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Flood Impact Assessment

Miriam Vale Battery Energy Storage System and Substation

Attexo Group Pty Ltd

29 May 2024

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Project Details

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29 May 2024

Chris Cantwell
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Via email: chris.cantwell@attexo.com.au

Dear Chris

Miriam Vale Battery Energy Storage System and Substation

Please see the attached report documenting Water Technology's assessment of the proposed development west of Miriam Vale. If you have any questions, please do not hesitate to contact me.

Yours sincerely

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1 INTRODUCTION

This report details the findings of a flood study to assess the local flood behaviour and impacts for a proposed battery energy storage system (BESS) and substation located in Miriam Vale, QLD. The study objective is to better understand the flooding mechanisms within the site, particularly across the location where the facility is proposed to be constructed. This site is referred to as 'the subject site' within this report. This report presents the flood modelling assumptions and results together with an investigation of the subject site flood risk.

1.1 Objectives

To provide Attexo Group Pty Ltd with a better understanding of the flooding and drainage behaviour within the subject site, by completing the following tasks:

- Review existing flood information.
- Hydrological assessment using a Rain-on-grid modelling methodology using the TUFLOW software.
- Development of a TUFLOW hydraulic flood model to assess existing conditions flood behaviour for the 1% and 0.5%[1] AEP flood events to inform the design.
- Provision of high-level recommendations for any mitigation or design alterations which may be required to reduce the risk associated with flooding and drainage.

Following the development of the site design (including earthworks), the following tasks will be completed:

- Use the TUFLOW hydraulic flood model to assess post-development conditions of the 1% and 0.5% AEP flood events.

1.2 Existing Flood Information

The Miriam Vale BESS and Substation is a 500 megawatt (MW) battery and associated infrastructure, including a substation. It is located to the west of the township of Miriam Vale and is to be constructed within the Miriam Vale BESS and Substation Development Area shown in Figure 1-1. This report has been prepared to support a development application for the Miriam Vale BESS and Substation Project under the Gladstone Regional Council Planning Scheme being:

- Development permit for Material Change of Use for an Undefined Use (BESS); and
- Development permit for Material Change of Use for a Substation.

The Miriam Vale BESS is to be situated on land containing minor overland flowpaths.

A review of available topographic data indicates that the proposed BESS and substation is located on land that is a significant distance from the closest perennial watercourse and is therefore not impacted by regional riverine flooding. As such, the flood assessment of the proposed substation only included an analysis of local catchment flooding.

No existing flood study is available for the subject site.

[1] Recommended flood immunity levels for community infrastructure (substations) is 0.5% AEP as detailed in Section 4.

1.3 Catchment Characteristics

The subject site is situated west of Miriam Vale and is bounded by Tributaries of Three Mile Creek with Burgess Road to the south and Cawthrays Road to the east. The subject site is situated within a rural zone and generally away from urbanised residential areas. The subject site drains towards the East, with flows conveyed through waterways and drainage channels that run through the subject site, which are shown in Figure 1-1.

The subject site is cleared of any significant vegetation and is blanketed by pasture grass. Areas of dense vegetation are still remnant; these areas reside along drainage channels which tend to border the areas of development.

The western catchment, upstream of the subject site, is both steep and heavily vegetated conservation zone. The area has a significant slope from West to East, as the site location is at the base of mountainous terrain. The Elevation of the area peaks at around 730 m AHD and drops to 32 m AHD, as shown in Figure 1-2.

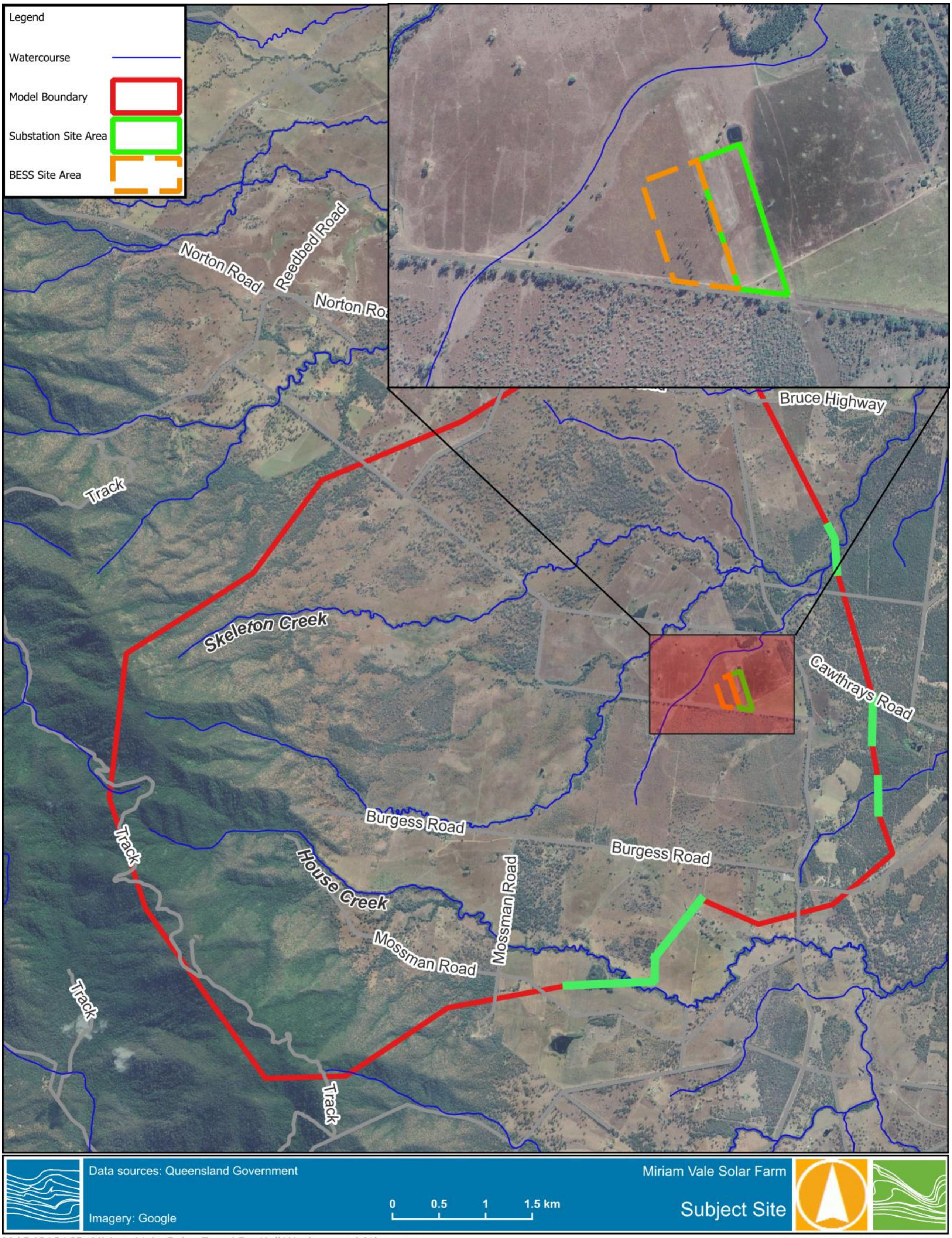

Figure 1-1 Subject Site

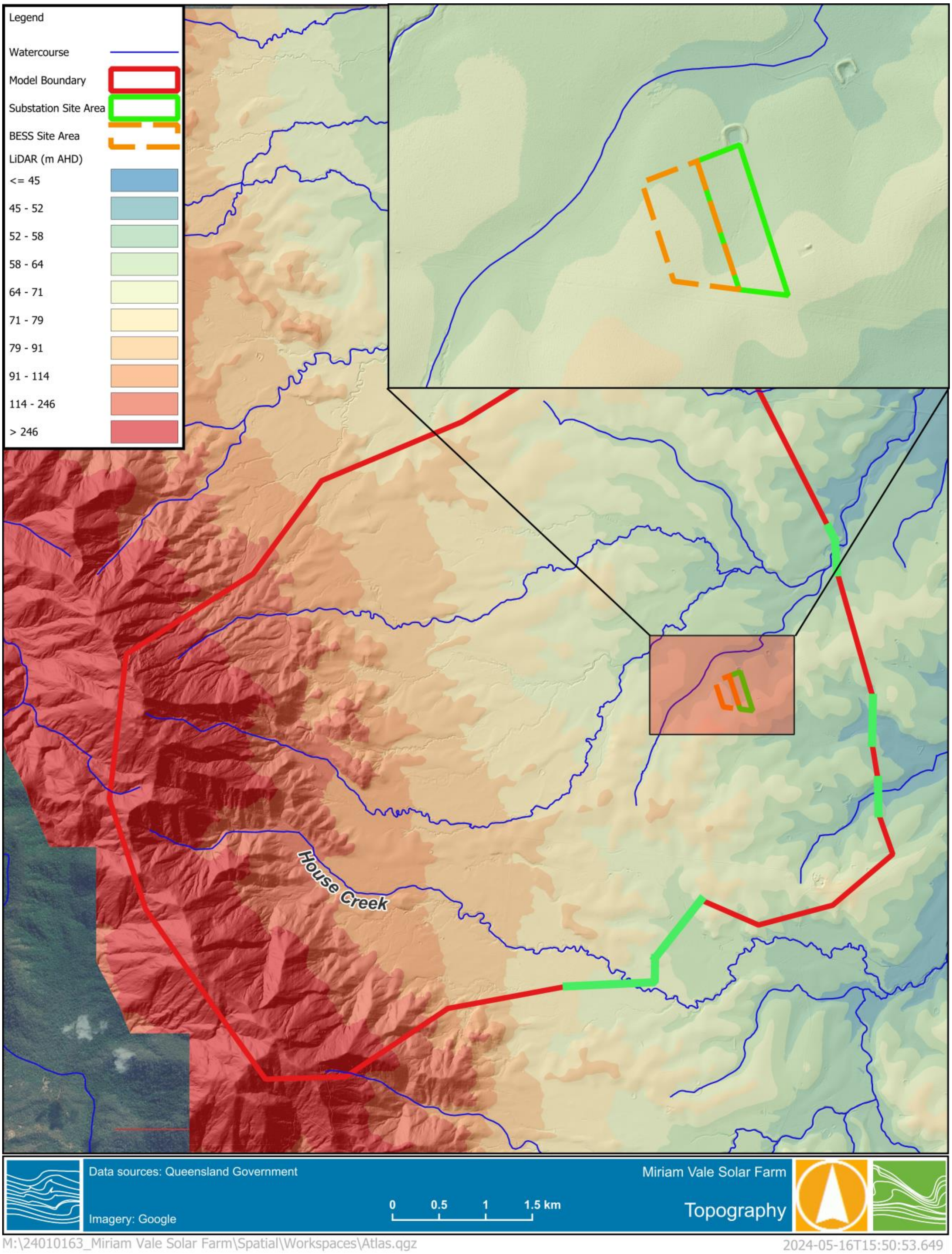

Figure 1-2 Study Area Topographic Features

2 FLOOD ASSESSMENT

2.1 Hydrology

A Rain-on-Grid (ROG) modelling methodology was adopted for this assessment as there is ample high resolution LiDAR available covering the entire catchment and a requirement to map various flow paths throughout the area of interest. ROG assessments are suited well to areas where flood behaviour is characterised by shallow inundation. A 2D TUFLOW model representing the local catchment was developed for the purposes of this local flood assessment. Figure 2-1 illustrates the extent of the TUFLOW model in relation to the substation location and the DEM incorporated into the model geometry.

2.1.1 Rain-on-grid Methodology

The ROG methodology is extensively used for flood mapping of urban and rural areas. It allows for a comprehensive flood risk assessment by identifying overland flow paths based on the topography as illustrated in the flow chart in Figure 2-1.

- The rainfall layer, which consists of one single rainfall polygon over the model extent was produced in a GIS package.
- Hyetographs (rainfall depth timeseries) were created for a range of design rainfall AEP events and durations using the QGIS TUFLOW plugin and the 2016 Bureau of Meteorology Intensity Frequency Duration (IFD) data at the centroid of the catchment (see Figure 2-2 and Figure 2-3). These were applied to the TUFLOW model to represent catchment rainfall under various durations for the 1% AEP design storm.

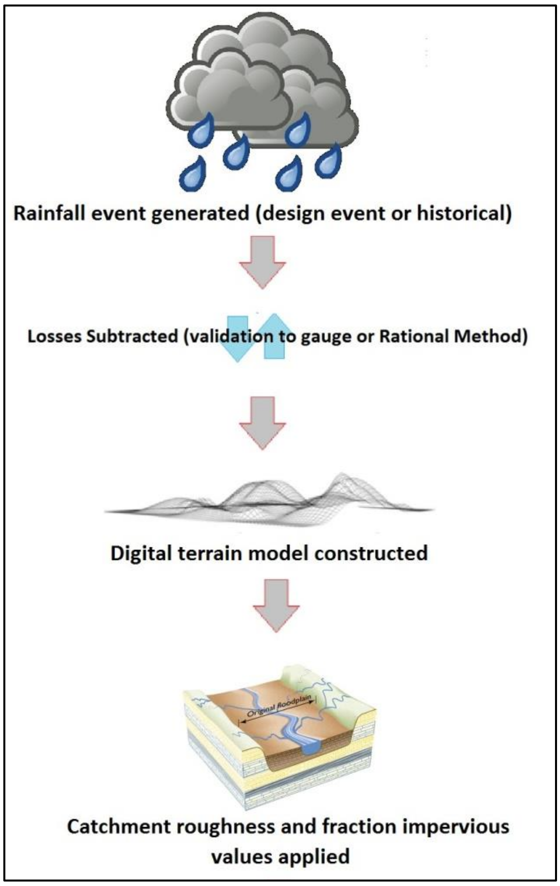

Figure 2-1 Rain on grid modelling

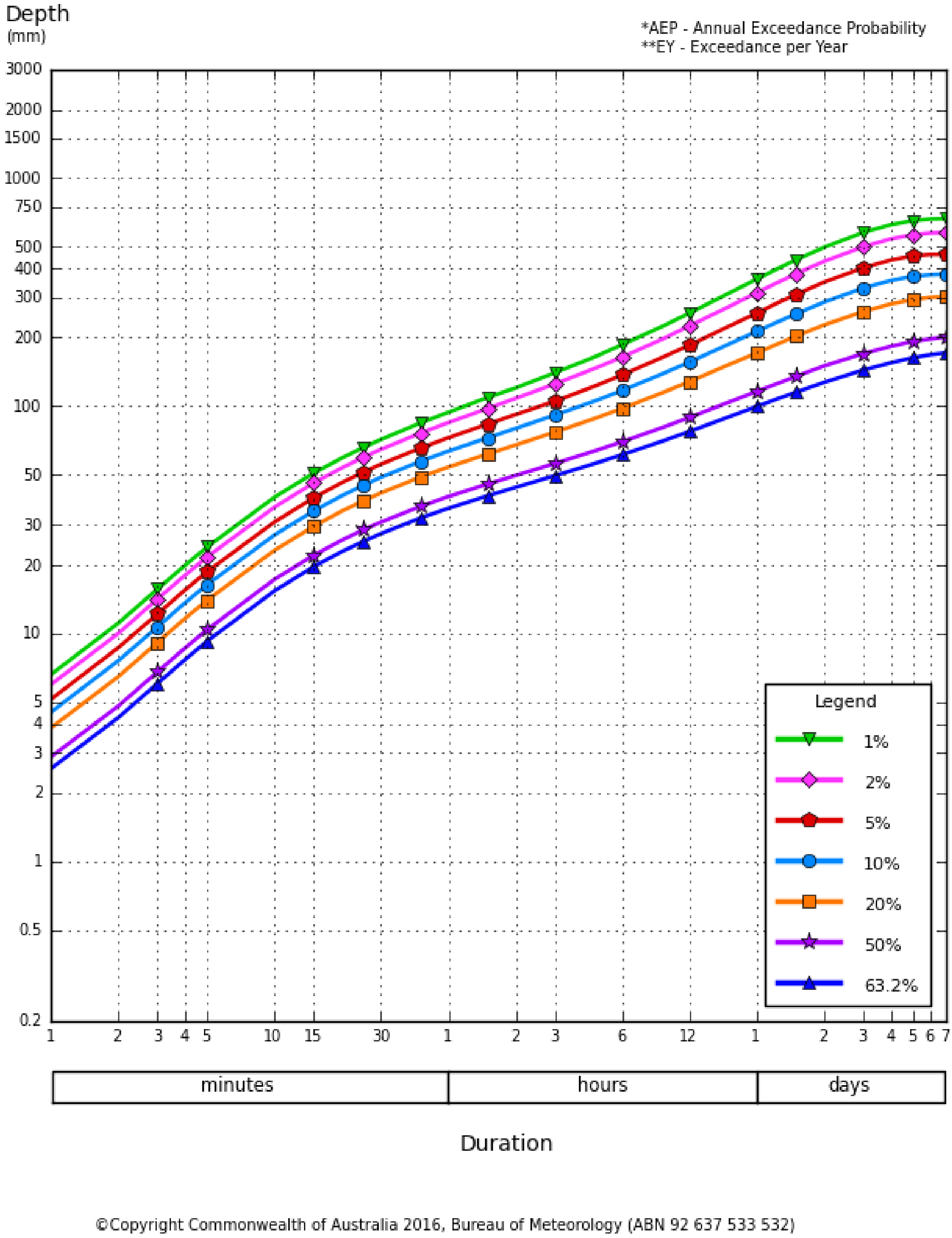

Figure 2-2 Design Rainfall Depths (Source: ARR2019)

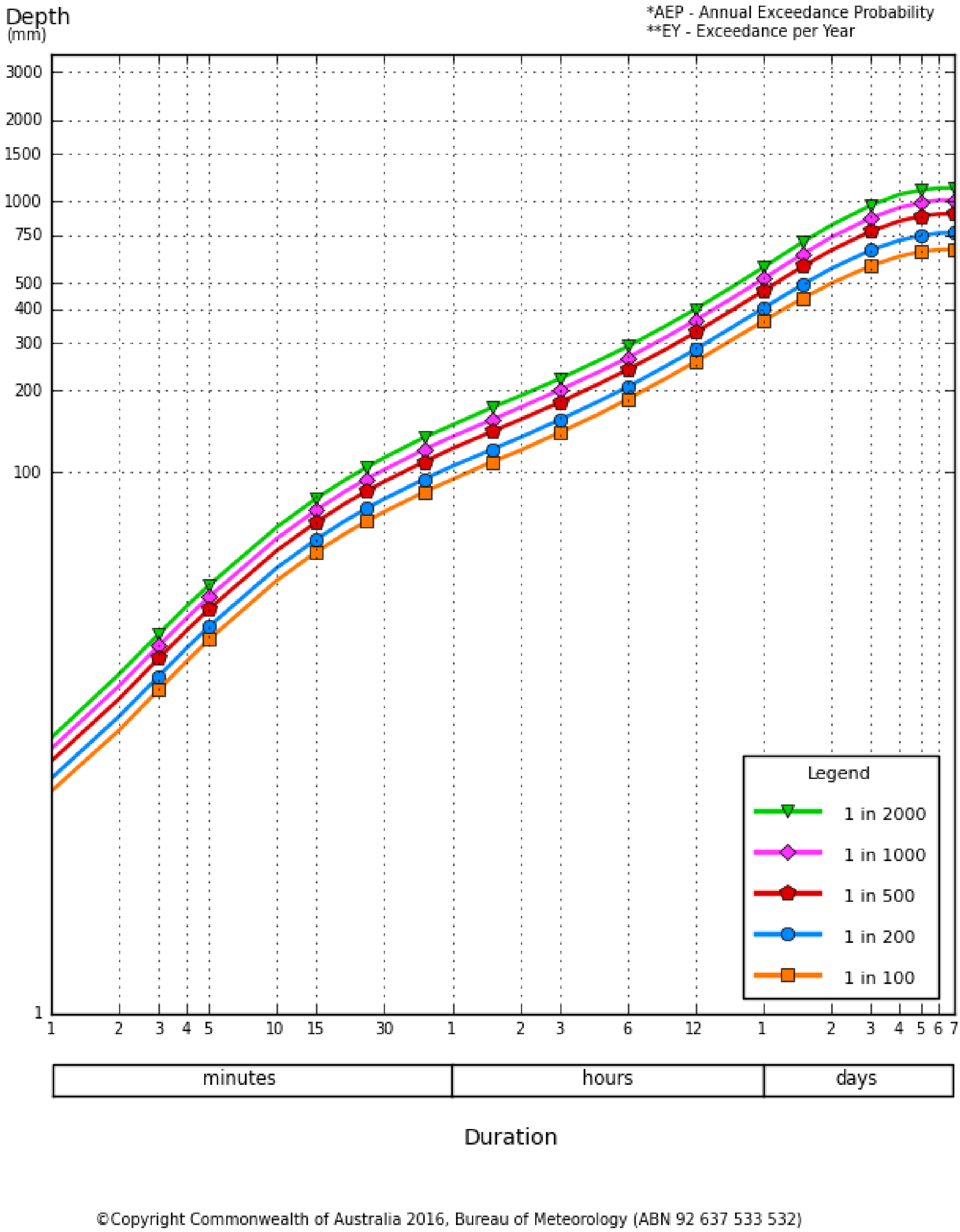

Figure 2-3 Design Rainfall Depths (Rare) (Source: ARR2019)

The ROG methodology was applied to the subject site and surrounding area. The TUFLOW model set-up is presented in Figure 2-4 highlighting the model extent and ROG extent.

