Navarre Green Power Hub

Preliminary Surface Water and Groundwater Assessment

Neoen Pty. Ltd.

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Document control record

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Executive summary

Neoen Pty. Ltd. (Neoen) is proposing to build and operate a wind farm and battery hub near the township of Navarre in north-western Victoria, known as the Navarre Green Power Hub or the Project. The Project will have a nominal capacity of around 600 MW and will incorporate a total of 102 wind turbines, split across two areas and will also include a 220 kV transmission line between the Western and Eastern Layouts and a 220kV transmission line between the Western Layout and Bulgana Terminal Station.

Aurecon was commissioned by Neoen to undertake a preliminary surface water and groundwater assessment to inform the development of the Project.

A desktop review was completed of publicly available information in relation to the hydrology, hydrogeology and catchment conditions of the Project Area. Information collated during this review has been used to prepare this Preliminary Surface Water and Groundwater Assessment.

The Project Area is located on the drainage divide between the Wimmera Catchment (south) and the Avon-Richardson Catchment (north) with both catchment areas forming part of the Murray-Darling Basin.

The main waterways within the Project Area include the Avon River, Paradise Creek, Morl Creek, Bolangum Creek, Reedy Creek, Wattle Creek, Howard Creek, Green Creek, Wimmera River and Six Miles Creek. Most of the waterways in the Project Area are ephemeral and only flow following rainfall events or in the wetter months.

The soils in the Project Area are typically duplex with highly dispersive characteristics and hence are vulnerable to erosion. Areas of elevated salinity potential are also present in the Project Area.

A flooding assessment undertaken for the Project modelled the extent of inundation by a 100-year Average Recurrence Interval (ARI) flood across the Project Area. In the modelled 100-year ARI flood event, inundation is typically constrained to the waterways and drainage lines within the Project Area except around Wattle Creek and Morl Creek where flood extents are more extensive.

Groundwater in the Project Area is typically saline and of variable depths with shallow watertables (< 1m) periodically present in the lower lying parts of the Project Area.

Construction and operation of the Project has the potential to impact local hydrology, surface water quality and groundwater. However, all impacts should be able to be mitigated through the appropriate siting of proposed infrastructure along with the implementation of appropriate management controls.

1 Introduction

Neoen Pty. Ltd. (Neoen) is proposing to build and operate a wind farm and battery hub near the township of Navarre in north-western Victoria, known as the Navarre Green Power Hub or the Project. Aurecon was commissioned by Neoen to undertake A Preliminary Surface Water and Groundwater Assessment to inform the development of the Project.

A desktop review was completed of publicly available information in relation to the hydrology, hydrogeology and catchment conditions of the Project site. Information collated during this review has been used to prepare this Preliminary Surface Water and Groundwater Assessment.

1.1 Purpose

The purpose of this Preliminary Surface Water and Groundwater Assessment is to:

- identify any risks to the Project associated with existing hydrological and hydrogeological conditions
- identify if the activities proposed as part of Project implementation may impact upon existing values
- nominate mitigation measures to minimise any impacts associated with Project implementation
- determine if any further approvals are required to support Project implementation.

In order to complete the above, this Preliminary Surface Water and Groundwater Assessment considers the following themes:

- Regional hydrology
- Receiving water environment
- Groundwater and geological conditions
- Local hydrology
- Design considerations relating to hydrology, surface water and groundwater
- Construction mitigation measures relating to hydrology, surface water and groundwater.

1.2 Assumptions and limitations

The assumptions and limitations of this report are as follows:

- The nominated description of the Project, its components and layout have been provided by Neoen on 14 March 2023 and have been used as the basis for this assessment and the conclusions developed.
- No site assessment has been undertaken. This assessment has been completed using desktop information only.

2 Project overview

2.1 Project location

The Project comprises approximately 18,404 hectares (ha) of predominantly private land immediately north of Navarre in north-western Victoria (Project Area). The Project Area consists of four (4) main sub-areas:

- Wind Farm Project Area – Eastern Layout: Approximately 5,266 ha located to the east of Ararat Street-Arnaud Road and west of Kara Kara National Park.
- Wind Farm Project Area – Western Layout: Approximately 4,873 ha located to the west of Ararat Street-Arnaud Road and east of Morrl Morrl Nature Conservation Reserve.

- Transmission Line Project Area – Eastern and Western Layout Link: Approximately 1,272 ha investigation corridor located between the Eastern Layout and Western Layout.
- Transmission Line Project Area – Bulgana Terminal Station Connection: Approximately 6,993 ha investigation corridor located between the Eastern Layout and Bulgana Terminal Station.

The location of the Project and the Project Area is shown in Figure 1.

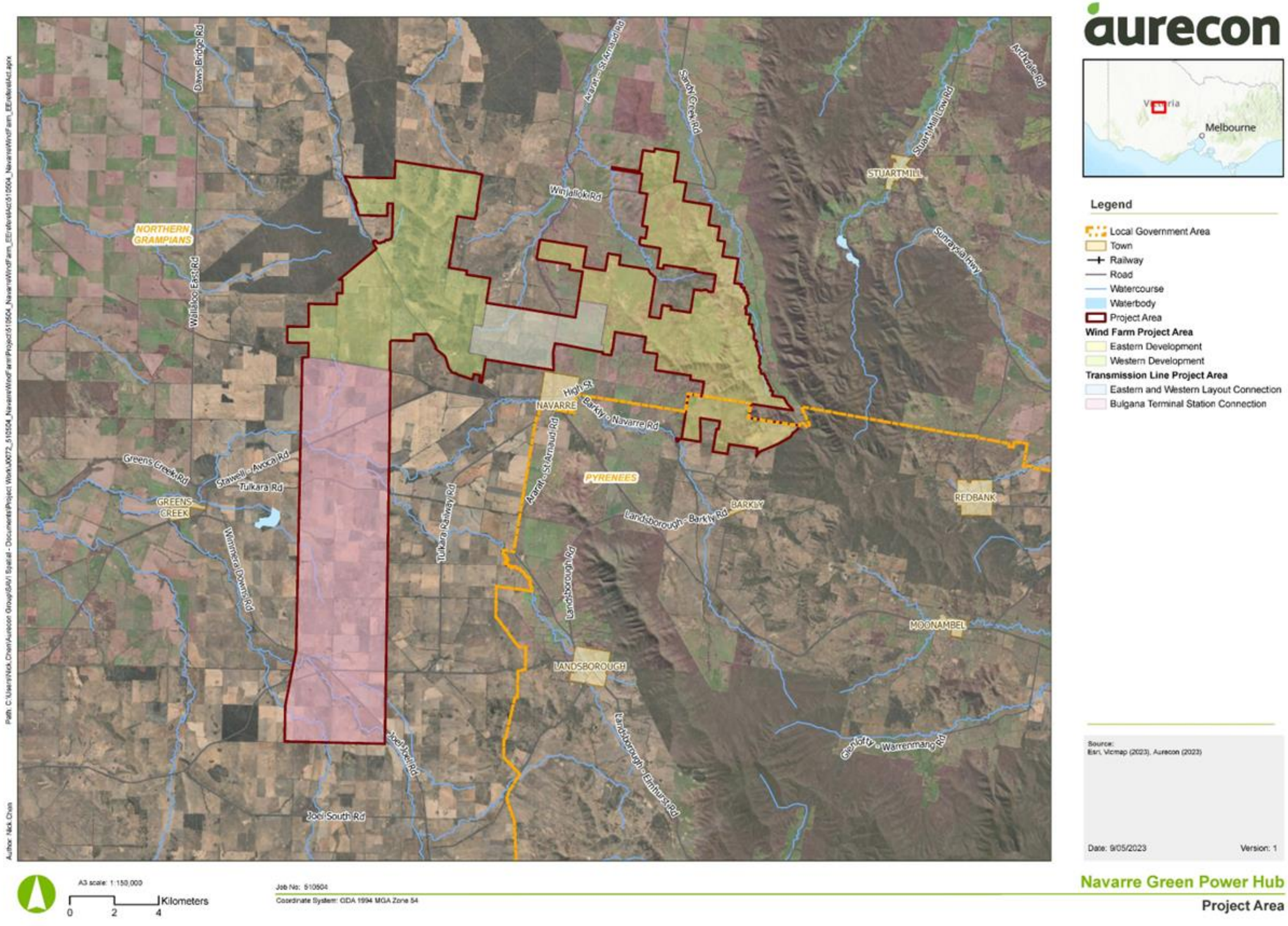

Figure 1 Project area

2.2 Project description

The Project will have a nominal capacity of around 600 MW and will incorporate a total of 102 wind turbines, split across two areas:

- The Wind Farm Project Area – Eastern Layout, which will consist of 50 wind turbines across approximately 5,266 ha of land.
- Wind Farm Project Area – Western Layout, which will consist of 52 wind turbines across approximately 4,873 ha of land.

The Project will include a 220 kV transmission line between the Western and Eastern Layouts and a 220kV transmission line between the western development and Bulgana Terminal Station.

In addition to the turbines and transmission lines, the Project will also include the permanent and temporary infrastructure listed Table 1 and Table 2 below.

Table 1 Infrastructure associated with Wind Farm Area - Eastern Layout

The Wind Farm Project Area – Eastern Layout	
Permanent	**Temporary**
■ A substation (up to 10ha) ■ Hardstand and laydown areas surrounding each turbine ■ Access tracks and site access points. It is expected the site access points will be at one location on Barkly-Navarre Road, one location on Ararat-St Arnaud Road and one location on Winjallock Road. ■ Operations and maintenance building and laydown ■ A Battery Energy Storage System with a capacity of 600MW / 1200MWh ■ Road upgrades to the local roads ■ Meteorological monitoring masts ■ Internal power collection stations ■ Internal underground cabling ■ A quarry to source raw material required for construction and maintenance during operations.	■ A construction office and compounds. This will include site offices, car parking, storage and amenities. ■ A concrete batching plant.

Table 2 Infrastructure associated with Wind Farm Area - Western Layout

The Wind Farm Project Area – Western Layout	
Permanent	**Temporary**
■ A substation (up to 10ha) ■ Hardstand and laydown areas surrounding each turbine. ■ Access tracks and site access points. It is expected the site access points will be at one location on Callawadda-Navarre Road and three locations on Bolangum Inn Road. ■ Operations and maintenance building and laydown. ■ Road upgrades to the local roads. ■ Meteorological monitoring masts. ■ Internal power collection stations. ■ Internal underground cabling. ■ A quarry to source raw material required for construction and maintenance during operations.	■ A construction office and compounds. This will include site offices, car parking, storage and amenities. ■ A concrete batching plant.

The proposed layout of the Project is shown in Figure 2.

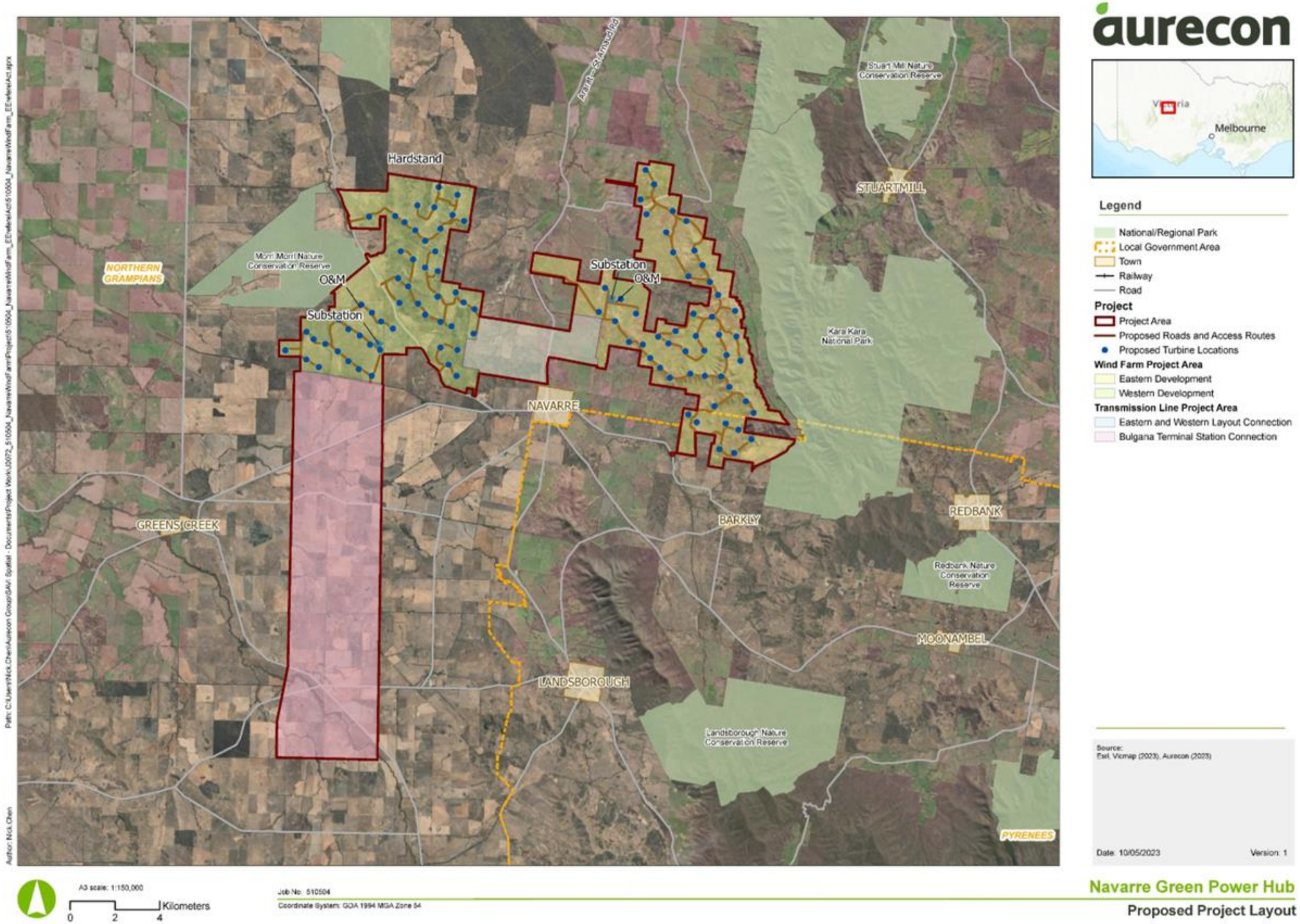

Figure 2 Proposed project layout

3 Hydrological assessment

3.1 Regional hydrology

3.1.1 Catchment overview

The Project Area, as shown in Figure 3, is located on the drainage divide between the Wimmera Catchment (south) and the Avon-Richardson Catchment (north). Both catchment areas form part of the Murray-Darling Basin.

