Studies (Flood Levels available 1% AEP)

Risk rating(s): Identified Flood Hazard Area
Max Flood 22.25m (AHD)
Height:
Max flood velocity: No Council flood study identifying velocity for this premises. Further assessment by Registered Professional Engineer Queensland (RPEQ) may be required.

Min habitable floor level: **22.55m (AHD)**
Source: Bowen Local Catchment Study 2015
Don River Flood Risk and Mitigation Study 2014



Legend

Selected Property

DNRME Restrictions and Covenants

Easement

Flood Studies

Flood Hazard

Low Risk Flood Hazard Area

Medium Risk Flood Hazard Area

High Risk Flood Hazard Area

Identified Flood Hazard Area

Coastal Hazard - Storm Tide

Inundation Area

Wave-Run Up Area



APPENDIX B

- KIRKNIE INTAKE FLOOD SEARCH



1% AEP Flood Certificate

Q100Cert23/0034

Address all communications to
The Chief Executive Officer

PO Box 974, Ayr Qld 4807
T (07) 4783 9800 | F (07) 4783 9999
enquiries@burdekin.qld.gov.au

Enquiries to: Allan Smith
Our reference: 1082

07/12/2023

Topo Group Pty Ltd
Unit 7
16 Innovation Parkway
BIRTINYA QLD 4575

Burdekin Shire Council provides this certificate using mapping data supplied by consultants Engeny Water Management and extracted from the Burdekin Shire Flood Study (June 2012) for the below property as requested.

Property Address:	5 Piva Road KIRKNIE QLD 4806
Legal Description:	Lot 8 RP908773
Q100 (1% AEP) Level:	23.2m AHD

Terms and Conditions

The information provided is subject to the following terms and conditions:

1. Council does not under any circumstances accept or admit liability in any way for an incorrect interpretation of the information derived from the mapping. It is the recipients' responsibility to verify the land height. *Please note there can be anomalies in flow depth across the flooded area, due to variations in flow restrictions, flow velocity and direction. The information is provided as a guide only and recipients are advised to seek professional assistance to interpret the data for their requirements.*
2. Council supplies this information with the understanding that the applicant will employ the services of a competent person to accurately provide the correct land height information to use in conjunction with the minimum floor level provided.
3. Floods greater than the level indicated can occur. Flood extents may vary between floods with the same gauge height due to factors such as duration of flooding, source of runoff and rate of rise of flood and changed flood plain topography. Flood extents should only be taken as indicative for the shown gauge height.
4. Local increases of peak storm tides, depths and-or velocities from local factors such as drain blockages and obstructions to overland flow paths such as fences, building and cars may also affect the level of flood water.

5. The mapping used to provide the above level has been prepared using the best available data and computer modelling and mapping techniques at the time, however, the accuracy of this system is not absolute and reflects only the accuracy of the data and the techniques used.
6. The level provided for this certificate is the highest Q100 (1%AEP) level from either a River Flood Model or Localised Flooding Model.
7. Burdekin Shire Council does not accept liability for any loss caused or arising from reliance on information provided on this certificate.
8. The information provided in this certificate is to be used to comply with Council's **Floor heights for Buildings with Habitable Rooms Policy**.

Yours faithfully,



Allan Smith
Building Certifier



APPENDIX C

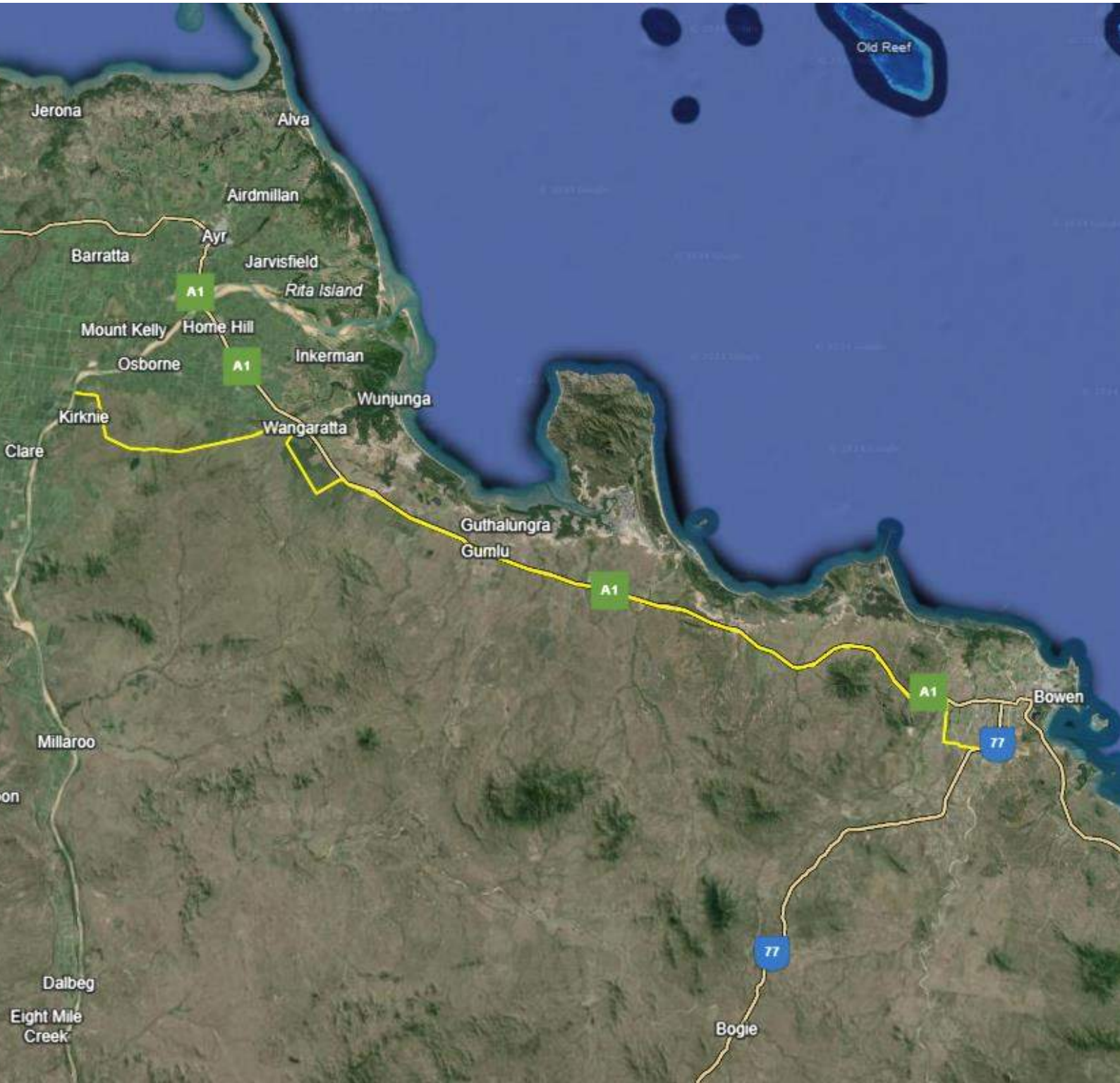
- INKERMAN FLOOD STUDY





BOWEN PIPELINE PROJECT

INKERMAN FLOOD STUDY



CLIENT: BOWEN PIPELINE COMPANY

DOCUMENT NUMBER: R3290

VERSION: B

DATE: 15-03-2024



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1 INTRODUCTION

Topo were engaged by Bowen Pipeline Company to undertake a Flood Study and assess the flood immunity requirements for pump stations and infrastructure associated with the Bowen Pipeline Project. The Bowen Pipeline Project is a 116 km underground water pipeline commencing 16 km upstream from Home Hill (Burdekin River) moving south to Bowen.

Flood search data was not available for the Inkerman site, so this assessment has been undertaken to identify the peak water level associated with the 1 % Annual Exceedance Probability (AEP) event and determine the Defined Flood Level. The works proposed at Inkerman are summarised in Appendix A.

1.1. GUIDELINES

This assessment has been prepared in accordance with:

- + *The Queensland Urban Drainage Manual* (IPWEAQ, 2017), and
- + *Australian Rainfall and Runoff* (Geoscience Australia, 2019).

1.2. REVISION

VERSION	DATE	AUTHOR	REVIEWED	APPROVED
A	12/03/2024	BS	SC	SC
B	15/03/2024	BS	SC	SC

2 HYDROLOGIC MODELLING

2.1. METHODOLOGY

Hydrologic modelling was undertaken using the XP-Storm software. The model represents the sub-catchments as a network of nodes linked by 1D sections extracted from LIDAR data. Each node is defined by its fraction impervious and average catchment slope. The net rainfall is routed through the network after appropriate losses (initial and continuing) and roughness factors are applied, resulting in a surface runoff hydrograph for each sub-catchment.

2.2. HYDROLOGY

The XP-Storm runoff-routing model has been used to estimate design flood discharges within the study area. The XP-Storm model was used to estimate the 1 % Annual Exceedance Probability (AEP) storm event for the 10 minute to 3 hour storm durations. The modelling undertaken as part of this assessment applies the Australian Rainfall and Runoff (ARR) 2019 hydrology. The XP-Storm Generator has been used, in conjunction with the Bureau of Meteorology (BOM) Intensity–Frequency–Duration (IFD) program and the ARR Data Hub to generate the rainfall intensities and temporal patterns for the site. By applying the ARR 2019 hydrologic methods, we have ensured this study is providing the best available information on design flood estimation.

2.3. RAINFALL DATA

Obtaining an estimated rainfall depth for a specified probability is an essential component of the design of infrastructure including. Design rainfalls are a probabilistic or statistically-based estimate of the likelihood of a specific rainfall depth being recorded at a particular location within a defined duration. This is generally classified by an AEP or Exceedances per Year (EY). Design rainfalls are therefore not real rainfall events, rather they are values that are probabilistic in nature.

The 2016 IFD design rainfalls are provided for use in conjunction with the 2019 edition of *Australian Rainfall and Runoff* (2019) <http://arr.ga.gov.au/arr-guideline> . Table 1 presents the AEP and EY rainfall data for the site with values reported in mm/hr.



Table 1 – BOM Intensity Frequency Duration Data (mm/hr)

Duration in min	63.20% AEP	50 % AEP	20 % AEP	10% AEP	5% AEP	2% AEP	1% AEP
10	93.8	107	148	174	198	228	250
15	81.1	92.7	128	150	171	197	216
20	71.9	82.3	113	133	151	175	191
25	65	74.4	103	120	137	158	173
30	59.5	68.2	94	110	126	145	159
45	48.1	55.1	76.4	90	103	118	130
60	40.7	46.8	65.2	77	88	102	112
90	31.8	36.7	51.4	61	70.1	81.5	89.9
120	26.4	30.5	43.2	51.4	59.3	69.3	76.7
180	20.1	23.4	33.5	40.1	46.5	54.9	61.2
270	15.2	17.8	25.8	31.2	36.4	43.4	48.8
360	12.5	14.6	21.4	26.1	30.6	36.7	41.5

Grid cell: Latitude -19.8375(S) Longitude 147.5875(E)

2.4. CATCHMENT CHARACTERISTICS

The representation of a catchment in a flood hydrograph estimation model is, by necessity, highly conceptualised and aims to represent those features and characteristics most influential in determining the overall flood response of the catchment. The distribution of storm rainfall over different parts of the catchment and the flood response to it may vary considerably, depending on the details of topography, vegetation cover, land use and drainage network characteristics. A catchment of approximately 2,070 ha has been identified as part of this assessment and has been further sub-divided to enable the flood regime of the site to be accurately determined. 32 sub-catchments have been delineated, as illustrated in Figure 1 and summarised in Table 2.

2.4.1. HYDROLOGIC MODELLING ROUGHNESS COEFFICIENTS

For hydrological purposes within XP-SWMM, Manning's n roughness values have been applied to represent the catchment. These values have been varied and defined for the pervious and impervious portions of the catchment. The following values have been adopted and while conservative for the pervious (vegetated) areas, are shown to correlate well with the results of the Regional Flood Frequency Estimates (RFFE). Refer to Section 2.5 for further discussion in relation to these assumptions.

- + Impervious $n = 0.014$
- + Pervious $n = 0.045$ (average grass)

2.4.2. RAINFALL LOSSES FOR XP-SWMM

Initial Loss (IL) and Continuing Loss (CL) rates applied to the modelling are summarised below. The loss rates are high, but it is noted there is a high pre-burst rainfall depth at this location and therefore the initial loss is also quite high. These adopted loss rates are consistent with the ARR DataHub recommendations and RFFE assumptions. Again, the adopted values have been reduced to assist in achieving greater correlation with the results of the RFFE as detailed in Section 2.5.