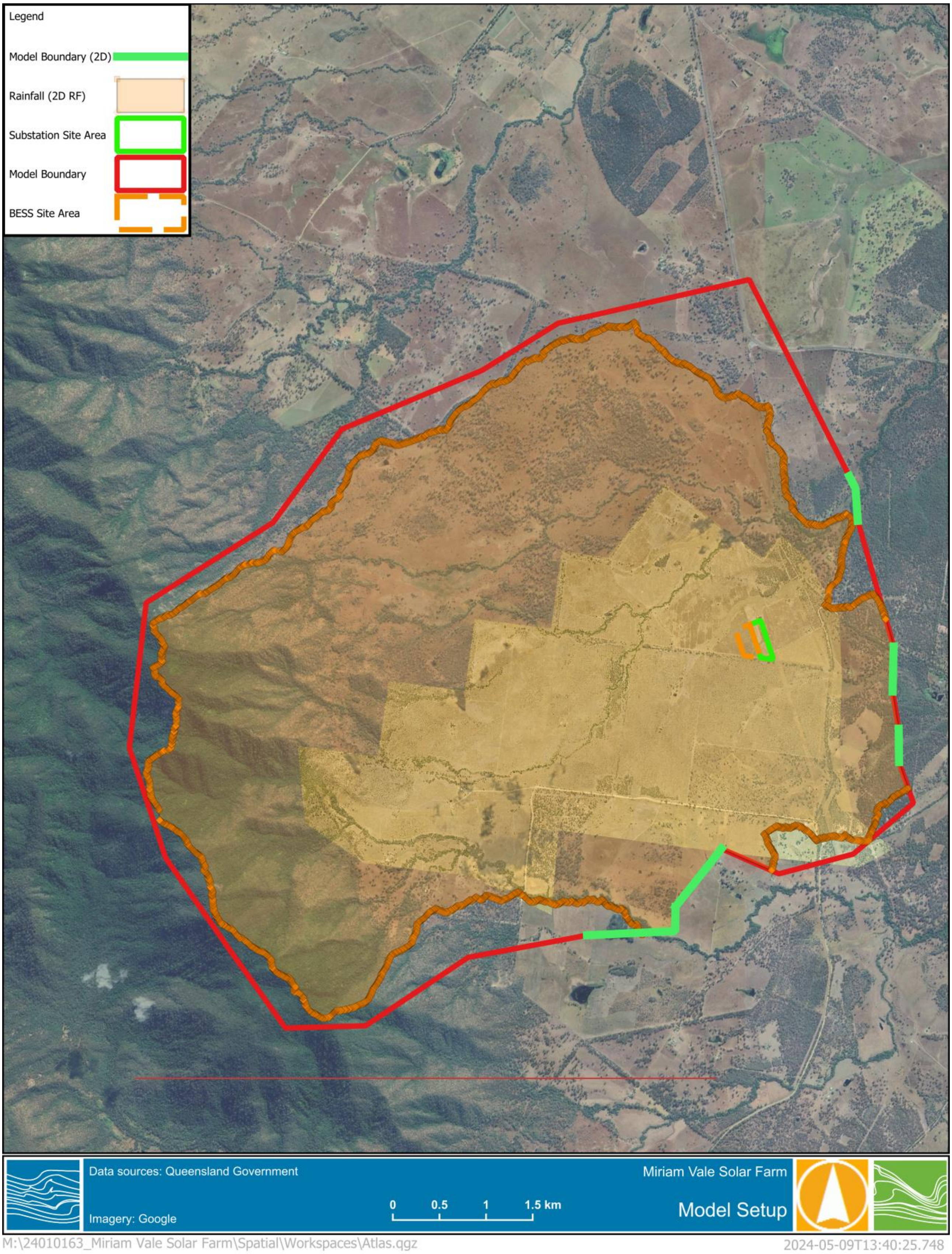

Figure 2-4 TUFLOW Model Schematic

2.2 Rainfall Losses

The rainfall losses were incorporated into the model via a TUFLOW soil infiltration file. The losses adopted for this assessment were extracted from the ARR2019 Datahub and reflect a conservative approach with regards to infiltration in predominantly rural areas. A summary of the adopted losses is outlined below:

- Initial Loss: 17.00 mm
- Continuing Loss: 2.3 mm/hr

The initial loss was varied for each storm by subtracting the pre-burst values from the initial storm loss. This is depicted in Figure 2-5.

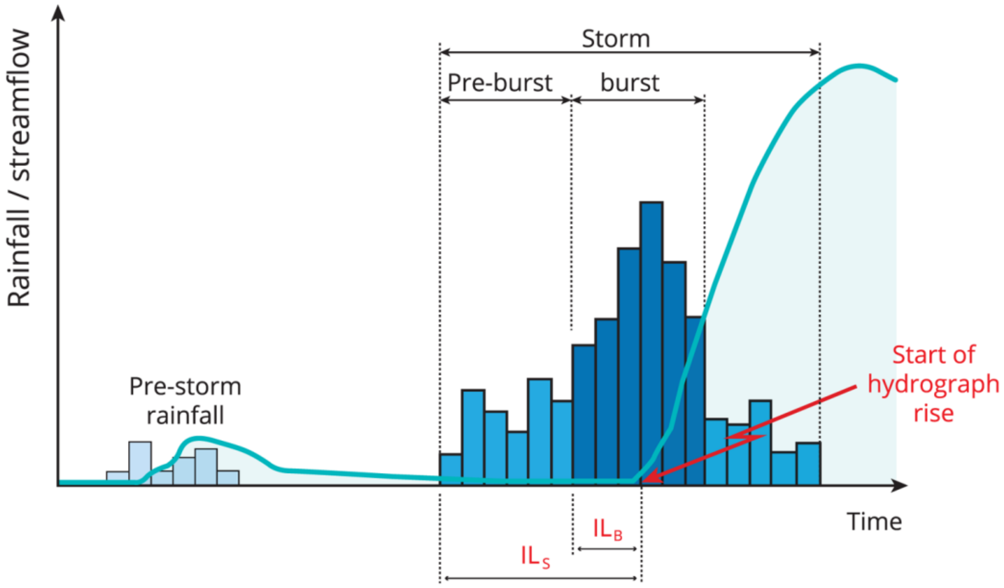

Figure 2-5 Distinction between Storm and Burst Initial Loss (ARR19)

2.3 Digital Elevation Model and Hydraulic Roughness

The topography incorporated into the model is presented in Figure 1-2 and included the publicly available 1.0 m DEM and the LiDAR data supplied for the project. The TUFLOW model adopted a grid size of 5.0 m with 1.0 m sub grid sampling. Table 2-1 summarises the hydraulic roughness used for the hydraulic modelling as per the land use types within the model (Figure 2-3). These values were adopted based on examination of aerial photography and guidance provided in ARR19.

Table 2-1 Model Parameters

Material ID	Mannings 'n'	Description
109	0.06	Open pervious areas – Moderate Vegetation
110	0.095	Open pervious areas – Thick Vegetation
111	0.03	Waterways/channels – minimal vegetation
112	0.07	Waterways/channels – vegetated
114	0.025	Paved roads/carpark/driveways
115	0.08	Lakes/Dams (no emergent vegetation)

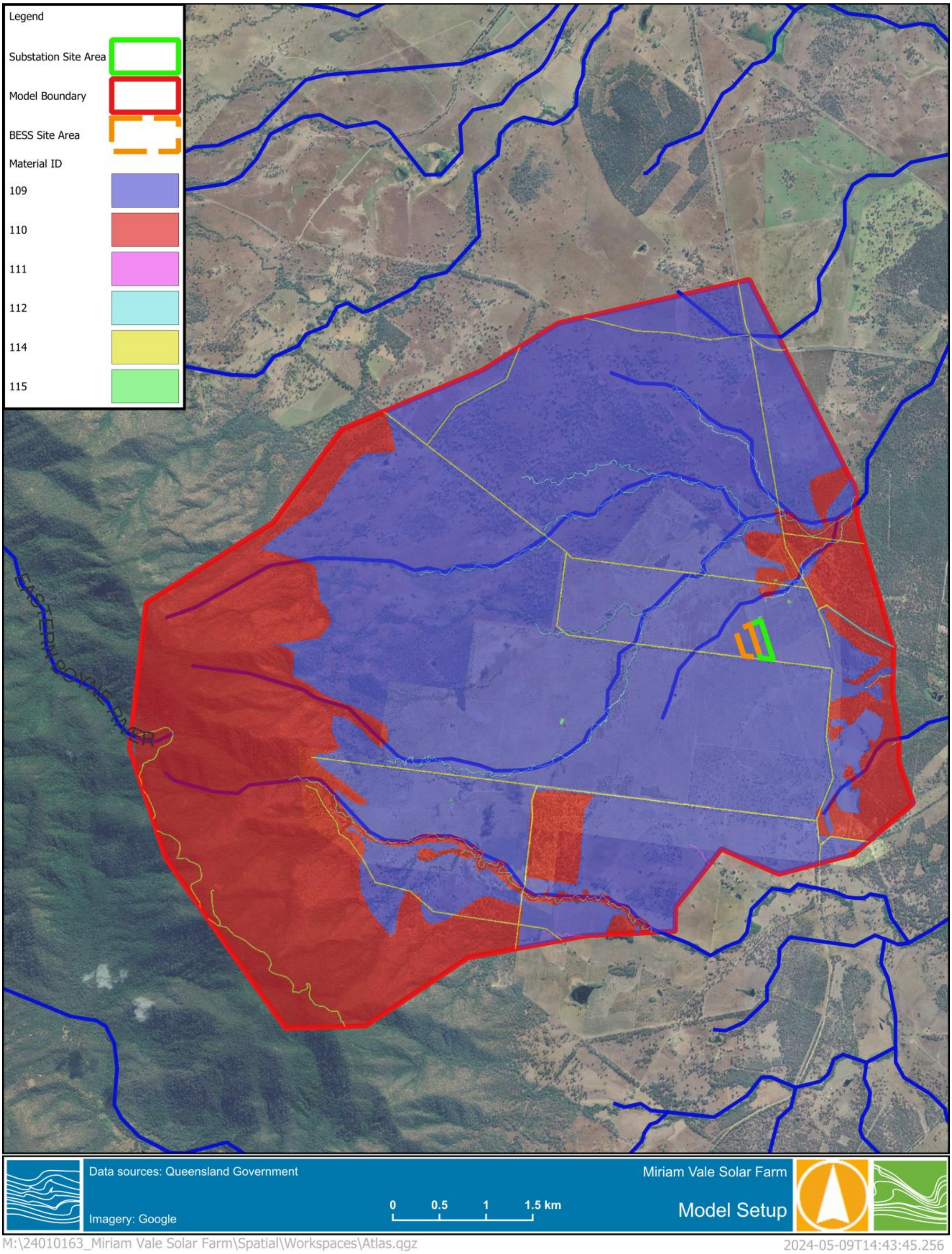

Figure 2-6 Hydraulic Model Roughness Delineation

2.3.1 Model Boundaries

As outlined in Figure 2-7, the downstream boundary was placed a suitable distance downstream of the area of interest to ensure that flooding behaviour at the model outlet did not influence flooding in the vicinity of the substation. Four HQ boundaries have been adopted using a slope to determine the water level at the boundary and resultant outflow of water from the model.

2.4 Model Validation

Given the lack of stream gauges within or downstream of the study area, there is no site-based data to validate the hydrologic or hydraulic model results. Accordingly, the TUFLOW hydraulic model has been validated using the Rational Method and the latest Regional Flood Frequency Estimation (RFFE) tool.

Validation was completed at the outlet of a local catchment as shown in Figure 2-8. Flooding in this local catchment, with an area of 2,327 ha, traverses in a general easterly direction to the immediate north of the substation. The parameters used for estimating peak discharge using the Rational Method are summarised in Table 2-2. The RFFE tool was also used to estimate the peak discharge for the 1% AEP flood event for the same catchment.

Table 2-2 Rational Method Parameters

Rational Method Parameter	Total Western Catchment to B10
Catchment Area (ha)	2327
Catchment C_{10}	0.677
Tc (minutes)	158

A comparison of flows during the 1% AEP design event as estimated by the TUFLOW model, Rational Method and RFFE is presented in Table 2-3. As evident from this table, the TUFLOW model is predicting a slightly lower flow. However, the simulated flow is within 5% of that estimated using the Rational Method and within the wide band of uncertainty associated with the RFFE estimate. Given the comparison above, the TUFLOW model is considered suitable for use in this assessment.

Table 2-3 TUFLOW Model Validation to Rational Method and RFFE

Design Event	TUFLOW Peak Flow (m^3/s)	Rational Method Discharge (m^3/s)	RFFE (m^3/s) Expected Value	RFFE (m^3/s) Upper Bound	RFFE (m^3/s) Lower Bound
1% AEP	297	343	690	2830	165

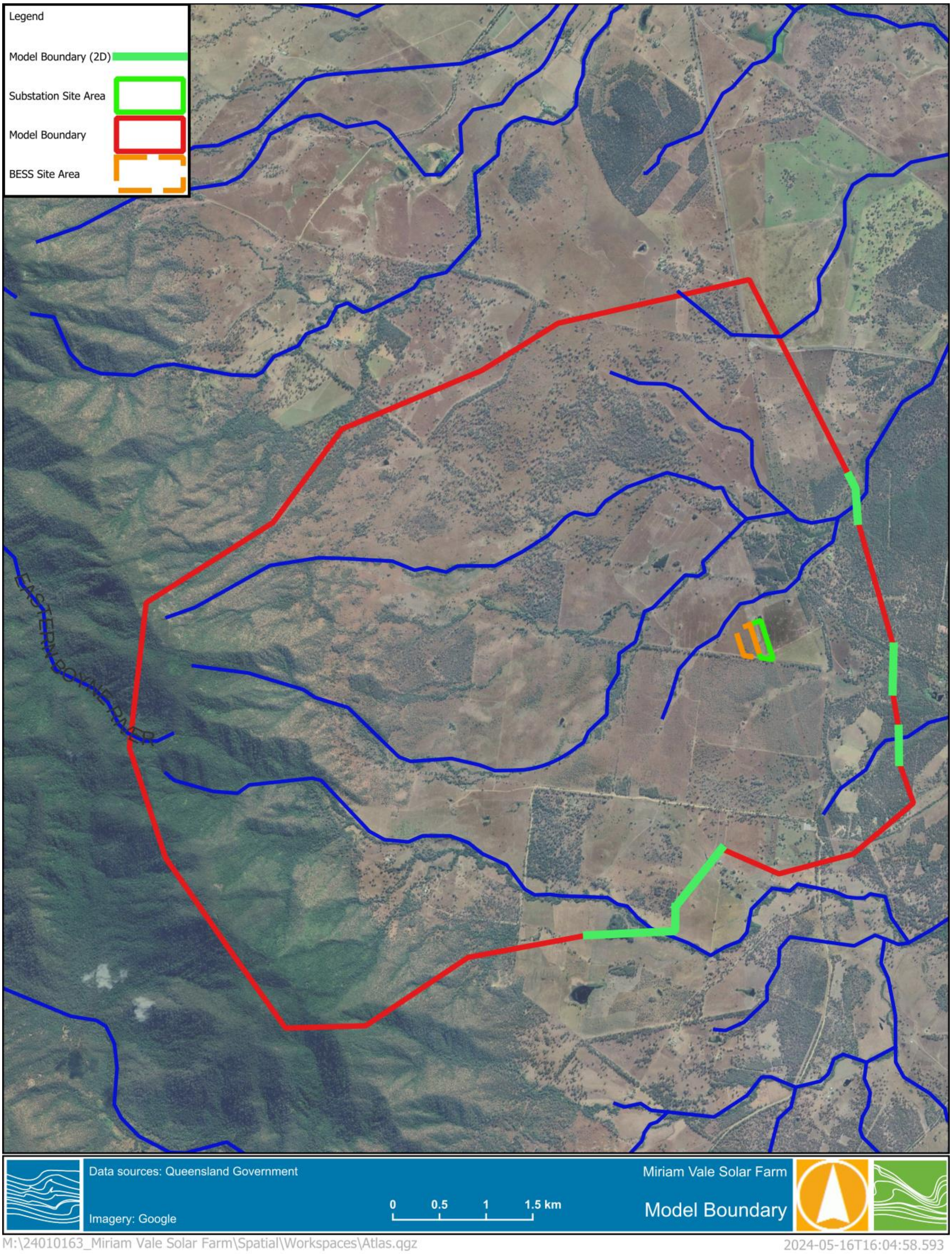

Figure 2-7 Model Boundary

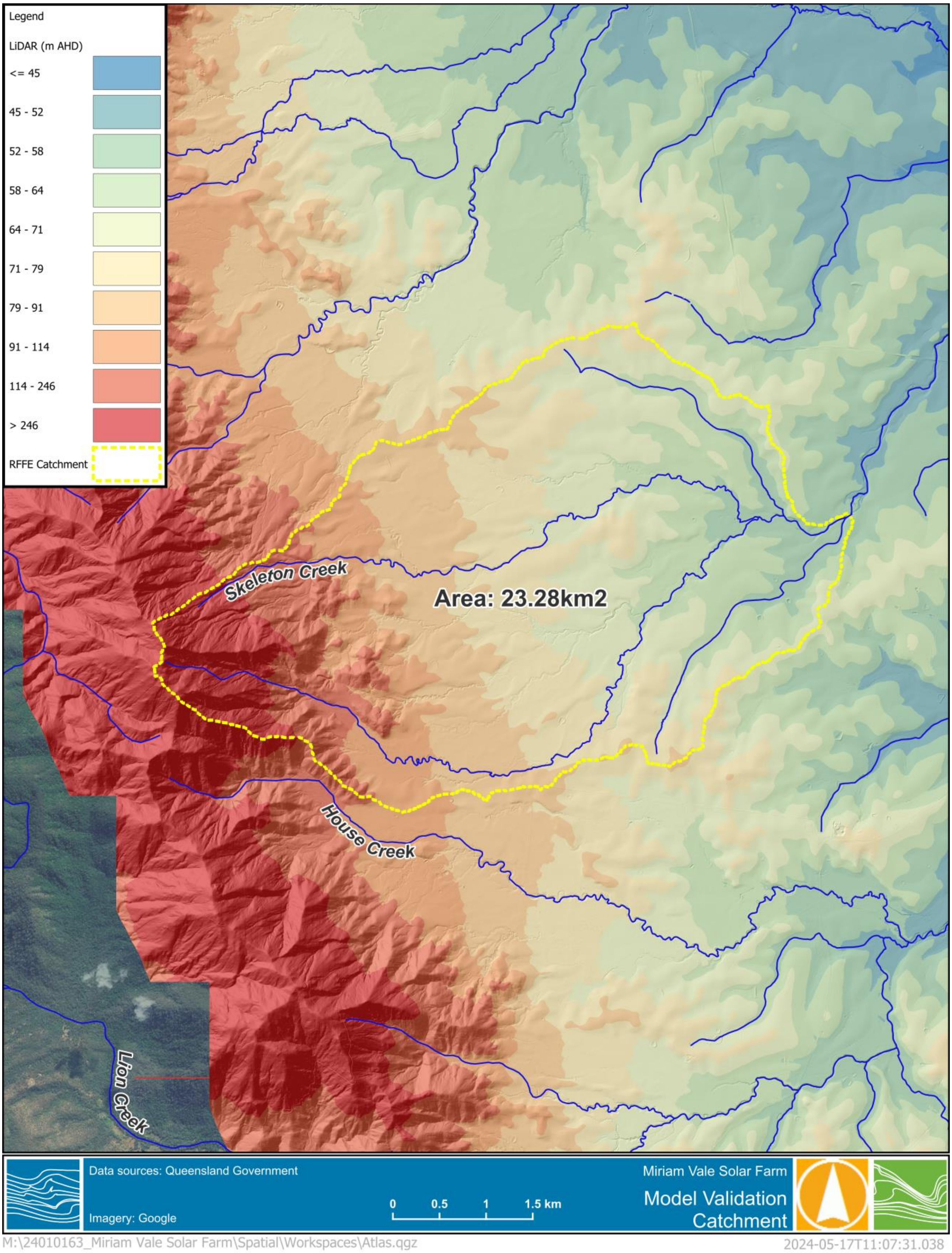

Figure 2-8 Rational Method Validation Overview

2.4.1 Critical Duration and Temporal Pattern Assessment

The TUFLOW model was used to identify the median water surface elevation for each of the modelled durations (2 hour to 24 hour duration events) by enveloping the median water surface elevation at each cell location across the modelled area. This was identified by running all durations and all temporal patterns through the model and determining the duration which resulted in the maximum inundation level within our area of interest.

Figure 2-9 shows that the maximum flood level, by duration, across the area of interest for the median temporal pattern was the 2-hour (120m) and 1-hour (60m) events. Both events were selected based on their criticality with respect to the median temporal pattern at each model cell. The results were enveloped such that each cell across the modelled area is represented by the median temporal pattern and maximum duration combination at that cell.

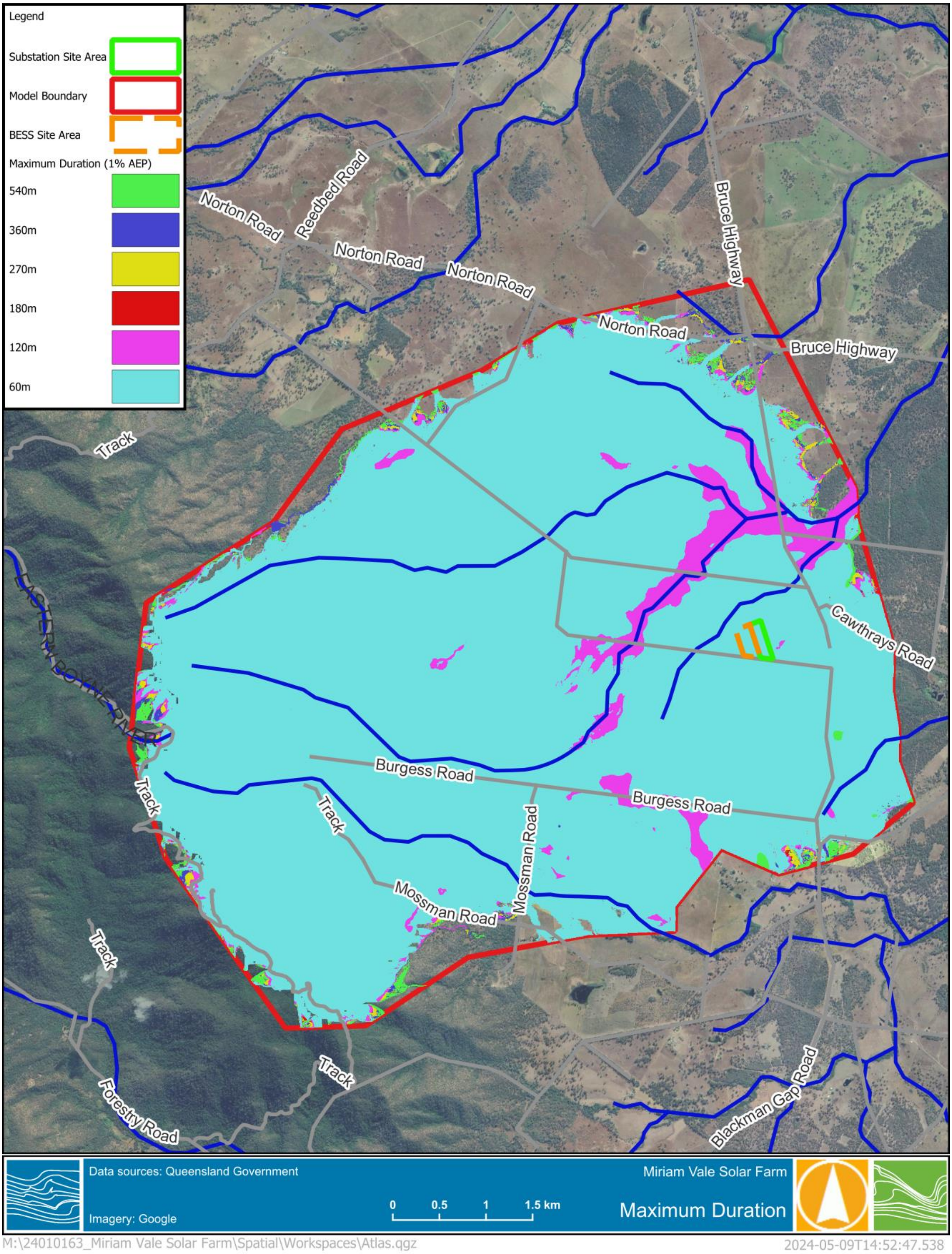

Figure 2-9 Maximum Flood Level by Duration

3 RESULTS

The hydraulic model was run for both the 1% and 0.5% AEP flood events using the 2-hour and 1-hour storms to determine the flood conditions on the subject site. The full set of results are shown in Appendix A.