The southern portion of the Project Area, approximately 44 percent of the total area, is located in the Wimmera Catchment Management Authority (WCMA) region. This portion of the Project Area drains directly into Wattle Creek, which is a tributary of the Wimmera River. The Wimmera River flows generally northwards from the Pyrenees Ranges and discharges into the terminal lake/wetland systems of Lake Hindmarsh and Lake Albacutya. Key management documents for this portion of the Project Area include:

- Wimmera Regional Catchment Strategy 2021-27 (WCMA, 2021)
- Environmental Water Management Plan – Wimmera River System (WCMA, 2015).

The northern portion of the Project Area, approximately 56 percent of the total area, is located in the North Central CMA region. This portion of the Project Area drains to the Avon River through its tributaries such as Paradise Creek and Reedy Creek. The Avon River flows in a northerly direction until it joins the Richardson River near the township of Donald. The Richardson River flows into Lake Buloke. Lake Buloke comprises wetland habitat of high significance for waterbirds, particularly waterfowl and waders (Agriculture Victoria, 2023a). Key management documents for this portion of the Project Area include:

- North Central Regional Catchment Strategy 2021-2027 (NCCMA, 2021).

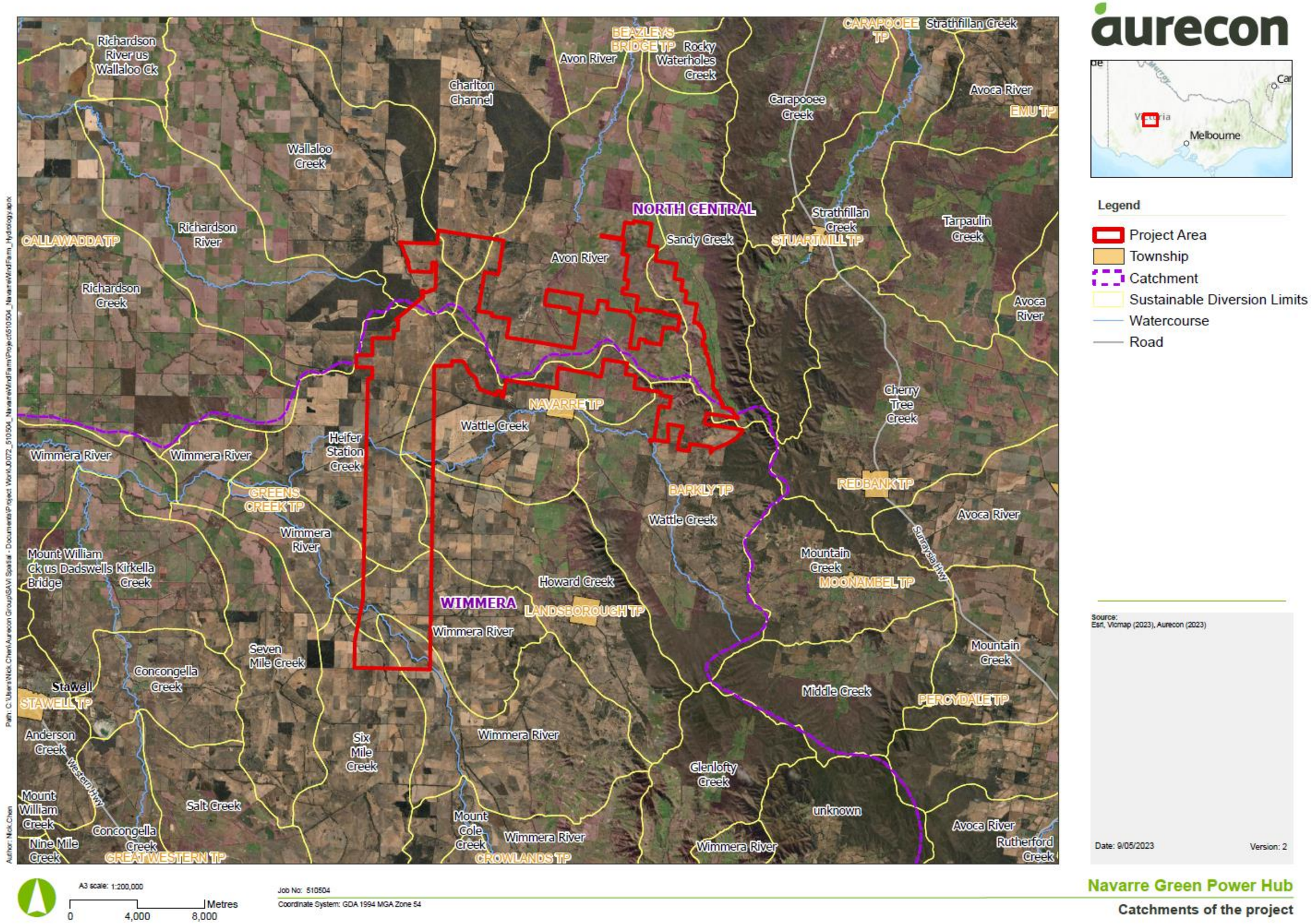

Figure 3 Catchments of the Project

3.1.2 Climate and rainfall

The Project Area has a warm temperate climate with Mediterranean characteristics. This climate is characterised by warm and dry summers and cool winters with increased rainfall. Long-term average rainfall and temperature data for the closest weather station (Navarre – 79037, located 7.6 km from the Project Area) is shown in Table 3.

Table 3 Monthly average rainfall and temperature (Navarre – 79037)

Month	Rain (mm)			Temperature (°C)		
	Mean	Minimum	Maximum	Mean	Minimum	Maximum
January	28.1	0	167.3	29.4	24.2	34.9
February	28.2	0	181.3	29.1	23.9	33.3
March	28.9	0	139.7	25.8	22.1	30.6
April	36.5	0	174.4	20.7	17.4	24.5
May	52.6	0	166.4	16.1	13.3	19.7
June	56.4	3.8	167.8	13	10.3	17.1
July	59.2	6.6	167.3	12.3	9.6	17.2
August	61.4	3.8	190.6	13.9	12	18
September	54.2	3.8	153.3	16.9	13.4	20.2
October	50.2	0	197.1	20.3	16.8	25.5
November	37.3	0.3	161	24.3	19.8	29.8
December	33.5	0	197.6	27.5	23.3	31.5
Annual	532.6	244.9	857.9	20.8	17.2	25.2

Rainfall patterns in the Project Area correspond to a single maximum rainfall season between May and September, where August is the month with the highest average rainfall with values of 61.4 mm. January to March are the months with the lowest rainfall values. Rainfall values may be inversely proportional to temperature values (see Figure 4).

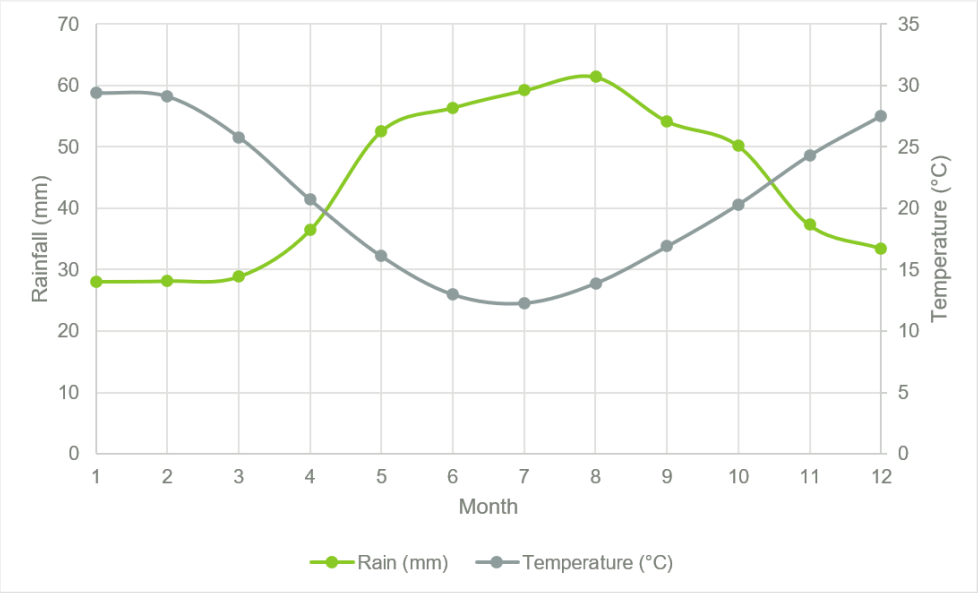

Figure 4 Monthly average rainfall and temperature

3.2 Local hydrology

3.2.1 Local waterways and waterbodies

The main waterways within the Project Area are shown in Figure 5 and include:

- Avon River
- Paradise Creek
- Morl Creek
- Bolangum Creek
- Reedy Creek
- Wattle Creek
- Howard Creek
- Green Creek
- Wimmera River
- Six Miles Creek.

There are also several minor smaller unnamed channels/waterways. Most of the waterways in the Project Area are ephemeral and only flow following rainfall events or in the wetter months.

The Project Area also contains one natural wetland (Wetland ID 40858) classified as seasonal freshwater marshes on inorganic soils, mapped in the Victorian Wetland inventory database (DEECA, 2019). This wetland is periodically inundated, depending on rainfall.

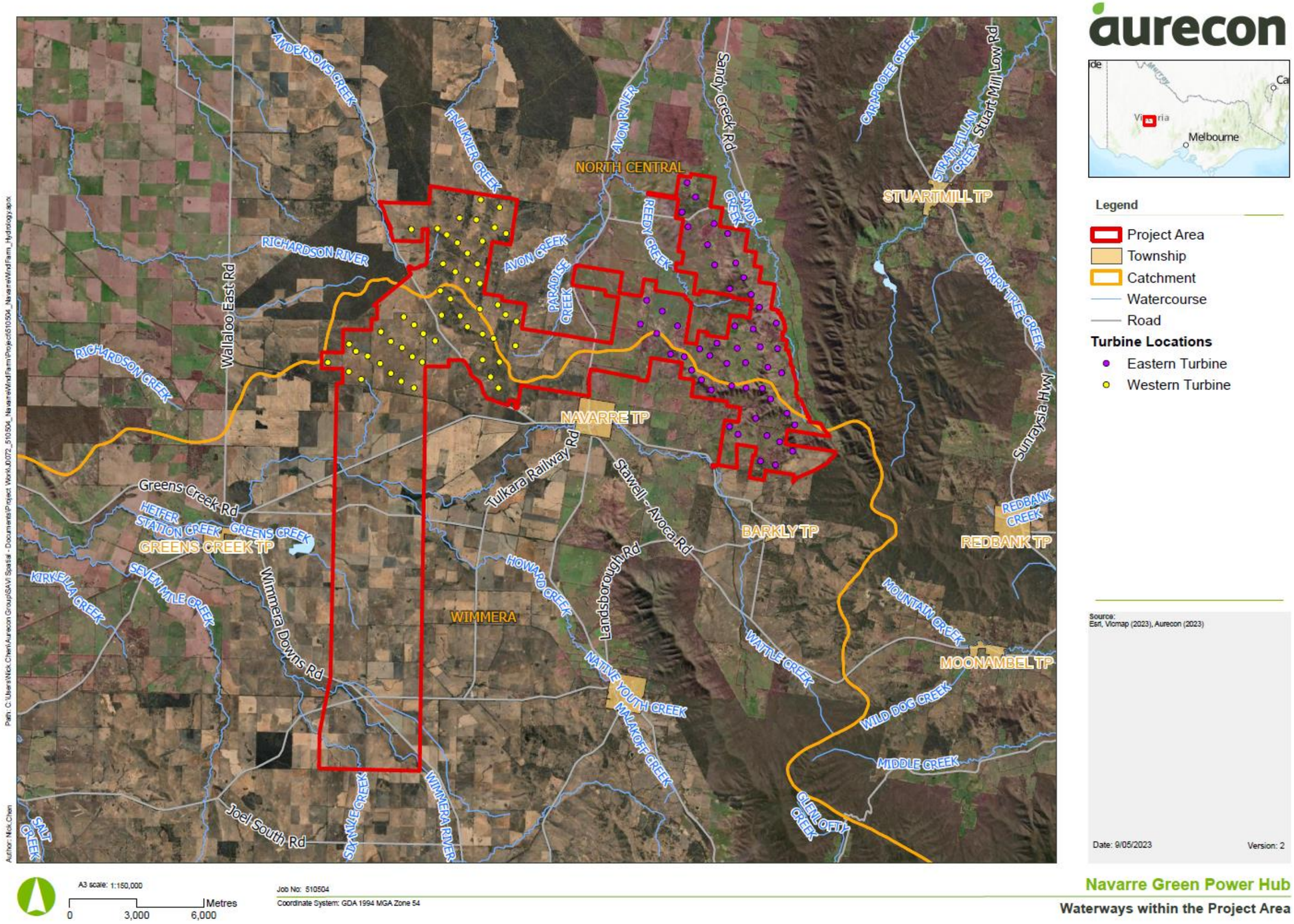

Figure 5 Waterways within the Project Area

3.2.2 Site topography

The topography of the Project Area typically consists of gentle to undulating rises and shallow valleys that range between 210 m to 460 m AHD.