- + Initial Loss, impervious IL = 1 mm CL = 0 mm/hr
- + Initial Loss, pervious IL = 57 mm CL = 5.6 mm/hr



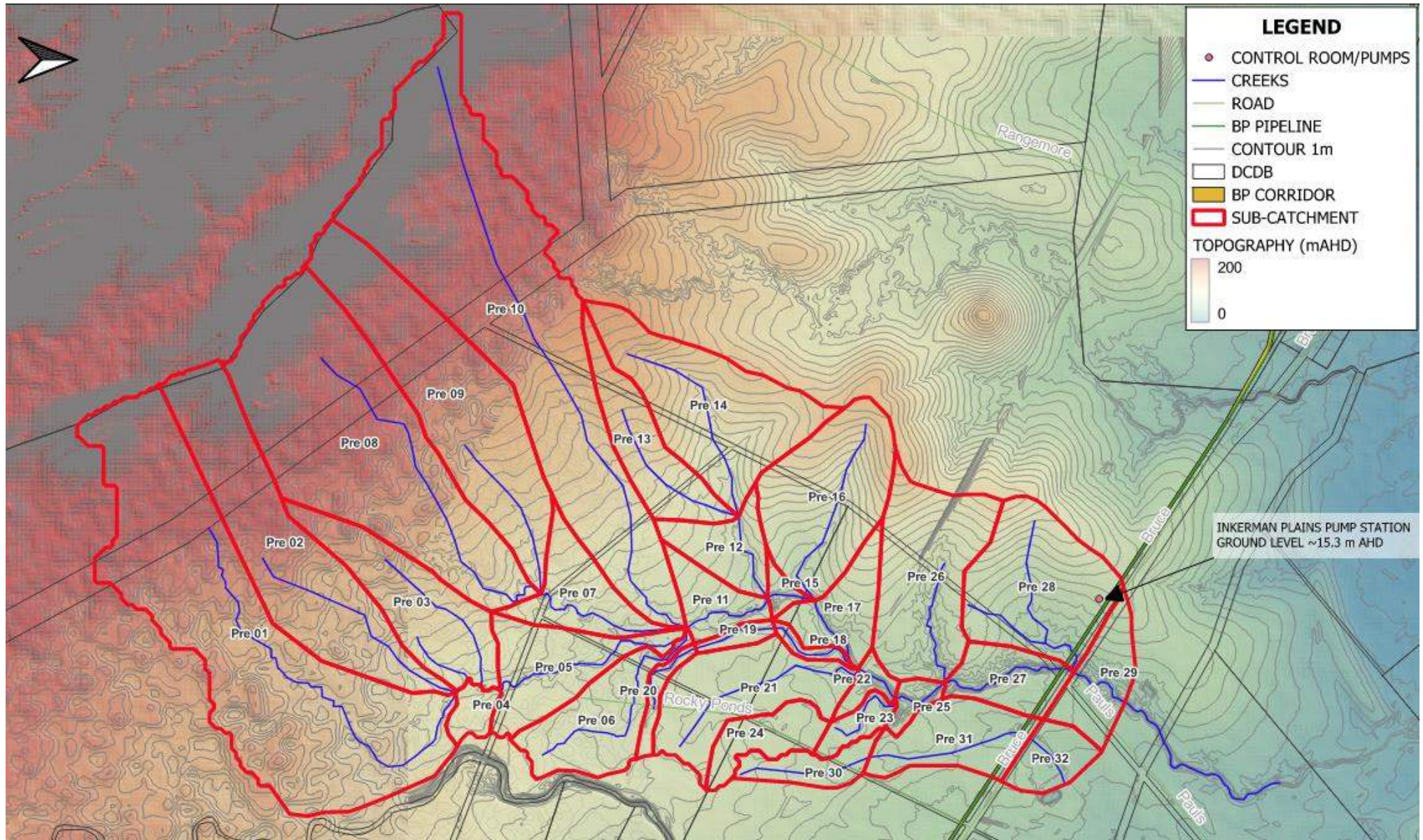


Figure 1 – Inkerman Catchment Plan



Table 2 – Catchment Details Applied to Hydrologic Assessment

CATCH ID	IMPERVIOUS AREA (ha)	PERVIOUS AREA (ha)	FRACTION IMPERVIOUS	SLOPE(%)
Pre 01	14.639	278.137	5	2
Pre 02	6.821	129.601	5	2
Pre 03	3.604	68.483	5	1
Pre 04	0.548	10.405	5	1
Pre 05	2.738	52.022	5	0.4
Pre 06	2.709	51.465	5	0.3
Pre 07	2.079	39.493	5	1
Pre 08	11.135	211.566	5	5
Pre 09	7.418	140.942	5	5
Pre 10	15.545	295.354	5	4
Pre 11	1.233	23.435	5	1
Pre 12	1.520	28.888	5	1
Pre 13	2.463	46.790	5	1
Pre 14	5.998	113.960	5	1
Pre 15	0.310	5.883	5	1
Pre 16	4.512	85.721	5	1
Pre 17	1.668	31.699	5	1
Pre 18	0.285	5.412	5	1
Pre 19	0.343	6.519	5	0.1
Pre 20	0.451	8.561	5	0.1
Pre 21	3.571	67.840	5	0.1
Pre 22	0.456	8.672	5	1
Pre 23	0.615	11.677	5	1
Pre 24	1.329	25.255	5	0.1
Pre 25	0.439	8.339	5	1
Pre 26	4.825	91.680	5	1
Pre 27	1.611	30.610	5	1
Pre 28	4.328	82.228	5	1
Pre 29	1.898	36.067	5	0.4
Pre 30	1.053	36.067	5	03
Pre 31	2.338	20.004	5	0.3
Pre 32	1.106	44.428	5	0.4



2.5. MODEL CALIBRATION / PEAK FLOW RATE COMPARISON

A comparison of the peak flow rates provided by the XP-Storm model and the results of the RFFE model has been undertaken. The RFFE technique is based on data from 853 gauged catchments and transfers flood frequency characteristics from a group of gauged catchments to the location of interest. The method ensures that design flood discharge estimates are consistent with the gauged records and with results for other ungauged catchments in a region.

The results of this comparison are summarised in Table 3.

Table 3 – Rational Method vs RFFE Peak Flow Comparison

AEP EVENT	RFFE (m ³ /s)	XP (m ³ /s)	DURATION/STORM NO.	DIFFERENCE
10 %	156	175	3h-10	19
2 %	273	278	3h-4	5
1 %	332	319	3h-8	-13

3 HYDRAULIC MODELLING

TUFLOW was used to undertake hydraulic modelling, utilising the design hydrographs from XP discussed in Section 2 as inputs into the hydraulic model. External catchments were applied to the model at relevant locations within the TUFLOW model as flow area polygons, as illustrated in Figure 2. Additional details in relation to the TUFLOW model are summarised below.

- + LIDAR data from the Elvis - Elevation and Depth - Foundation Spatial Data website was applied to create the surface file over the site and surrounding areas.
- + Manning's n roughness values across the site as described in Section 3.2.
- + Critical duration design hydrographs for the external catchments are applied to the model at the respective upstream boundary locations. The hydrographs are applied to the invert of drainage line as Flow v Time hydrographs (QT lines), with the depth and velocity of flow being determined by the surface file and roughness factors at the particular location.
- + Critical duration design hydrographs for the site catchments are applied at the respective catchment centroids as Flow vs Time (SA) polygons.
- + A cell size of 2 m was applied to the simulation area.
- + A free-flowing Flow versus Height (QH) boundary at the downstream model extent. Note, there is no impacts of any external regional flooding from downstream areas and therefore for then use of the QH boundary is appropriate.
- + Initial water levels applied to farm dams so the storage volume associated with them is removed from the model.

3.1. BRUCE HIGHWAY CROSSING

No details were available at the time of preparing this assessment for the drainage infrastructure crossing of the Bruce Highway. Based on best estimates of this In lieu of these details, a 1D link was extracted from the topographic data and applied to the assessment. A 50 % blockage factor was applied to the modelling and for the results presented herein.

3.2. ROUGHNESS COEFFICIENTS (2D MODELLING)

The following values have been adopted and applied to the surface for the existing scenario:

- + Road n = 0.015
- + Scattered trees and grass (majority of site) n = 0.06
- + Drainage lines n = 0.08

The TUFLOW model feature map is provided as Figure 2, including the 1D elements representing the culverts, RoG extents and downstream boundary location.



Figure 2 - TUFLOW Feature Map

3.3. RESULTS

The results of the flood model for the pre-development scenario have been extracted for the 1 % AEP for the critical storm durations. The full set of flood maps is provided within Appendix B including:

- + Peak Water Level,
 - o 1 m water level contours
- + Maximum Depth
- + Maximum Velocity, and
- + Hazard
 - o Hazard mapping is represented as the velocity-depth product.

A full set of plans, including catchment map, TUFLOW model features and flood maps is included as Appendix B.

3.3.1. DEFINED FLOOD LEVEL (DFL)

An extract from the peak water level map for the site is provided as Figure 3. Based on the modelling undertaken, the 1 % AEP peak water level and therefore DFL is nominated as 12.51 m AHD. It is noted the existing ground level at this location is approximately 15.3 m AHD, so there is expected to be no issues with flooding for the proposed infrastructure, up to and including the 1 % AEP and slightly beyond.

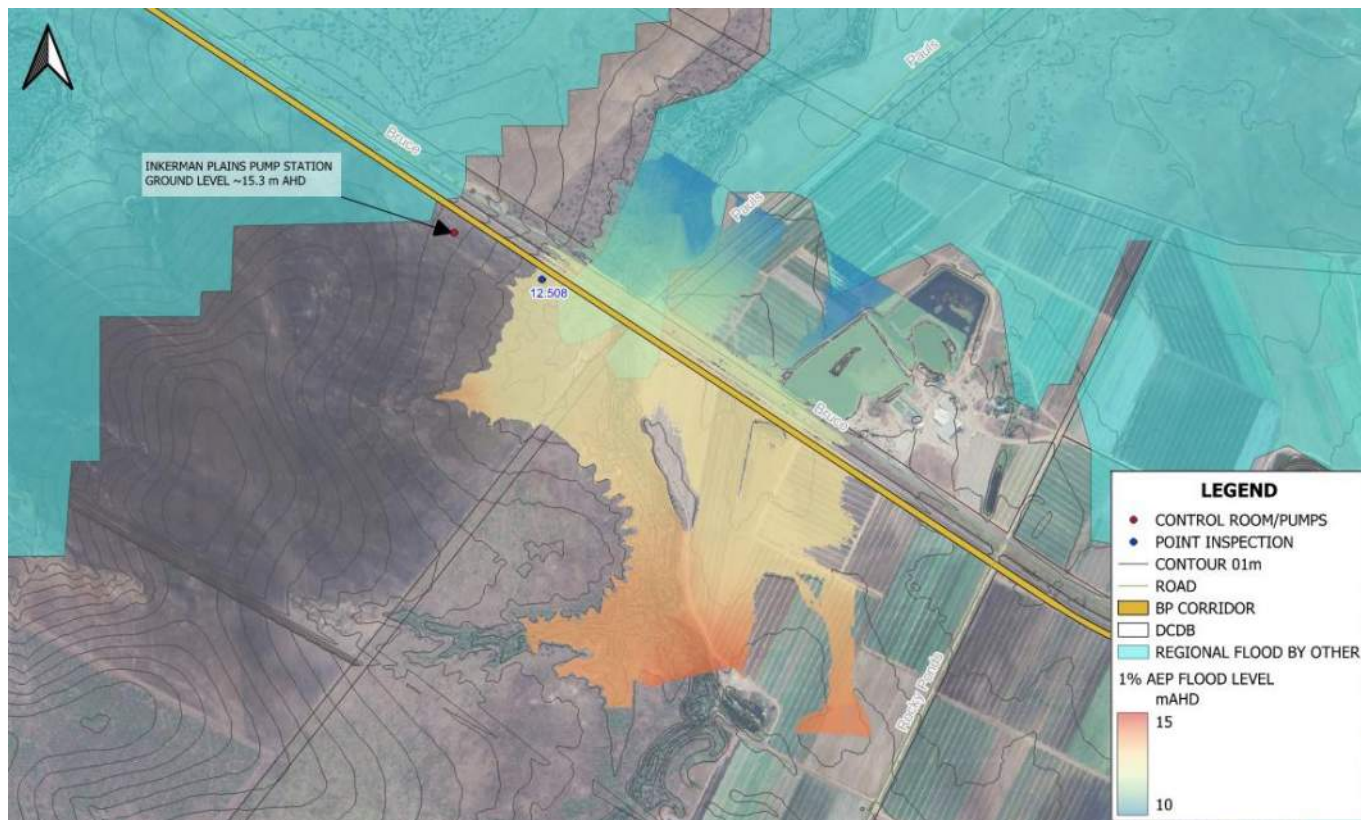


Figure 3 – 1 % AEP Peak Water Level

4 CERTIFICATION

This report and associated modelling have been prepared by Steven Chamberlain of Topo (RPEQ 15,545).

Signature:



Date: 15-03-2024

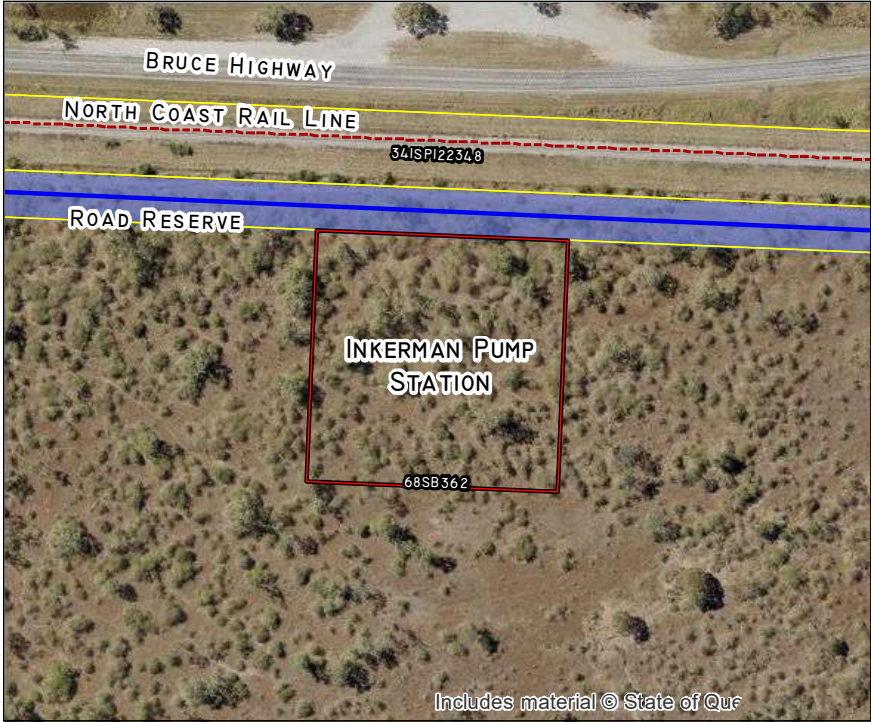


APPENDIX A

- PROPOSED DEVELOPMENT LAYOUT



CONCEPT ALIGNMENT LAYOUT PLAN - SHEET 9



INSET 8 (SCALE 1:3,000)