3.1 Existing Conditions

The extent of the 1% and 0.5% AEP flood events is confined reasonably well within the drainage channels and watercourses for most of the catchment external to the subject site. Multiple breakouts are apparent across the development area, with flood depths reaching above 1.0 m in areas closest to the main channels. Most flood depths, however, sit at around 0.2 – 0.3 m, which overflow from shallower and less significant drainage channels. A summary of the results for each event is provided below:

- **0.5% AEP Event**
  - The 0.5% AEP flood levels vary over the development area. Within the centre of the model extent depths mostly range from 0.1-0.5m. In the centre of the development area, larger flood depths are simulated, with watercourse depths exceeding 4.4m. The Northeast part of the development area experiences the largest flood depths.
  - Most of the area has a H1 hazard level, only really exceeding this around the drainage channels and the Northeastern part of the area.
  - Flood velocities follow a similar pattern as the hazard and depth, with maximums located within the drainage channels and in the Northeast of the area. Most areas have simulated flood velocities between 0.5 and 1.0 m/s.

- **1% AEP Event**
  - The 1% AEP flood levels vary over the development area. Within the centre of the model extent, flood depths mostly range from 0.1-0.5m. In the centre of the development area larger depths are experienced, with watercourse depths exceeding 4.3m.
  - For the 1% AEP, the velocity of the flood water impacting the subject site is approximately 0.5 – 1.0 m/s within the defined channels. Areas outside of defined channels in the flat floodplains generally have lower velocities between 0.01 and 0.3 m/s.
  - Flood hazard for the 1% AEP flood event, is generally H1 across the model extent. However, the hazard does increase in the deeper areas East of the drainage channels, reaching H5 in some isolated locations.

3.3 Developed Conditions

3.3.1 Overview

A preliminary development was proposed for the Miriam Vale BESS. After initial modelling it was found that this proposed development positioned a substation within the 0.5% AEP flood event. In line with Gladstone Regional Councils planning requirements, substations are required to be set above the 0.5% AEP flood level.

The proposed layout was adjusted to ensure that the substation is above the 0.5% AEP extent. This adjustment included raising the area above the 0.5% AEP extent compared to the existing topography. The results show that mitigation will be required to divert runoff from the upstream catchment around the proposed fill and prevent permanent ponding of water against the fill pad.

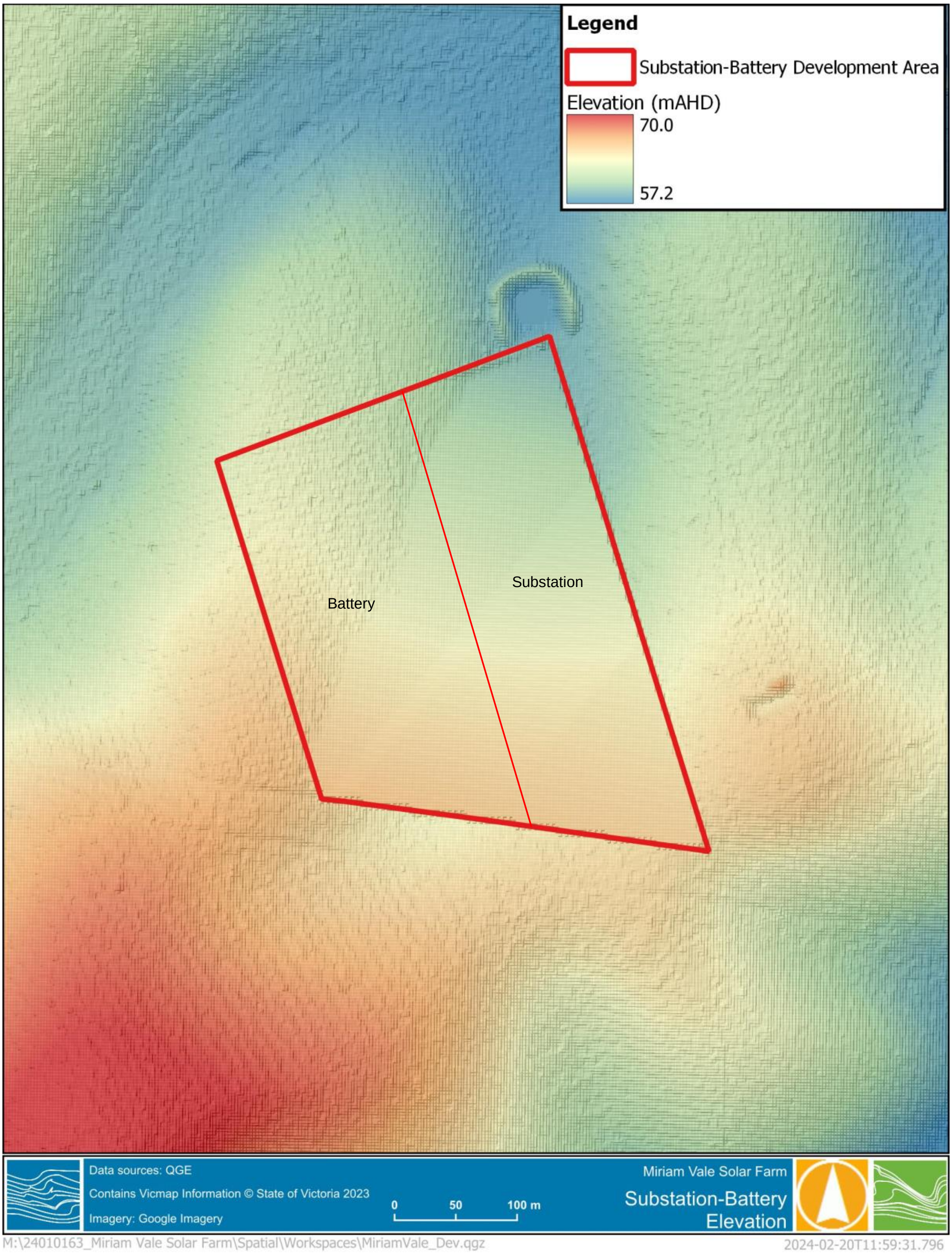

Figure 3-1 Proposed Substation and BESS Development Topography

3.3.2 Results

3.3.2.1 Substation Development

- The proposed development of the substation fill pad impacts runoff from the upstream catchment as it backs up along the west side of the development and pools against the fill pad. Modelling shows flood depths reaching a maximum of approximately 0.7m. The flow path follows a similar pattern, draining towards the north dam. It also appears that some areas are not free draining which would result in extended ponding of water against the fill.
- Velocities for the 0.5% AEP flood event are generally similar to the pre-developed case. Consideration in the design of mitigation infrastructure must consider velocity and the changes from the pre-development case.

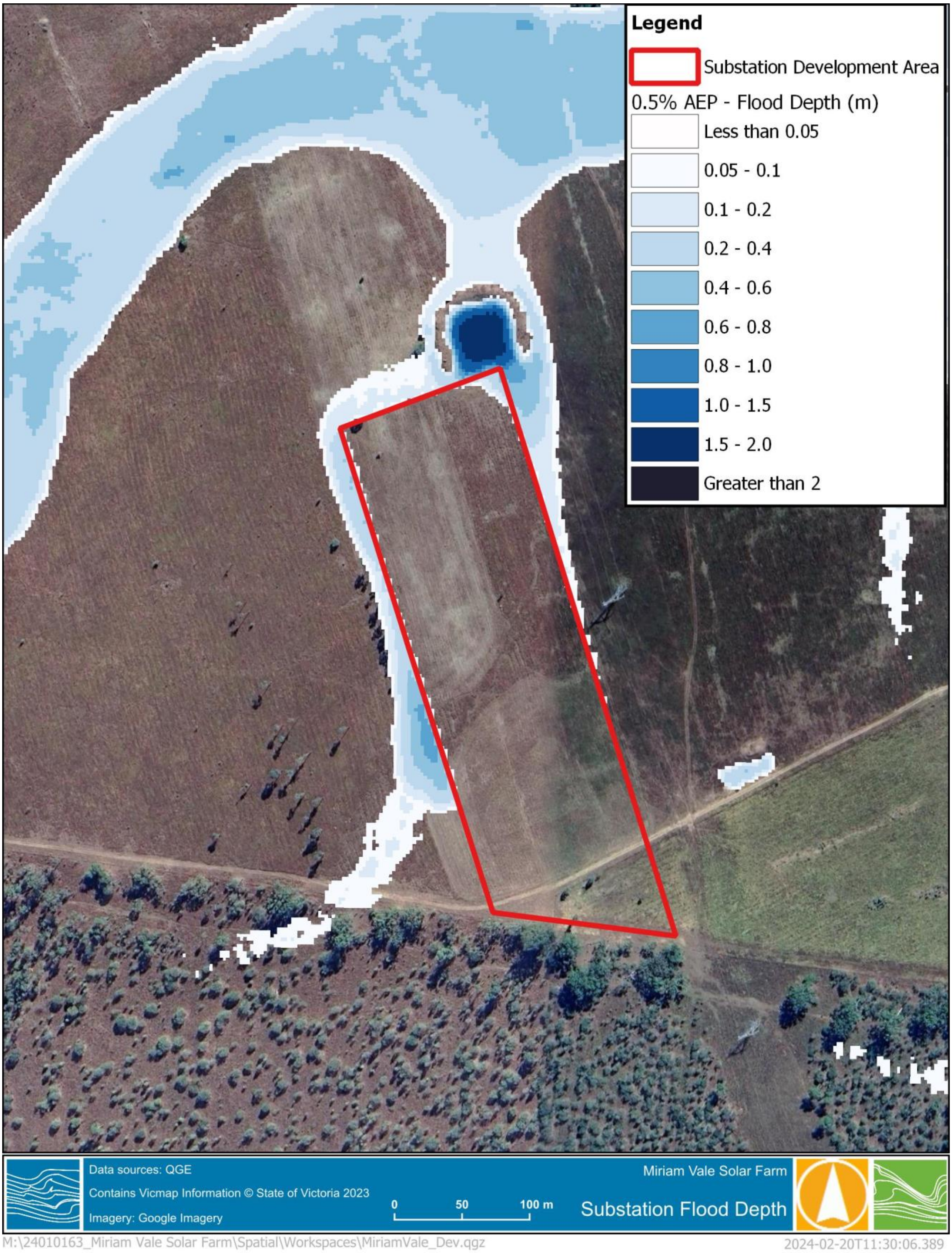

Figure 3-2 0.5% AEP Flood Depth – Substation Developed Conditions

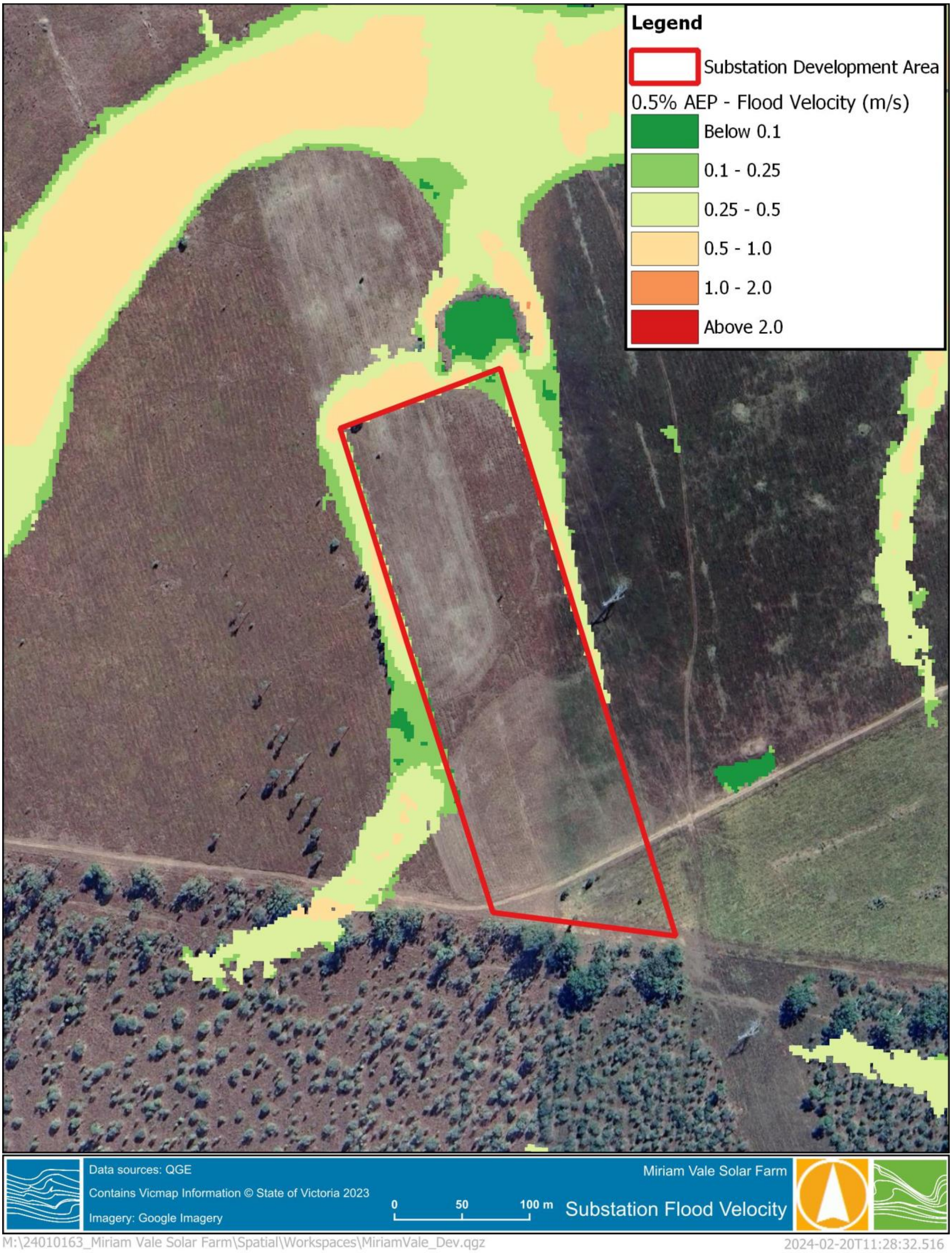

Figure 3-3 0.5% AEP Flood Velocity – Substation Developed Conditions

3.3.2.2 Substation and BESS development

- The combined Substation and Battery development causes water to pond south of the proposed fill pad with peak flood depths of approximately 1.7m. The flow path deviates from the existing conditions, moving southeast to combine with the southern flow path.
- Velocities for the 0.5% AEP flood event are generally similar to the pre-developed case. Consideration in the design of mitigation infrastructure must consider velocity and the changes from the pre-development case.

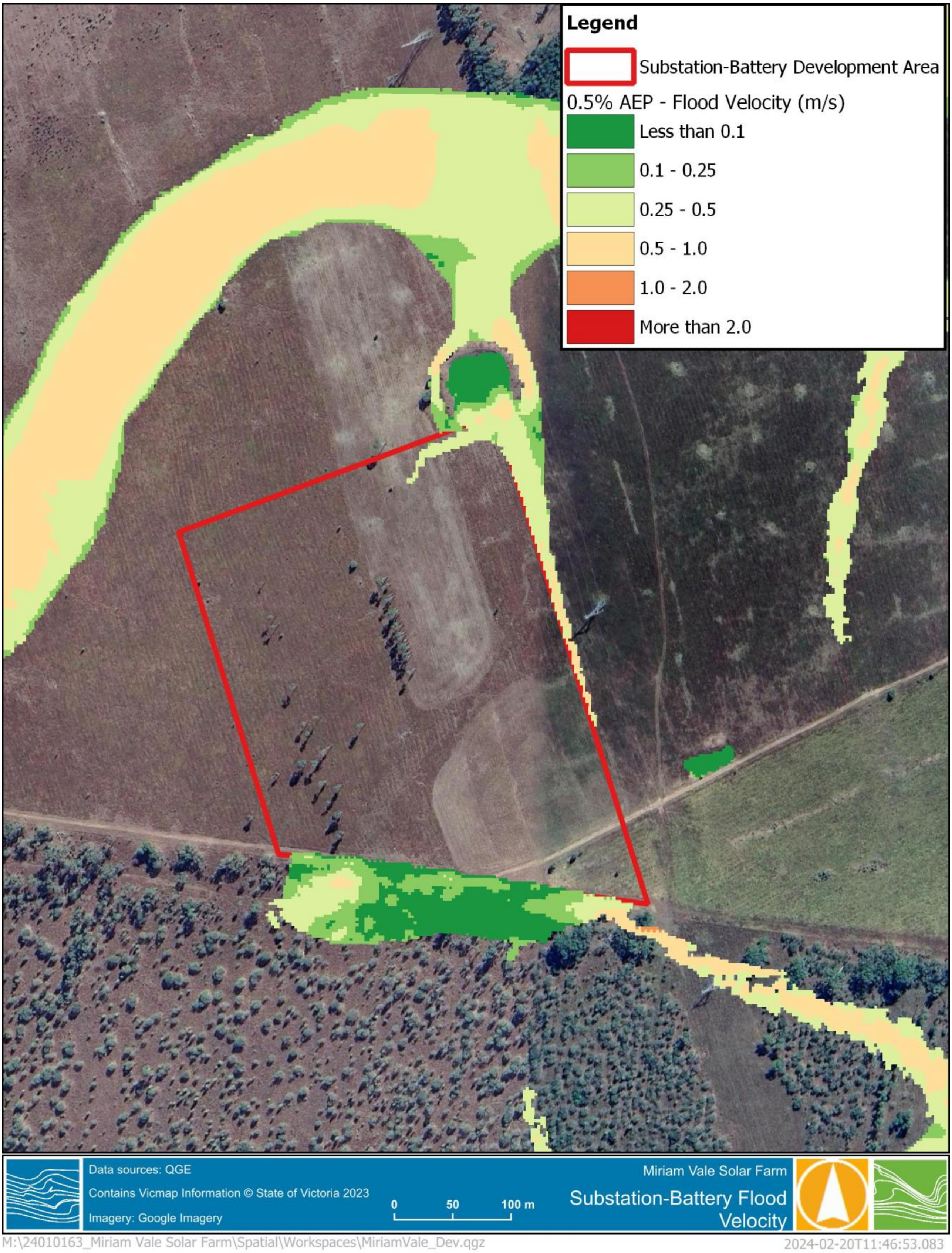

Figure 3-4 0.5% AEP Flood Velocity – Substation-BESS Developed Conditions

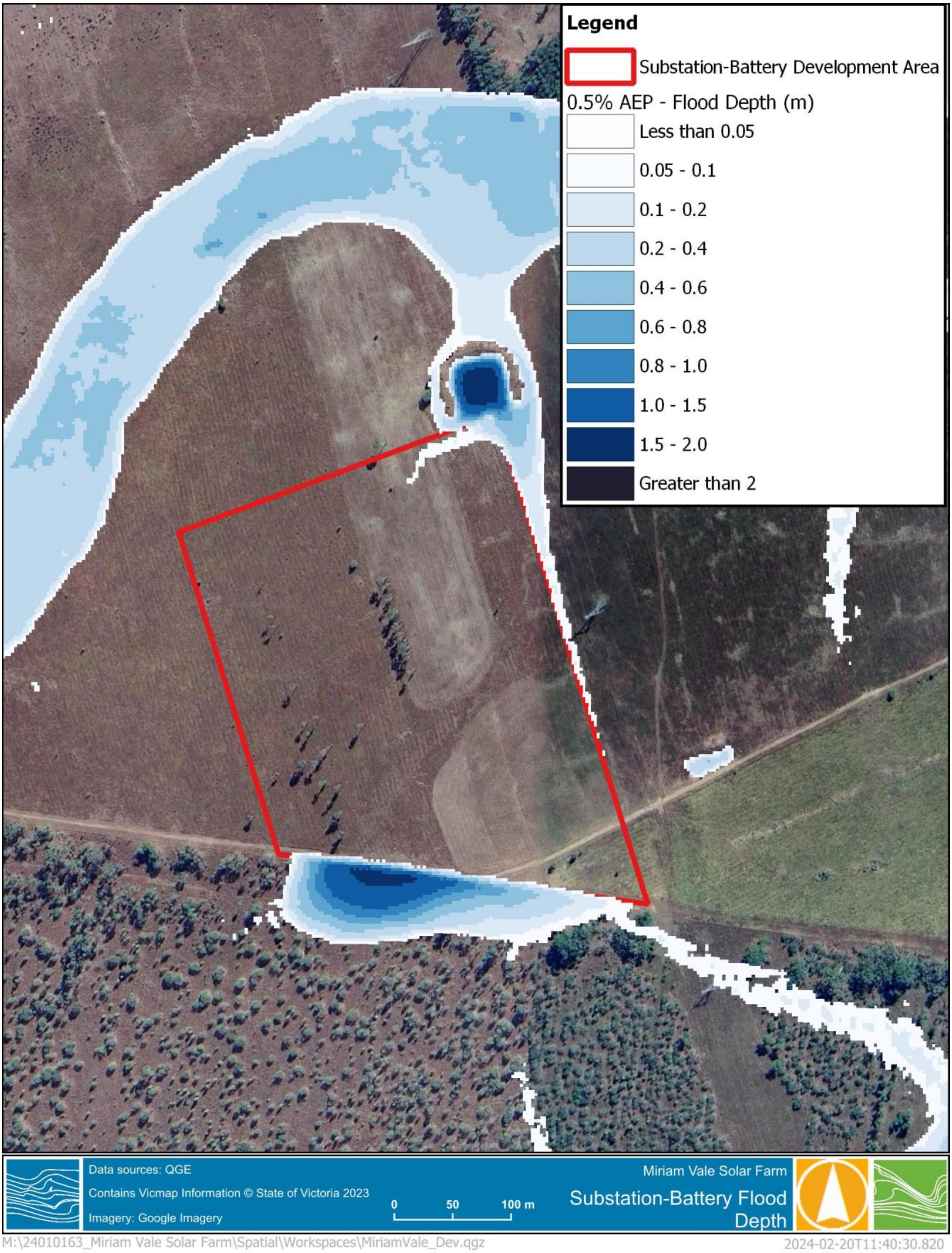

Figure 3-5 0.5% AEP Flood Depth – Substation-BESS Developed Conditions

3.3.2.3 BESS Development

- The Battery development causes water to pond south of the proposed fill pad with peak flood depths of approximately 1.5m. The flow path moves to the east along the fill pad and re-joins the existing conditions flow path upstream of the existing dam.
- Velocities for the 0.5% AEP flood event are generally similar to the pre-developed case. Consideration in the design of mitigation infrastructure must consider velocity and the changes from the pre-development case.