The northern portion of the Project Area generally slopes from south to north with higher elevations of approximately 420 m to 460 m AHD in the most western section of the Project Area. Surface water in this area flows south to north towards the main watercourses – Avon River, Paradise Creek and Reedy Creek.

The southern portion of the Project Area is typically flatter than the northern portion, with elevations that vary between 210 m to 280 m AHD. Surface water in this area flows to the southwest towards Wattle Creek and the Wimmera River.

Figure 6 shows the topography of the area as well as all local waterbodies and waterways.

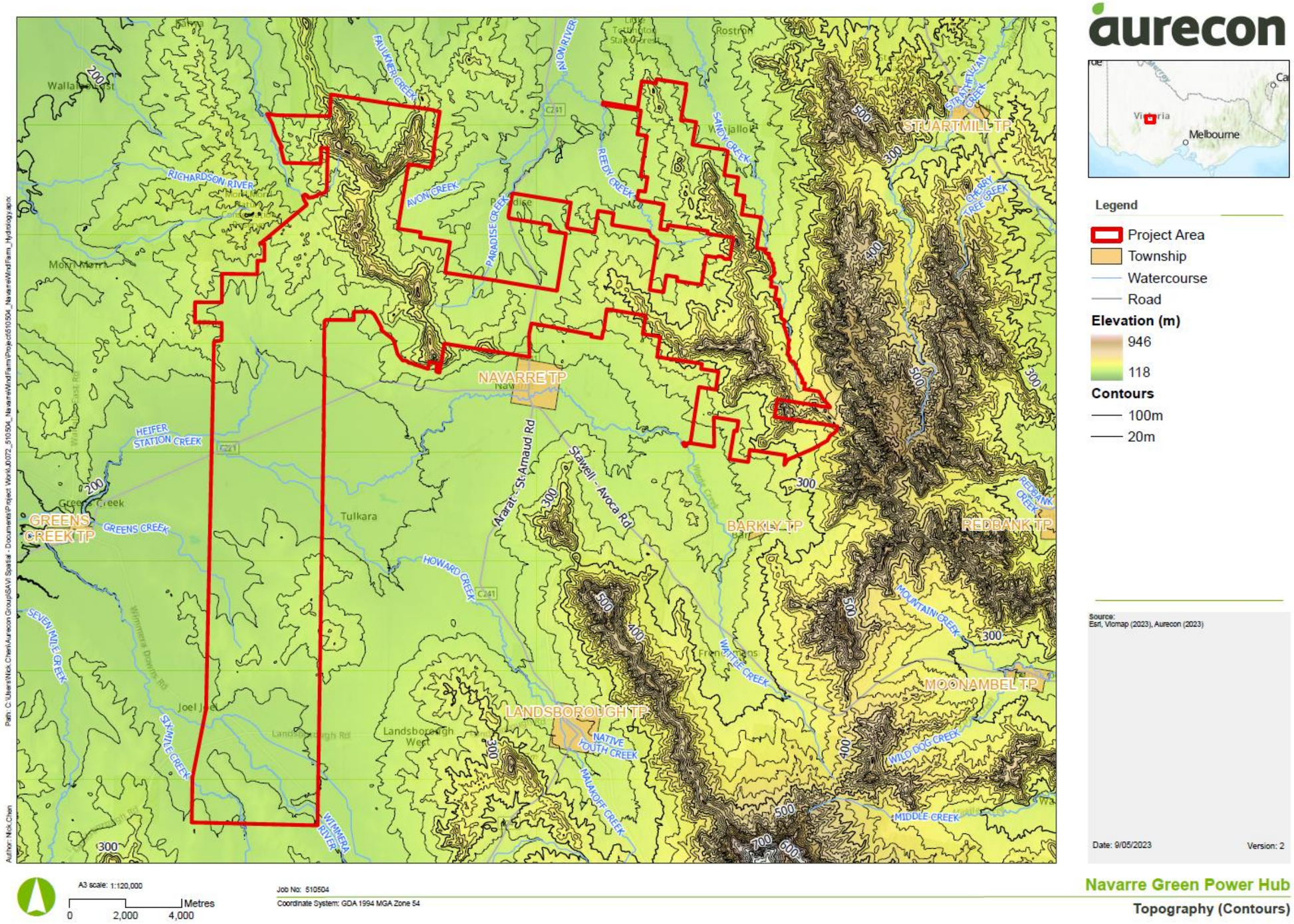

Figure 6 Topography (contours)

3.2.3 Soil

Soil texture affects the movement and retention of water. The ease with which water can move through the soil profile depends on the porosity of the soil. The porosity is larger in coarse-textured soils (sands) than in fine-textured soils (clays). As a result, water (and dissolved nutrients) can move faster through coarse-textured soils than fine-textured soils; conversely, fine-textured soils will tend to generate more surface runoff.

There is limited information available about soil characteristics of the Project Area however it was possible to determine that the Project Area is typically dominated by duplex soils, with an abrupt textural contrast between the surface soil horizons and the subsurface. Soils in the Project Area may be vulnerable to acidification (Agriculture Victoria, 2023b), salinity (Land Conservation Council, 1981) and, because the subsoils are moderately permeable but highly dispersible, severe erosion (Land Conservation Council, 1981). Across the Project Area erosion risk varies with sheet and rill erosion present throughout much of the Project Area, and gully erosion being more prevalent on lower slopes where there is a greater depth of unconsolidated material.

Soil acidification is a process where, over time, soil pH drops to the point that it becomes slightly acidic to acidic. This is a different process and a significantly lower risk than what would be presented by the presence of acid sulfate soils. In most instances (generally an agricultural context) soil acidification is mitigated through the application of lime to increase pH and thereby improve the agricultural productivity of the soil.

3.2.4 Existing flood risk

The 100-year Average Recurrence Interval (ARI) flood event is defined as an event that has a 1% chance of being equalled or exceeded in any one year. A flooding assessment undertaken for the Project modelled the extent of inundation by a 100-year ARI flood across the Project Area. Flood modelling, shown in Appendix A, was completed for the Wind Farm Project Areas - Eastern and Western Layouts. Neither of the Transmission Line Project Areas were included in the modelling. The modelling found that inundation in a 100-year ARI flood event is typically limited to the waterways in the Wind Farm Project Areas.

Flooding extents in the Wind Farm Project Area – Western Layout are predicted in Wattle Creek and Reedy Creek, while in the Wind Farm Project Area – Eastern Layout, part inundation is predicted in Avon River, Paradise Creek and Morl Creek, as well as around other local unnamed waterways/drainage lines and other small portions of the site where natural depressions are present.

The small portions of the Wind Farm Project Area – Western Layout, that are covered by the 100-year ARI flood extent generally correspond with the waterbodies layer (Map 1 and Map 4 - Appendix A) with most of these waterways being ephemeral and only active following high rainfall events.

The flood extents around Wattle Creek and Morl Creek are greater than other parts of the Wind Farm Project Areas due to the flatter topography of these locations.

Flood maps have been provided for flood depths, levels, velocities, and hazard for the 1% and 10% Annual Exceedance Probability (AEP) design flood events. In general, the proposed infrastructure for the Project is not highly susceptible to flooding up to the 1% AEP event. The wind turbines and roads are located on ridge lines away from major and minor overland flow paths. The south-west area of the western site (near Callawadda-Navarre Road) has some turbines adjacent to the Morl Creek, but outside of the floodplain, and some access tracks in that location may need to be realigned to minimise potential impact.

4 Groundwater and geological conditions

Groundwater in Victoria is managed by Rural Water Authorities. From a groundwater perspective, the Project Area is managed by two authorities:

- Grampians Wimmera Mallee Water for the portion of the Project Area in the Wimmera Catchment
- Goulburn Murray Water for the portion of the Project Area in the North Central Catchment.

Where groundwater is considered to be over utilised, the Rural Water Authority will designate either a Water Supply Protection Area or a Groundwater Management Area both of which introduce specific management protocols to protect the groundwater resource. Groundwater Management Areas in relation to the Project Area are shown in Figure 7. This shows that the Project Area is not located within either a Water Supply Protection Area or a Groundwater Management Area, therefore no specific protocols in relation to groundwater management are in place.

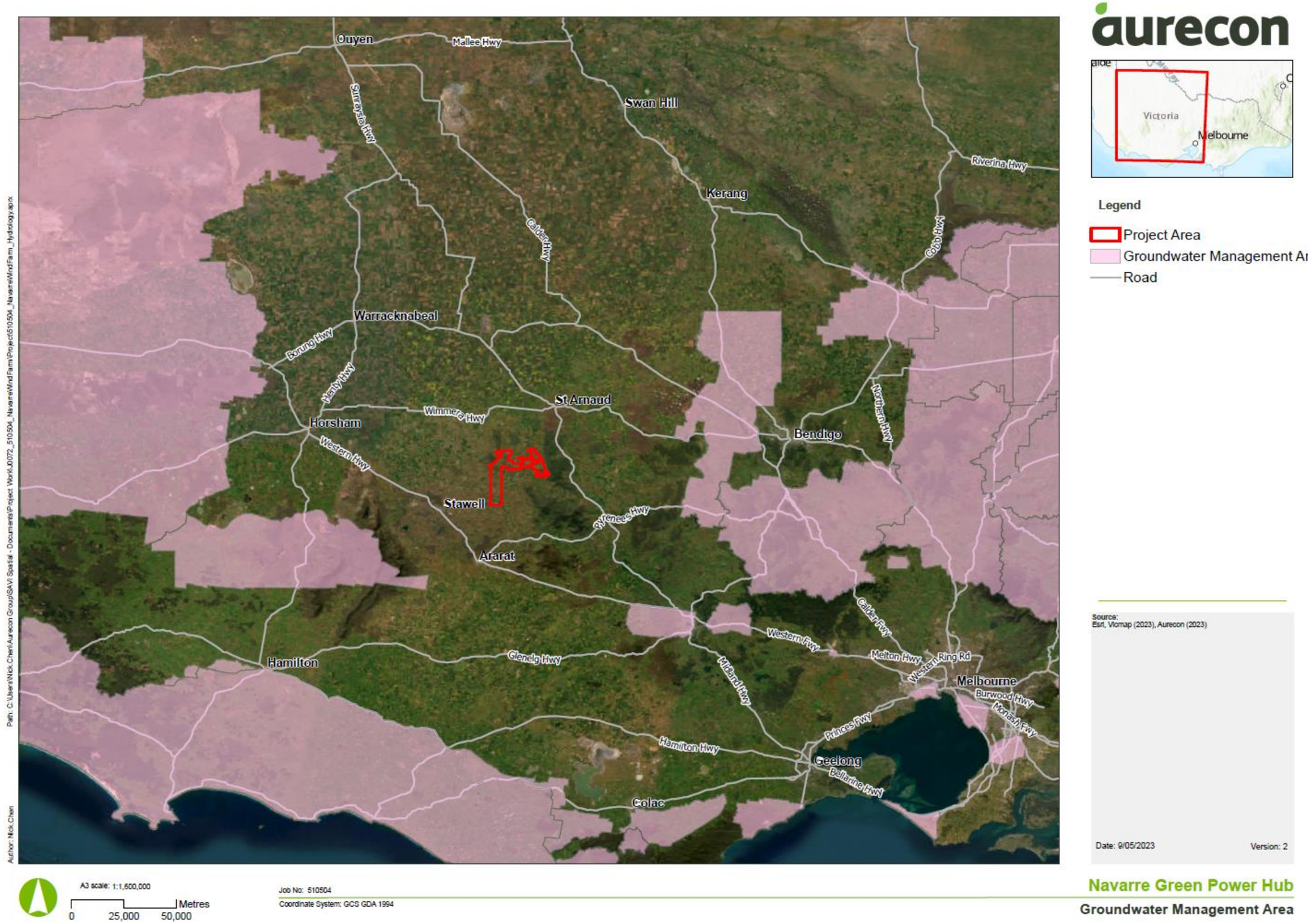

Figure 7 Groundwater Management Areas

A review of the existing groundwater bores within the vicinity of the Project has been undertaken to gain a high-level understanding of the groundwater characteristics of the area (VVG, 2023). A total of seven groundwater bores are located within 5 km of the Project Area with details presented in Table 4.

Table 4 Existing bores within 5 km of the Project Area

Borehole No.	Depth of Hole (m)	Water level below ground (m)	Electrical Conductivity (EC) (mS/cm)
WRK956407	18	3.56	17.8
WRK956408	13	1.95	11.3
117928	18	2.77	7
WRK958081	79	2.33	23.4
117926	18	1.56	23.7
117931	29	13.92	22.6
117924	18	2.62	13.1

Water level data for groundwater bores within 5 km of the Project Area shows significant variation over time. Figure 8 shows the water level data measured at borehole 117928 between May 1984 and April 2016. This groundwater bore is located inside the Project Area, within the Wind Farm Project Area – Western Layout.

In 1984 and in 2011, recorded groundwater levels were very close to the surface at less than 1 m below ground level. The intermittent presence of shallow groundwater levels in the Project Area is likely to represent a risk for the infrastructure which may require additional consideration as the Project progresses.