LEGEND

CONCEPT PIPELINE ALIGNMENT

EXTENT OF PIPELINE CORRIDOR

QLD DCDB

NORTH COAST RAIL NETWORK

MINOR WATERWAY

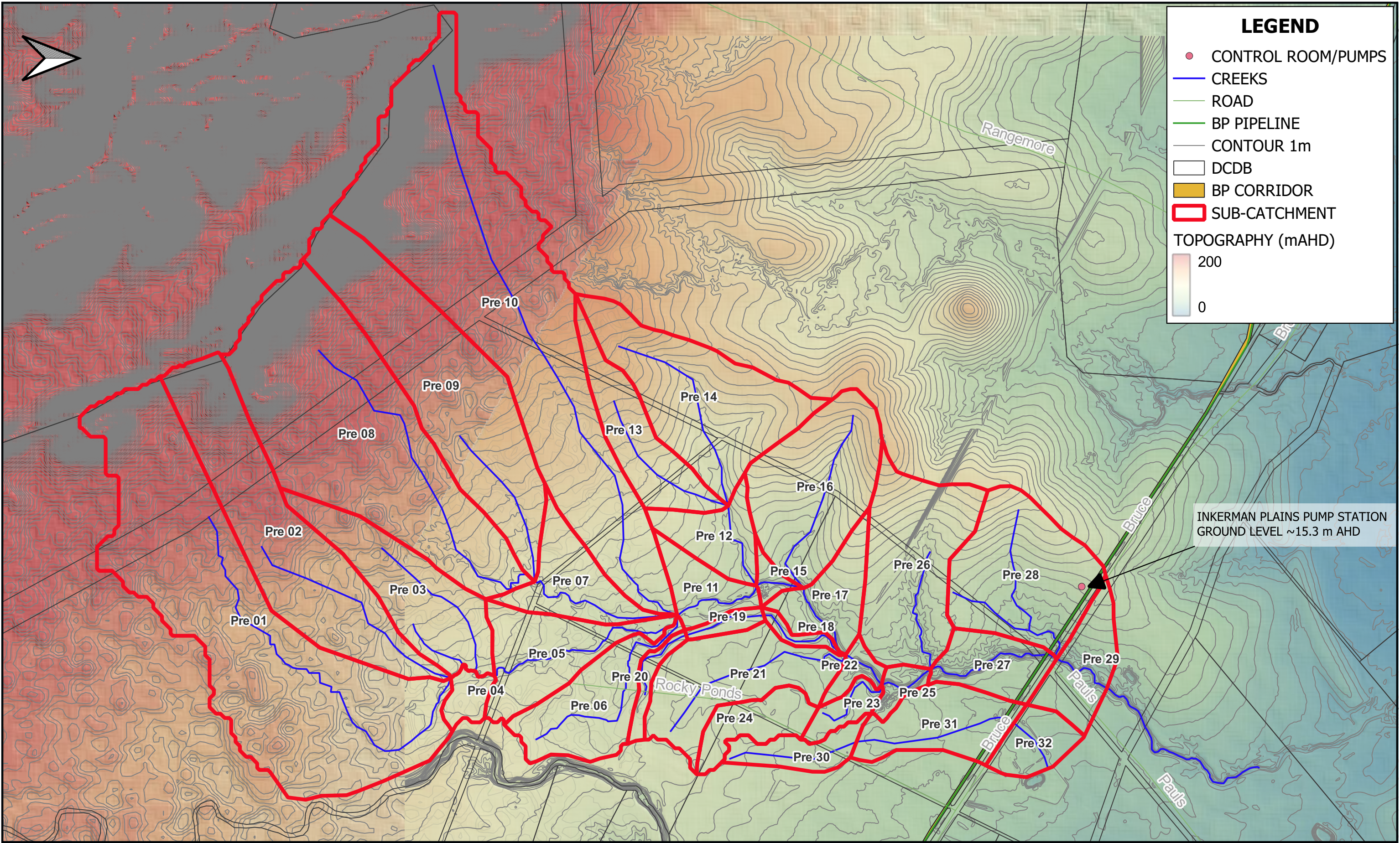
MAJOR WATERWAY



APPENDIX B

- MODEL SETUP & FLOOD MAPS





REV.	DATE
A	12/03/24

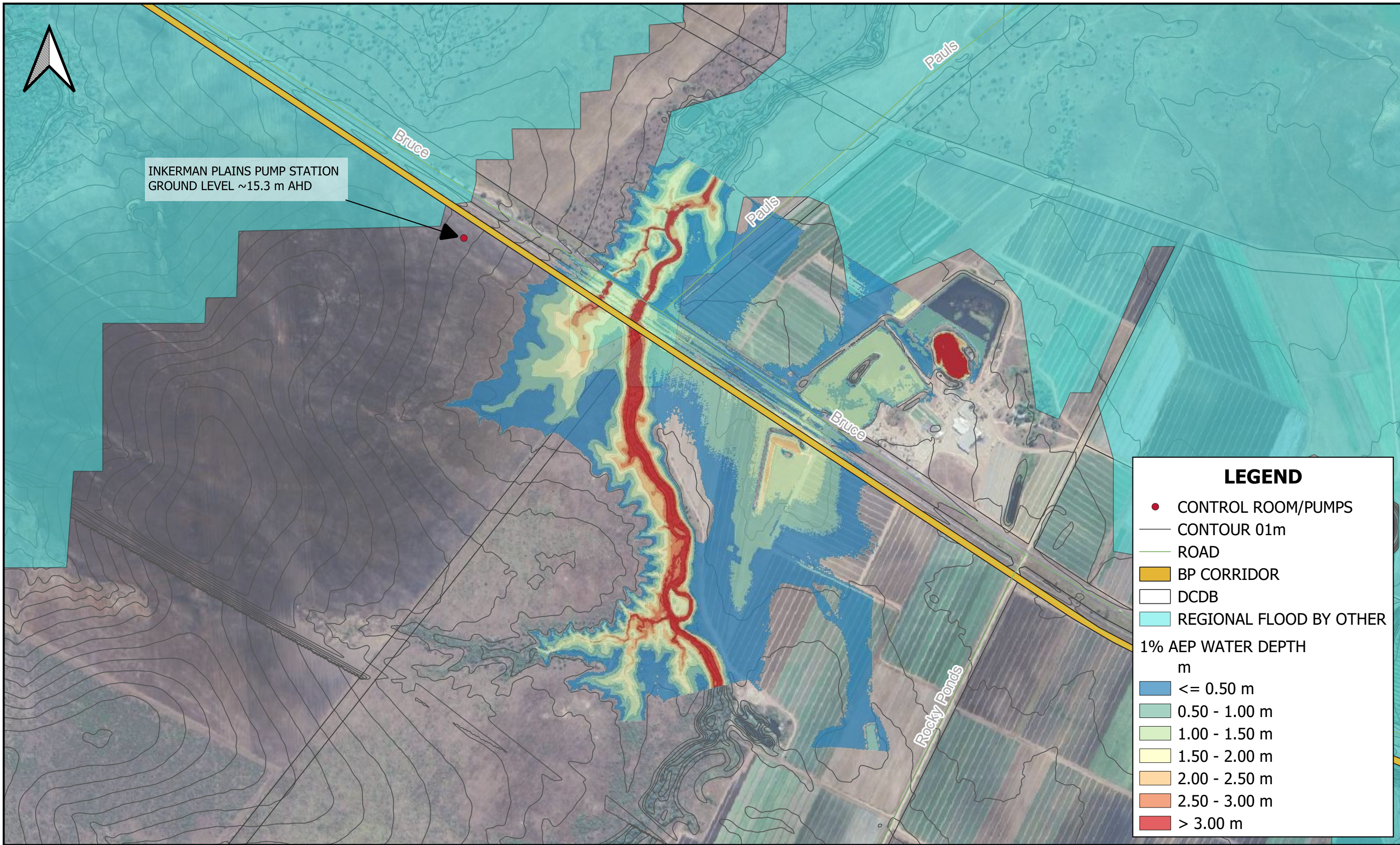


REV.	DATE
A	12/03/24

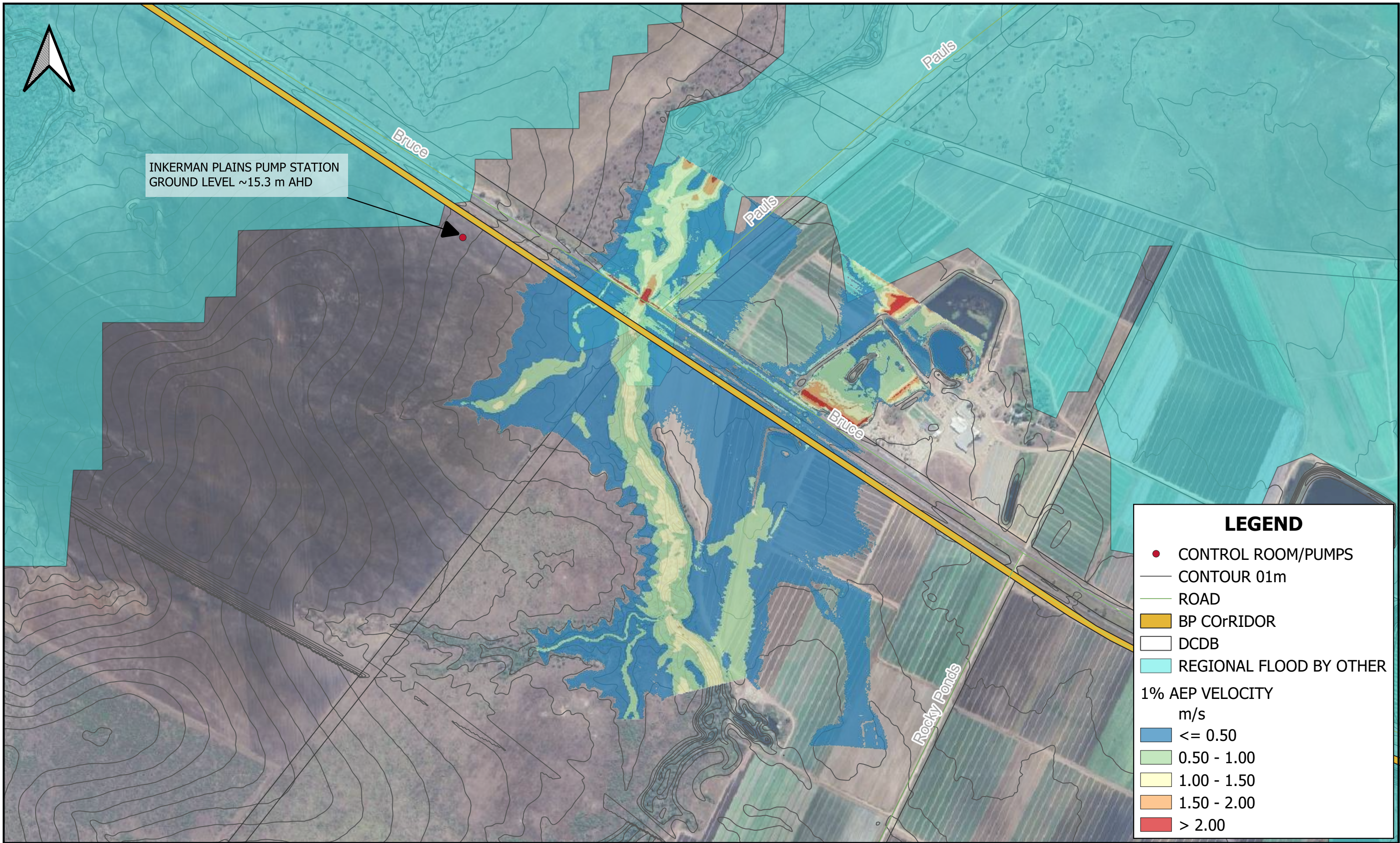


REV.	DATE
A	12/03/24

PROJECT: BOWEN PIPELINE PROJECT	DATE: MAR 2024
CLIENT: BOWEN PIPELINE COMPANY	PROJECT: 23- 0290
FIGURE: INKERMANSITE - 1% AEP PEAK WATER LEVEL	DRAWING: #C03

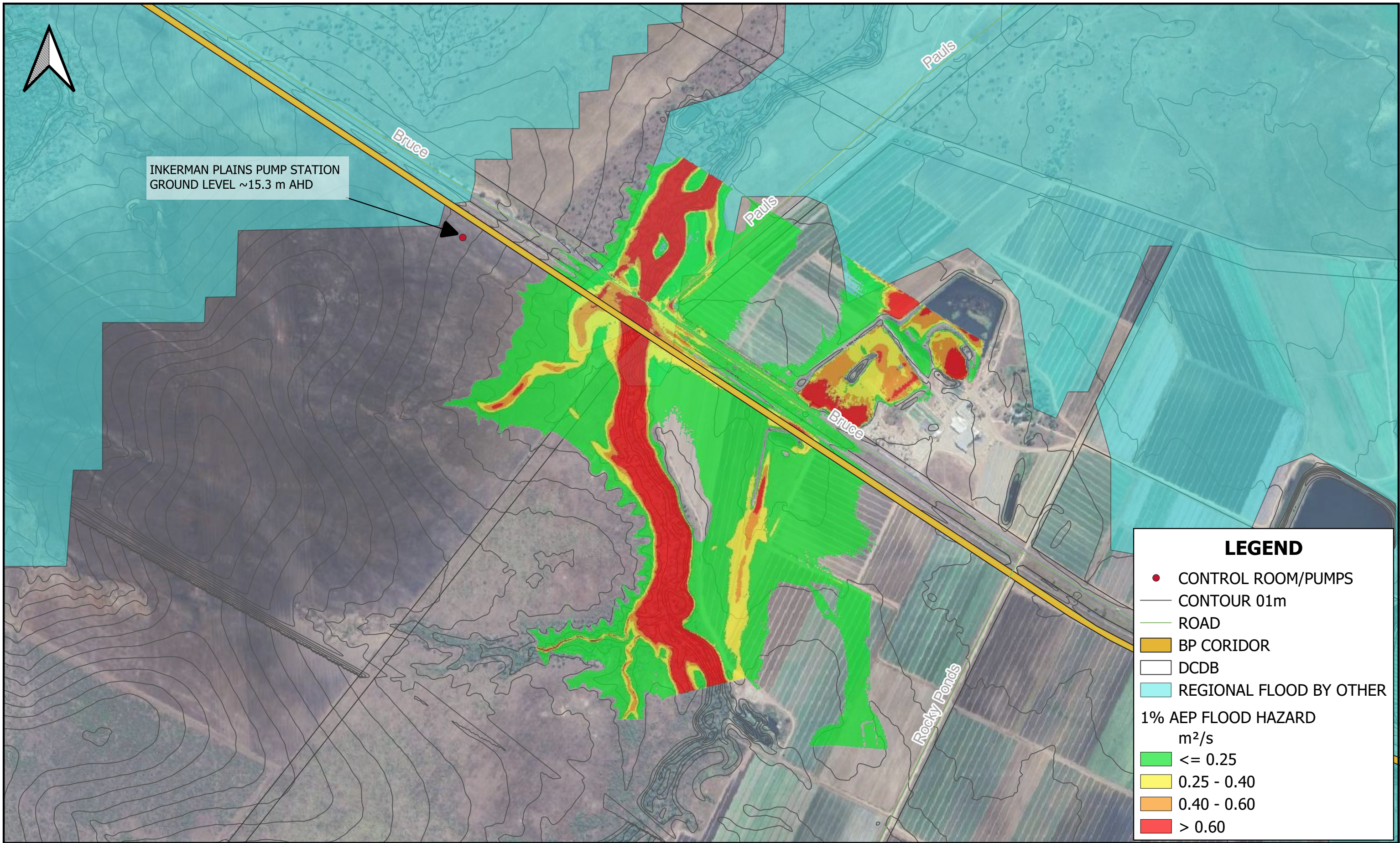


REV.	DATE
A	12/03/24



REV.	DATE
A	12/03/24

PROJECT: BOWEN PIPELINE PROJECT	DATE: MAR 2024
CLIENT: BOWEN PIPELINE COMPANY	PROJECT: 23- 0290
FIGURE: INKERMANSITE - 1% AEP MAXIMUM VELOCITY	DRAWING: #C05