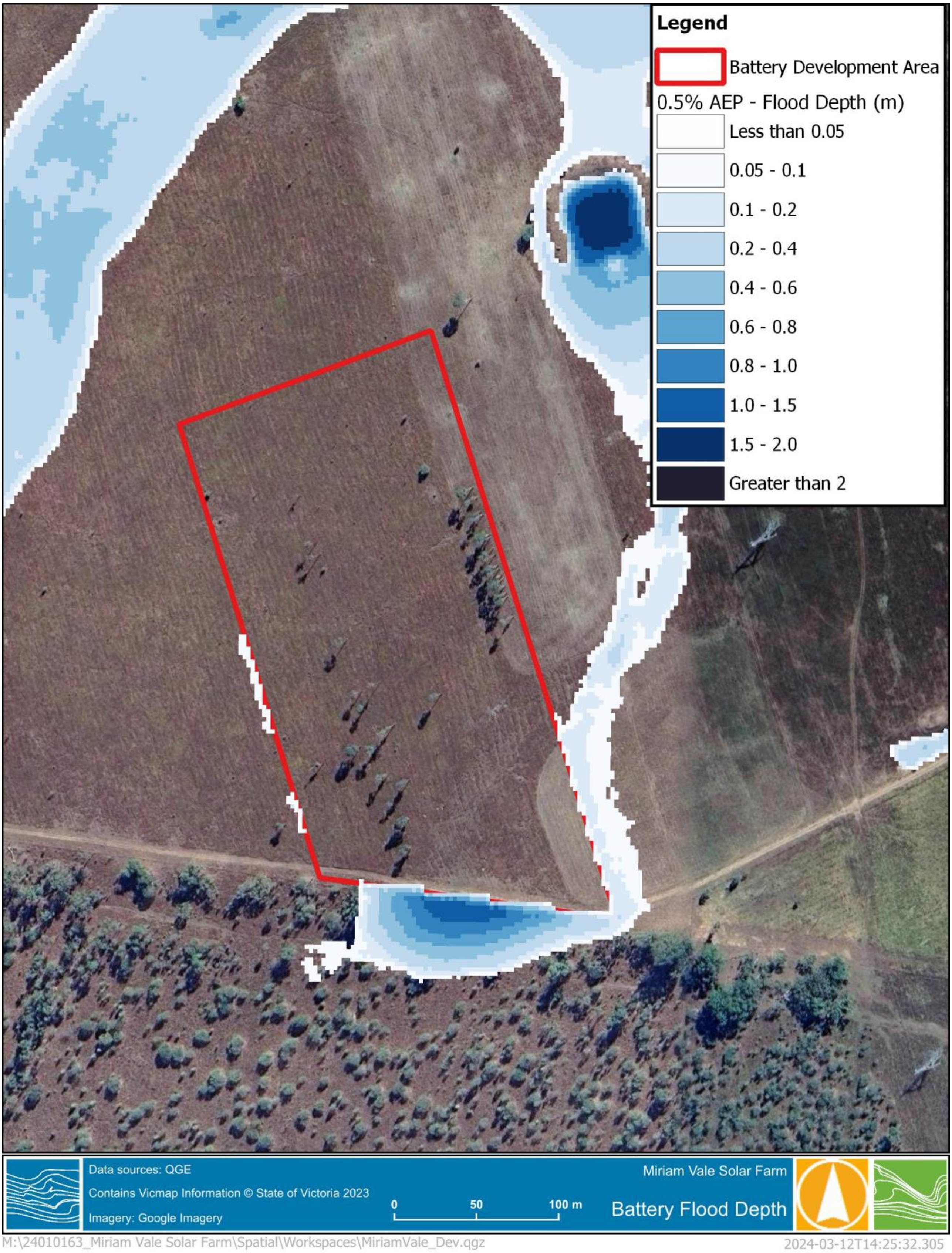

Figure 3-6 0.5% AEP Flood Depth – BESS Developed Conditions

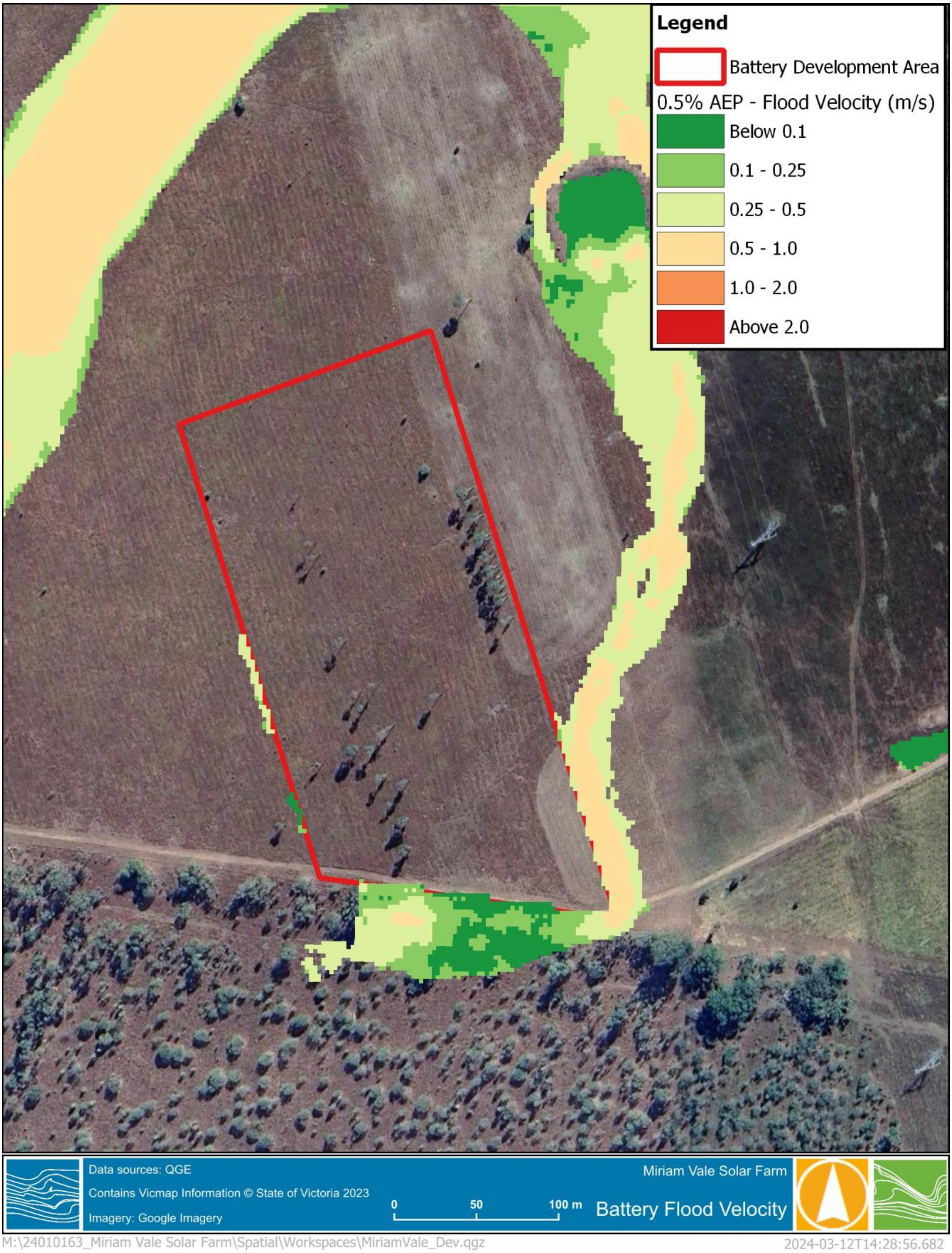

Figure 3-7 0.5% AEP Flood Velocity – BESS Developed Conditions

3.3.2.4 Flood Hazard

Flood hazard is used to determine if overland flows are considered safe for people and vehicles to evacuate during a flood event. The recommended criteria for assessing flood hazard are outlined in ARR2019 and the Australian Emergency Management handbook[2]. The flood hazard curve, shown in Figure 3-8, and vulnerability thresholds, shown in Table 3-1, specifies safety/risk levels for floodplain management or emergency management during a 1% AEP storm event.

The behaviour of flood waters within the proposed development are generally within the safety limits advised in ARR2019, with localised areas which are unsafe for people and vehicles (H4). The 0.5% AEP flood hazard for developed conditions is shown in Figure 3-9 below.

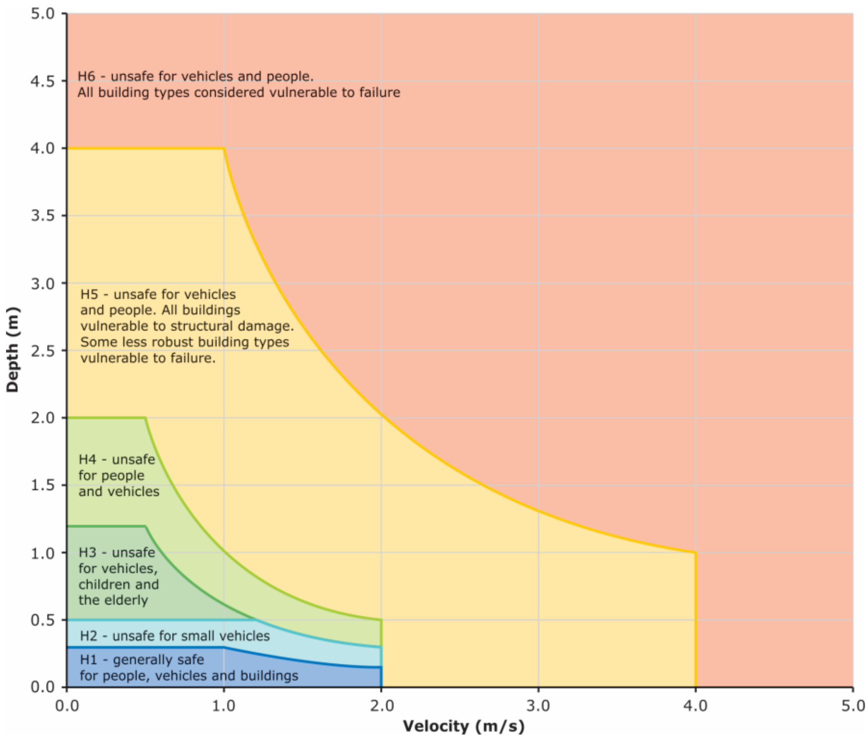

Figure 3-8 Flood Hazard Curves (Smith et al., 2014)

Table 3-1 Combined Hazard Curves – Vulnerability Thresholds Classification Limits (Smith et al., 2014)

Classification	Classification Limit (D and V in combination)	Limiting Still Water Depth (D)	Limiting Velocity (V)
H1	D*V ≤ 0.3	0.3	2.0
H2	D*V ≤ 0.6	0.5	2.0
H3	D*V ≤ 0.6	1.2	2.0
H4	D*V ≤ 1.0	2.0	2.0
H5	D*V ≤ 4.0	4.0	4.0
H6	D*V > 4.0	-	-

[2] Technical flood risk management guideline: Flood hazard - Supporting document for the implementation of Australian Emergency Management Handbook 7, Managing the floodplain: Best practice in flood risk management in Australia" by Australian Emergency Management Institute

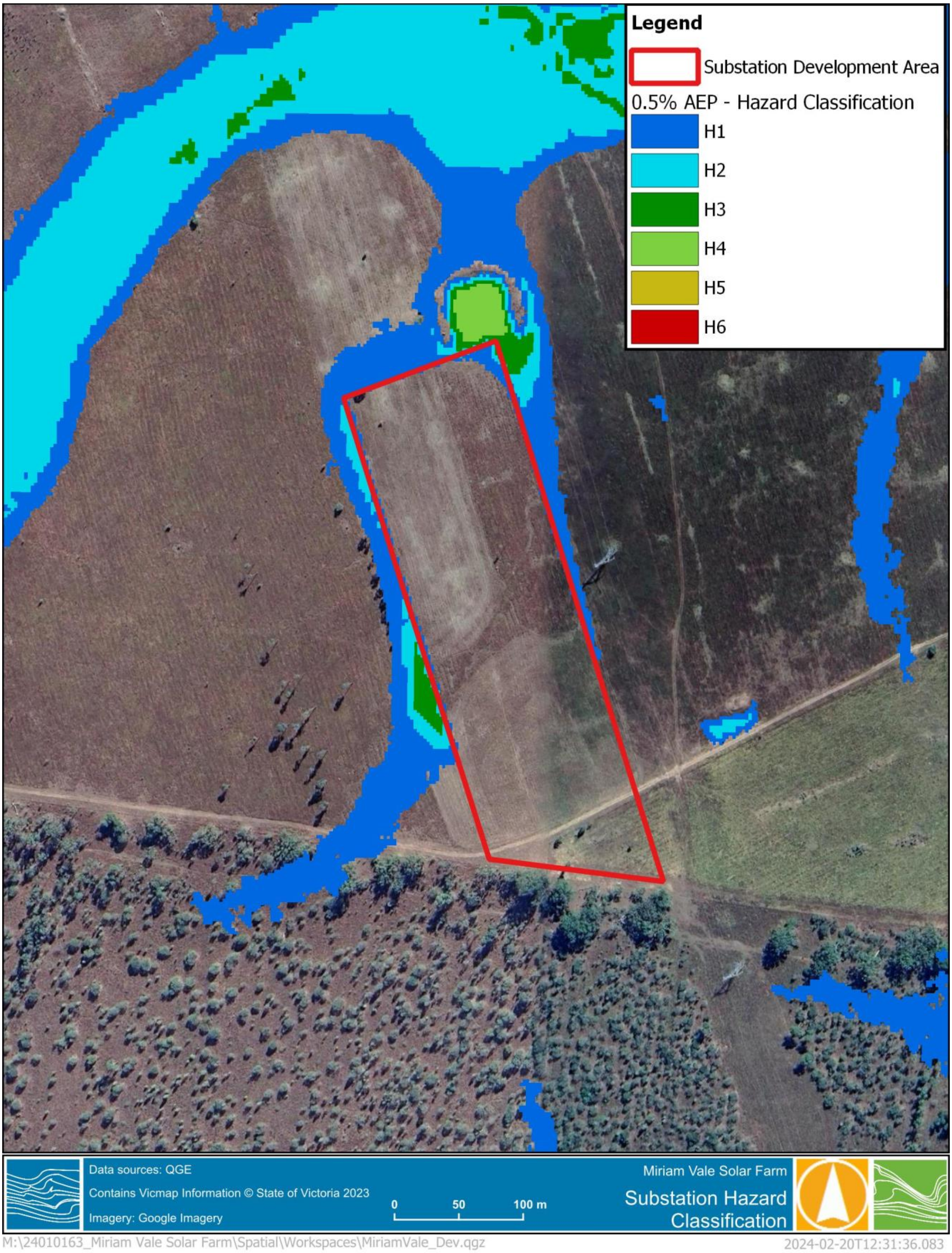

Figure 3-9 0.5% AEP Flood Hazard Classification – Substation Development

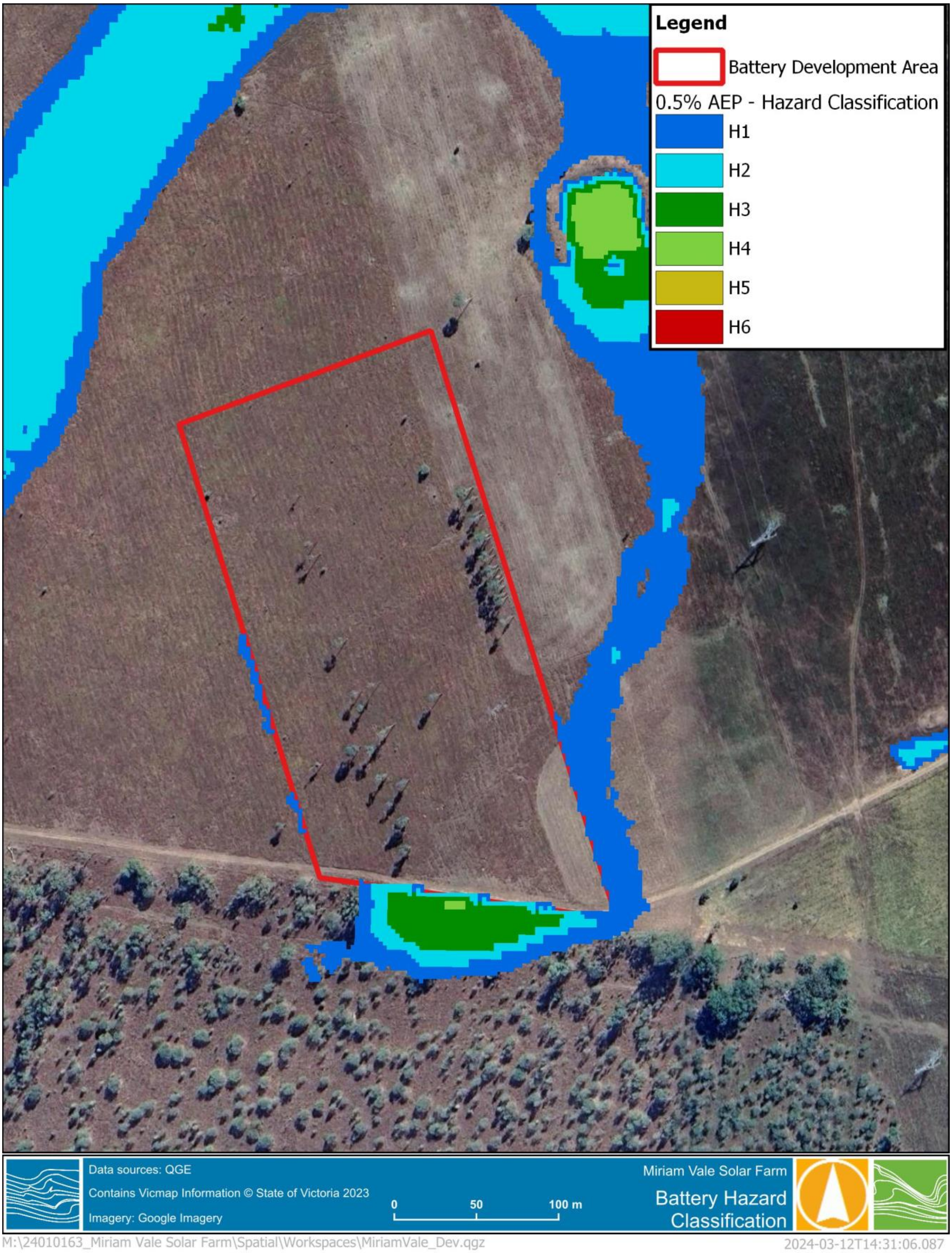

Figure 3-10 0.5% AEP Flood Hazard Classification – Battery Development

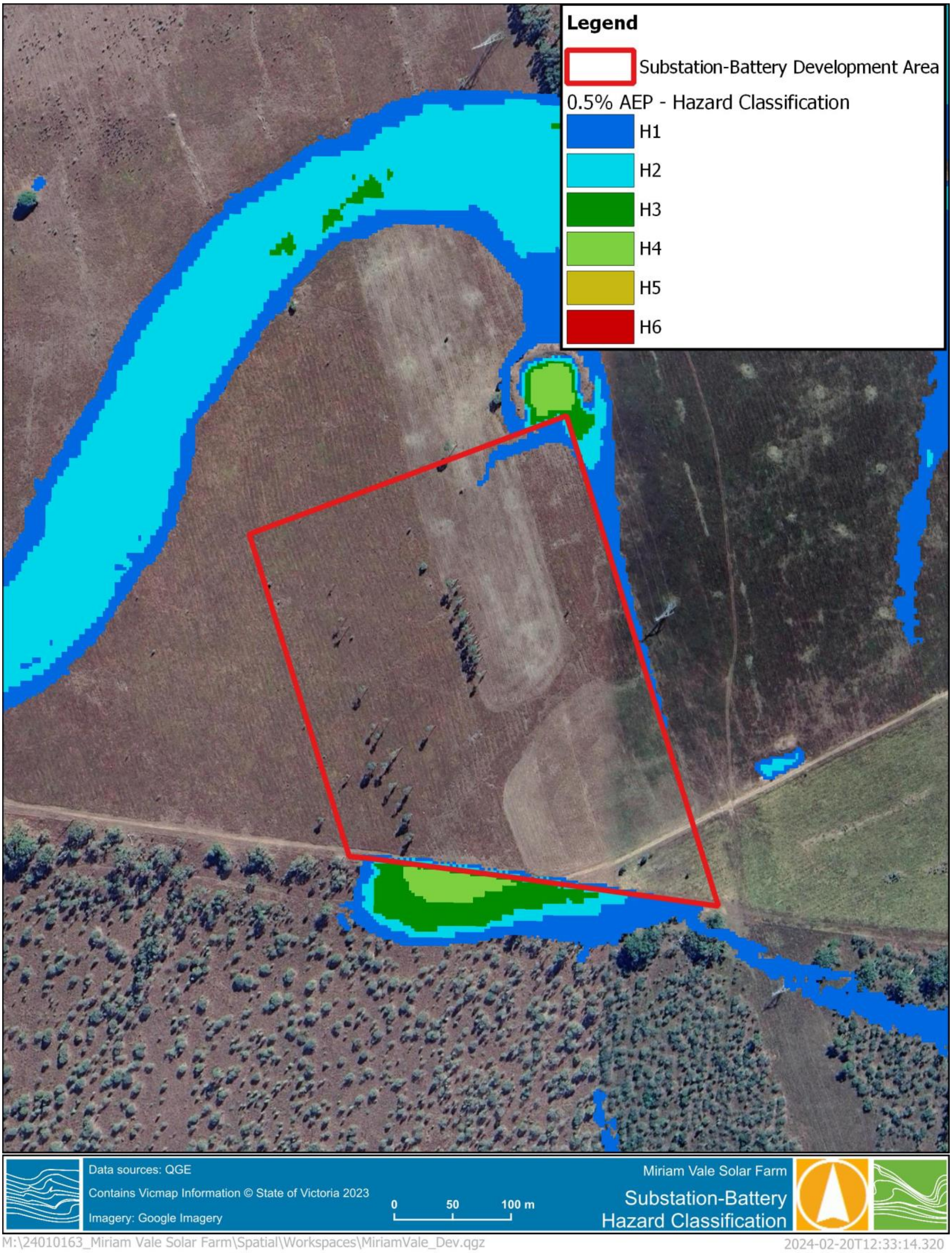

Figure 3-11 0.5% AEP Flood Hazard Classification – Substation-Battery Development

3.3.3 Afflux Assessment

Existing and developed conditions water elevations were compared for the 0.5% AEP event to highlight any impact the proposed development may have on neighbouring properties. This comparison was determined by subtracting the existing conditions water levels from the developed conditions and comparing the difference, as shown in the equation below.

$$Change\ in\ Flood\ Level = Developed\ Conditions\ Flood\ Level - Existing\ Conditions\ Flood\ level$$

- **Substation Development**
  - Extents of the 0.5% AEP flood event no longer inundate the proposed location of Substation due to the proposed fill pad. Flood depths have reduced by approximately 0.4m immediately downstream of the fill pad. Increases are present significantly at the western (upstream) side of the proposed fill pad, reaching a maximum increase of approximately 0.6m. These increases are due to the barrier created from the raise of the site. Implementation of appropriate drainage in this area may mitigate these impacts.
- **BESS Development**
  - Extents of the 0.5% AEP flood event no longer inundate the proposed location of the Battery Area due to the proposed fill pad. Flood depths have reduced by approximately 0.1m along the northeast (downstream) border of the proposed fill pad. Decreases are also present further east around the dam. Increases are present along the southern (upstream) border of the fill pad, reaching a maximum increase of around 1.0m. These increases are due to the barrier created from the raise of the site. Implementation of appropriate drainage in this area may mitigate these impacts.
- **BESS and Substation Development**
  - Due to the raise of the Substation and battery site the area no longer sits within the 0.5% AEP flood extent. The resulting diversion of flow causes significant increases in flood depths along the southern (upstream) border of the proposed fill pad, with these increases reaching around 1.2m. Increased flood depths are also simulated toward the southeast. These increases are due to the barrier created from the raise of the site. Implementation of appropriate drainage in this area may mitigate these impacts.
  - There are some local reductions in flood depth to the northeast (downstream) side of the proposed fill pad, with these decreases reaching around 0.07m