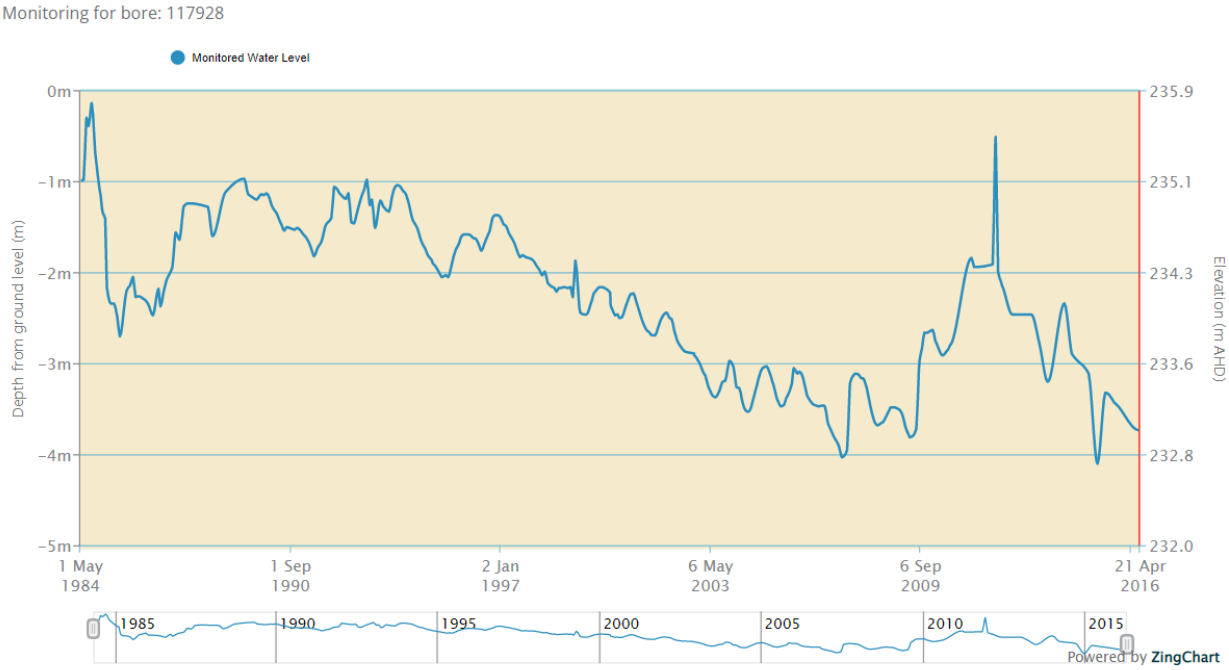

Figure 8 Ground water levels in the borehole 117928

Limited water quality information is available for the groundwater bores within 5 km of the Project Area, with salinity (EC) being the only parameter monitored for all bores. The salinity data collected notes that the local groundwater is saline (EC > 10mS/cm). This is consistent with the management approach nominated by Agriculture Victoria, which establishes that in the Navarre area, there is a salinity province that contributes a high salt load to the upper valley of the Wimmera River system (Agriculture Victoria, 2023c).

Figure 9 shows the mapped locations of salinity areas. Three areas of salinity were identified in the Project Area in the Wind Farm Project Area – Western Layout.

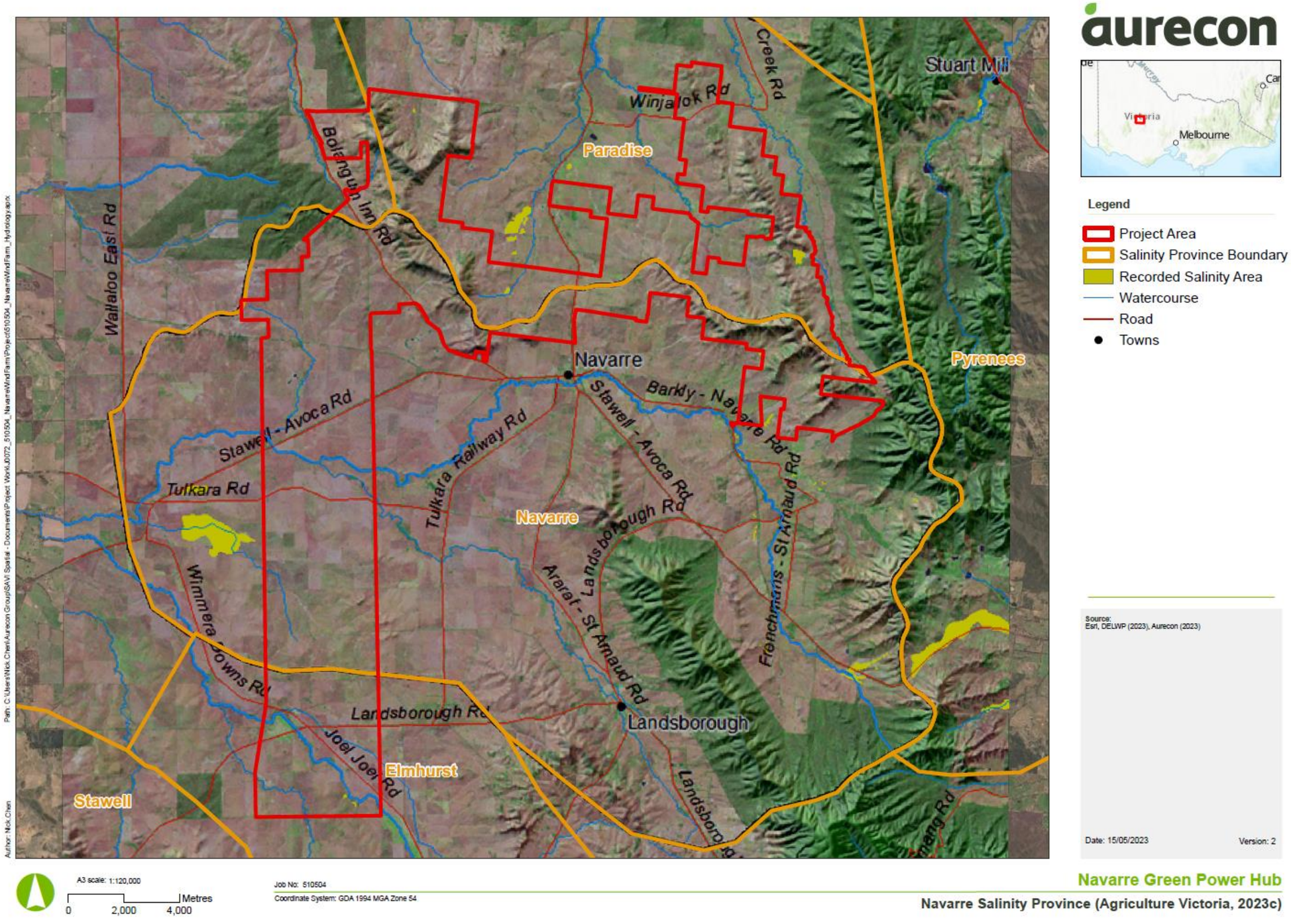

Figure 9 Navarre Salinity Province

5 Water quality assessment

Without appropriate management the construction and operation of the Project has potential to impact on the water quality of the waterways within and surrounding the Project Area.

This water quality assessment presents a desktop assessment of issues that should be considered in the ongoing design and development of the Project and subsequent Project approvals. The issues relate to existing water quality, potential water quality impacts associated with the Project and recommended mitigation options.

5.1 Pollution point sources

The proposed Project Area is currently used for agricultural purposes, including cropping and grazing (DTP, 2023). There are no obvious point sources of pollutants within the Project Area in its current state. Cropping and grazing activities are likely to be contributing diffuse pollutant inputs to the waterways that run through the Project Area. These inputs are likely to include sediment, nutrients, pathogens from grazing stock and potentially herbicides and pesticides.

Project construction has the potential to generate point sources of pollution where high levels of activity are proposed at discrete locations compared to background conditions.

5.2 Water quality data

The Victorian Water Measurement Information System (DELWP, 2023) shows water quality monitoring sites in Victoria. There are no monitoring sites within the Project Area, though there is one on the Wattle Creek in Navarre approximately 4 km southwest of the Project Area. Water Quality parameters that are monitored at this site are noted in Table 5.

Table 5 Water Quality Data

Site Number	Name	Available data
415238	Wattle Creek - Navarre	Stream water level, discharge, rainfall, and turbidity

6 Impacts and mitigation

6.1 Impact assessment

The construction and operation of the Project will include a range of civil infrastructure development activities that have the potential to modify the terrain of the Project Area. A variety of activities will be undertaken to construct the permanent and temporary infrastructure associated with project implementation (see Table 1 and Table 2). Many of the construction activities required to develop Project infrastructure have the potential to have an impact on surface water flows and water quality in the Project Area as described below.

Potential impacts on surface water flows and water quality relate primarily to the following factors:

- Flooding of Project infrastructure
  - Construction of any Project infrastructure either within or immediately adjacent to waterways or ephemeral waterbodies increases the potential of the infrastructure being flooded during or following high rainfall events. Building within the 100-year ARI flood extent and/or depressions across the site may result in the displacement or diversion of storm water flows. This may result in an increase in flood levels in the immediate vicinity of the newly constructed infrastructure.
- Physical damage to waterways of waterbodies

- Physical damage to waterways and/or waterbodies may occur as a direct result of construction activities throughout the Project Area, such as the installation of waterway crossings. Works in or over waterways, such as bridges, culverts or ford crossings, can result in direct and indirect impacts. Impacts include increased instream erosion and sedimentation, direct damage to waterway bed and banks, and the creation of instream barriers that affect water flow and movement of aquatic biota.
- Direct physical damage will occur if infrastructure or construction activities take place in wetland areas.

- Changes to hydrology of the Project Area
  - The construction of Project infrastructure will result in greater volumes of runoff and increased flow velocities across the Project Area due to an increase in the area of impervious surfaces compared to the current conditions.
  - An increase in the proportion of impervious surfaces in the Project Area will likely result in higher flow peaks and shorter flow durations during rainfall events. This can in turn result in an increase in pollutant and sediment transport to waterways, and can also create in-stream scour, generating additional sediment loads in receiving waterways.
  - Construction of drainage infrastructure associated with Project infrastructure can change water flow patterns within the Project Area potentially changing waterway hydrology at a sub-reach scale.
  - Impeding flow within a waterway due to the construction of a waterway crossing. The size and position of obstructions such as bridge piers or fords has the potential to impact flood water conveyance, local flow regime and floodplain storage.
  - The Project will require significant excavation works and there is the potential that excavations may intercept the shallow, saline groundwater that can be present in the Project Area. If excavations result in groundwater interactions, there is potential for saline groundwater intrusion into streams and wetlands. Groundwater investigations should be conducted to assess potential interactions with and impacts on groundwater.
- Inflow of pollutants and increased sediment loads
  - A key potential impact from construction work is an increase in sediment runoff from disturbed construction areas and exposed soil. Construction activities will result in soil disturbance with disturbed areas being more vulnerable to erosion and the generation of sediment during rainfall events. Any increase in sediment loads has the potential to impact on receiving waterways.
  - Any increase in sediment generation and transport as a result of construction activities is likely to also be associated with increased nutrient transport to waterways, as nutrients adsorb to sediment particles. An increase in nutrient loads to receiving waterways will result in a decrease in water quality and may result in an increased presence of nuisance plants and algae. This impact particularly applies during summer when weather conditions are warmer.
  - Creation of unsealed roads throughout the site could also lead to increased generation of dust due to an increase in vehicle movement throughout the site, resulting in an increase in pollutants and sediment reaching the local waterways.
- Spills of construction or associated materials
  - There is the potential for spillage of chemicals such as oils, fuels, and sprays associated with construction activities. Spills or leaks of liquids have the potential to impact water quality and aquatic biota in waterways and wetland within the Project Area and downstream. Spills and leaks can also collect on constructed hard surfaces, and wash into waterways with stormwater runoff.
- Vegetation clearance
  - Clearing of vegetation from the site could lead to increased erosion and sediment runoff. Clearance of riparian vegetation can cause erosion, destabilisation or undercutting of banks, leading to increased erosion and sediment generation in the impacted waterways.
  - Loss of riparian or site vegetation can lead to a loss of natural nutrient buffer/filter capacity. This can result in greater concentrations of sediment and nutrients entering waterways in surface runoff.

- On-site wetland areas (deep and shallow freshwater marsh, meadows) may support distinct vegetation which is important for the maintenance of wetland water quality. Direct clearance of wetland vegetation is likely to impact the water quality in those areas.

- Aquatic impacts
  - Impacts to water quality have potential to affect aquatic biota. Although this is outside the scope of this assessment, water quality changes (for example, increased turbidity and sediment, potential toxicant input, physical alterations to waterways) have been considered in this context. It is assumed that a comprehensive flora and fauna survey will be undertaken at the site, incorporating the expanded site boundary, to survey aquatic, terrestrial and wetland species present at the site, and to identify the presence of any significant species.

6.2 Mitigation measures and recommendations

The key mitigation measures recommended to control hydrological and water quality impacts associated with the Project relate to the prevention of significant alterations in flow, sediment and erosion control, spill control, and avoiding direct impacts on waterways.

The following mitigation measures are recommended:

- Avoid locating Project infrastructure adjacent to waterways, major drainage lines and riparian zones to avoid increasing flood levels or diverting flood flows. Most Project infrastructure is currently located away from major and minor overland flow paths, however due to site constraints some may be sited within or near a 100-year ARI flood extent, or near a watercourse. If Project infrastructure is required to be located near a 100-year ARI flood extent or near a watercourse then a flood impact assessment should be undertaken to quantify impacts. This investigation may include detailed site survey, catchment hydrology and flood modelling for the affected infrastructure sites.
- Ensure that the construction of culverts, bridges or ford crossings on access roads across creeks and major drainage lines minimise any increase in flood levels through appropriate consideration in the design of these structures. If creek crossings cannot be avoided the use of bridges is recommended. It is likely that a Permit under the Victorian *Water Act 1989* (Works on Waterways Permit) would be required for any waterway crossings. This permit would be issued by the relevant CMA and would include standard conditions for issue and guidelines to avoid damage and ensure approval compliance.
- Implement appropriate sediment and erosion control measures to minimise the amounts of sediment entering the waterways. This should be done both throughout the construction period (where more rigorous sediment controls will need to be implemented due to high soil disturbances associated with excavation works) and operational period.
- Implement appropriate spill control and bunding measures to control and contain spills, minimise the amount of fuels and chemicals stored on site and implement contingency plans to handle spills.
- During construction, divert clean stormwater away from the parts of the site where the soil will be disturbed, to not contaminate clean stormwater.
- Avoid any instream or riparian works that could cause direct damage to waterways, including loss of riparian or instream vegetation, or construction or installation of instream barriers.
- Prevent dust generation by applying dust suppression methods, to avoid increase in dust and soils entering waterways. In general, these measures can be achieved through compliance with all industry standard guidelines relating to construction, sediment and erosion control.
- Appropriate geotechnical testing should occur to confirm the pH of native soils and hence their broader suitability for the proposed construction activities.