REV.	DATE
A	12/03/24



APPENDIX D

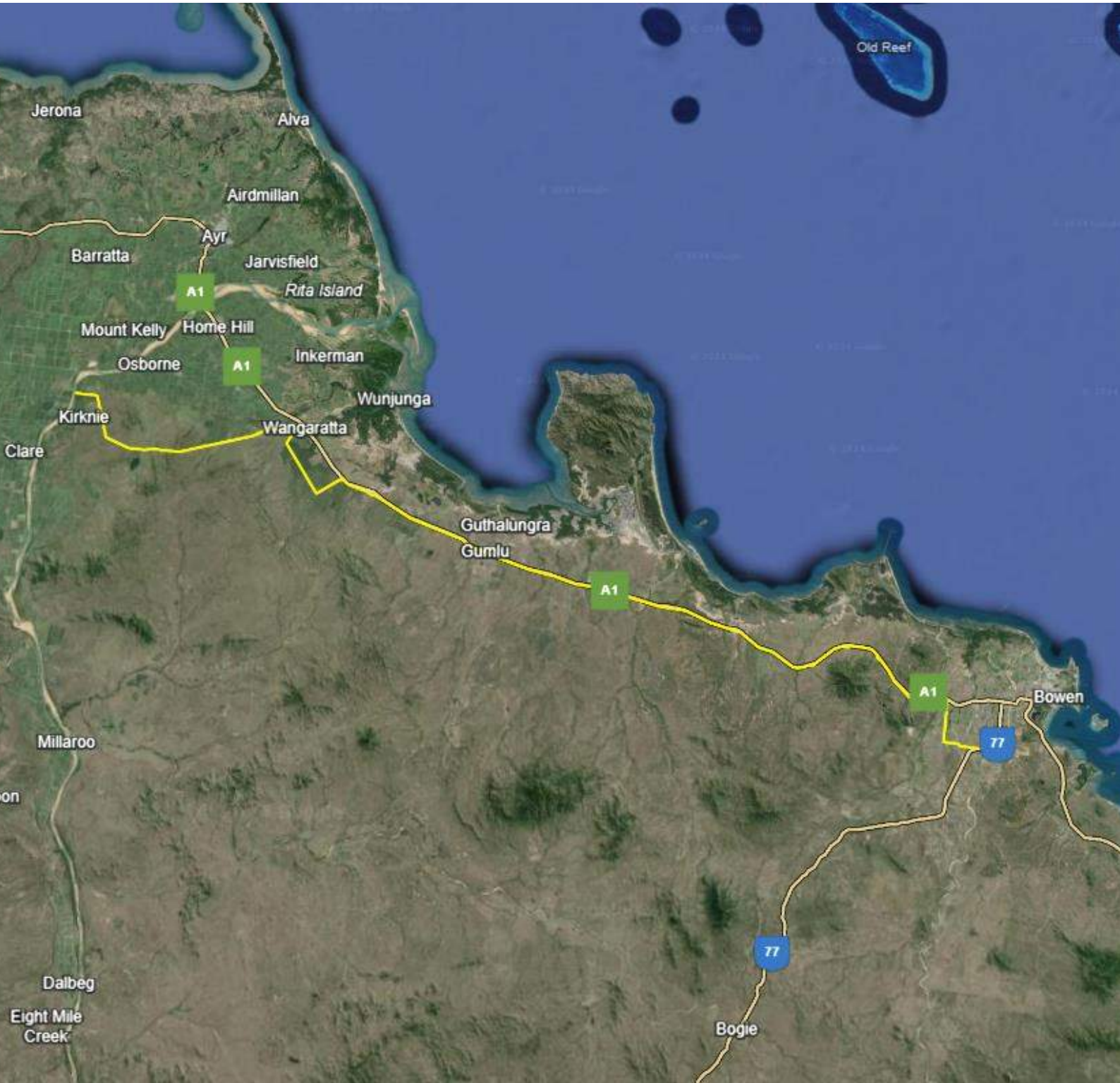
- SALISBURY PLAINS FLOOD STUDY





BOWEN PIPELINE PROJECT

SALISBURY PLAINS FLOOD STUDY



CLIENT: BOWEN PIPELINE COMPANY

DOCUMENT NUMBER: R3291

VERSION: B

DATE: 15-03-2024



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1 INTRODUCTION

Topo were engaged by Bowen Pipeline Company to undertake a Flood Study and assess the flood immunity requirements for pump stations and infrastructure associated with the Bowen Pipeline Project. The Bowen Pipeline Project is a 116 km underground water pipeline commencing 16 km upstream from Home Hill (Burdakin River) moving south to Bowen.

Flood search data was not available for the Salisbury Plains site, so this assessment has been undertaken to identify the peak water level associated with the 1 % Annual Exceedance Probability (AEP) event and determine the Defined Flood Level. The works proposed at Salisbury Plains are summarised in Appendix A.

1.1. GUIDELINES

This assessment has been prepared in accordance with:

- + *The Queensland Urban Drainage Manual* (IPWEAQ, 2017), and
- + *Australian Rainfall and Runoff* (Geoscience Australia, 2019).

1.2. REVISION

VERSION	DATE	AUTHOR	REVIEWED	APPROVED
A	12/03/2024	BS	SC	SC
B	15/03/2024	BS	SC	SC

2 HYDROLOGIC MODELLING

2.1. METHODOLOGY

Hydrologic modelling was undertaken using the XP-Storm software. The model represents the sub-catchments as a network of nodes linked by 1D sections extracted from LIDAR data. Each node is defined by its fraction impervious and average catchment slope. The net rainfall is routed through the network after appropriate losses (initial and continuing) and roughness factors are applied, resulting in a surface runoff hydrograph for each sub-catchment.

2.2. HYDROLOGY

The XP-Storm runoff-routing model has been used to estimate design flood discharges within the study area. The XP-Storm model was used to estimate the 1 % Annual Exceedance Probability (AEP) storm event for the 10 minute to 3 hour storm durations. The modelling undertaken as part of this assessment applies the Australian Rainfall and Runoff (ARR) 2019 hydrology. The XP-Storm Generator has been used, in conjunction with the Bureau of Meteorology (BOM) Intensity–Frequency–Duration (IFD) program and the ARR Data Hub to generate the rainfall intensities and temporal patterns for the site. By applying the ARR 2019 hydrologic methods, we have ensured this study is providing the best available information on design flood estimation.

2.3. RAINFALL DATA

Obtaining an estimated rainfall depth for a specified probability is an essential component of the design of infrastructure including. Design rainfalls are a probabilistic or statistically-based estimate of the likelihood of a specific rainfall depth being recorded at a particular location within a defined duration. This is generally classified by an AEP or Exceedances per Year (EY). Design rainfalls are therefore not real rainfall events, rather they are values that are probabilistic in nature.

The 2016 IFD design rainfalls are provided for use in conjunction with the 2019 edition of *Australian Rainfall and Runoff* (2019) <http://arr.ga.gov.au/arr-guideline> . Table 1 presents the AEP and EY rainfall data for the site with values reported in mm/hr.



Table 1 – BOM Intensity Frequency Duration Data (mm/hr)

Duration in min	63.20% AEP	50 % AEP	20 % AEP	10% AEP	5% AEP	2% AEP	1% AEP
10	93.8	107	148	174	198	228	250
15	81.1	92.7	128	150	171	197	216
20	71.9	82.3	113	133	151	175	191
25	65	74.4	103	120	137	158	173
30	59.5	68.2	94	110	126	145	159
45	48.1	55.1	76.4	90	103	118	130
60	40.7	46.8	65.2	77	88	102	112
90	31.8	36.7	51.4	61	70.1	81.5	89.9
120	26.4	30.5	43.2	51.4	59.3	69.3	76.7
180	20.1	23.4	33.5	40.1	46.5	54.9	61.2
270	15.2	17.8	25.8	31.2	36.4	43.4	48.8
360	12.5	14.6	21.4	26.1	30.6	36.7	41.5

Grid cell: Latitude -19.8375(S) Longitude 147.5875(E)

2.4. CATCHMENT CHARACTERISTICS

The representation of a catchment in a flood hydrograph estimation model is, by necessity, highly conceptualised and aims to represent those features and characteristics most influential in determining the overall flood response of the catchment. The distribution of storm rainfall over different parts of the catchment and the flood response to it may vary considerably, depending on the details of topography, vegetation cover, land use and drainage network characteristics. A catchment of approximately 360 ha has been identified as part of this assessment and has been further sub-divided to enable the flood regime of the site to be accurately determined. 23 sub-catchments were delineated as illustrated in Figure 1. However, as the assessment continued and further details were provided, it became clear that a number of these catchments would not contribute to the flooding over the proposed works area. The catchments applied to the hydraulic modelling are highlighted in Figure 1.

2.4.1. HYDROLOGIC MODELLING ROUGHNESS COEFFICIENTS

For hydrological purposes within XP-SWMM, Manning's n roughness values have been applied to represent the catchment. These values have been varied and defined for the pervious and impervious portions of the catchment. The following values have been adopted and while conservative for the pervious (vegetated) areas, are shown to correlate well with the results of the Rational Method comparison. Refer to Section 2.5 for further discussion in relation to these assumptions.

- + Impervious $n = 0.014$
- + Pervious $n = 0.045$ (average grass)

2.4.2. RAINFALL LOSSES FOR XP-SWMM

Initial Loss (IL) and Continuing Loss (CL) rates applied to the modelling are summarised below. The loss rates are high, but it is noted there is a high pre-burst rainfall depth at this location and therefore the initial loss is also quite high. These adopted loss rates are consistent with the ARR Data Hub recommendations.

- + Initial Loss, impervious IL = 1 mm CL = 0 mm/hr
- + Initial Loss, pervious IL = 57 mm CL = 5.6 mm/hr



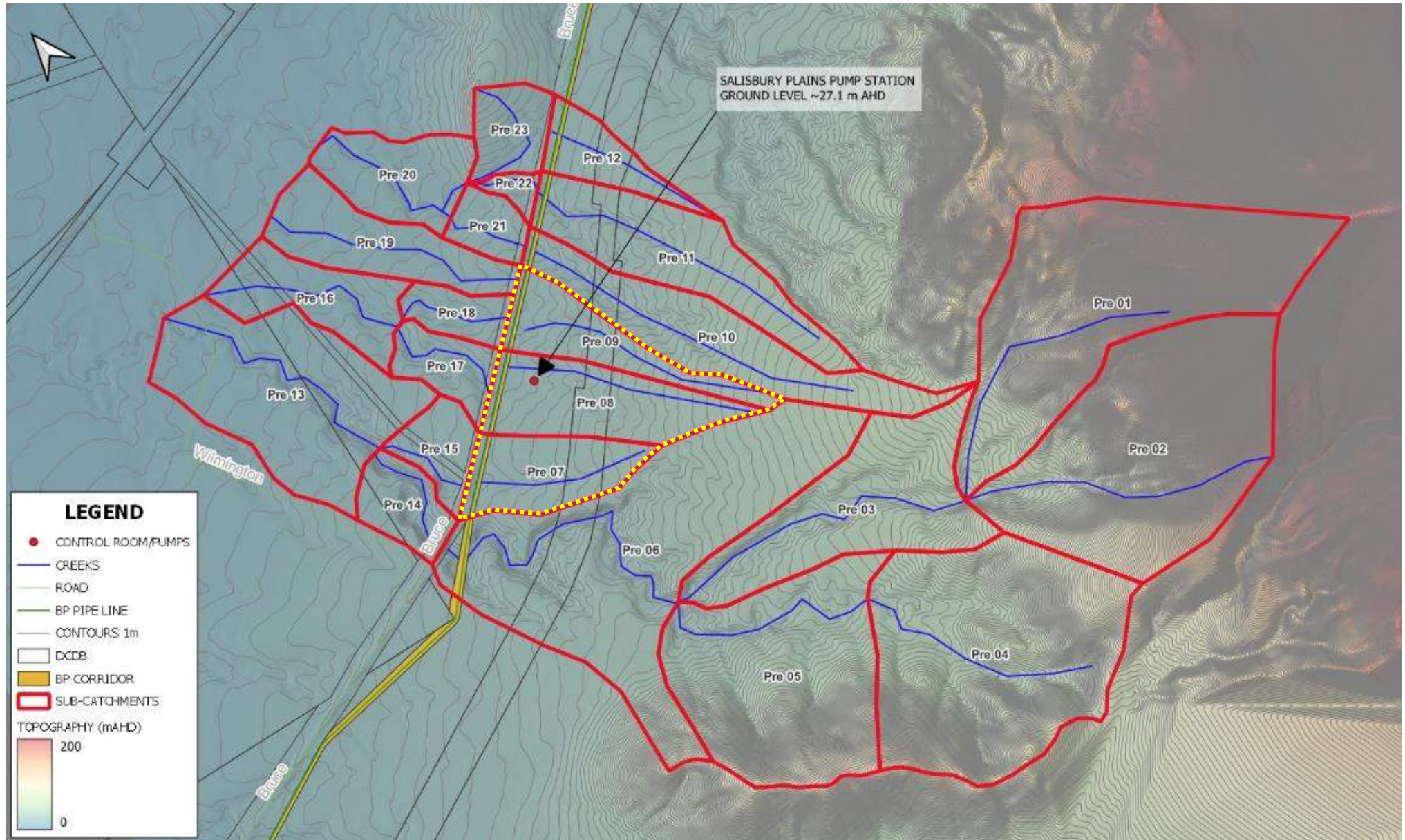


Figure 1 – Salisbury Plains Catchment Plan

Table 2 – Catchment Details Applied to Hydrologic Assessment

CATCH ID	IMPERVIOUS AREA (ha)	PERVIOUS AREA (ha)	FRACTION IMPERVIOUS	SLOPE (%)
PRE 07	0.476	9.044	5	5
PRE 08	0.665	12.644	5	5
PRE 09	0.454	8.631	5	3

2.5. RATIONAL METHOD COMPARISON

A comparison of the peak flow rates provided by the XP-Storm model and the Rational Method has been undertaken. The results of this comparison of 1 % AEP event are summarised in Table 3.