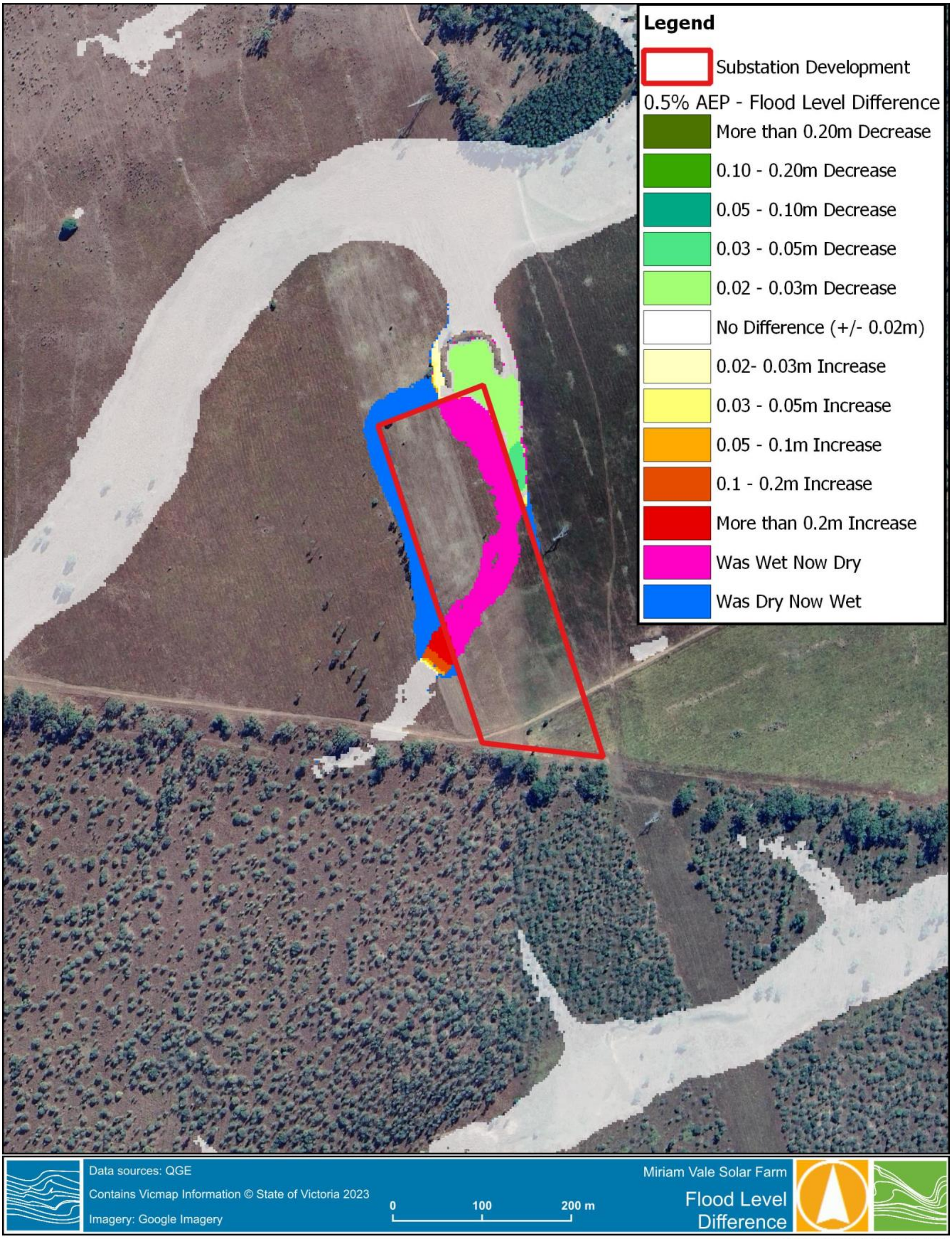

Figure 3-12 0.5% AEP Flood Level Difference – Substation Development

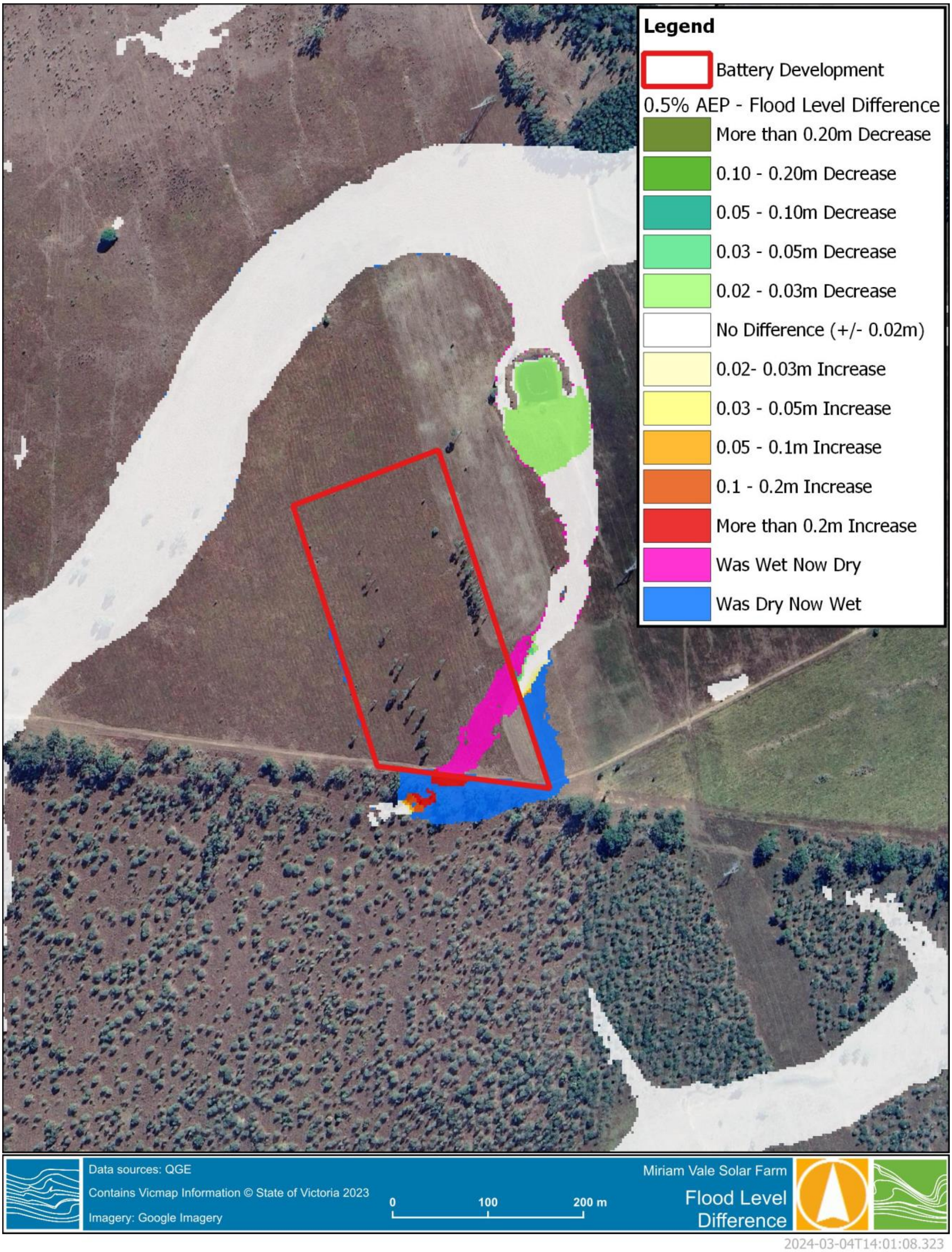

Figure 3-13 0.5% AEP Flood Level Difference – BESS Development

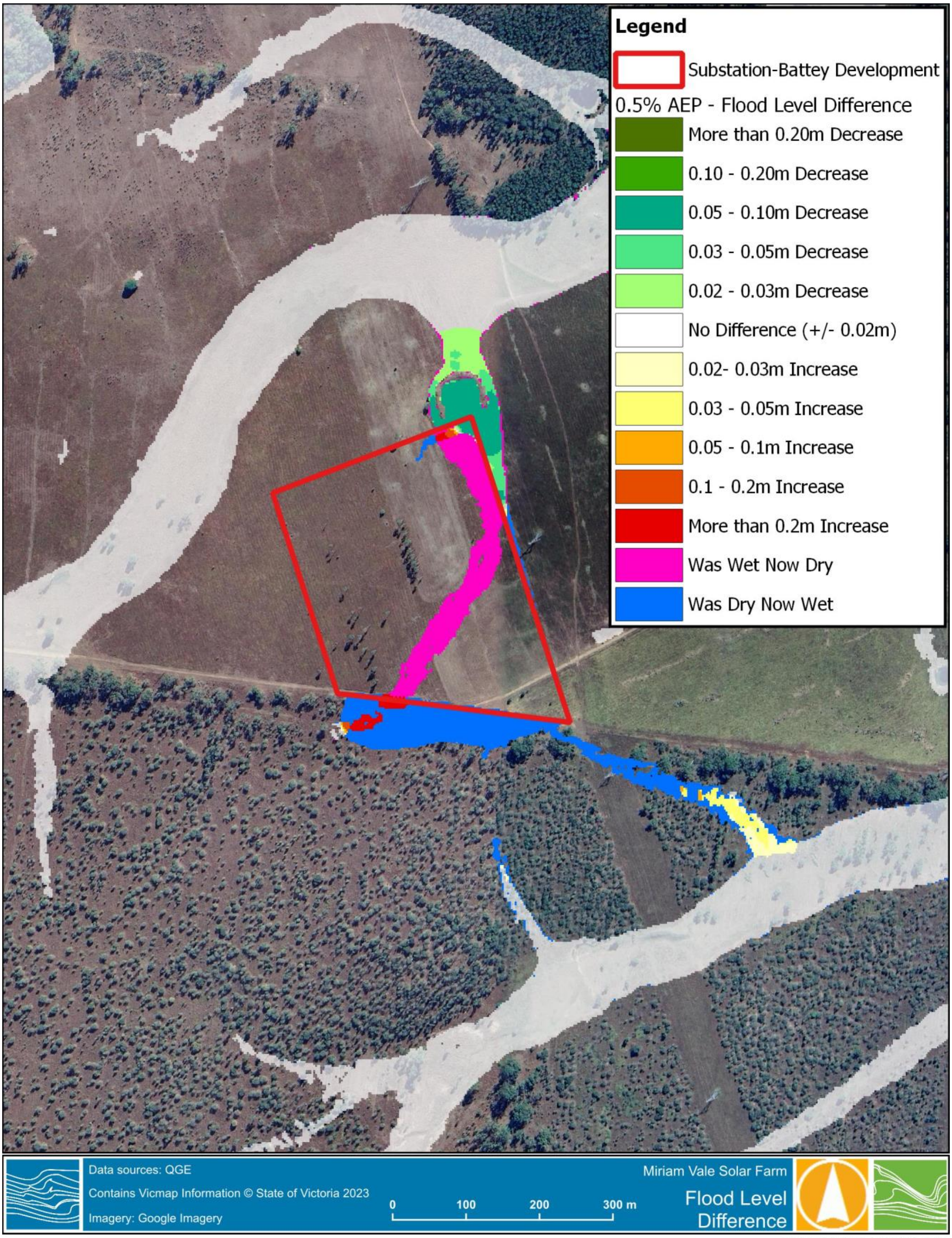

Figure 3-14 0.5% AEP Flood Level Difference – Substation-BESS Development

4 GLADSTONE REGIONAL COUNCIL PLANNING SCHEME OVERVIEW

The following assumptions have been made about the application after a review of the Gladstone Planning Scheme version 2, specifically the requirements relating to flooding:

- The proposed substation, BESS and switchyard is considered Operational works under Table 5.8.1, shown in Figure 4-1, categories of development and assessment.
- The proposed Development involves earthworks greater than 100m^3 for 'other activities' and therefore triggers assessment for the Rural zone code, Operational works code and development design code as a Renewable energy facility.
- Despite not being mapped in the flood hazard overlay, Water Technology's flood mapping reveals there is a waterway through the subject site. Therefore, we have considered the requirements of the Flood hazard overlay code.

Zone and Development	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Rural zone Carrying out operational work (all instances) and involving earthworks, including filling or excavating land.	**Accepted development subject to requirements**	
	Where development: involves earthworks of 500m3 or more for the purpose of water retention (for stock handling and agricultural activities) or 100m3 for other activities, and complies with the accepted development subject to requirements acceptable outcomes.	Rural zone code Operational works code Development design code
	Code assessable	
	Where development: involving earthworks of 500m3 or more for the purpose of water retention (for stock handling and agricultural activities); and does not comply with the accepted development subject to requirements acceptable outcomes.	Rural zone code Operational works code Development design code
	Accepted development	
	Where involving earthworks of less than 500m3 for water retention purposes (for stock handling or agricultural activities) or less than 100m3 for other activities.	

Figure 4-1 Gladstone Regional Council Planning Scheme v2 - 5.8 Categories of development and assessment: Operational work

4.1 Rural Zone Code

PO16 of the Rural zone code, requires that the development ensures ecological values, habitat corridors and soil and water quality are protected, having regard to:

a. maximising the retention of vegetation and the protection of vegetation from the impacts of development;

b. minimising the potential for erosion and minimisation of earthworks;

c. maximising the retention and protection of natural drainage lines and hydrological regimes; and

d. avoidance of leeching by nutrients, pesticides or other contaminants, or potential for salinity.

The proposed substation and switchyard as shown in drawing number PRI-001_018[A] (5Appendix B) is likely to create a modification to a minor drainage flow path. The proposed infrastructure is not located within a main watercourse and therefore the erosion risks are minimised, however mitigation infrastructure will be required as per the SMP.

4.2 Operational Works Code

PO7 of the operational works codes, requires that earthworks do not create or worsen any flooding, drainage issues, ponding or an increase in flow directions or volumes, on the site or adjoining or nearby sites to ensure that:

a. environmental values and water quality objectives of receiving waters within or downstream of the proposal are protected or enhanced during the construction, operation and maintenance phases, and

b. The release of sediment–laden stormwater for all land disturbances is minimised through the use of all reasonable and practicable erosion and sediment control measures with degraded areas reinstated.

The proposed substation and switchyard as shown in drawing number PRI-001_018[A] is likely to create a modification to a minor drainage flow path. However, the impacts are contained within the Miriam Vale BESS and Substation facility site and are therefore not impacting on downstream or upstream properties. The proposed earthworks do not create or worsen any flooding, drainage issues, ponding or an increase in flow directions or volumes, on the site or adjoining or nearby sites.

Consideration must be given to the unconstructed council road corridor south of the proposed substation and switching yard site. Mitigation measures are likely required to not make flooding worse at this location. Confirmation of this requirement should be sought from council.

4.3 Flood Hazard Overlay Code

The proposed substation and switchyard as shown in drawing number PRI-001_018[A] likely complies with PO8 of the Flood hazard overlay code in so much that the proposed earthworks does not adversely impact on or change the flood characteristics of a floodplain or waterway, nor do the earthworks increase the depth, velocity or direction of the flow, the rate of flood level rise or the duration of inundation on land external to the site.

4.4 Gladstone Regional Council Recommendations

The model results indicate that the proposed substation site intersects a minor flow path. To be considered free from inundation, the substation may need to be raised to a level above the flood immunity level outlined in Figure 4-2, being 0.5% AEP for substations. The flood level for the 0.5% AEP at the current substation location grades from 65m AHD to 59.5m AHD with existing flood depths up to 0.7m.

Table 8.2.7.3.2—Recommended flood immunity levels for community infrastructure

Type of Community infrastructure	Recommended flood immunity levels
Community and cultural facilities, including facilities where an education and care service under the Education and Care Services National Law (Queensland) is operated or a child care service under the Child Care Act 2002 is conducted, community centres, meeting halls, galleries and libraries.	1% AEP
Correctional facilities	0.2% AEP
Education establishment/child care centre	0.5% AEP
Emergency services facilities	Emergency services 0.2% AEP Emergency shelters 0.5% AEP Police facilities 0.5% AEP
Hospitals and associated institutions	0.2% AEP
Operating works under the Electricity Act 1994	Power stations 0.2% AEP Major switch yards 0.2% AEP Substations 0.5% AEP
Stores of valuable records or items of historic or cultural significance	0.5% AEP
Sewerage treatment plant	0.2% AEP
Water treatment plant	0.5% AEP

Figure 4-2 Recommended flood immunity levels for community infrastructure (Gladstone Regional Council)

Modelling of existing conditions suggests that the current proposed location of the Substation sits within the 0.5% AEP extent. Therefore, further works in addition to the proposed fill pad may be required to mitigate the associate impacts to the unconstructed council road corridor south of the proposed BESS, substation and switching yard site. These mitigation measures will also be required to ensure appropriate drainage around the fill pad and ensure there is no extended ponding of water against the fill pad.

To meet these recommendations, the Substation will have to be raised above the 0.5% AEP extent which reaches a maximum depth of 0.7m.

5 SUMMARY

A detailed TUFLOW hydraulic model was developed to assess flood behaviour within the Miriam Vale BESS and Substation project area. Due to the broad study area and the requirement to map all flowpaths within the study area, a rain on grid TUFLOW model was developed. The model results show that overland flooding is typified by slow-moving shallow sheet flow with sections of deeper, faster moving water confined to designated watercourses and defined flow paths. The model results have found that the proposed BESS and substation site would be within a minor flow path and may require elevation above the recommended flood immunity event level.

The flood mapping produced for this investigation demonstrates that the proposed development itself has negligible impacts to flood conditions. The impact on flood levels is localised to the BESS, Substation and Switching yard, with some increases apparent at the substation.

WATER TECHNOLOGY
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APPENDIX A
FLOOD MAPPING

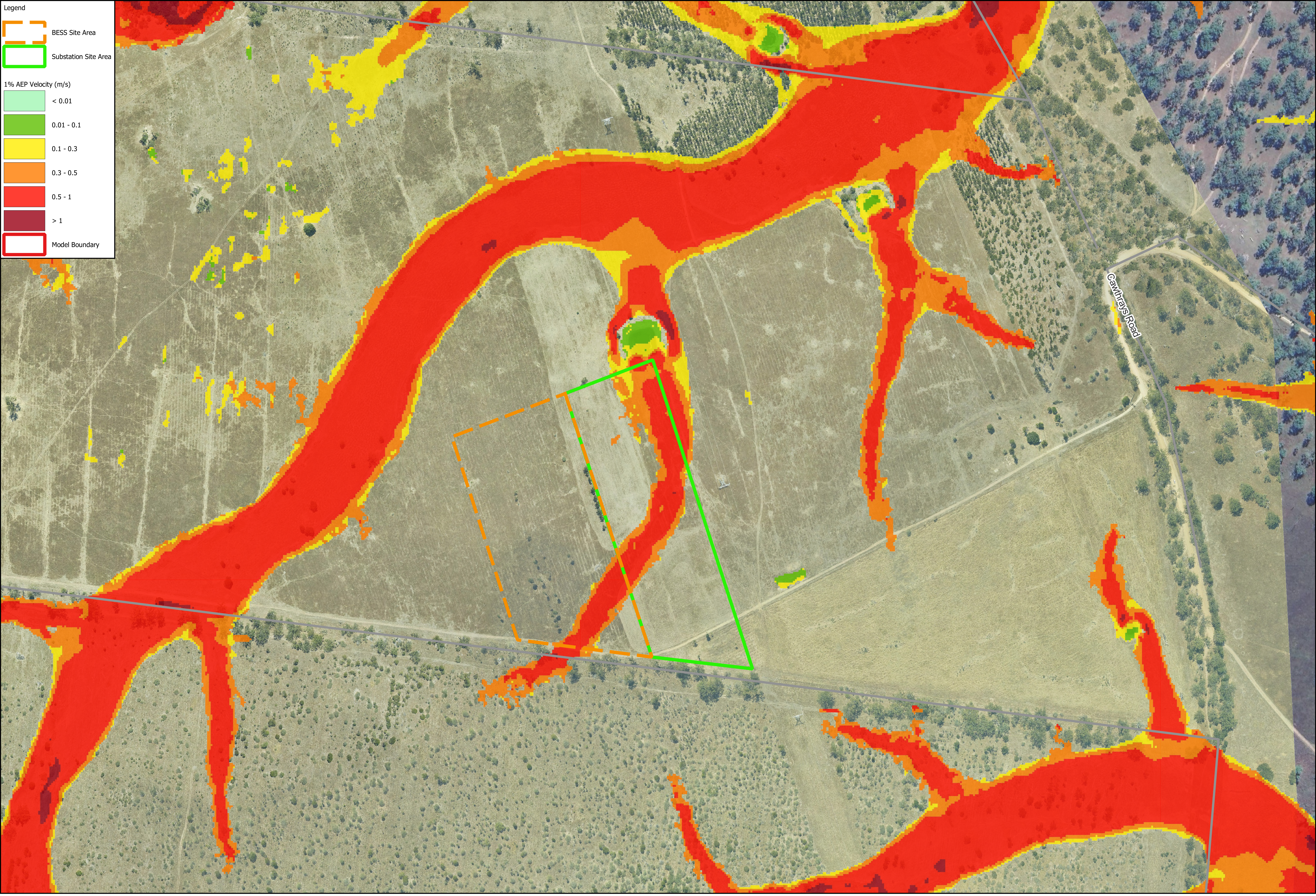
Data sources: QLD Gov, Client, Google

Imagery date: Client Supplied

Miriam Vale Battery Energy Storage System and Substation

1% AEP Depth

2024-05-17T14:22:19.895



Data sources: QLD Gov, Client, Google

Imagery date: Client Supplied

0 0.2 0.4 km

Miriam Vale Battery Energy Storage System and Substation

1% AEP Velocity

2024-05-17T14:22:25.631

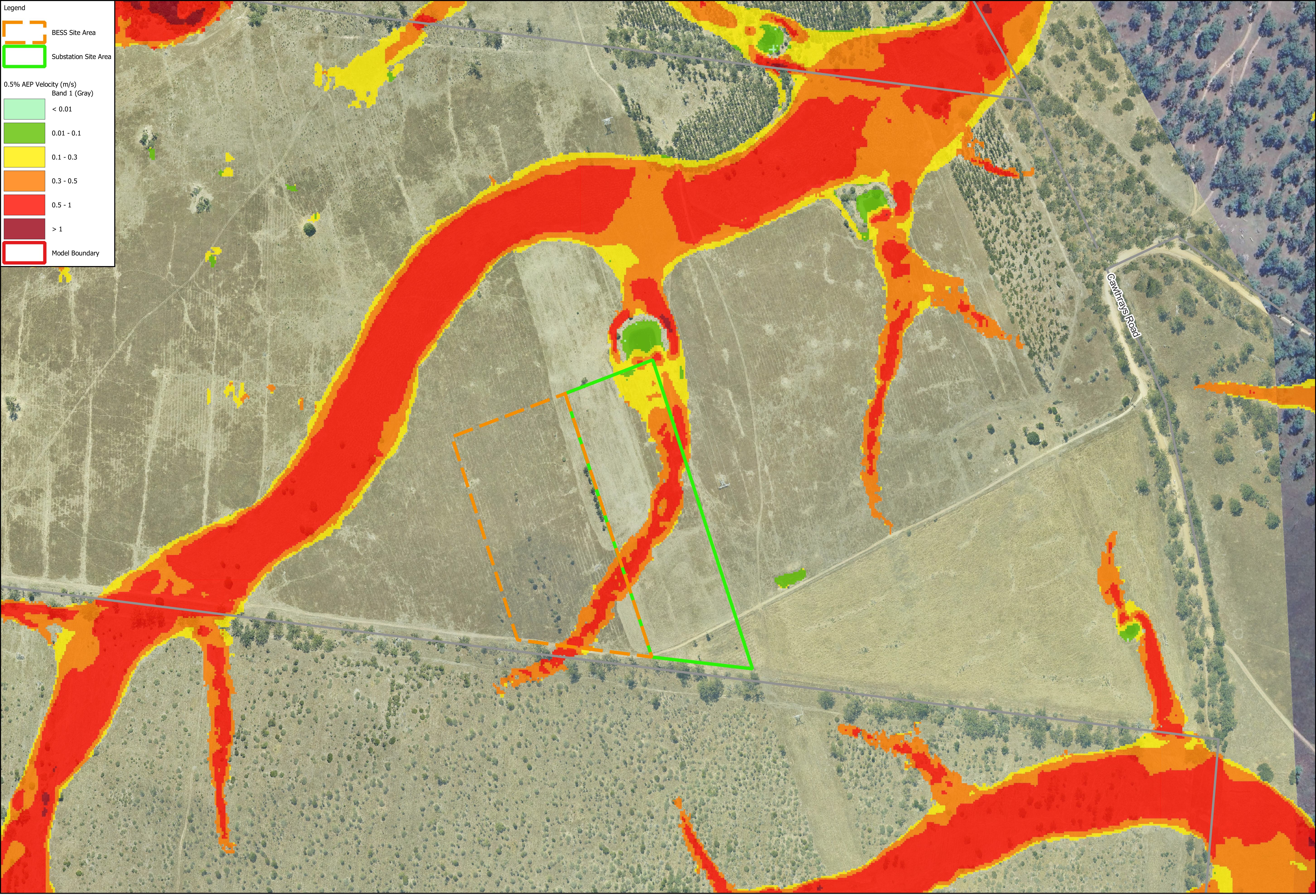
Data sources: QLD Gov, Client, Google
Contains QLD Information © State of Queensland 2023
Imagery date: Client Supplied