7 Conclusions

This assessment has been undertaken to identify any key surface water and groundwater issues that may be relevant to the ongoing design of the Project. The assessment has found that:

- The Project Area is located on the drainage divide between the Wimmera Catchment (south) and the Avon-Richardson Catchment (north) with both catchment areas forming part of the Murray-Darling Basin.
- There are a number of waterways present across the Project Area. The main waterways that traverse the Project Area are the Avon River, Paradise Creek, Morl Creek, Bolangum Creek, Reedy Creek, Wattle Creek, Howard Creek, Green Creek, Wimmera River and Six Miles Creek. There are also several other minor unnamed channels/waterways and wetland areas. Most of the proposed Project infrastructure is located on ridge lines away from major and minor overland flow paths.
- Modelling indicates that parts of the Project Area are likely to be inundated by the 100-year ARI flood extents. These extents are mostly around the extents of Morl Creek, close to the Callawadda – Navarre Road. Where possible, the 100-year ARI flood extents have been avoided. In instances where the turbine locations, roads or transmission lines are currently proposed within or directly adjacent to a 100-year ARI flood extent, further assessment would be required. This may include site survey and catchment hydrology and flood modelling for the affected locations.
- For the transmission lines, information on flooding in the area is required at more advanced stages of the Project.
- There are no obvious point sources of pollutants within the Project Area at present. Cropping and grazing are likely to be contributing diffuse pollutant inputs to the waterways that run through the Project Area. Water quality data for the Project Area is limited.
- The Project has the potential to impact surface water quality and quantity in a number of ways. Key potential impacts relate to changes to site hydrology and surface water flows; increased sediment generation and transport into waterways, and direct impacts on waterways and vegetation.
- Groundwater in the Project Area is saline and in some locations is at a shallow depth. Design of Project infrastructure should be considerate of these factors and further investigation may be required.

The recommended mitigation measures as outlined in this report will help to control impacts associated with impacts upon surface water, groundwater and water quality at the site. These measures can be achieved through compliance with all industry standard guidelines relating to construction, flood management and sediment and erosion control.

A Works on Waterways Permit under the Victorian *Water Act 1989* will likely be required and will include standard conditions to mitigate potential impacts.

As part of the planning approvals process for a wind energy facility it is typical that a planning permit will require the preparation and approval of an Environmental Management Plan (EMP). The EMP must address identified environmental issues and constraints including surface water and groundwater impacts and mitigation responses to the satisfaction of the relevant statutory and referral authorities.

8 References

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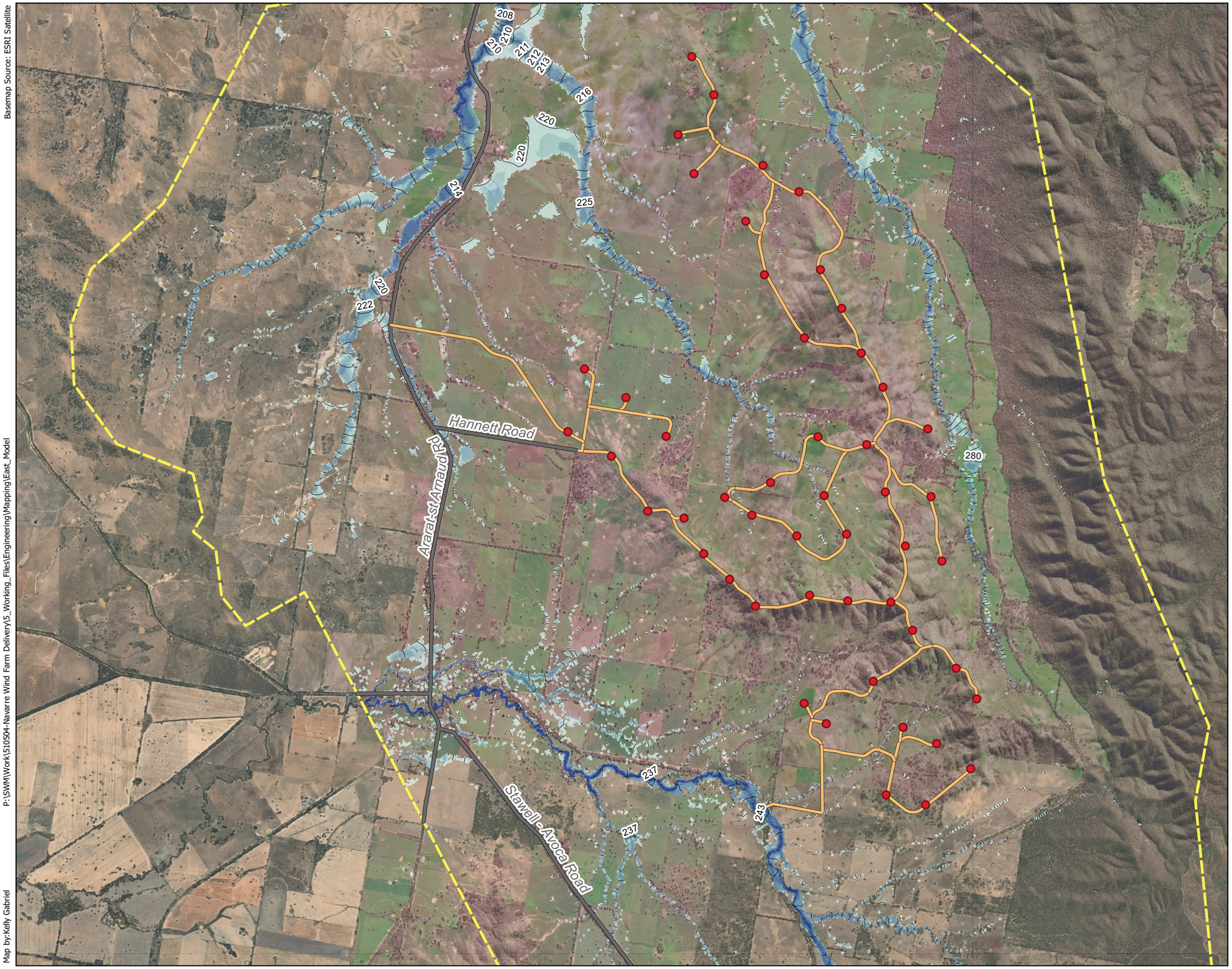
Appendix A – Flood modelling

Basemap Source: ESRI Satellite

P:\SWM\Work\510504-Navarre Wind Farm Delivery\5_Working_Files\Engineering\Mapping\East_Model

Map by:Kelly Gabriel



aurecon

Legend

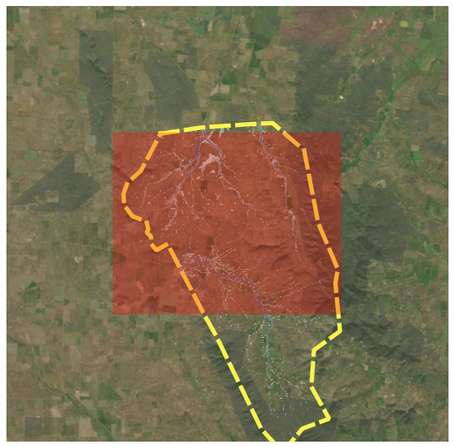
- Proposed wind turbines
- Proposed access tracks
- Existing roads
- TUFLOW model extent

10% AEP

- Peak water surface level contours (mAHD)

Peak flood depth (m)

- <0.05
- 0.05-0.1
- 0.1-0.2
- 0.2-0.5
- 0.5-1.0
- >1.0



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0 2,000 4,000 m

A3 1:65,000

Date: 09/03/2023 Job No: P510504 EPSG:7854

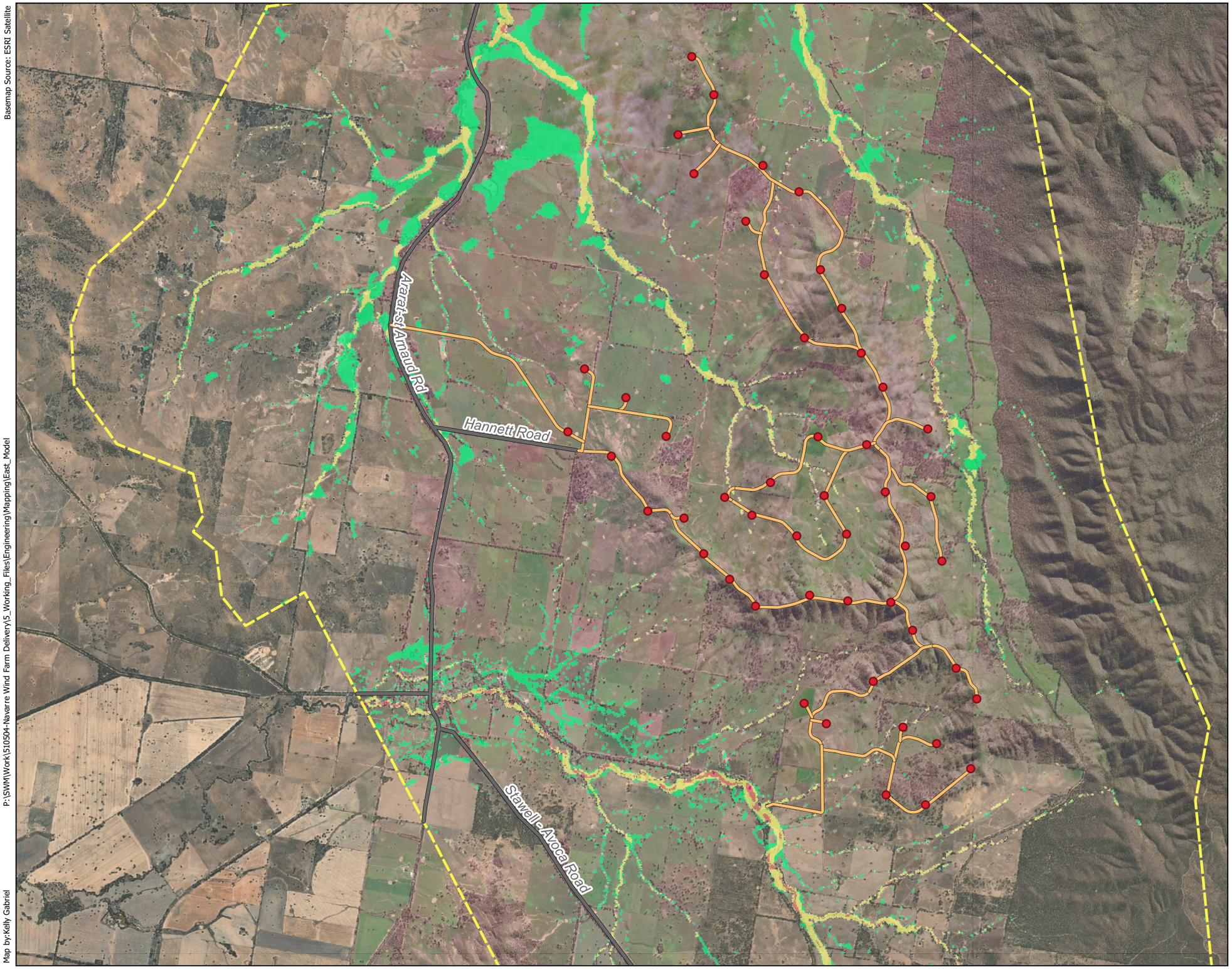
Navarre Wind Farm Flood Study (East)

Appendix B.1 - 10% AEP Event - Peak Flood Depth

Basemap Source: ESRI Satellite

P:\SWM\Work\510504-Navarre Wind Farm Delivery\5_Working_Files\Engineering\Mapping\East_Model

Map by:Kelly Gabriel



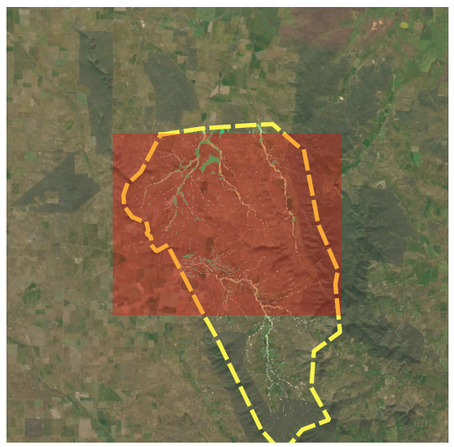
aurecon

Legend

- Proposed wind turbines
- Proposed access tracks
- Existing roads
- TUFLOW model extent

Peak flood velocity (m/s)