Table 3 – Rational Method vs XP-SWMM Peak Flow Comparison

CATCHMENT	RATIONAL METHOD (m ³ /s)	XP (m ³ /s)	DURATION/STORM NO.	DIFFERENCE
PRE 07	3.616	3.215	45min_8	-11.1
PRE 08	4.715	4.159	45min_9	-11.8
PRE 09	3.148	2.740	1hr_8	-12.9

3 HYDRAULIC MODELLING

TUFLOW was used to undertake hydraulic modelling, utilising the design hydrographs from XP discussed in Section 2 as inputs into the hydraulic model. External catchments were applied to the model at relevant locations within the TUFLOW model as flow area polygons, as illustrated in Figure 2. To ensure an accurate flow regime through the site was obtained, the rain-on-grid (ROG) model was applied. Additional details in relation to the TUFLOW model are summarised below.

- + LIDAR data from the Elvis - Elevation and Depth - Foundation Spatial Data website was applied to create the surface file over the site and surrounding areas.
- + Manning's n roughness values across the site as described in Section 3.2.
- + A cell size of 2 m was applied to the simulation area.
- + A free-flowing Flow versus Height (QH) boundary at the downstream model extent. Note, there is no impacts of any external regional flooding from downstream areas and therefore for then use of the QH boundary is appropriate.
- + Initial water levels applied to farm dams so the storage volume associated with them is removed from the model.

3.1. BRUCE HIGHWAY CROSSING

No details were available at the time of preparing this assessment for the drainage infrastructure crossings of the Bruce Highway. Based on an assessment of the LIDAR data and aerial photography, 7 crossing locations were identified as needing to be taken into consideration. Refer to Figure 2 and Appendix B for further details in relation to the topography in these locations. Table 4 provides a summary of the culvert details that were applied to the modelling as 1D links. Inlet and exit losses of 0.5 and 1.0 respectively were applied to these structures.

3.2. ROUGHNESS COEFFICIENTS (2D MODELLING)

The following values have been adopted and applied to the surface for the existing scenario:

- + Road n = 0.015
- + Scattered trees and grass (majority of site) n = 0.06
- + Drainage lines n = 0.045 to 0.060



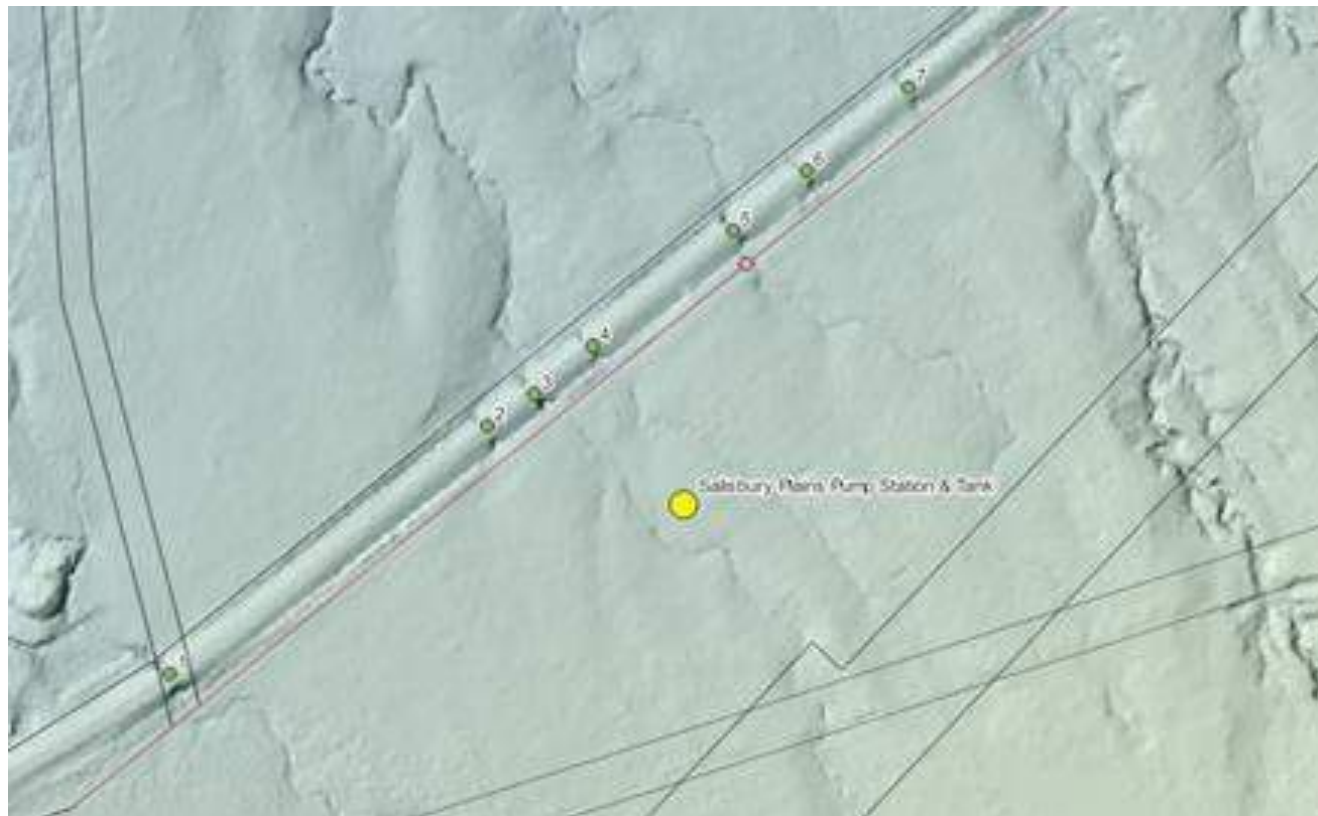


Figure 2 – Bruce Highway Culvert Locations

Table 4 – Estimated Culvert Sizes

LOCATION	ESTIMATED WIDTH (m)	SIZE (m)/SHAPE	NUMBER
1	~1	1.2 Circular	1
2	~2	0.9 Circular	2
3	~2	1.2 Circular	2
4	~2	0.9 Circular	1
5	~1	0.75 Circular	1
6	~1	0.9 Circular	1
7	~1	0.75 Circular	1

The TUFLOW model feature map is provided as Figure 3, including the 1D elements representing the culverts, RoG extents and downstream boundary location.

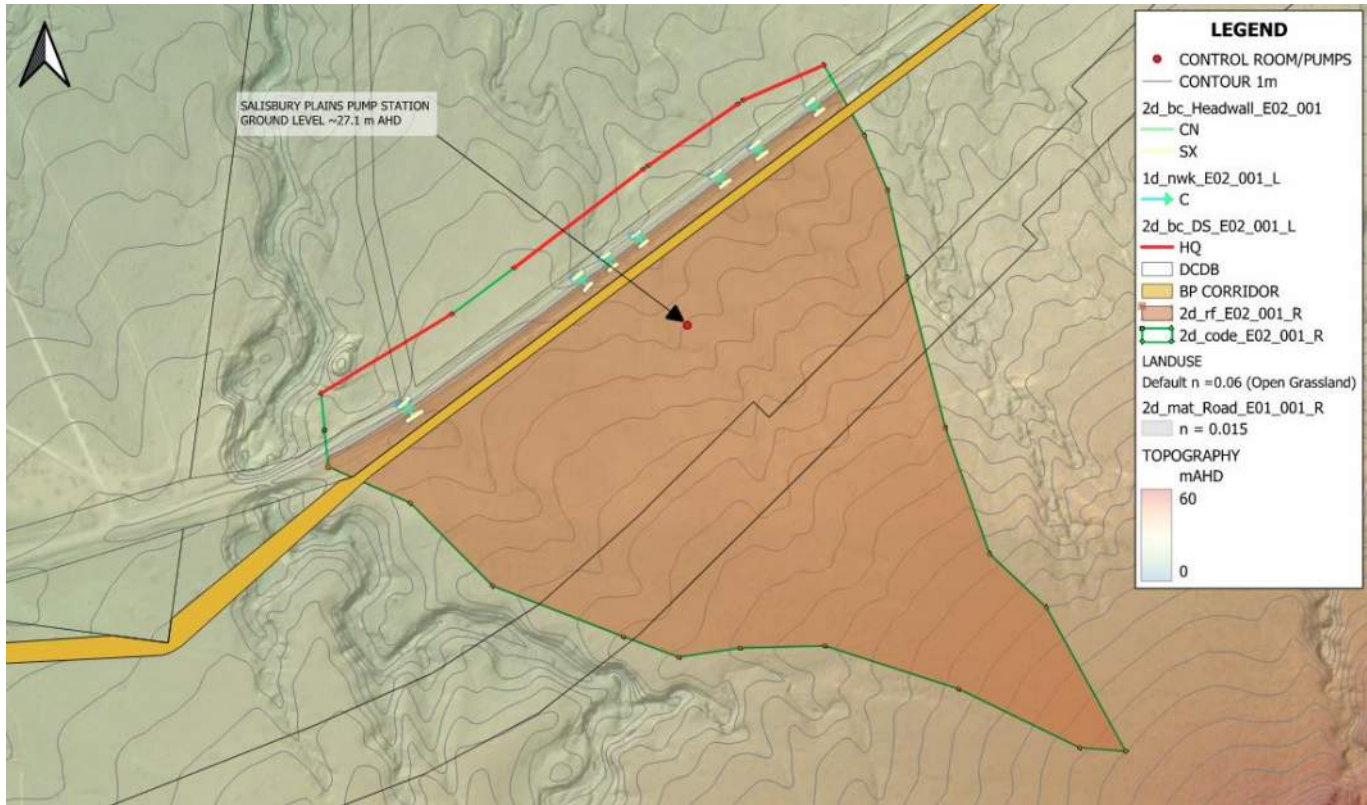


Figure 3 - TUFLOW Feature Map

3.3. RESULTS

The results of the flood model for the pre-development scenario have been extracted for the 1 % AEP for the critical storm durations. The full set of flood maps is provided within Appendix C including:

- + Peak Water Level,
- + Maximum Depth
- + Maximum Velocity, and
- + Hazard
 - Hazard mapping is represented as the velocity-depth product.

A full set of plans, including catchment map, TUFLOW model features and flood maps is included as Appendix C.

3.3.1. DEFINED FLOOD LEVEL (DFL)

An extract from the peak water level map for the site is provided as Figure 4. Based on the modelling undertaken, the peak water level is approximately 26.91 m AHD, and has been nominated as the DFL. It is noted the existing ground level at this location is 27.1 m AHD, so there is expected to be no issues with flooding for the proposed infrastructure, up to and including the 1 % AEP and slightly beyond.

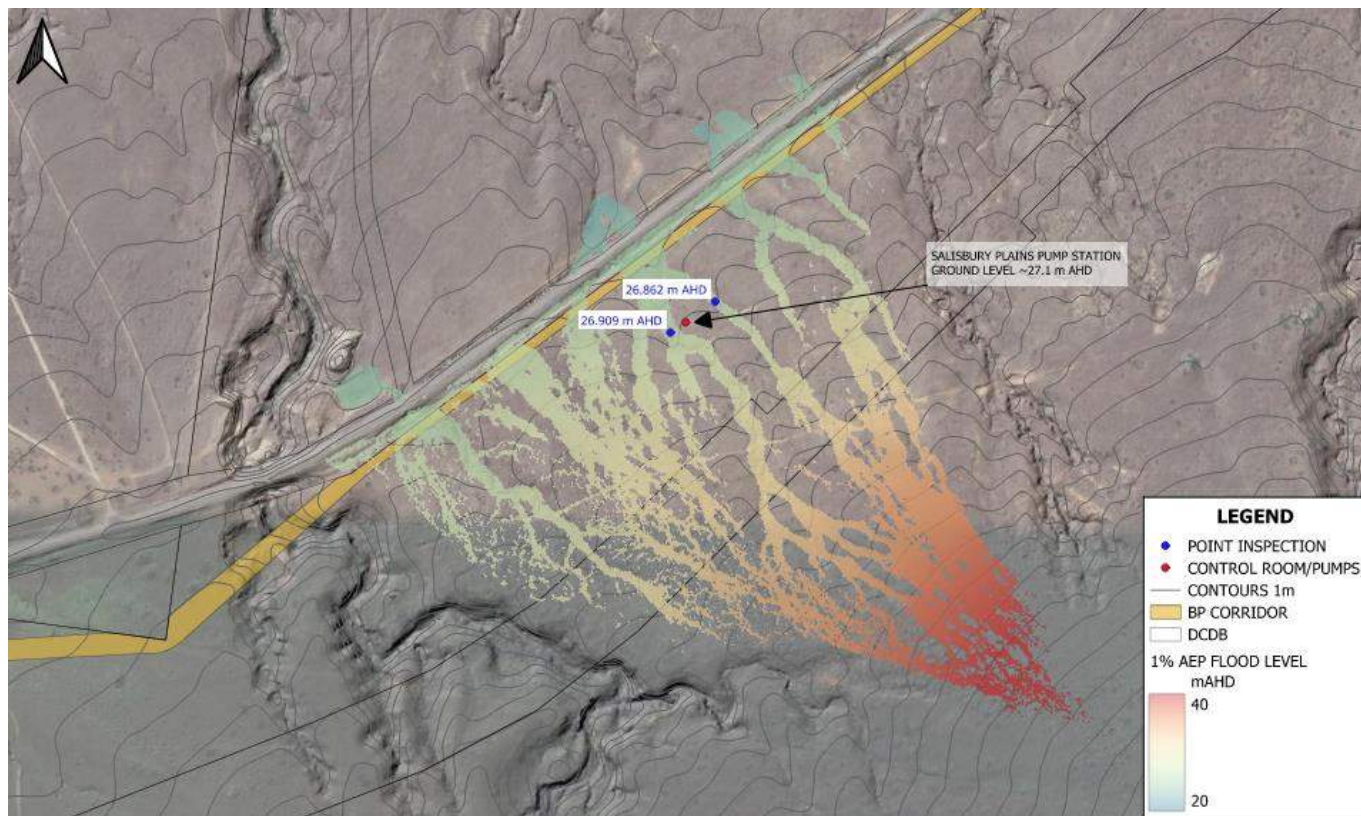


Figure 4 – 1 % AEP Peak Water Level

4 CERTIFICATION

This report and associated modelling have been prepared by Steven Chamberlain of Topo (RPEQ 15,545).