0 0.2 0.4 km

Miriam Vale Battery Energy Storage System and Substation

0.5% AEP Depth

2024-05-17T14:22:31.239



Data sources: QLD Gov, Client, Google

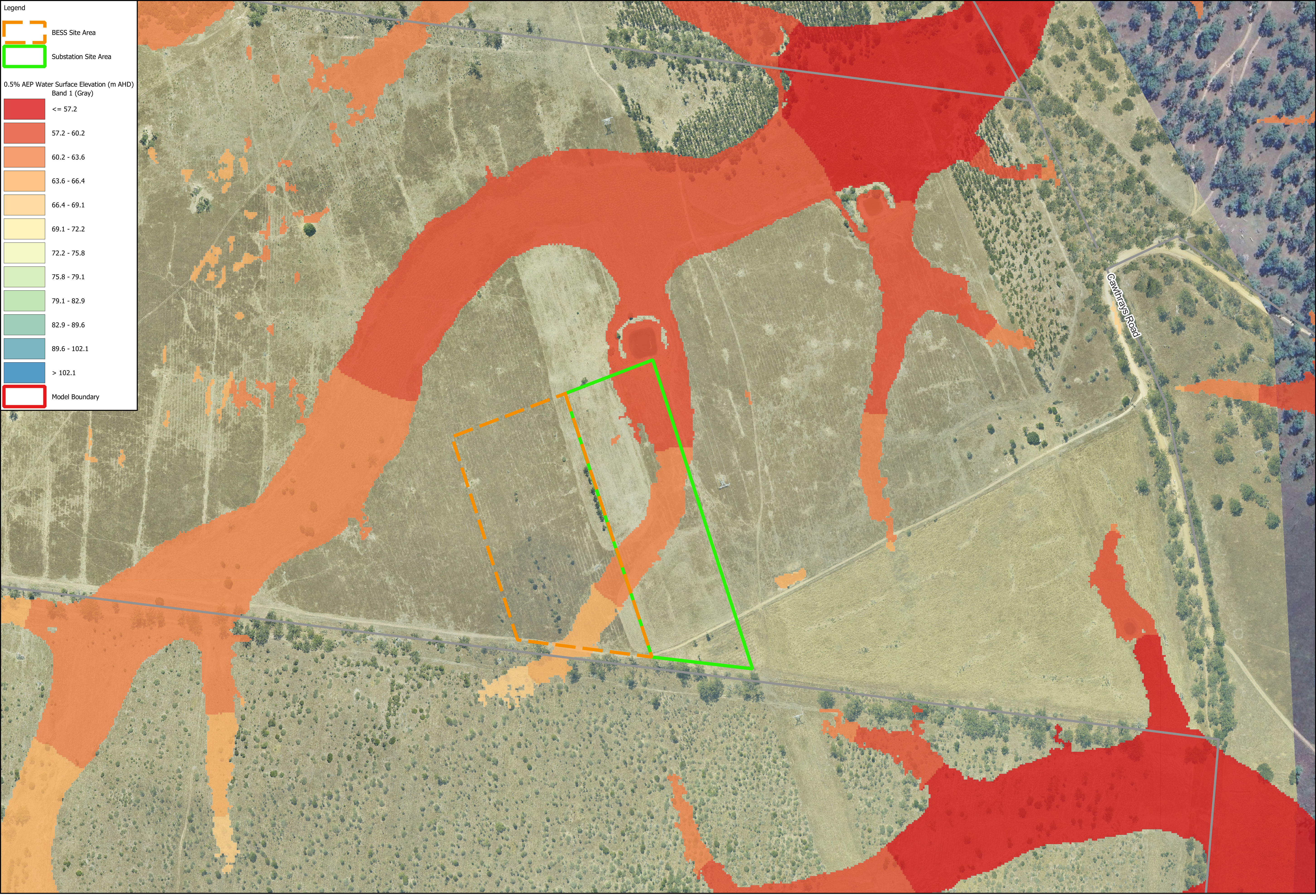
Imagery date: Client Supplied

0 0.2 0.4 km

Miriam Vale Battery Energy Storage System and Substation

0.5% AEP Velocity

2024-05-17T14:22:36.892



Data sources: QLD Gov, Client, Google

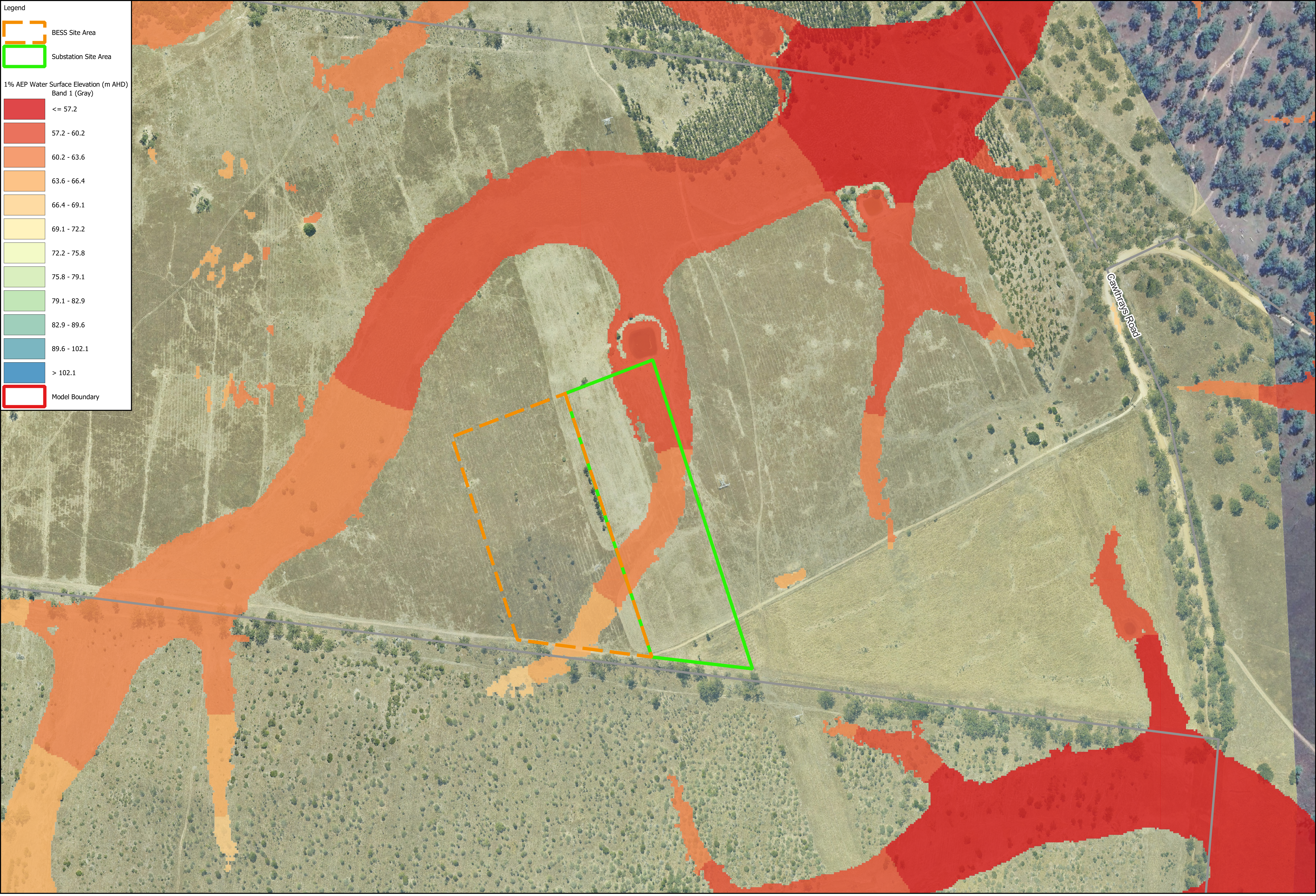
Imagery date: Client Supplied

0 0.2 0.4 km

Miriam Vale Battery Energy Storage System and Substation

0.5% AEP Water Surface Elevation (m AHD)

2024-05-17T14:22:42.528



Data sources: QLD Gov, Client, Google

Imagery date: Client Supplied

Miriam Vale Battery Energy Storage System and Substation

1% AEP Water Surface Elevation (m AHD)

2024-05-17T14:22:48.240

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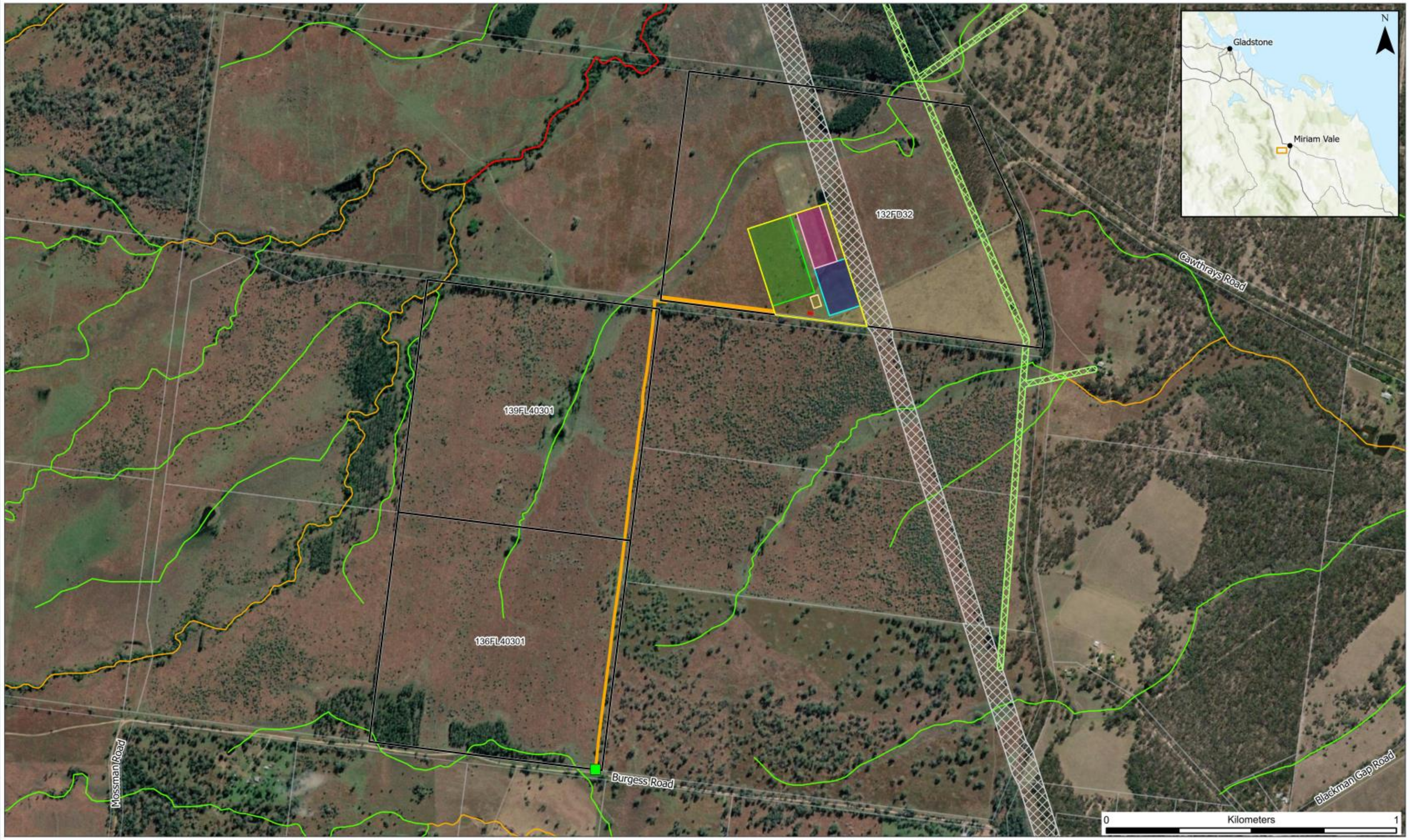
APPENDIX B
LAYOUT PLAN



Project Layout

- Burgess Road Access Point
- Local Road
- Waterways for Waterway Barrier Works:
  - High
  - Moderate
  - Low
- Proposed BESS, Substation and Switchyard Area
- Proposed BESS
- Proposed Internal Access Track
- Proposed Substation Development Area
- Proposed Switchyard Development Area
- Proposed Laydown Area
- Proposed Maintenance and Storage Shed Area
- Powerlink Corridor Easement
- OHTL Exclusion Zone
- Property Boundary
- Lot Type Parcel

MIRIAM VALE BESS

Attexo

REVIEWED: MW **DRAWN:** FM **SCALE (A3):** 1:12,500 **DATE:** 17/04/2024 **DWG No:** PRI-001_018[A] **FIGURE 5-1**

GDA2020 MGA Zone 56

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watertech.com.au

Stormwater Management Plan – Battery and Substation

Miriam Vale BESS

Attexo Group Pty Ltd

10 April 2024

Document Status

Version	Doc type	Reviewed by	Approved by	Date issued
01	DRAFT	C. Wallis	C. Wallis	10 April 2024

Project Details

Project Name	Miriam Vale Battery Energy Storage System
Client	Attexo Group Pty Ltd
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Certified System Quality ISO 9001 SAI GLOBAL
Certified System Environment ISO 14001 SAI GLOBAL
Certified System OHS ISO 45001 SAI GLOBAL

ACKNOWLEDGEMENT OF COUNTRY

The Board and employees of Water Technology acknowledge and respect the Aboriginal and Torres Strait Islander Peoples as the Traditional Custodians of Country throughout Australia. We specifically acknowledge the Traditional Custodians of the land on which our offices reside and where we undertake our work.

We respect the knowledge, skills and lived experiences of Aboriginal and Torres Strait Islander Peoples, who we continue to learn from and collaborate with. We also extend our respect to all First Nations Peoples, their cultures and to their Elders, past and present.

Artwork by Maurice Goolagong 2023. This piece was commissioned by Water Technology and visualises the important connections we have to water, and the cultural significance of journeys taken by traditional custodians of our land to meeting places, where communities connect with each other around waterways.

The symbolism in the artwork includes:

- *Seven circles representing each of the States and Territories in Australia where we do our work*
- *Blue dots between each circle representing the waterways that connect us*
- *The animals that rely on healthy waterways for their home*
- *Black and white dots representing all the different communities that we visit in our work*
- *Hands that are for the people we help on our journey*

10 April 2024

Chris Cantwell
Partner and Principal Consultant
Attexo Group Pty Ltd

Via email: chris.cantwell@attexo.com.au

Dear Chris,

Miriam Vale BESS

Please see the attached report documenting Water Technology's Stormwater Management Plan for the proposed Miriam Vale substation and BESS facility located West of Miriam Vale. If you have any questions, please do not hesitate to contact me.

Yours sincerely,

Alex Barton NER
Senior Engineer
alex.barton@watertech.com.au
WATER TECHNOLOGY PTY LTD

CONTENTS

APPENDICES

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

1.1 Overview

Water Technology has been engaged by Attexo to prepare a Stormwater Management Plan (SMP) for the proposed Miriam Vale BESS and substation facility located approximately 5 km west of Miriam Vale, Queensland. The site is shown in Figure 1-1 and is wholly located within the Gladstone Regional Council (GRC) Local Government Area (LGA). A layout plan for the overall site is provided in **Appendix A**. A SMP is required to inform planning and design of infrastructure and support the development application over the site.

This SMP documents the methodology and outcomes of the assessments undertaken to demonstrate that the proposed development achieves the required stormwater quality provisions required by GRC and the Queensland Government. This SMP specifically relates to the nominated switchyard, substation and battery area only.

This assessment is limited to addressing stormwater quality and potential impacts associated with additional hardstand areas within the switchyard, substation and battery area. Impacts on stormwater runoff quantity and flooding will be addressed as part of a flood impact assessment documented separately to this report.

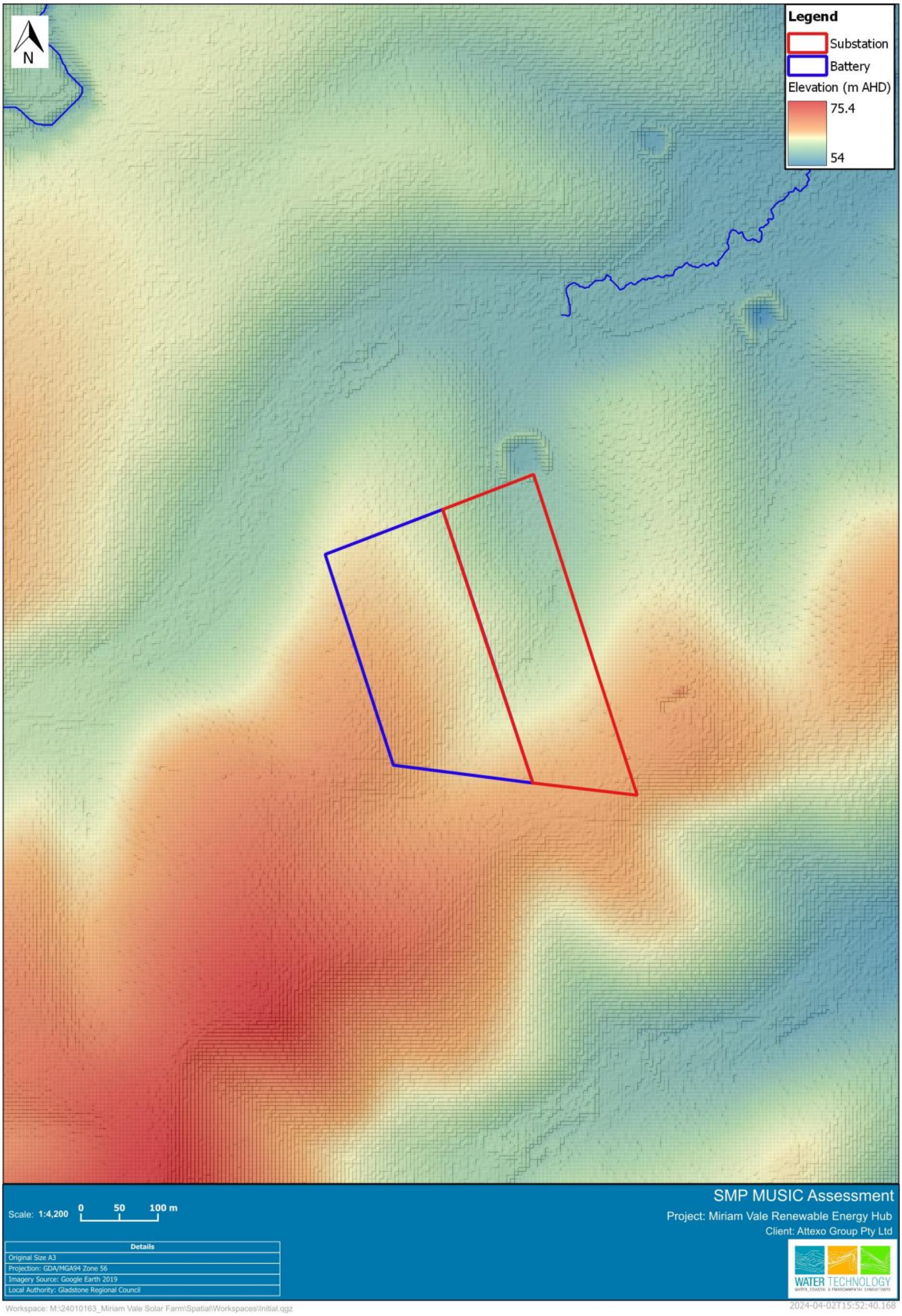


Figure 1-1 Subject Site (Zoomed)