- <0.5
- 0.5-1.0
- 1.0-1.5
- 1.5-2.0
- >2.0



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0 2,000 4,000 m

A3 1:65,000

Date: 09/03/2023 Job No: P510504 EPSG:7854

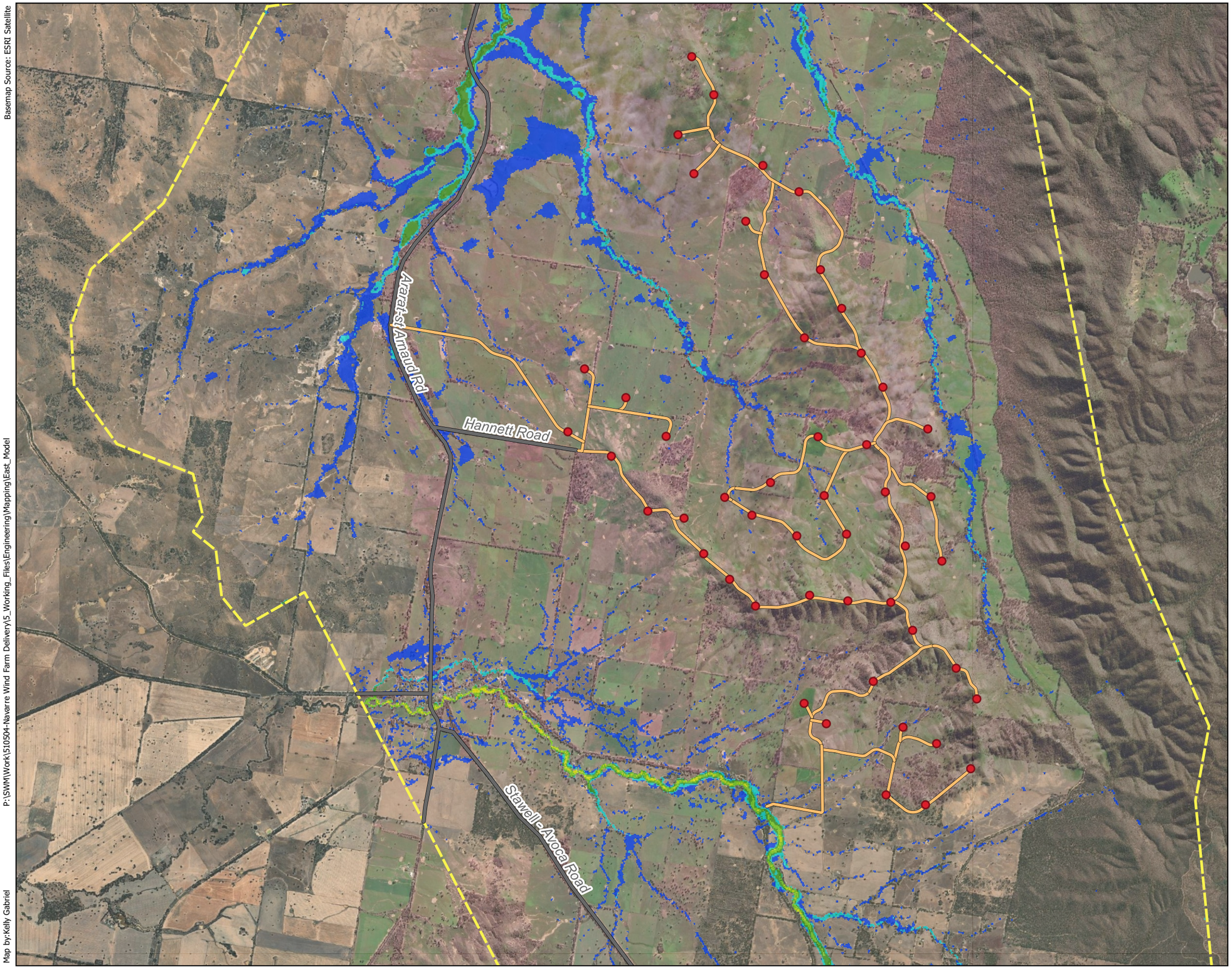
Navarre Wind Farm Flood Study (East)

Appendix B.2 - 10% AEP Event - Peak Flood Velocity

Basemap Source: ESRI Satellite

P:\SWM\Work\510504-Navarre Wind Farm Delivery\5_Working_Files\Engineering\Mapping\East_Model

Map by:Kelly Gabriel



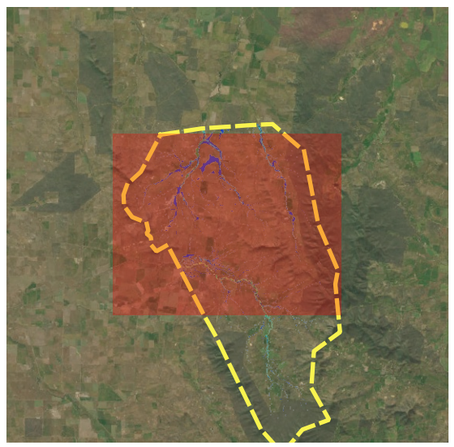
aurecon

Legend

- Proposed wind turbines
- Proposed access tracks
- Existing roads
- TUFLOW model boundary

Peak flood hazard category

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



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0 2,000 4,000 m

1:65,000

Date: 09/03/2023 Job No: P510504 EPSG:7854

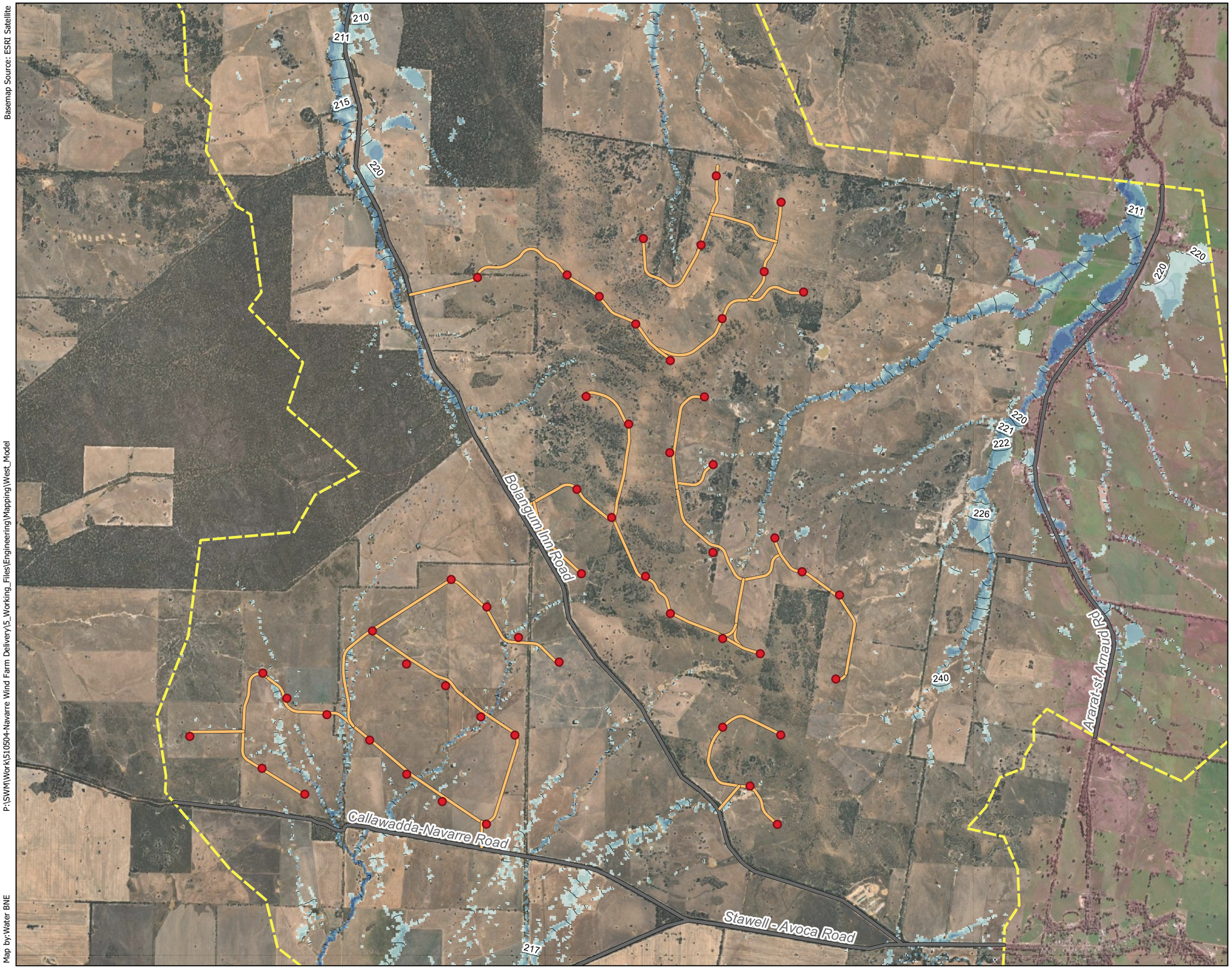
Navarre Wind Farm Flood Study (East)

Appendix B.3 - 10% AEP Event - Hazard

Basemap Source: ESRI Satellite

P:\SWM\Work\510504-Navarre Wind Farm Delivery\5_Working_Files\Engineering\Mapping\West_Model

Map by:Water BNE



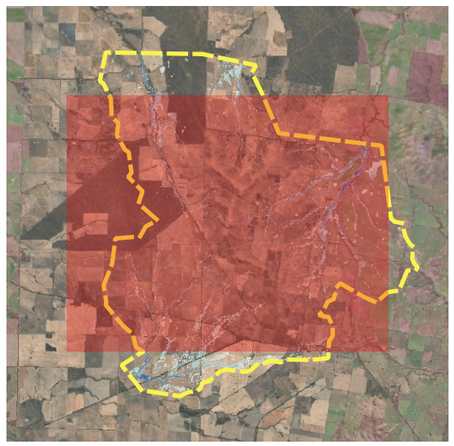
aurecon

Legend

- Proposed wind turbines
- Proposed access tracks
- Existing roads
- TUFLOW model extent
- Peak water surface level contours (mAHD)

Peak flood depth

- <0.05
- 0.05-0.1
- 0.1-0.2
- 0.2-0.5
- 0.5-1.0
- >1.0



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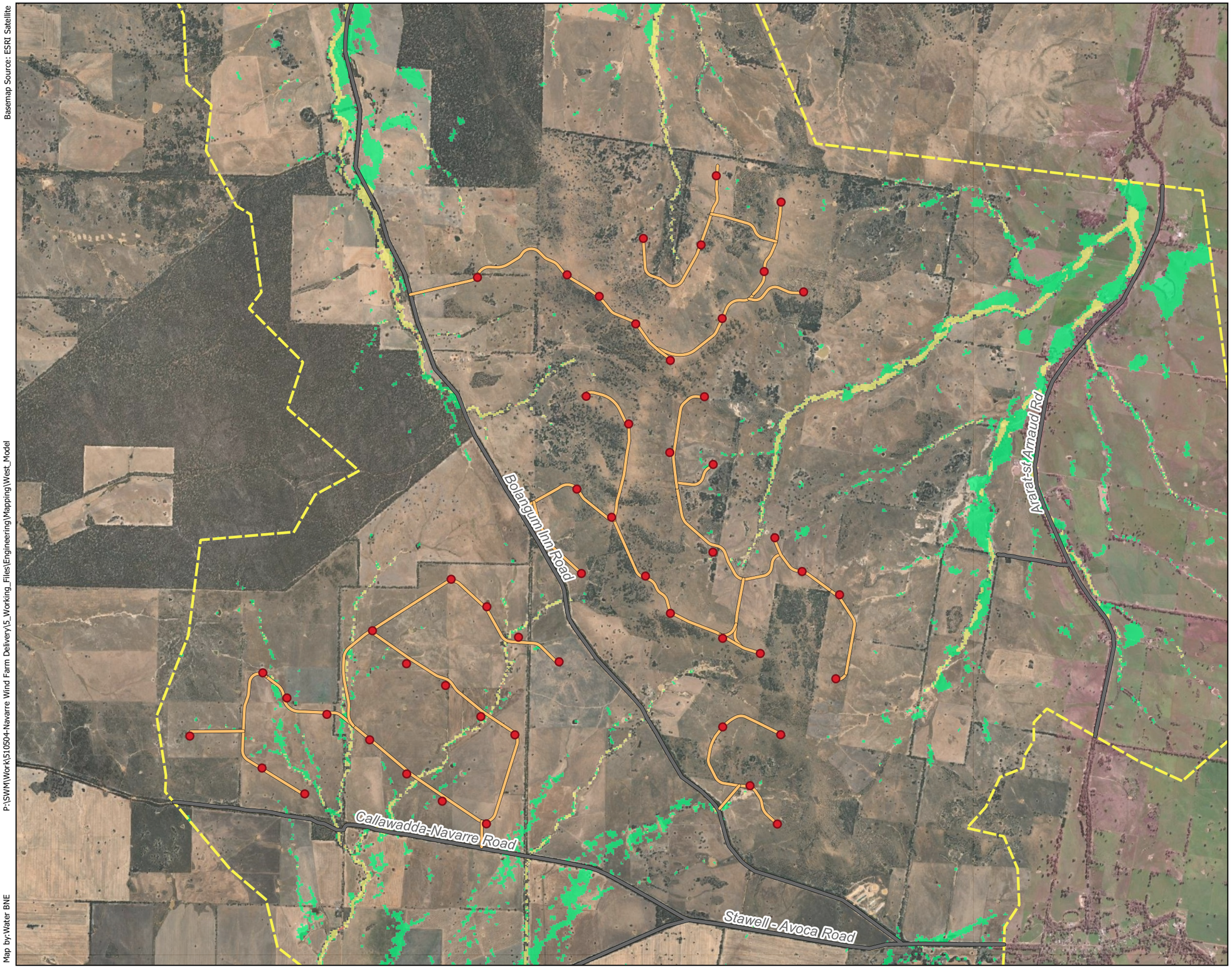
0 1,900 3,800 m

A3 1:50,000

Date: 09/03/2023 Job No: P510504 EPSG:7854

Navarre Wind Farm Flood Study (West)

Appendix B.4 - 10% AEP Event - Peak Flood Depth



Basemap Source: ESRI Satellite

P:\SWM\Work\510504-Navarre Wind Farm Delivery\5_Working_Files\Engineering\Mapping\West_Model

Map by:Water BNE

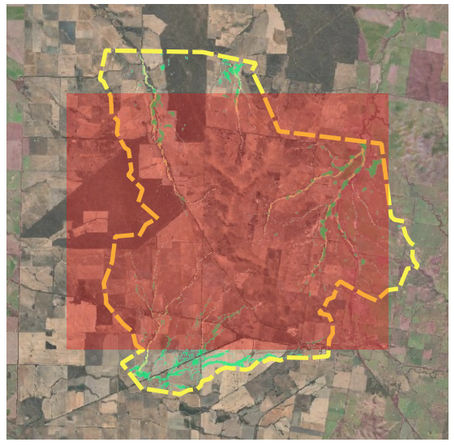
aurecon

Legend

- Proposed wind turbines
- Proposed access tracks
- Existing roads
- TUFLOW model extent