Signature:

Date: 15-03-2024



APPENDIX A

- PROPOSED SITE LAYOUT



REFER DRAWING 8704 E BPI6



LEGEND

- CONCEPT PIPELINE ALIGNMENT
- EXTENT OF PIPELINE CORRIDOR
- QLD DCDB
- NORTH COAST RAIL NETWORK
- MINOR WATERWAY
- MAJOR WATERWAY

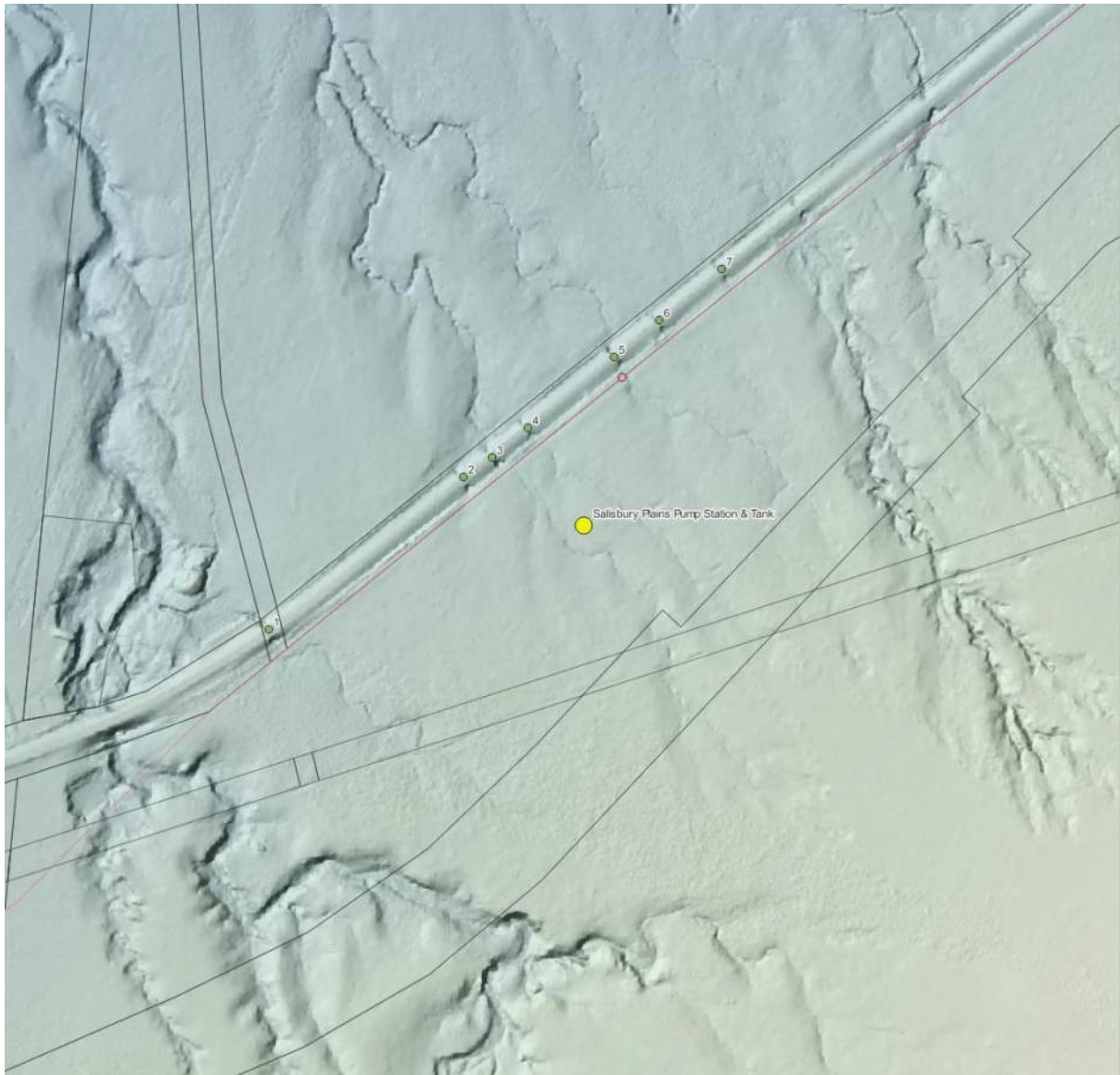
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B	2021 SEPTEMBER UPDATES	7/09/2021	TC	SB	8704 E BPI7 I	
C	2021 NOVEMBER UPDATES	5/11/2021	TC	SB		
D	INTAKE LOCATION UPDATE	16/08/2022	TC	SB		
E	TMR RFI	28/11/2022	TC	SB	SHEET No. 17	VERSION I
F	2023 MARCH UPDATES	22/03/2023	TC	SB	PROJECT No. 8704	
G	2023 NOVEMBER UPDATES	6/11/2023	TC	SB		
H	2023 DECEMBER UPDATES	6/02/2024	TC	SB		
I	INTAKE LOCATION UPDATE	23/02/2024	TC	SB		



APPENDIX B

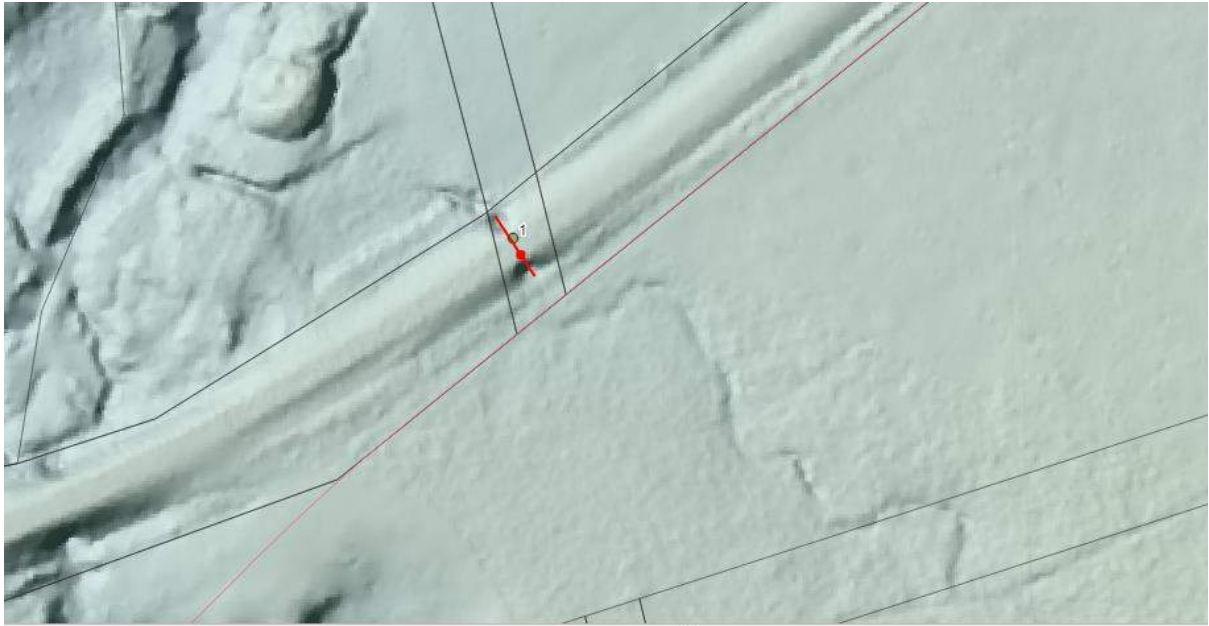
- CULVERT ASSUMPTIONS





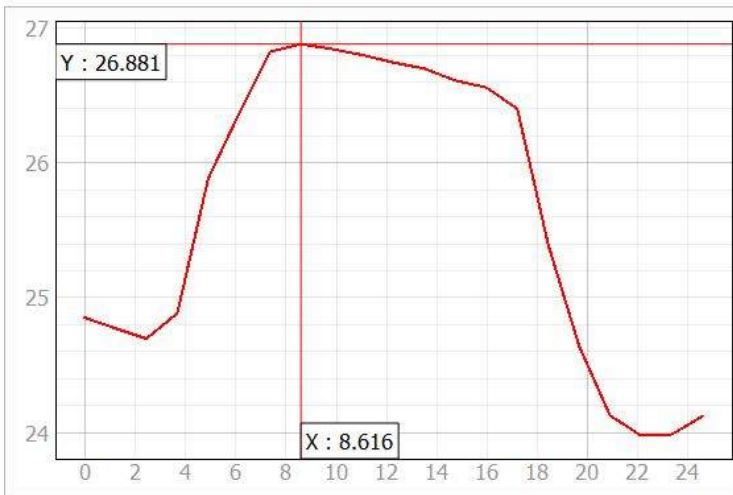
Estimated culvert sizes

Culvert	Width (from QLD Globe)	Size (m)	# of
1	~1m	1.2m Circular	1
2	~2m	0.9 C	2
3	~2m	1.2 C	2
4	~2m	0.9 C	1
5	~1m	0.75 C	1
6	~1m	0.9 C	1
7	~1m	0.75 C	1



le Tool

rofile Table Settings



27.05
maximum
23.81
minimum

	Layer	Base
1	salisbury	1

Add Layer R

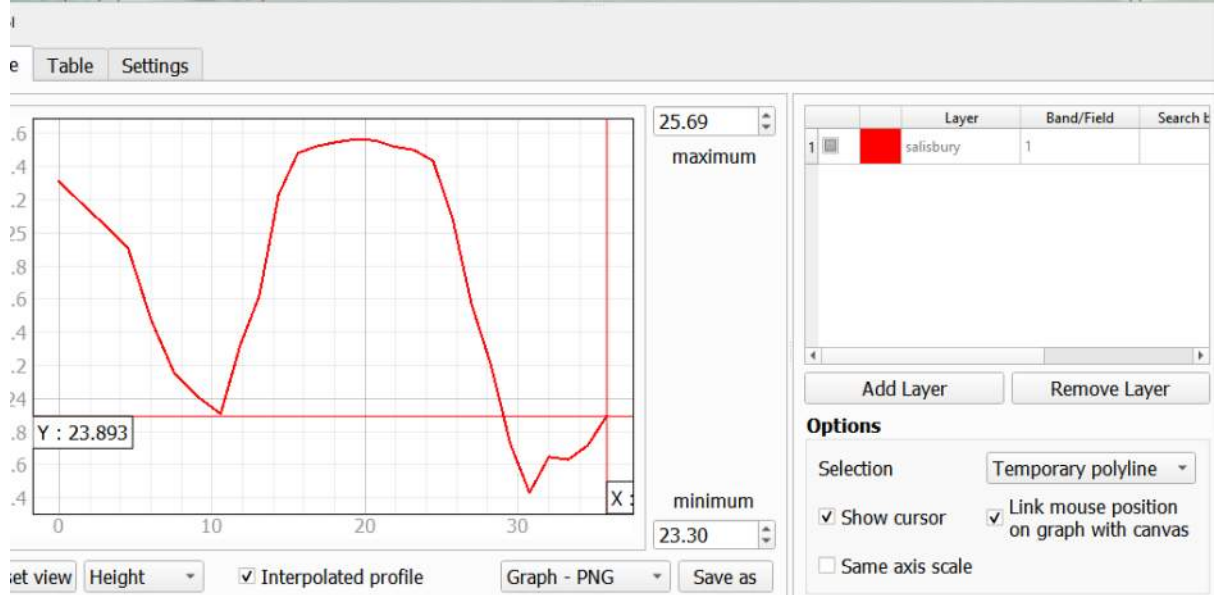
Options

Selection Temporal

☒ Show cursor ☒ Link n on gra

☐ Same axis scale

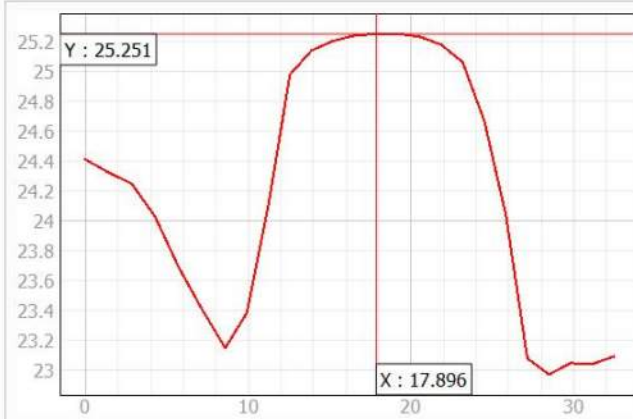
Reset view Height ☐ Interpolated profile Graph - PNG Save as





Profile Tool

Profile Table Settings



25.39
maximum

minimum
22.84

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Add Layer Remove Layer

Options

Selection Temporary polyline
☒ Show cursor ☒ Link mouse position on graph with canvas
☐ Same axis scale

Reset view

Height

☒ Interpolated profile

Graph - PNG

Save as



Profile Tool

Profile Table Settings



25.22
maximum
23.16
minimum

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Add Layer Remove Layer

Options

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☒ Show cursor ☒ Link mouse position on graph with canvas