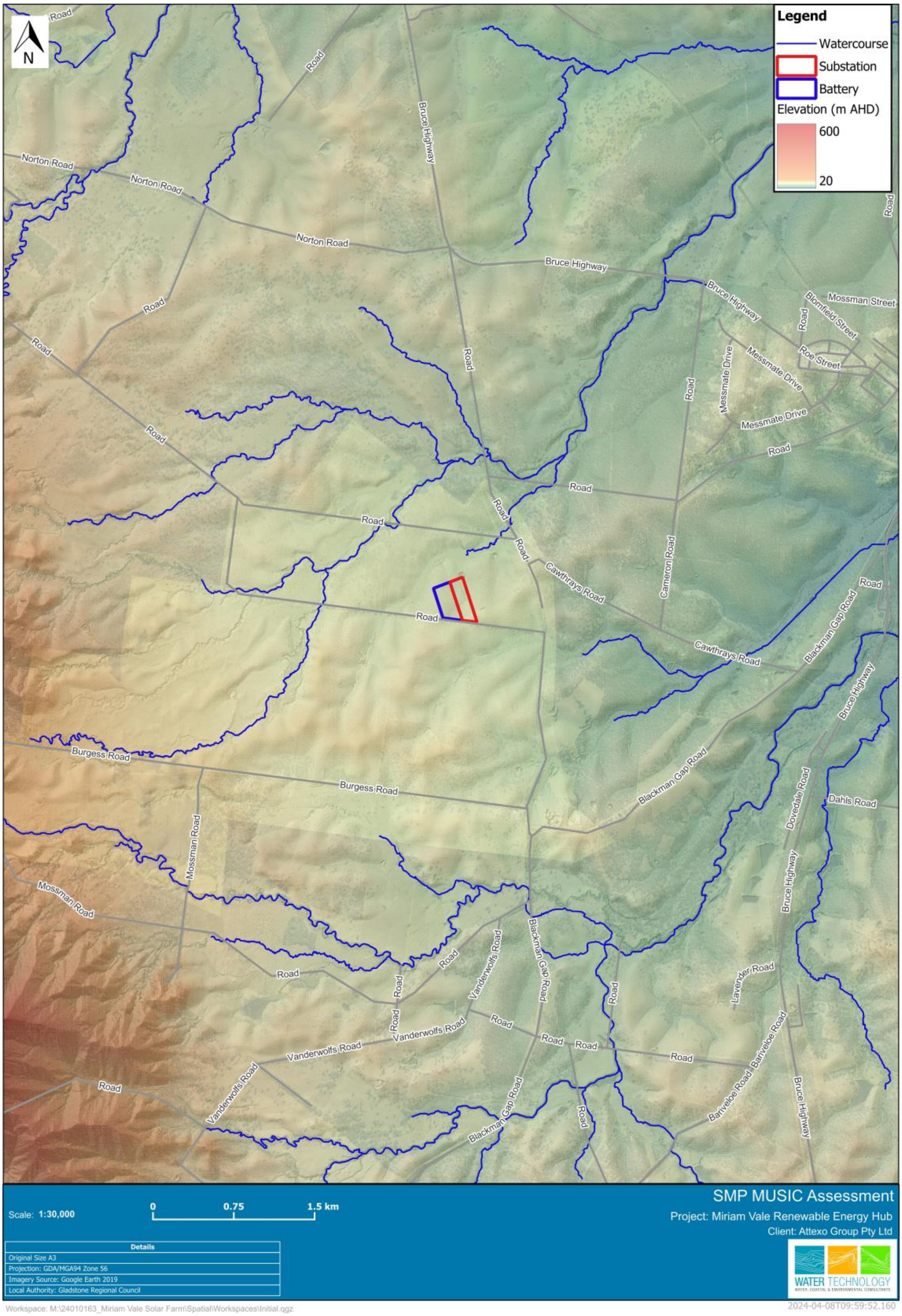


Figure 1-2 Subject Site

1.2 Legislation and General Guidelines

The following legislation and guidelines are applicable to stormwater management for the proposed development:

- Environmental Protection Act 1994.
- Environmental Protection (Water and Wetland Biodiversity) Policy 2019
- Water Act 2000
- Vegetation Management Act 1999 and Vegetation Management Regulation 2012
- Soil Conservation Act 1986
- Environmental Protection Act 1994
- State Planning Policy (SPP) 2017
- Gladstone Regional Council Planning Scheme
- Environmental Protection (Water and Wetland Biodiversity) Policy 2019
- Reef 2050 Water Quality Improvement Plan 2017–2022, 2018
- Water Quality Improvement Plan for the Burnett Mary Region
- Australian and New Zealand Governments (ANZG) 2018, Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia.
- Monitoring and Sampling Manual: Environmental Protection (Water) Policy, 2018
- Australian Drinking Water Guidelines, 2011 (Updated August 2018)
- Queensland Urban Drainage Manual, 2017
- Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia - Geoscience Australia, 2019.
- Best Practice Erosion and Sediment Control, IECA, 2008.
- Healthy Land and Water (2018) MUSIC Modelling Guidelines
- Water by Design Bioretention Technical Design Guidelines (Version 1.1), 2014
- Urban Stormwater Quality Planning Guidelines, 2010
- Urban Stormwater – Queensland best practice environmental management guidelines – Technical Note: Derivation of Design Objective, 2009
- Urban Stormwater Quality Planning Guidelines 2010

2 CATCHMENT HYDROLOGY AND ENVIRONMENTAL VALUES

2.1 Catchment Hydrology

The proposed BESS and substation development covers a total area of approximately 10.5 ha as shown in Figure 1-1. The overall site is situated within the Skeleton Creek catchment (part of the greater Baffle Creek catchment). Tributaries to Skeleton Creek traverse the site, comprising multiple land parcels, draining generally from east to west.

2.2 Environmental Values

The Environmental Protection (Water and Wetland Biodiversity) Policy 2019, which is subordinate legislation to the *Environmental Protection Act 1994*, provides a framework for identifying environmental values (EV) for a waterway and deciding water quality objectives (WQO) to protect or enhance those EV's. EV's for water are the qualities of water that make it suitable for supporting aquatic ecosystems and human water uses. These EVs need to be protected from the effects of habitat alteration, waste releases, contaminated runoff and changed flow to ensure healthy aquatic ecosystems and waterways that are safe for community use.

The site is located within the Baffle Creek catchment. There are currently no catchment specific EVs or WQOs developed for the Baffle Creek catchment under the Environmental Protection (Water and Wetland Biodiversity) Policy 2019. However, based on our understanding of the Baffle Creek catchment, the following EVs require protection:

- Aquatic ecosystems
- Irrigation
- Farm supply/use
- Stock water
- Human consumer
- Primary recreation
- Secondary recreation
- Visual recreation
- Drinking water
- Industrial use
- Cultural and spiritual values

2.3 Water Quality Objectives

Water Quality Objectives are intended to protect the EVs of receiving waters and as such set out parameters for biological, chemical and other measures to be met in the receiving waters. Based on the guidance provided in DES (2022)[1], the Skeleton Creek catchment would be considered a 'moderately disturbed' aquatic ecosystem indicating water quality should be maintained or improved in line with the WQOs. The WQO's for aquatic ecosystem EVs and human use EVs, are outlined in Table 2-1. Reference in this table is made to the following documents:

[1] DES (2022), Guideline - Environmental Protection (Water and Wetland Biodiversity) Policy 2019 - Deciding aquatic ecosystem indicators and, local water quality guideline values, Queensland Government Department of Environment and Science, March 2022.

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (AWQG) are available on the National Water Quality Management Strategy website.
- Australian Drinking Water Guidelines (ADWG) are available on the NHMRC website.
- The Australia New Zealand Food Standards Code is available on the Food Standards Australia and New Zealand website.

Management of riparian vegetation with regards to WQOs should be conducted with reference to regional vegetation management codes under the *Vegetation Management Act 1999*. This is aimed at maintaining water quality, bank stability and aquatic and terrestrial habitat. Clearing controls vary according to stream order.

Table 2-1 Water quality objectives to protect human use environmental values (Source: DES 2020)

Environmental value	Water Quality Objective to protect EV
Protect aquatic ecosystems	Objectives as per AWQG.
Suitability for drinking water supply	For water quality after treatment or at point of use refer to legislation and guidelines, including: ■ *Public Health Act 2005* and Regulations ■ *Water Supply (Safety and Reliability) Act 2008*, including any approved drinking water management plan under the Act ■ ADWG
Protection of the human consumer	Objectives as per AWQG and Australia New Zealand Food Standards Code, Food Standards Australia New Zealand, 2007 and updates.
Protection of cultural and spiritual values	Protect or restore indigenous and non-indigenous cultural heritage consistent with relevant policies and plans.
Suitability for industrial use	Water quality requirements for industry vary within and between industries. The AWQG do not provide guidelines to protect industries, and indicate that industrial water quality requirements need to be considered on a case-by-case basis. This EV is usually protected by other values, such as the aquatic ecosystem EV.
Suitability for irrigation	Objectives as per AWQG.
Suitability for stock watering	Objectives as per AWQG, including median faecal coliforms <100 organisms per 100 mL. For other objectives, such as total dissolved solids, metals, cyanobacteria and pathogens, see AWQG.
Suitability for farm supply/use	Objectives as per AWQG.
Suitability for primary contact recreation	Objectives as per NHMRC (2008), including: ■ water free of physical (floating and submerged) hazards ■ temperature range: 16–34°C ■ pH range: 6.5–8.5 ■ DO: >80% ■ faecal contamination: designated recreational waters are protected against direct contamination with fresh faecal material, particularly of human or

<table>
<tr><th>Environmental value</th><th>Water Quality Objective to protect EV</th></tr>
<tr><td></td><td>domesticated animal origin. Two principal components are required for assessing faecal contamination:
assessment of evidence for the likely influence of faecal material.
counts of suitable faecal indicator bacteria (usually enterococci).
These two components are combined to produce an overall microbial classification of the recreational water body
intestinal enterococci: 95th percentile ≤ 40 organisms per 100mL (for healthy adults) (NHMRC, 2008; Table 5.7).
direct contact with venomous or dangerous aquatic organisms should be avoided. Recreational water bodies should be reasonably free of, or protected from, venomous organisms.
waters contaminated with chemicals that are either toxic or irritating to the skin or mucous membranes are unsuitable for recreational purposes.
cyanobacteria/algae: Recreational water bodies should not contain:
Level 1: ≥ 10 µg/L total microcystins; or ≥ 50 000 cells/mL toxic Microcystis aeruginosa; or biovolume equivalent of ≥ 4 mm^3/L for the combined total of all cyanobacteria where a known toxin producer is dominant in the total biovolume; or
Level 2: ≥ 10 mm^3/L for total biovolume of all cyanobacterial material where known toxins are not present; OR cyanobacterial scums consistently present. Further details are contained in NHMRC (2008) and Table 12.</td></tr>
<tr><td>Suitability for secondary contact recreation</td><td>Objectives as per NHMRC (2008), including:
intestinal enterococci: 95th percentile ≤ 40 organisms per 100 mL (for healthy adults) (NHMRC, 2008; Table 5.7).
cyanobacteria/algae—refer objectives for primary recreation, NHMRC (2008) and Table 12 of DES 2020.</td></tr>
<tr><td>Suitability for visual recreation</td><td>Objectives as per NHMRC (2008), including:
Recreational water bodies should be aesthetically acceptable to recreational users. The water should be free from visible materials that may settle to form objectionable deposits; floating debris, oil, scum and other matter; substances producing objectionable colour, odour, taste or turbidity; and substances and conditions that produce undesirable aquatic life.
cyanobacteria/algae—refer objectives for primary recreation, NHMRC (2008) and Table 12.</td></tr>
</table>

2.3.1 Water Quality Improvement Plan

The Burnett-Mary Water Quality Improvement Plan (WQIP) guides investments in activities addressing water quality issues in both urban and rural catchments. It explicitly considers feasibility, cost-benefits, and research needs to achieve water quality objectives. The Burnett Mary Regional Group, in collaboration with industry and landholders, focuses on improving land management practices to enhance water quality across the region. Their efforts aim to reduce sediment, nutrients, and pesticides entering waterways.

2.3.2 Great Barrier Reef Discharge Standards

Great Barrier Reef (GBR) catchment waters have end-of-basin load water quality objectives, which are to be achieved and maintained as per s11(4) of the Great Barrier Reef River Basins End-of-Basin Load Water Quality Objectives (Environmental Protection Policy (Water) 2019). The objectives establish locally relevant anthropogenic[2] loads for each of the GBR catchments and are considered in the assessment of applications in addition to relevant environmental values and associated water quality objectives.

End-of-basin load Reef water quality objectives (WQOs) have been established for dissolved inorganic nitrogen (DIN) and fine sediment (FS) as these two pollutants have been found to have the greatest overall impact on the health and resilience of the Reef. End-of-basin load Reef WQOs specified for the Burrum River aim to reduce anthropogenic nutrient and sediment loads over time with the aim of achieving Reef WQOs by 2025 (see Table 2-2). End-of-catchment anthropogenic load reductions are required from the 2013 baseline. Where anthropogenic nutrient and sediment loads in a river basin are already at low levels, it is understood that the current low levels should be maintained to ensure there is no increase in pollutant loads.

Table 2-2 End-of-catchment anthropogenic water quality targets for the Baffle catchment by 2025 and relative priorities for water quality improvement

Region: Baffle catchment, Burnett Mary Region (Area: 4,085 km^2)		
Parameter	**Target**	**Management Priority**
Dissolved Organic Nitrogen (DIN)	16 tonnes, 50% reduction	Minimal
Fine Sediment[3]	11 kilo-tonnes, 20% reduction	Minimal
Particulate Phosphorus	15 tonnes, 20% reduction	Minimal
Particulate Nitrogen	33 tonnes, 20% reduction	Minimal
Pesticide target to protect min 99% aquatic species at end of catchment	n/a	Not assessed

[2] Pollutants derived from human-based activities (e.g. sewage treatment, fertiliser application)
[3] Fine sediment is measured as total suspended solids.

3 STORMWATER MANAGEMENT PLAN

3.1 Construction Phase

3.1.1 Overview

Management of water quality during the construction phase is necessary to minimise environmental harm to downstream receiving waters. The following section provides a brief outline of the construction phase stormwater management requirements for the proposed development. Construction water quality management approaches are highly-site specific, therefore, refinements to this management approach will occur prior to the commencement of construction. Additionally, construction phase water quality management will be subject to an appropriate erosion and sediment control plan (ESCP) for the Site.

3.1.2 Construction Water Quality Management

Construction phase stormwater management will occur in accordance with current best industry practice, the requirements of the State Planning Policy (SPP) and Best Practice Erosion and Sediment Control (International Erosion Control Association (IECA) 2008). The main tenets of construction phase water quality management are contained in Table 3-1. These have been adapted from the SPP and a general management approach has been nominated for each issue. Further details of the management approach (i.e. such as sediment basin design) will be determined by construction ESCPs prepared by a suitably qualified person as required by the IECA 2008.

Table 3-1 Stormwater Management Actions (Construction Phase)

Issue	Management Actions
Drainage control	▪ Design storm and design life for temporary works: – Distributed area open for <12 months – 1 in 2-year ARI event – Distributed area open for 12-24 months – 1 in 5-year ARI event – Distributed area open for >24 months – 1 in 10-year ARI event ▪ Design capacity excludes minimum 150mm freeboard. ▪ Temporary culvert crossing – minimum 1 in 1-year ARI hydraulic capacity. ▪ Manage sheet flow to minimise gully and rill erosion. ▪ Temporary drainage to provide stable concentrated flow paths, catch drains and flow diversions where necessary. ▪ The disturbed area is anticipated to be greater than 2,500 m^2, therefore, a sediment basin will likely be required to manage sediment run-off and regulate flows. ▪ Temporary sediment basin/s to be constructed in accordance with the Best Practice Erosion and Sediment Control guideline (IECA 2008).
Erosion control	▪ Stage clearing and construction activities to minimise exposed soil. ▪ Progressive stabilisation is to be undertaken in accordance with IECA 2008 Table 4-2 and nominated groundcover percentages achieved prior to the removal of control devices.
Sediment control	▪ Implement sediment controls such as sediment traps, silt fences, channel linings and check dams in accordance with construction ESCPs. ▪ Sediment traps are to be designed and positioned by a suitably qualified person to achieve site discharge water quality objectives.
Flow management	▪ Earthworks and the implementation of erosion and sediment controls are undertaken in ways which ensure flooding characteristics are not worsened.

3.2 Post-Construction Phase

An assessment of stormwater quality at the Site, including Water Sensitive Urban Design (WSUD) measures adopted to mitigate impacts to the quality of runoff leaving the developed site, has been undertaken using the Model for Urban Stormwater Conceptualisation (MUSIC). The following section documents the conceptual sizing of bioretention basin requirements to inform site layout and civil arrangements. These WSUD measures are proposed for the operational phase of the development and are, therefore, long-term water quality management measures following the post-construction phase of the proposed development. Typical pollutants from this development are listed in Table 3-2.

Table 3-2 Typical Pollutants from Site (Post-Construction Phase)

Pollutant Type	Pollutant sources
Gross Pollutants	Litter such as food, drink and materials packaging and wrappers, leaf matter and grass clippings.
Sediment	Sediment brought in by vehicles, erosion, atmospheric deposition, organic matter, spills and accidents.
Hydrocarbons	Fuel and oil spills from cars and trucks, asphalt pavements.
Nutrients	Fertiliser, decaying organic matter, animal faeces, detergents, atmospheric deposition.

3.3 Model Setup

Water quality modelling of the proposed development has been undertaken using the Model for Urban Stormwater Conceptualisation (MUSIC). The MUSIC model enables the user to estimate the pollutant export from the proposed development site and quantify the effectiveness of the proposed stormwater quality treatment train. MUSIC provides quantitative modelling for Total Suspended Solids (TSS), Total Phosphorous (TP), Total Nitrogen (TN) and Gross Pollutants (GP).

The MUSIC model was set up in accordance with Water by Design MUSIC Modelling Guidelines (2018) which has been produced under the Water by Design Program by the South-East Queensland Healthy Waterways Partnership. In addition, Healthy Waterways recommends using MUSIC Version 6 to ensure compliance with stormwater pollutant loads reduction objectives.

We have adopted the parameters for the proposed layout of the substation and battery area. A 100% impervious was given to the areas of the development that are to be constructed, such as the batteries and items relating to the substation.

3.3.1 Catchment Areas

The multiple catchment approach has been adopted for this assessment based on the proposed layout provided. A summary of the catchment areas based on the land use type as applied in the MUSIC model are summarised in Table 3-3, and illustrated in Figure 3-1.

As there are no site-specific water quality or pollutant data available, pollutant export parameters were adopted based on the Water by Design MUSIC guidelines as per best practice. The land use type adopted in MUSIC for the predeveloped case was the ‘Agriculture’ type, with 0% imperviousness. The substation was assigned to be ‘Rural Residential’, although with 95% imperviousness. The battery pads were assigned ‘Unsealed Road’ land use type with 20% imperviousness. The previous gravel area was assigned as ‘Rural Residential’ with 1% imperviousness. The total impervious value for each of the catchments is shown in Table 3-3.

Figure 3-1 Water Quality Catchments

Table 3-3 Catchment Breakdown – Proposed Development

Catchment	Total Area (ha)	Fraction Impervious (%)
Battery Pad	3.5	20
Pervious Gravel Area	4.6	1
Substation Area	2.4	95
Pre-Developed Catchment	10.5	0

3.3.2 Rainfall and Evapotranspiration Data

Rainfall data was sourced from the Australian Bureau of Meteorology (BoM) for Builyan Gum Street Rainfall Station (Station Number 039297) and covered the period from the April 1984 to the July 2010 with 6-minute rainfall data resolution, as recommended by the MUSIC Modelling Guidelines (2018). A summary of the monthly evapotranspiration data adopted for the MUSIC analysis is presented in Table 3-4.

Table 3-4 Evapotranspiration Data (PET) Observed at Greenbank Station

Month	Evapotranspiration (mm/month)
January	220.8
February	189.5
March	165.1
April	131.9
May	99.6
June	77.9
July	86.1
August	111.1
September	139.1
October	178.0
November	191.9
December	210.4

3.3.3 Pollutant Export Parameters

As there are no site-specific water quality or pollutant data available, pollutant export parameters were adopted based on the Water by Design MUSIC guidelines as per best practice. Table 3-5 summarises the pollutant export parameters adopted for the analysis.

Table 3-5 Pollutant export parameters

Land type	Flow Type	TSS log10 values		TP log10 values		TN log10 values	
-	-	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
Rural Residential	Baseflow Parameters	1.15	0.17	-1.22	0.19	-0.05	0.12
	Stormflow parameters	1.95	0.32	-0.66	0.25	0.3	0.19
Unsealed Road	Baseflow Parameters	1.2	0.170	-0.85	-0.3	0.11	0.34
	Stormflow parameters	3	0.32	0.19	0.25	0.12	0.19

3.3.4 Treatment Nodes

It is proposed to treat run-off from the site through the use of swales and bioretention basins located either within the internal site layout or locating the bioretention basins immediately downstream of the site footprint. Treatment areas are shown in Table 3-6 to Table 3-10. These devices have been modelled in MUSIC with the model schematic shown Figure 3-2.