Peak flood velocity (m/s)

- <0.5
- 0.5-1.0
- 1.0-1.5
- 1.5-2.0
- >2.0



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0 1,900 3,800 m

A3 1:50,000

Date: 09/03/2023 Job No: P510504 EPSG:7854

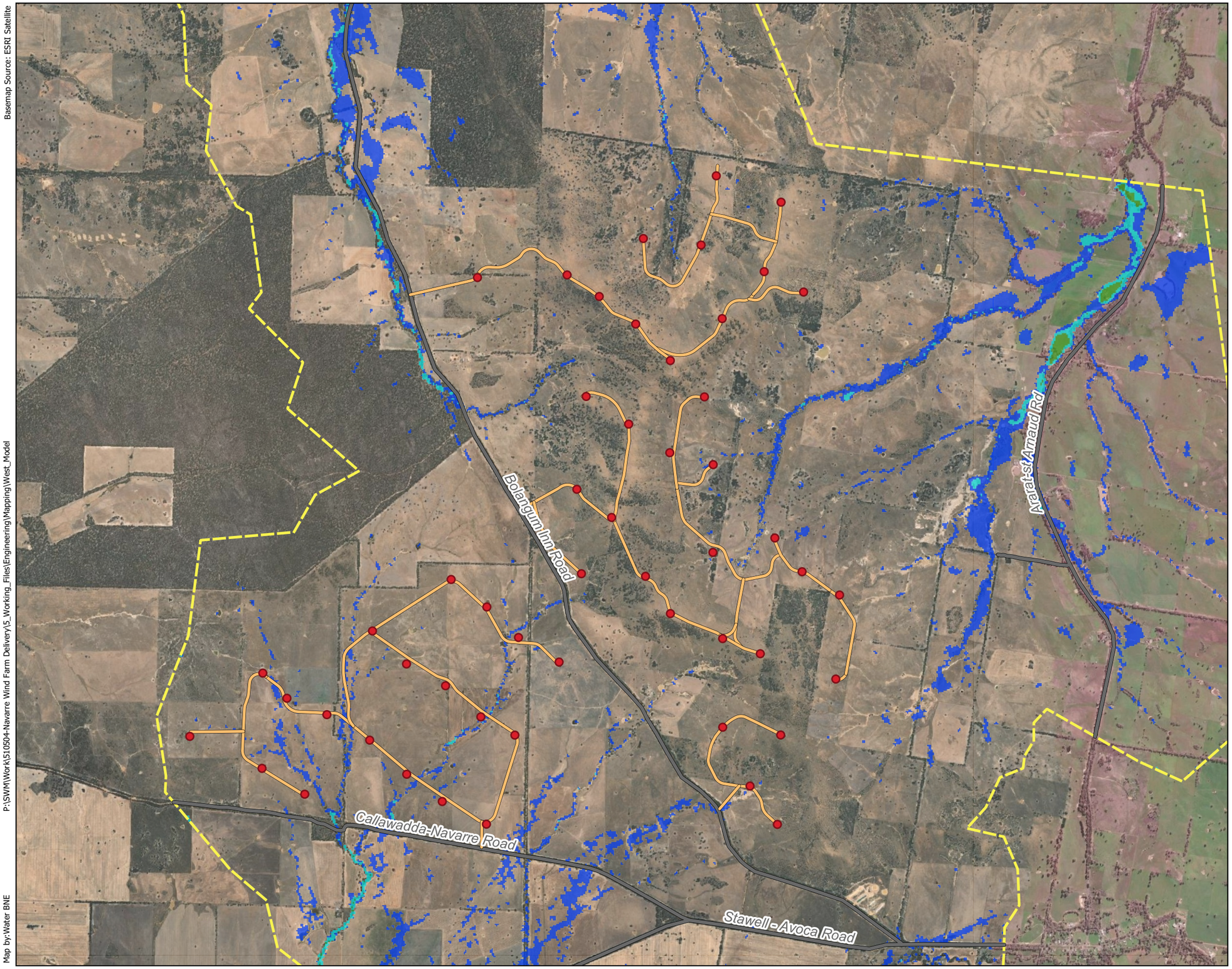
Navarre Wind Farm Flood Study (West)

Appendix B.5 - 10% AEP Event - Peak Velocity

Basemap Source: ESRI Satellite

P:\SWM\Work\510504-Navarre Wind Farm Delivery\5_Working_Files\Engineering\Mapping\West_Model

Map by:Water BNE



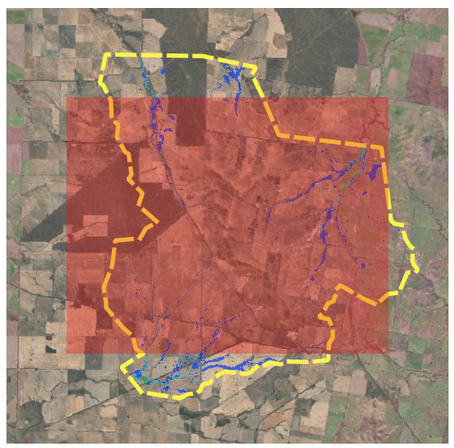
aurecon

Legend

- Proposed wind turbines
- Proposed access tracks
- Existing roads
- TUFLOW model extent

Peak Flood Hazard Category

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



DRAFT

0 1,900 3,800 m

A3 1:50,000

Date: 09/03/2023 Job No: P510504 EPSG:7854

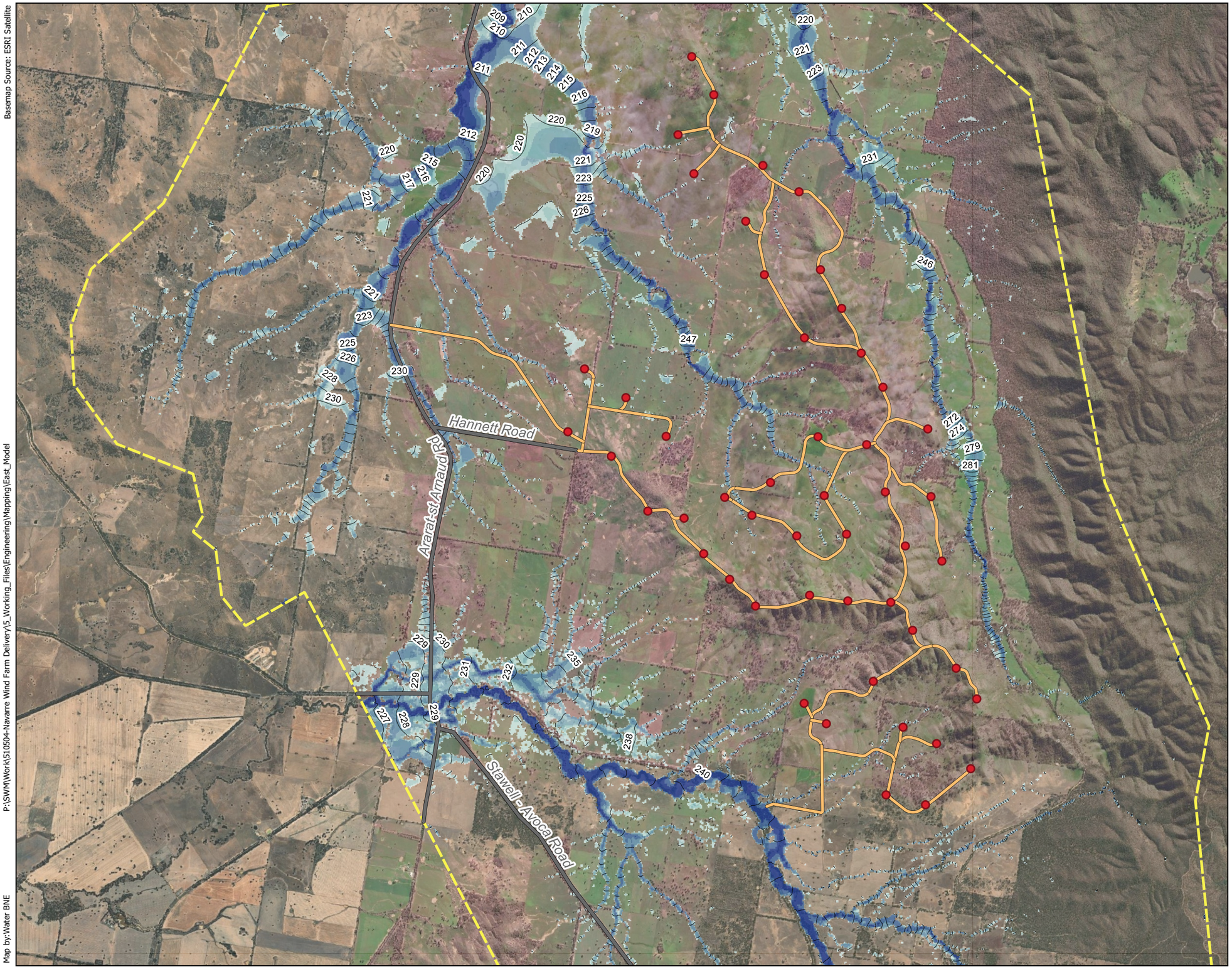
Navarre Wind Farm Flood Study (West)

Appendix B.6 - 10% AEP Event - Hazard

Basemap Source: ESRI Satellite

P:\SWM\Work\510504-Navarre Wind Farm Delivery\5_Working_Files\Engineering\Mapping\East_Model

Map by:Water BNE



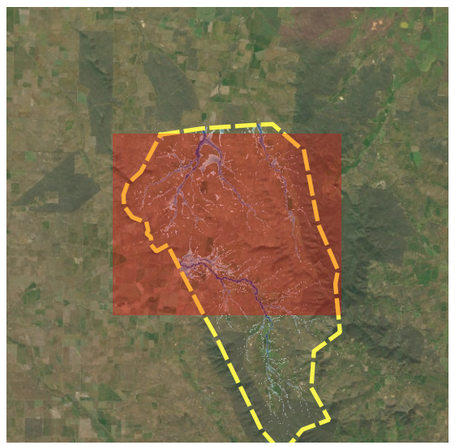
aurecon

Legend

- Proposed wind turbines
- Proposed access tracks
- Existing roads
- TUFLOW model extent
- Peak water surface level contours (mAHD)

Peak flood depth (m)

- <0.05
- 0.05-0.1
- 0.1-0.2
- 0.2-0.5
- 0.5-1.0
- >1.0



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0 2,000 4,000 m

A3 1:65,000

Date: 09/03/2023 Job No: P510504 EPSG:7854

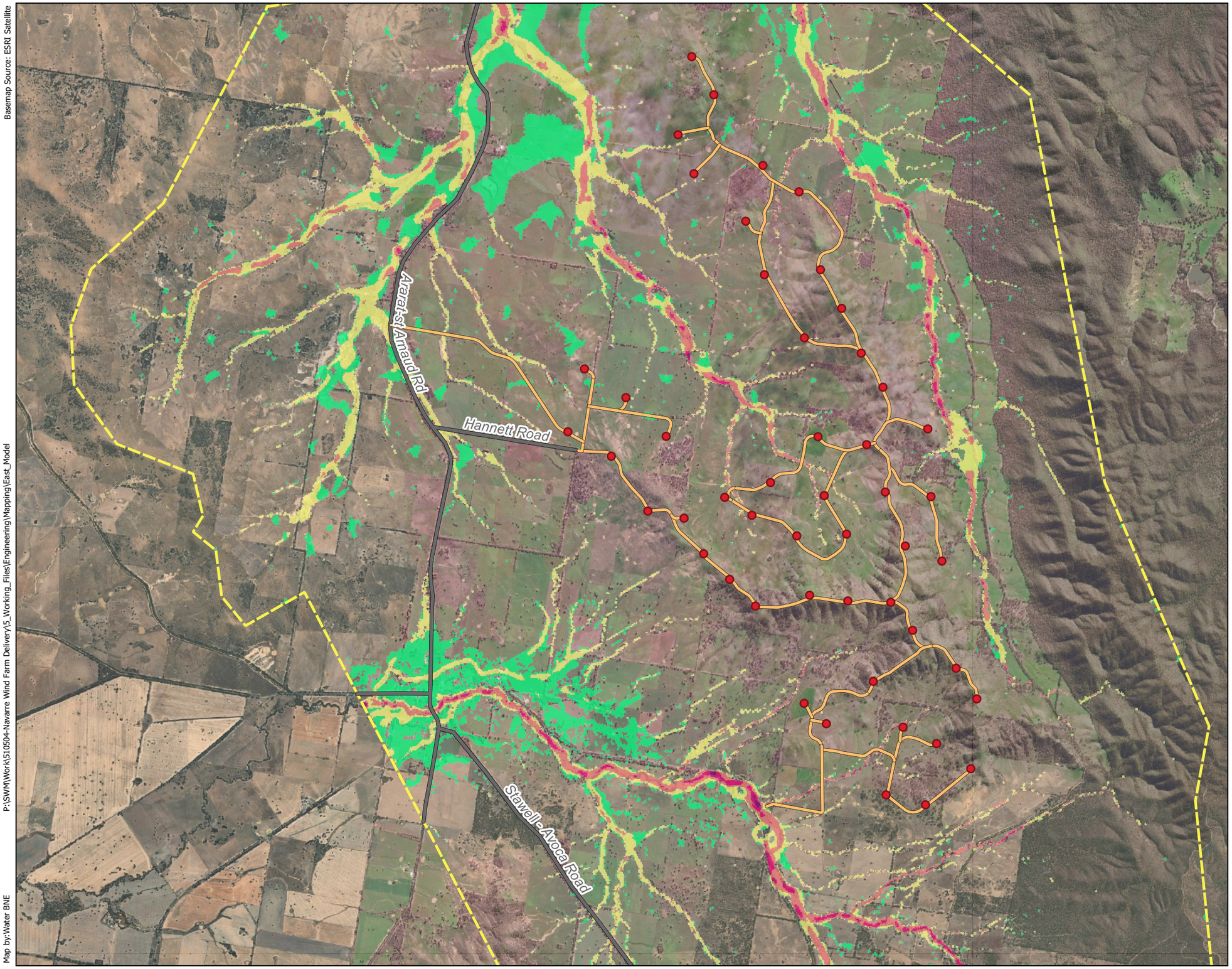
Navarre Wind Farm Flood Study (East)