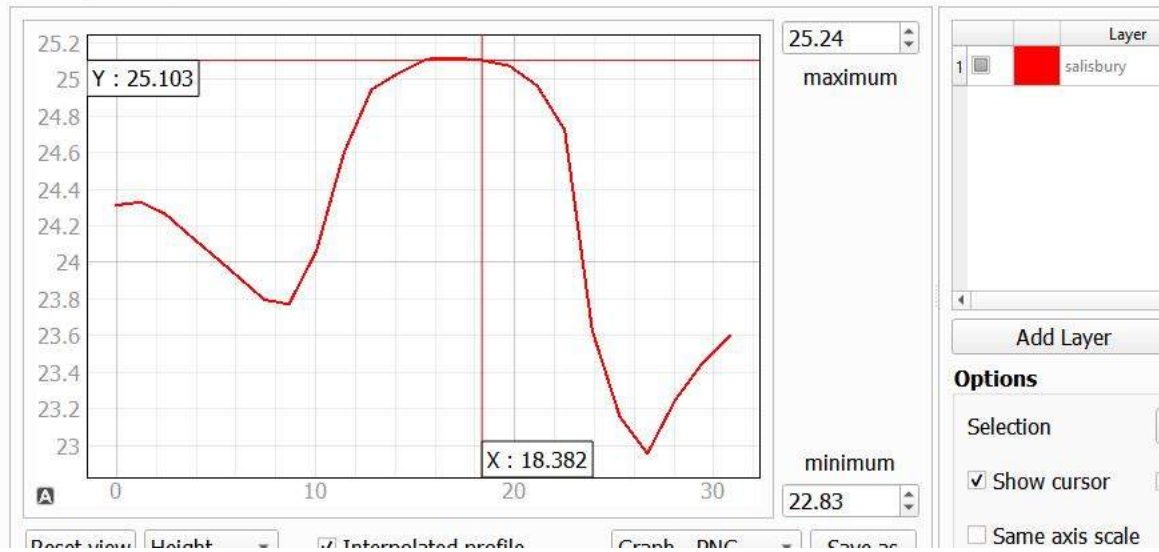
☐ Same axis scale

Reset view Height ☐ Interpolated profile Graph - PNG Save as



Profile Tool

Profile Table Settings





Profile Tool

Profile Table Settings



25.28
maximum

minimum
23.63

Reset view

Height

☒ Interpolated profile

Graph - PNG

Save as

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Add Layer

Options

Selection

☒ Show cursor

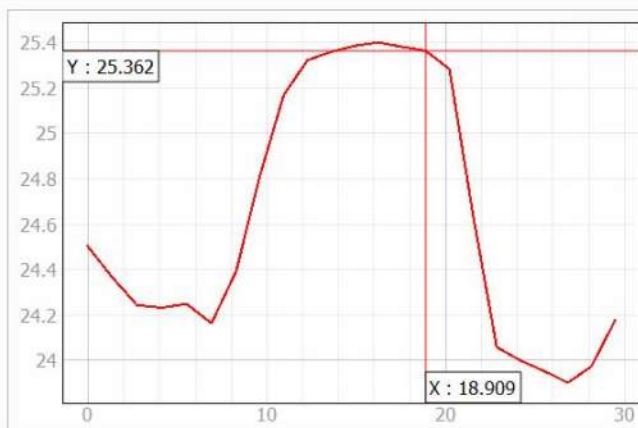
☒ Link n on gra

☐ Same axis scale



Profile Tool

Profile Table Settings



25.49
maximum

minimum
23.81

Reset view Height ☐ Interpolated profile Graph - PNG Save as

Layer	Band/Field	Search
1	salisbury	1

Add Layer Remove Layer

Options

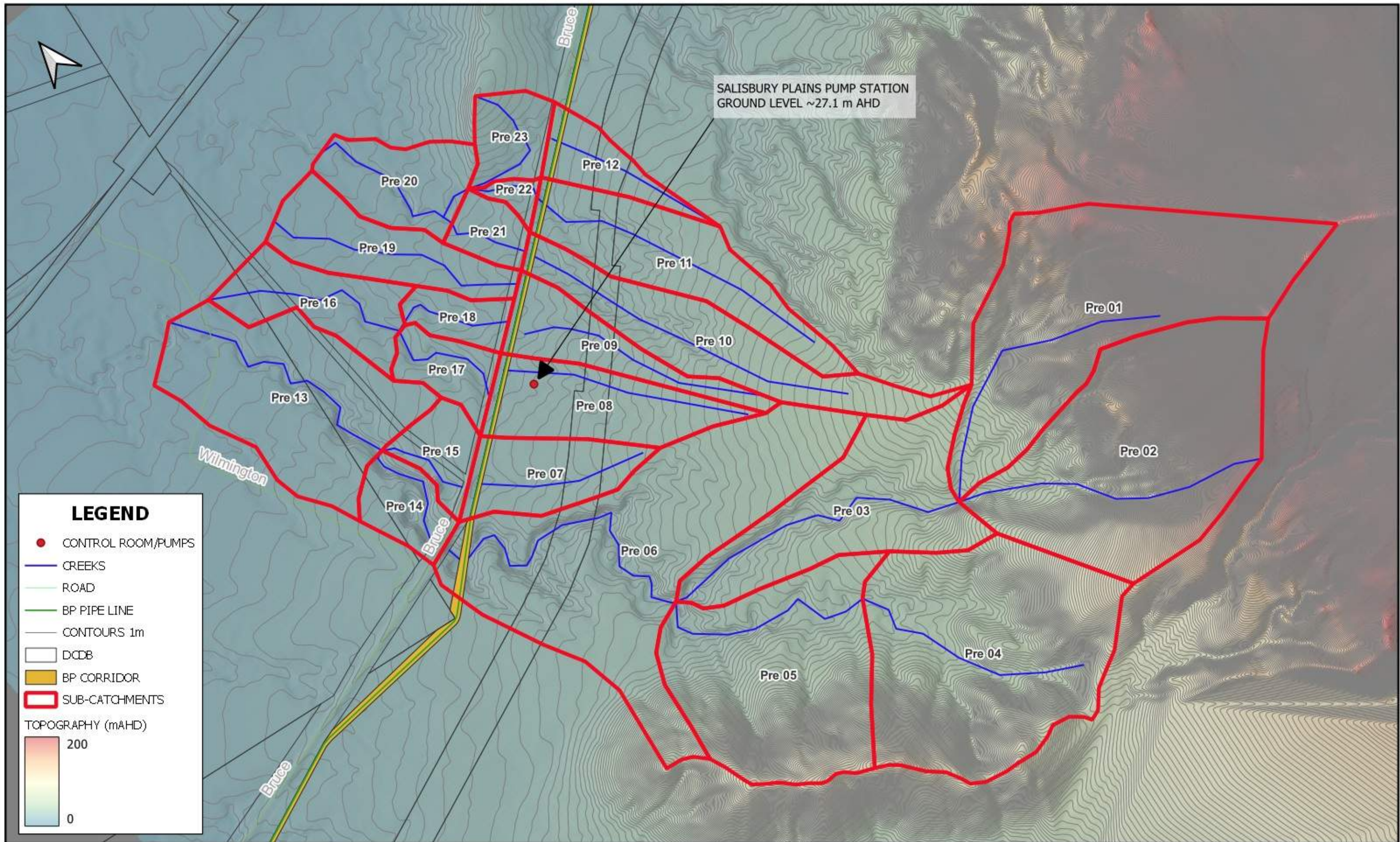
Selection Temporary polyline ☐ Show cursor ☒ Link mouse position on graph with canvas ☐ Same axis scale



APPENDIX C

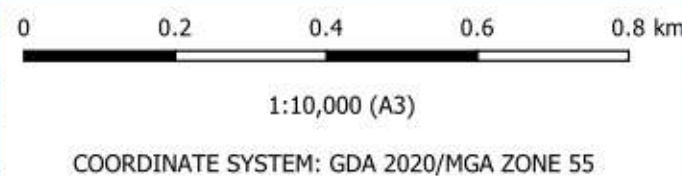
- MODEL SETUP & FLOOD MAPS





Topo Group Pty Ltd.
Unit 7, 16 Innovation Parkway
Birtinya, Queensland. 4575.

REV.	DATE
A	13/03/24



PROJECT: BOWEN PIPELINE PROJECT

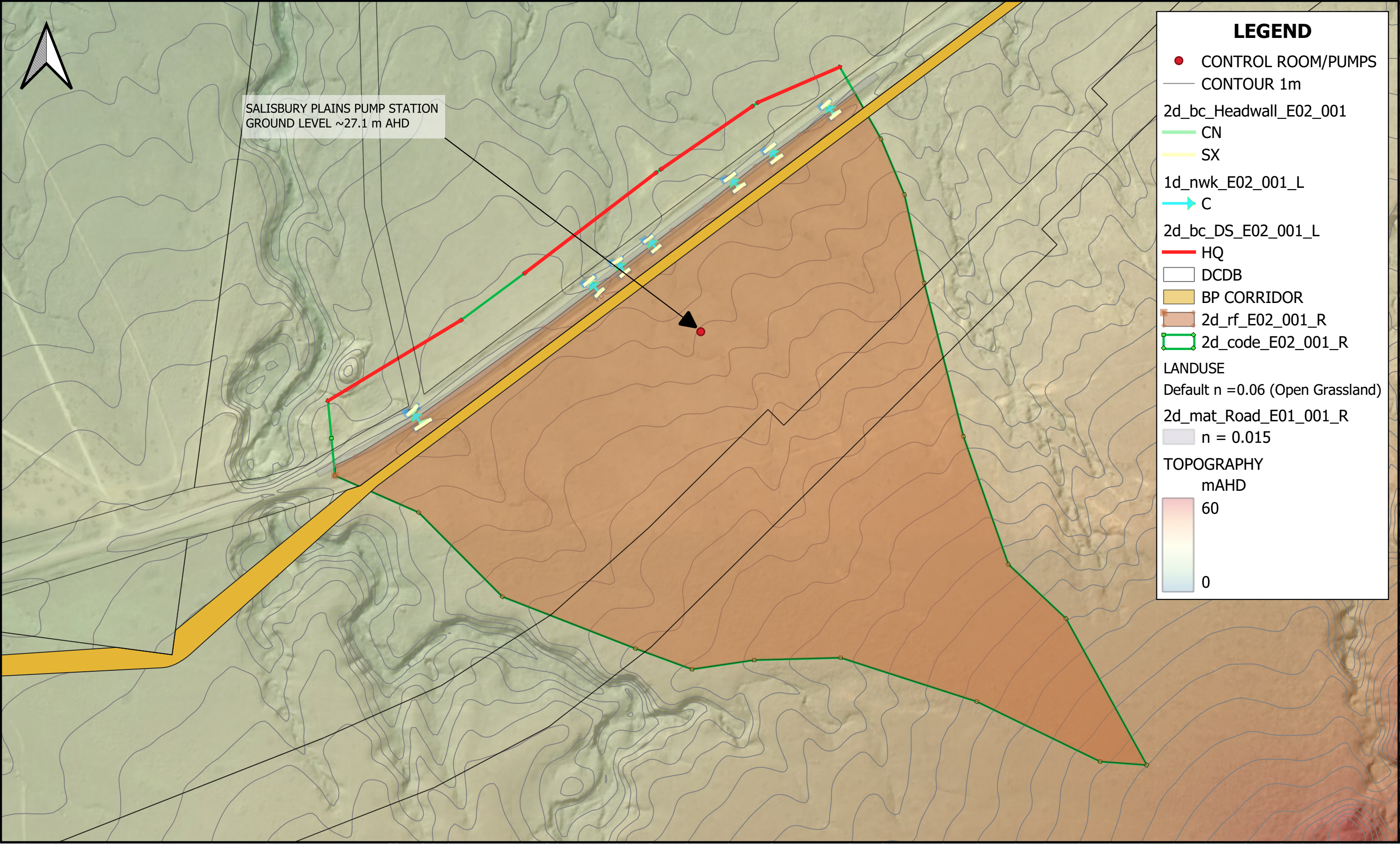
CLIENT: BOWEN PIPELINE COMPANY

FIGURE: SALISBURY SITE - CATCHMENT PLAN

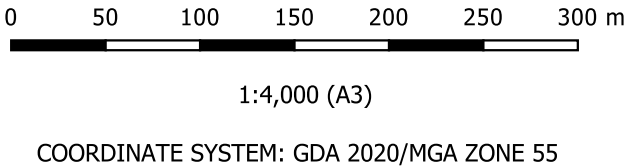
DATE:
Mar 2024

PROJECT:
23- 0290

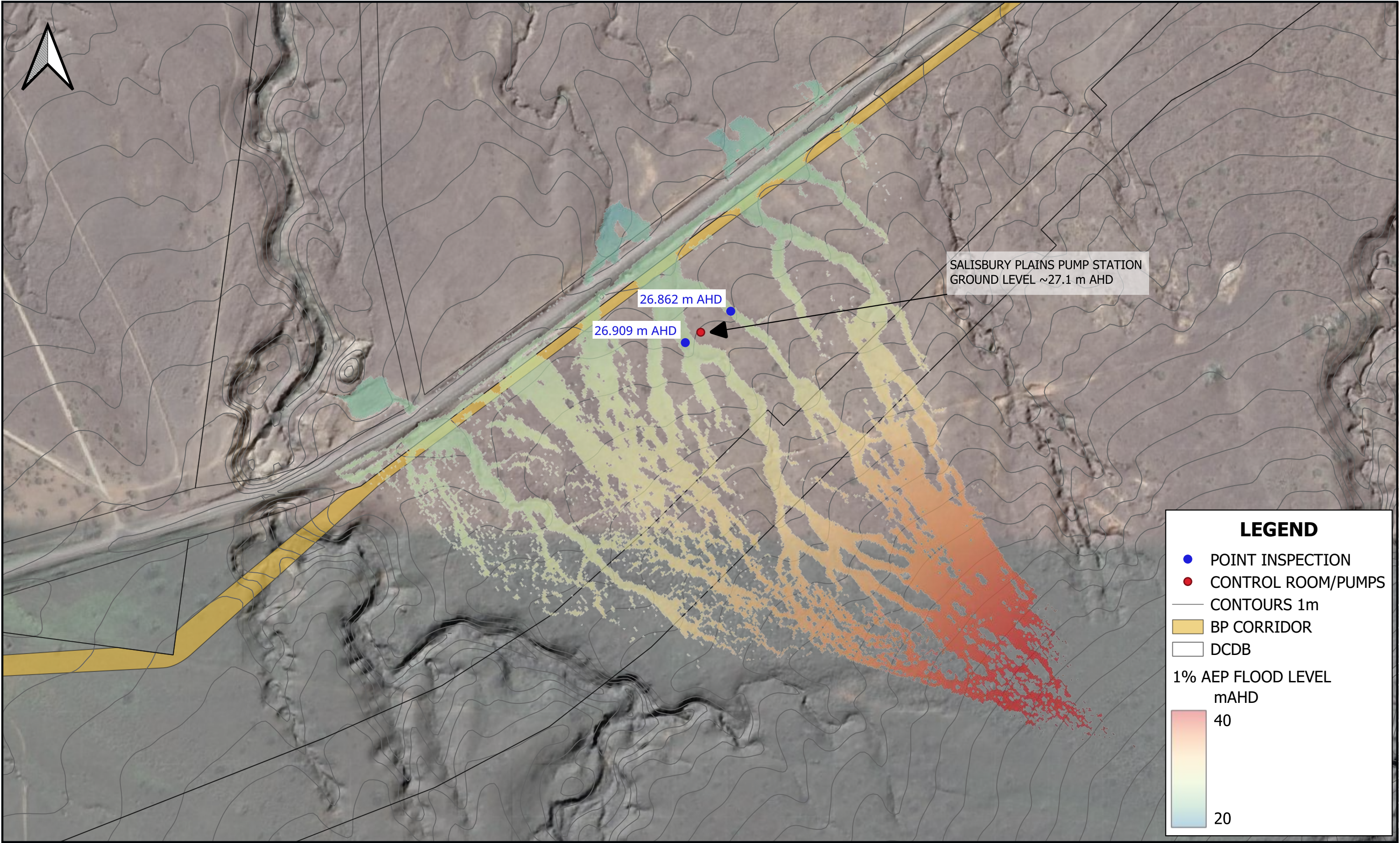
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#D01



REV.	DATE
A	13/03/2024



PROJECT: BOWEN PIPELINE PROJECT	DATE: MAR 2024
CLIENT: BOWEN PIPELINE COMPANY	PROJECT: 23- 0290
FIGURE: SALISBURY SITE - TUFLOW CONFIGURATION	DRAWING: #D02



LEGEND

- POINT INSPECTION
- CONTROL ROOM/PUMPS
- CONTOURS 1m
- BP CORRIDOR
- DCDB

1% AEP FLOOD LEVEL
mAHd

40

20



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Birtinya, Queensland. 4575.