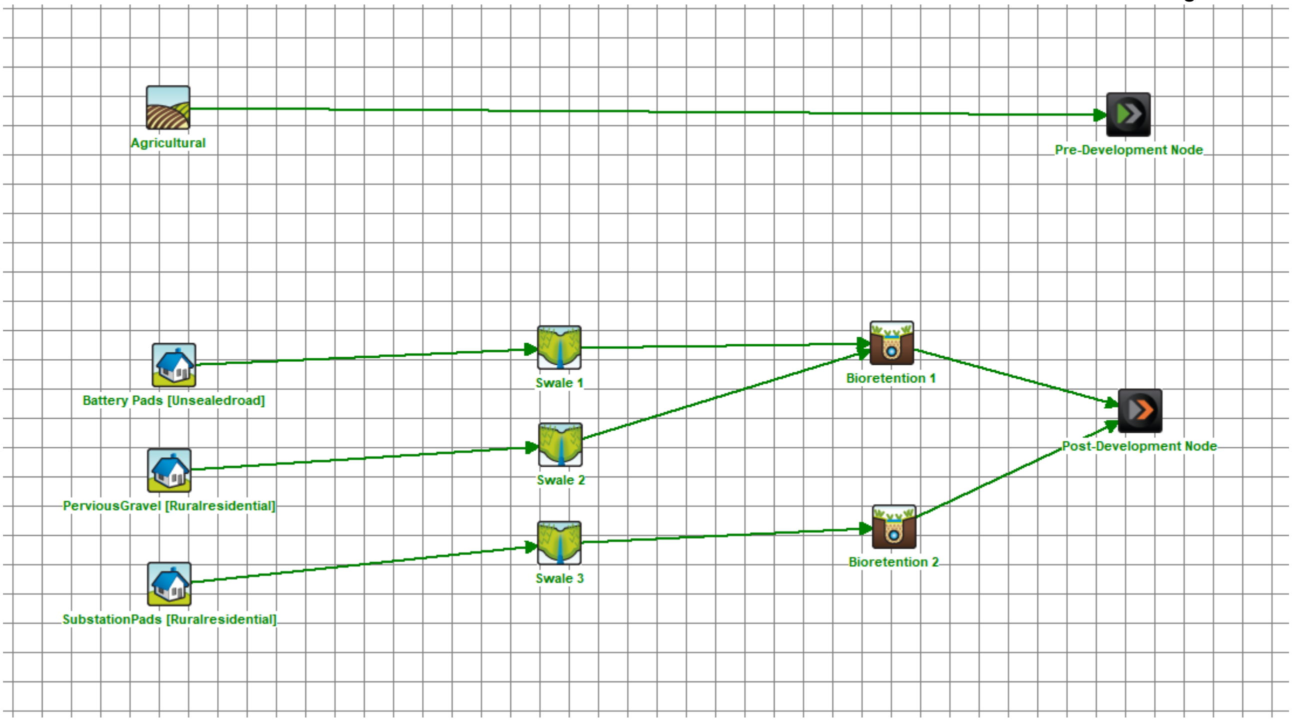


Figure 3-2 MUSIC Model Layout – Sedimentation Basin and wetland

Table 3-6 MUSIC Bioretention Basin 1 System Details

Parameter	Bioretention Basin
Low Flow By-pass (m^3/s)	0
High Flow By-pass (m^3/s)	1.5

Parameter	Bioretention Basin
Surface Area (m^2)	500
Extended Detention Depth (m)	0.30
Filter Area (m^2)	500
Unlined Filter Media Perimeter (m)	90
Filter Depth (m)	0.50
Saturated Hydraulic Conductivity (mm/hr)	200
TN Content of Filter Media (mg/kg)	400
Orthophosphate Content of Filter Media (mg/kg)	30

Table 3-7 MUSIC Bioretention Basin 2 System Details

Parameter	Bioretention Basin
Low Flow By-pass (m^3/s)	0
High Flow By-pass (m^3/s)	1.5
Surface Area (m^2)	600
Extended Detention Depth (m)	0.30
Filter Area (m^2)	600
Unlined Filter Media Perimeter (m)	90
Filter Depth (m)	0.50
Saturated Hydraulic Conductivity (mm/hr)	200
TN Content of Filter Media (mg/kg)	400
Orthophosphate Content of Filter Media (mg/kg)	30

Table 3-8 MUSIC Swale 1 System Details

Parameter	Swale
Low Flow By-pass (m^3/s)	0
High Flow By-pass (m^3/s)	1.5
Length (m)	100
Bed Slope %	1
Base Width (m)	2
Top Width (m)	5
Depth (m)	0.5
Vegetation Height (m)	0.25

Table 3-9 MUSIC Swale 2 System Details

Parameter	Swale
Low Flow By-pass (m^3/s)	0
High Flow By-pass (m^3/s)	1.5
Length (m)	100

Parameter	Swale
Bed Slope %	1
Base Width (m)	2
Top Width (m)	5
Depth (m)	0.5
Vegetation Height (m)	0.25

Table 3-10 MUSIC Swale 3 System Details

Parameter	Swale
Low Flow By-pass (m^3/s)	0
High Flow By-pass (m^3/s)	1.5
Length (m)	200
Bed Slope %	1
Base Width (m)	2
Top Width (m)	5
Depth (m)	0.5
Vegetation Height (m)	0.25

3.4 MUSIC Results and Discussion

The MUSIC pollutant load reductions for the Site are detailed in Table 3-11. The MUSIC pollutant load reduction targets have been derived from the Great Barrier Reef Discharge Standards set out in the Reef 2050 Water Quality Improvement Plan 2017–2022 (State of Queensland, 2018) as shown in Table 2-2. The requirements under the Reef WQIP indicate that the Baffle Creek catchment water quality targets (Appendix B) must achieve reductions from the 2013 baseline. Therefore, the performance of the proposed water quality treatment train must be compared to the pre-developed condition of the site.

The results demonstrate the proposed water quality treatment train performs extremely well meeting most of the pollutant load reduction targets. However, the required pollutant reductions cannot be achieved for Dissolved Organic Nitrogen (DIN) without the use of additional assets such as sediment basins or wetlands or alternative methods like revegetation of other areas of the site. The results do show that the proposed water treatment devices will reduce DIN below the pre-developed source load and thus the proposed development will have a net positive impact on water quality in the receiving environment.

The remainder of the targets can be achieved with the use of swales and bioretention basins as detailed in Section 3.3.3. The analysis undertaken provides conceptual sizing of the treatment devices. Detailed design will be undertaken with subsequent design stages.

Table 3-11 MUSIC Model Results – Sedimentation Basin and Wetland

Parameter	Pre-Developed Source Load (kg/yr)[4]	Developed Source Load (kg/yr)	Residual Load (kg/yr)	*Required Load Reduction*	Pollutant Reduction from developed source	Pollutant Reduction from pre-developed source	Target Achieved from pre-developed source
Total Suspended Solids (TSS)	1,260	10,000	567	*20%*	94%	55%	Yes
Total Phosphorus (TP)	4	8	1	*20%*	85%	67%	Yes
Total Nitrogen (TN)	27	56	22	*Nil*	61%	21%	Nil
Particulate Nitrogen[5]	8	17	6	*20%*	61%	21%	Yes
Dissolved Organic Nitrogen (DIN)6	19	39	15	*50%*	61%	21%	**No**
Gross Pollutants (GP)	0	616	0	*Nil*	100%	100%	Yes

3.5 Hazardous Materials

The introduction of contaminants to the project area for the construction, maintenance, operation and decommissioning of the project infrastructure poses a risk of these contaminants ending up in the receiving environment. Local storage of chemicals and fuels within the project area will increase this risk along with concrete batching and associated materials. Therefore, relevant guidelines and standards governing the storage and use of hazardous materials and waste removal will be followed to reduce this risk Appropriate measures will be incorporated in the Final SMP, Construction Management Plan and Emergency Response Plan, which will be prepared in accordance with relevant conditions of the development approval.

3.6 Water Supply

3.6.1 Construction Phase

Water will be required during the construction phase for:

- Construction works
- Dust suppression
- Vegetation establishment

[4] 2013 Baseline Source Load
[5] Particulate Nitrogen is calculated as 30% of TN
[6] DIN is calculated as 70% of TN

Water required during the construction phase will be transported to the site by water tankers and stored appropriately at the site where required. Potable water will be supplied by contractors for their workforce during construction.

3.6.2 Operational Phase

During the operational phase of the project there will be minimal demand for water. Potable water required by site personnel will be supplied by individuals as required. Any non-potable water requirements like short term dust suppression, cleaning or maintenance of vegetation will be transported to the site by water tankers as required.

4 SUMMARY

Water Technology has been engaged by Attexo to prepare a Stormwater Management Plan (SMP) for a proposed BESS and substation facility located approximately 5 km west of Miriam Vale, Queensland. This SMP outlines the requirements for water quality management throughout the constructions phase and the post-construction phase in line with statuary requirements.

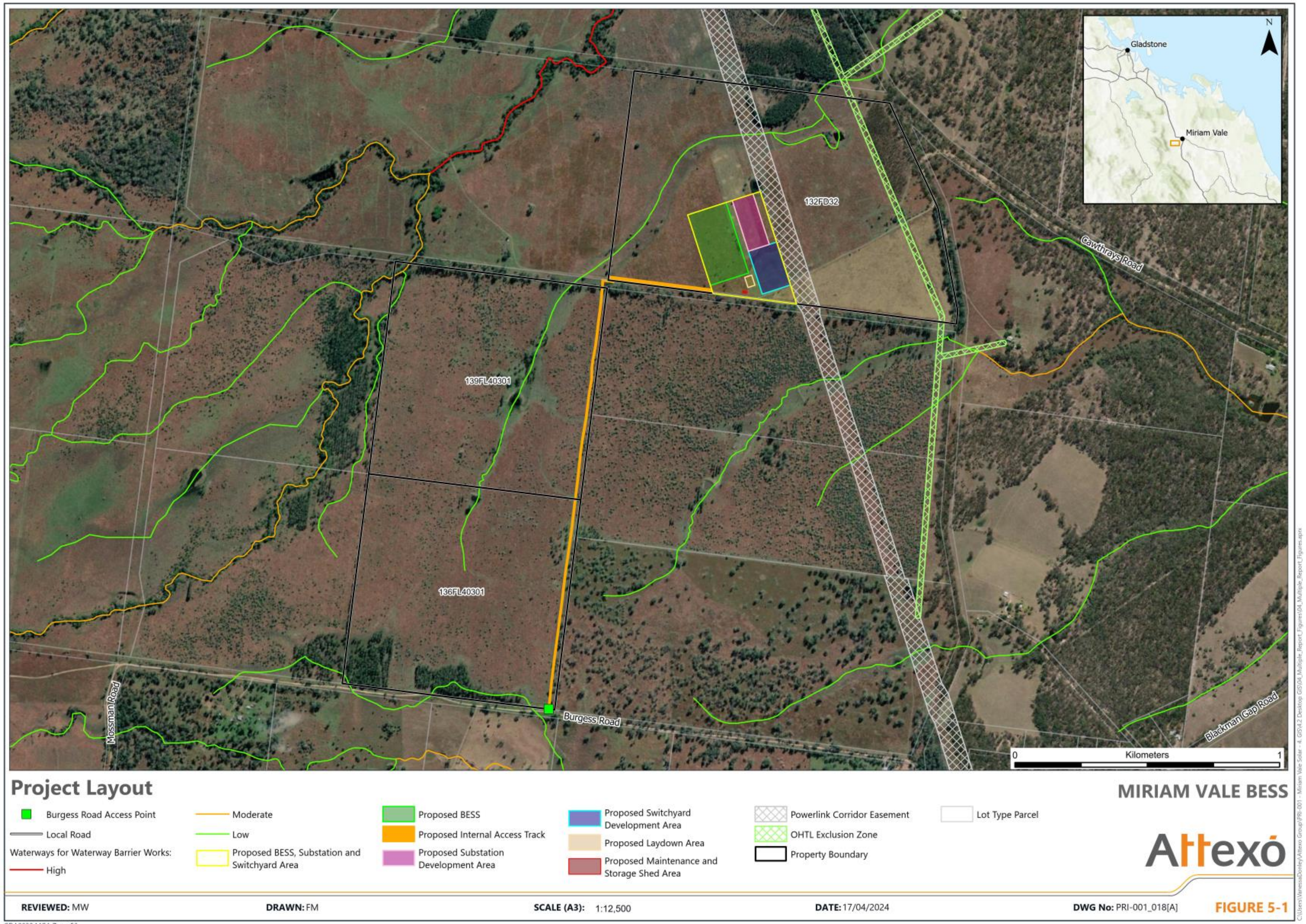
The surface water assessment showed that the proposed development has the potential to increase the quantity of pollutants discharging to the receiving environment. We have undertaken MUSIC modelling to provide a conceptual design for treatment devices associated with the nominated switchyard, substation and battery area.

The modelling results indicate that swales and bioretention basins can be used to achieve all water quality targets except Dissolved Organic Nitrogen. Achieving targets for Dissolved Organic Nitrogen will require additional infrastructure. It is recommended to discuss achievement of this target with council before proceeding to functional design. To confirm the conceptual design findings, further functional design must be undertaken to understand site, soil, and land constraints.

Appropriate measures for the safe handling and storage of chemicals and hazardous materials at the project site during the construction and operational phases should be included in the Final Stormwater Management Plan, Construction Management Plan and Emergency Response Plan.

The assessments undertaken are limited to addressing stormwater quality and potential impacts associated with additional hardstand areas within the switchyard, substation and battery area. Impacts on stormwater runoff quantity and flooding will be addressed as part of a flood impact assessment documented separately to this report.

APPENDIX A
LAYOUT PLAN



GDA2020 MGA Zone 56

APPENDIX B
BAFFLE CATCHMENT WATER QUALITY TARGETS

BURNETT MARY REGION

Baffle catchment water quality targets

Catchment profile

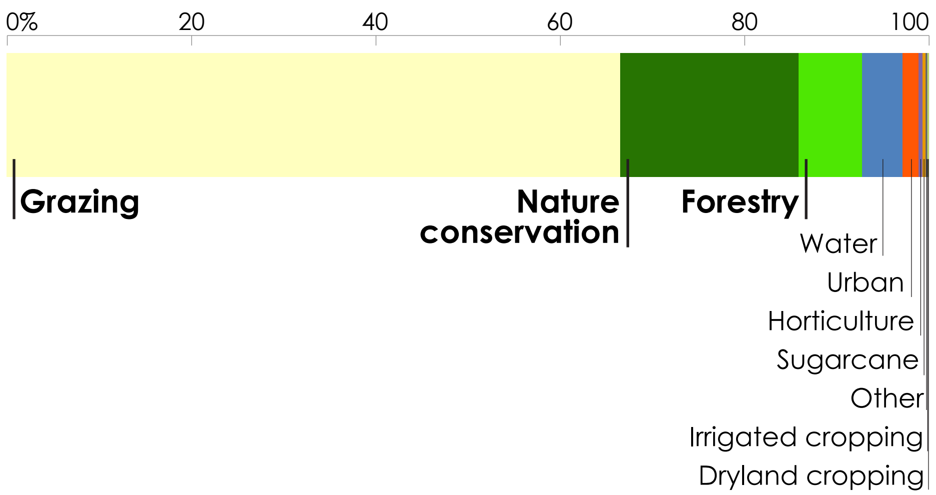
Under the Reef 2050 Water Quality Improvement Plan, water quality targets have been set for each catchment that drains to the Great Barrier Reef. These targets (given over the page) consider land use and pollutant loads from each catchment.

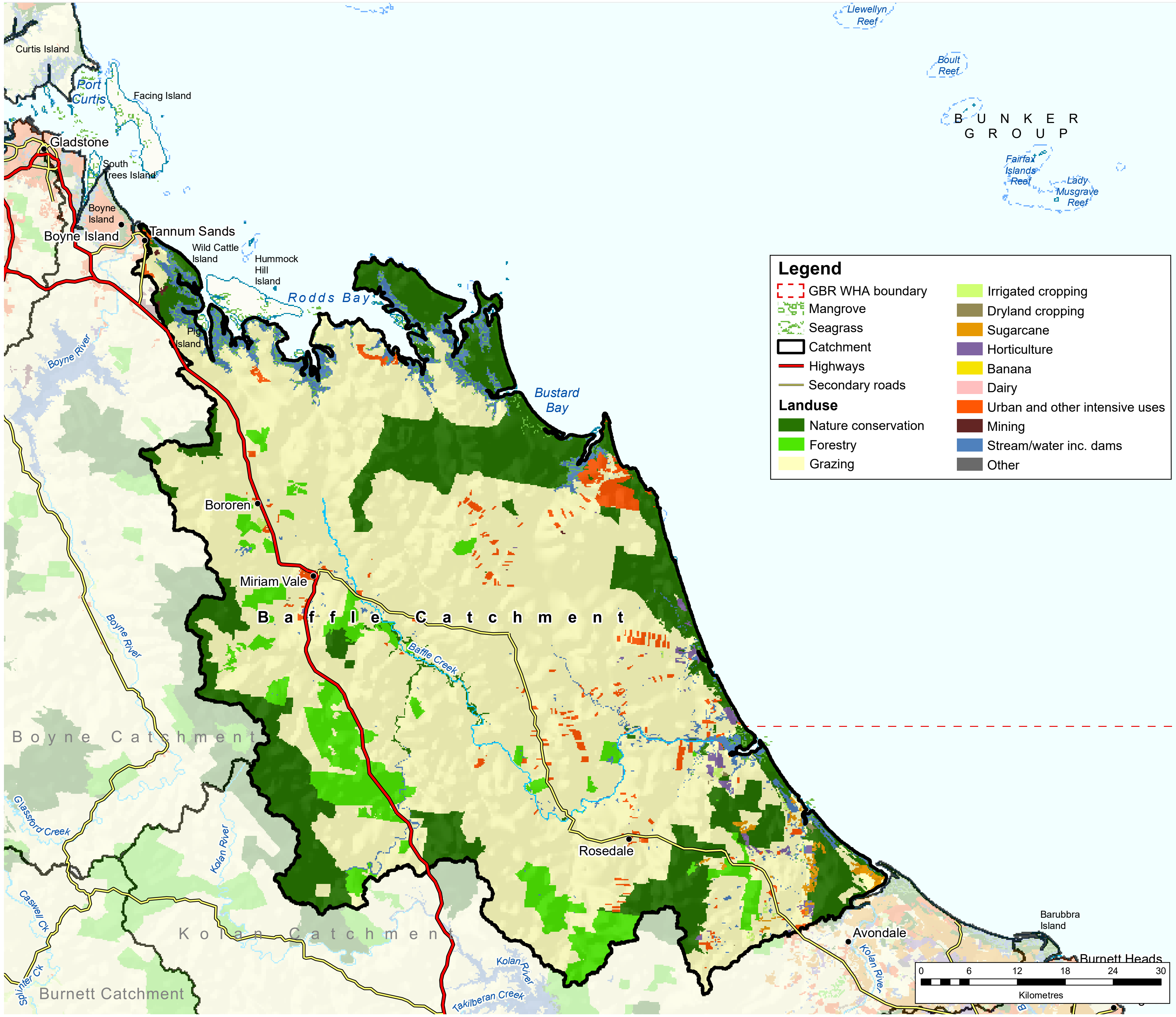
The Baffle catchment covers 4085 km^2 (8% of the Burnett Mary region). Rainfall averages 1045 mm a year, which results in river discharges to the coast of about 797 GL each year.

The Baffle catchment is the northernmost catchment in the Burnett Mary region. It lies adjacent to the Mackay/Capricorn section of the Great Barrier Reef Marine Park on the coast, with mountain ranges bordering the catchment in the south and west. The main waterway, Baffle Creek, captures the whole western section of the catchment, which is primarily grazing land with smaller areas of forestry and conservation. The coastal fringe is mostly used for grazing. A number of small creeks flow straight to the coast which includes seven relatively pristine estuaries.

Land uses in the Baffle catchment

The main land uses are grazing (67%), nature conservation (19%), and forestry (7%).





2025 water quality targets and priorities

End-of-catchment anthropogenic load reductions required from 2013 baseline				Pesticides
Dissolved inorganic nitrogen (DIN)	Fine sediment	Particulate phosphorus (PP)	Particulate nitrogen (PN)	
50% 16 tonnes	**20%** 11 kilotonnes	**20%** 15 tonnes	**20%** 33 tonnes	To protect at least **99%** of aquatic species at the end of catchment

The 2025 targets aim to reduce the amounts of fine sediments, nutrients (nitrogen and phosphorus) and pesticides flowing to the reef. Each target for sediment and nutrients is expressed as: (a) the percentage load reduction required compared with the 2013 estimated load of each pollutant from the catchment; and (b) the load reductions required in tonnes. Progress made since 2013 will count towards these targets. Previously reported progress between 2009 and 2013 has already been accounted for when setting the targets. The pesticide target aims to ensure that concentrations of pesticides at the end of each catchment are low enough that 99% of aquatic species are protected. The targets are ecologically relevant for the Great Barrier Reef, and are necessary to ensure that broadscale land uses have no detrimental effect on the reef's health and resilience.

A high percentage reduction target may not necessarily mean it is the highest priority. The priorities (ranked by colour) reflect the relative risk assessment priorities for water quality improvement, based on an independent report, the 2017 Scientific Consensus Statement. The priorities reflect scientific assessment of the likely risks of pollutants damaging coastal and marine ecosystems.

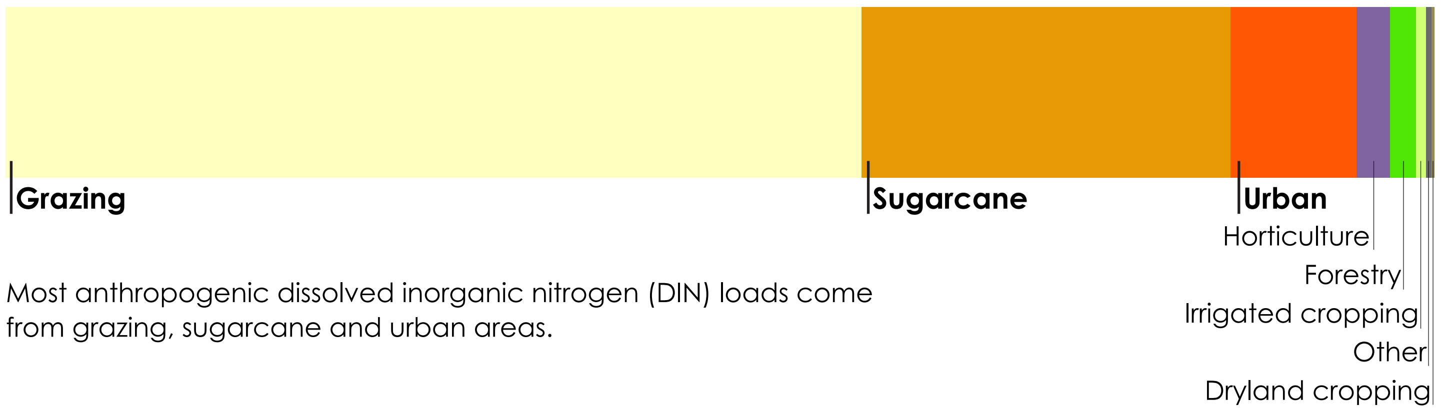
Water quality relative priority

- Very high
- High
- Moderate
- Low
- Minimal
- Not assessed

Modelled water quality pollutant loads

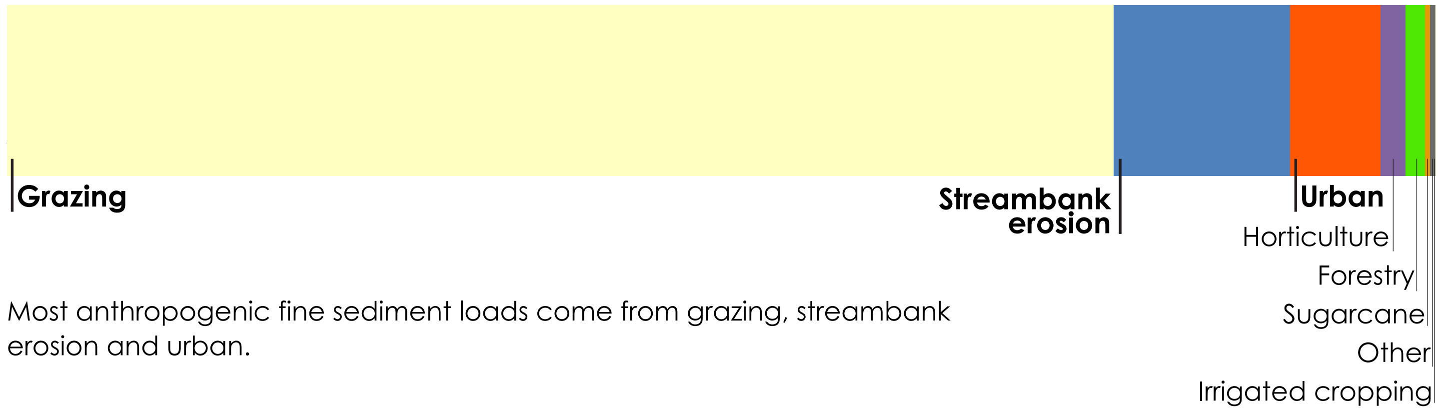
The Baffle catchment has small loads of anthropogenic dissolved inorganic nitrogen and fine sediment, mostly from grazing.

Dissolved inorganic nitrogen



Most anthropogenic dissolved inorganic nitrogen (DIN) loads come from grazing, sugarcane and urban areas.

Fine sediment



Most anthropogenic fine sediment loads come from grazing, streambank erosion and urban.

Types of sediment erosion

Most sediment erosion comes from hillslopes and gullies in the Baffle catchment.

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Adelaide
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