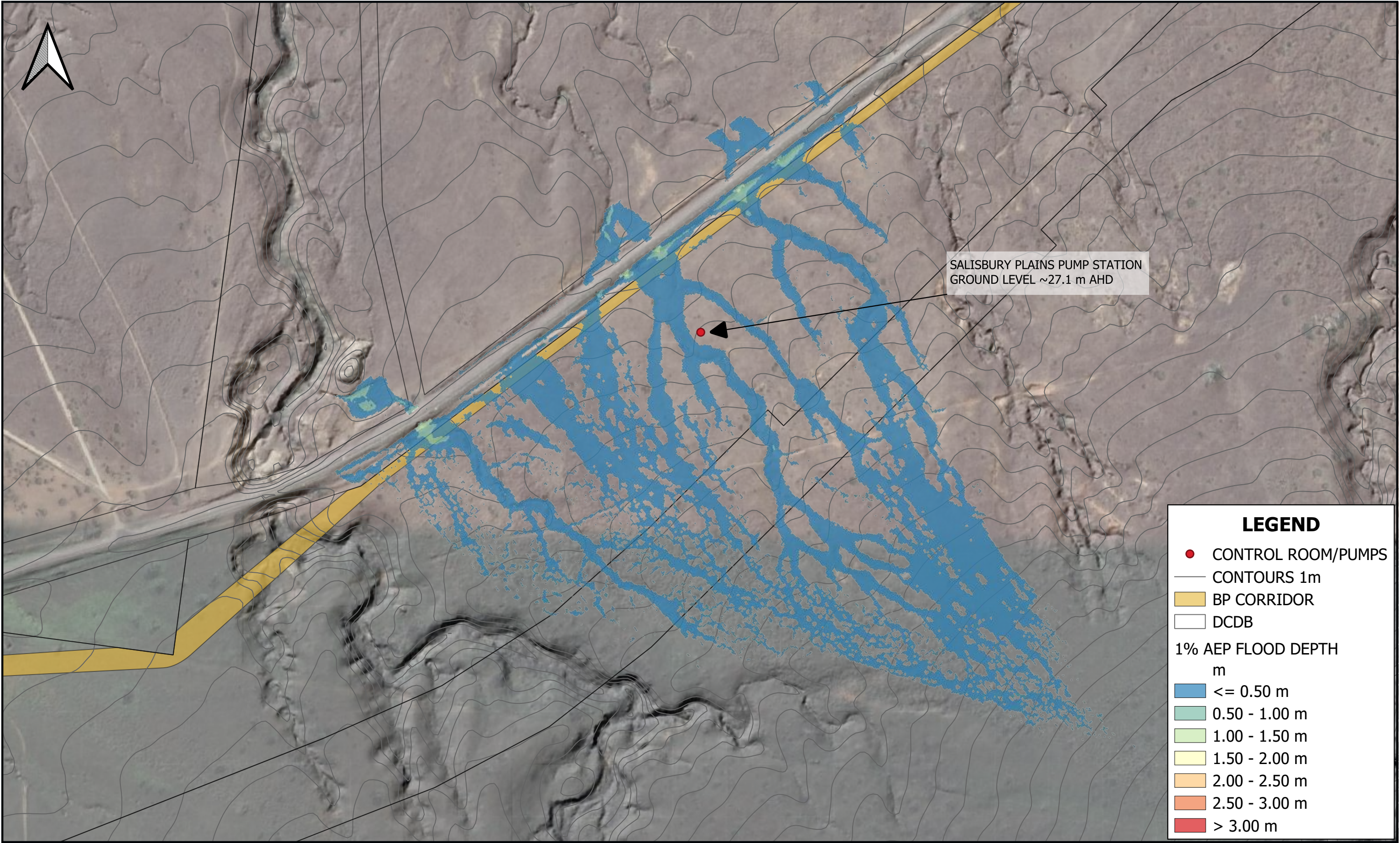
REV.	DATE
A	13/03/2024

0 50 100 150 200 250 300 m

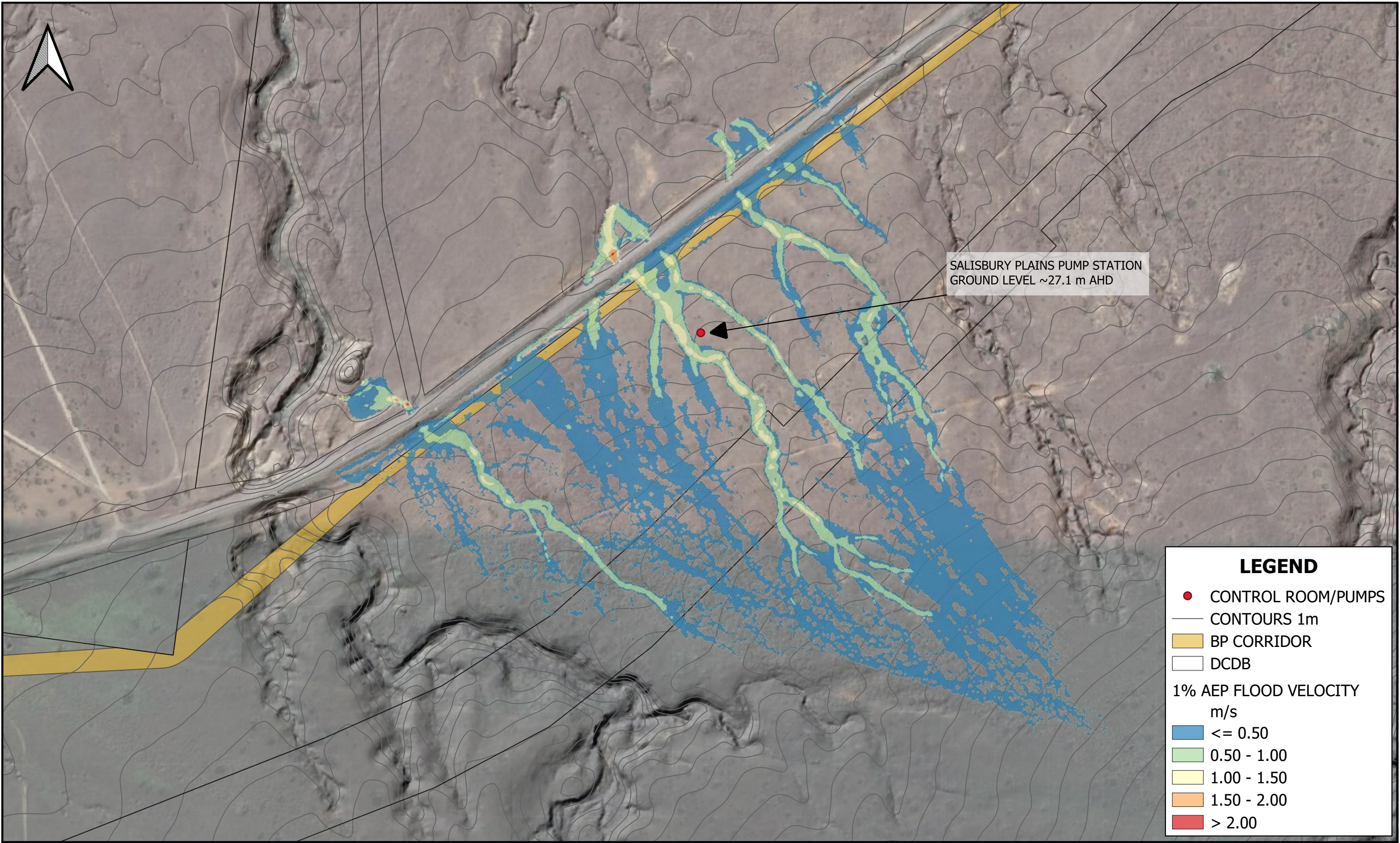
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COORDINATE SYSTEM: GDA 2020/MGA ZONE 55

PROJECT: BOWEN PIPELINE PROJECT	DATE: MAR 2024
CLIENT: BOWEN PIPELINE COMPANY	PROJECT: 23- 0290
FIGURE: SALISBURY SITE - 1% AEP PEAK WATER LEVEL	DRAWING: #D03

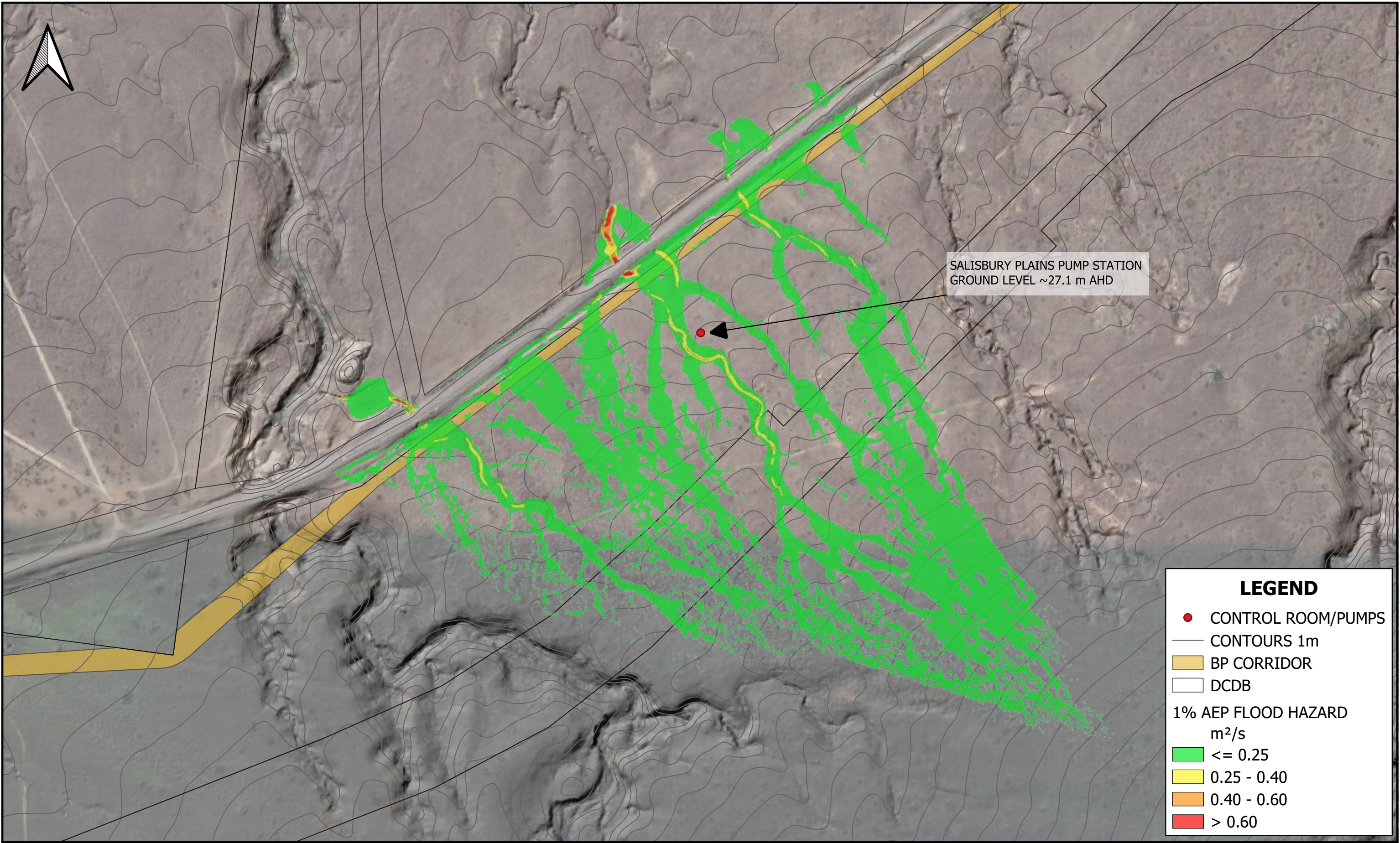


REV.	DATE
A	13/03/2024



REV.	DATE
A	13/03/2024

PROJECT: BOWEN PIPELINE PROJECT	DATE: MAR 2024
CLIENT: BOWEN PIPELINE COMPANY	PROJECT: 23- 0290
FIGURE: SALISBURY SITE - 1% AEP MAXIMUM VELOCITY	DRAWING: #D05



LEGEND

- CONTROL ROOM/PUMPS
- CONTOURS 1m
- BP CORRIDOR
- DCDB

1% AEP FLOOD HAZARD
m²/s

- ≤ 0.25
- 0.25 - 0.40
- 0.40 - 0.60
- > 0.60



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REV.		DATE
A		13/03/2024

050100150200250300 m

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COORDINATE SYSTEM: GDA 2020/MGA ZONE 55

PROJECT: BOWEN PIPELINE PROJECT	DATE: MAR 2024
CLIENT: BOWEN PIPELINE COMPANY	PROJECT: 23- 0290
FIGURE: SALISBURY SITE - 1% AEP FLOOD HAZARD DxV	DRAWING: #D06