Appendix C.1 - 1% AEP Event - Peak Flood Depth

Basemap Source: ESRI Satellite

P:\SWM\Work\510504-Navarre Wind Farm Delivery\5_Working_Files\Engineering\Mapping\East_Model

Map by:Water BNE



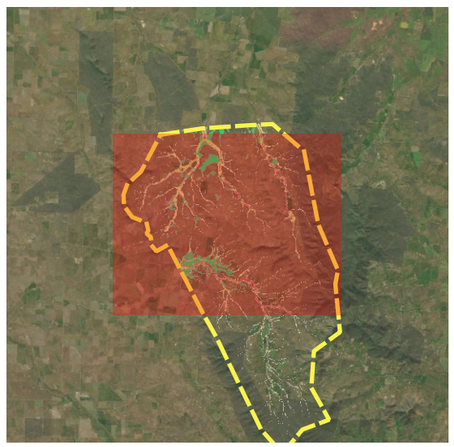
aurecon

Legend

- Proposed wind turbines
- Proposed access tracks
- Existing roads
- TUFLOW model extent

Peak flood velocity (m/s)

- <0.5
- 0.5-1.0
- 1.0-1.5
- 1.5-2.0
- >2.0



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0 2,000 4,000 m

A3 1:65,000

Date: 09/03/2023 Job No: P510504 EPSG:7854

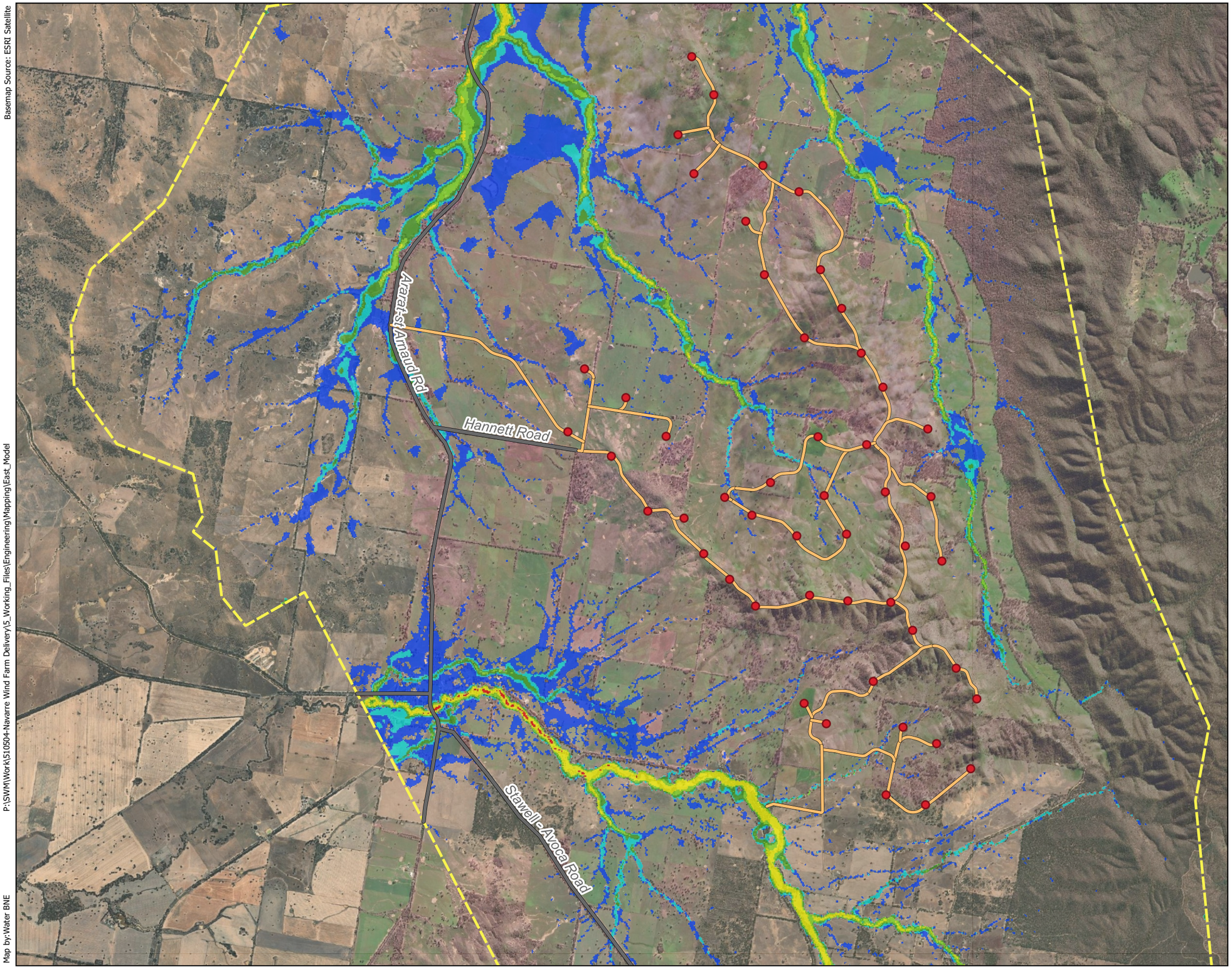
Navarre Wind Farm Flood Study (East)

Appendix C.2 - 1% AEP Event - Peak Flood Velocity

Basemap Source: ESRI Satellite

P:\SWM\Work\510504-Navarre Wind Farm Delivery\5_Working_Files\Engineering\Mapping\East_Model

Map by:Water BNE



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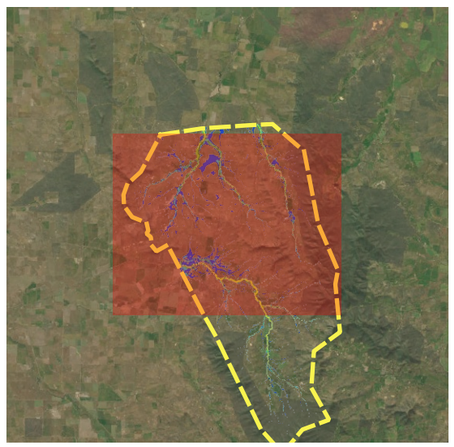
Legend

- Proposed wind turbines
- Proposed access tracks
- Existing roads
- TUFLOW model boundary

Peak flood hazard category

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



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0 2,000 4,000 m

1:65,000

Date: 09/03/2023 Job No: P510504 EPSG:7854

Navarre Wind Farm Flood Study (East)

Appendix C.3 - 1% AEP Event - Hazard

Basemap Source: ESRI Satellite

P:\SWM\Work\510504-Navarre Wind Farm Delivery\5_Working_Files\Engineering\Mapping\West_Model

Map by:Water BNE

Bolangum Inn Road

Callawadda-Navarre Road

Stawell - Avoca Road

Ararat-st Arnaud Rd

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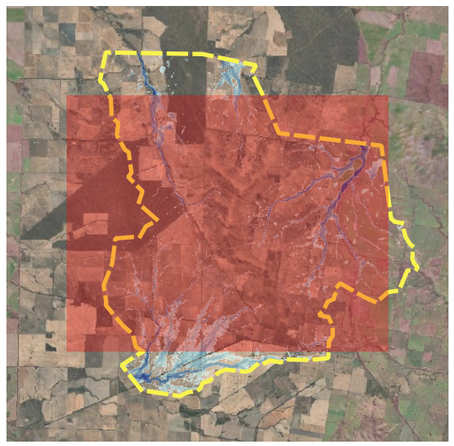
Legend

- Proposed wind turbines
- Proposed access tracks
- Existing roads
- TUFLOW model extent
- Peak water surface level contours (mAHD)

Peak flood depth

- <0.05
- 0.05-0.1
- 0.1-0.2
- 0.2-0.5
- 0.5-1.0
- >1.0



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0 1,900 3,800 m

A3 1:50,000

Date: 09/03/2023 Job No: P510504 EPSG:7854

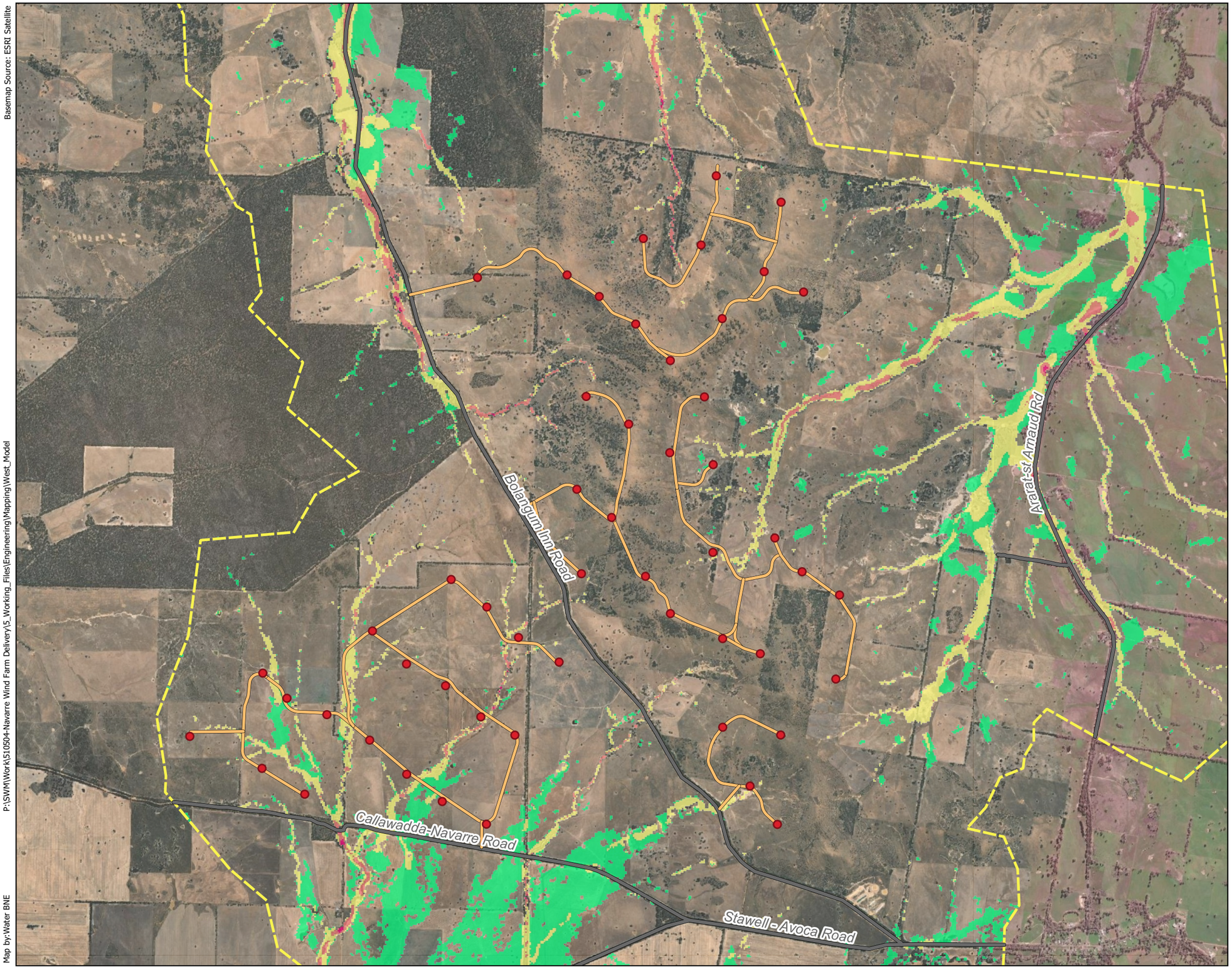
Navarre Wind Farm Flood Study (West)

Appendix C.4 - 1% AEP Event - Peak Flood Depth

Basemap Source: ESRI Satellite

P:\SWM\Work\510504-Navarre Wind Farm Delivery\5_Working_Files\Engineering\Mapping\West_Model

Map by:Water BNE



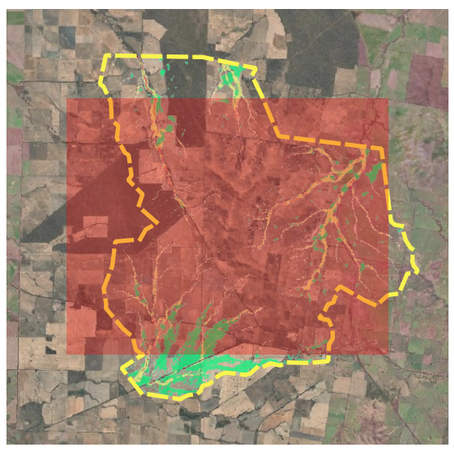
aurecon

Legend

- Proposed wind turbines
- Proposed access tracks
- Existing roads
- TUFLOW model extent

Peak flood velocity (m/s)

- <0.5
- 0.5-1.0
- 1.0-1.5
- 1.5-2.0
- >2.0



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0 1,900 3,800 m

A3 1:50,000

Date: 09/03/2023 Job No: P510504 EPSG:7854

Navarre Wind Farm Flood Study (West)

Appendix C.5 - 1% AEP Event - Peak Velocity

Basemap Source: ESRI Satellite

P:\SWM\Work\510504-Navarre Wind Farm Delivery\5_Working_Files\Engineering\Mapping\West_Model

Map by:Water BNE

Bolangum Inn Road

Ararat-st Amaud Rd

Callawadda-Navarre Road

Stawell - Avoca Road

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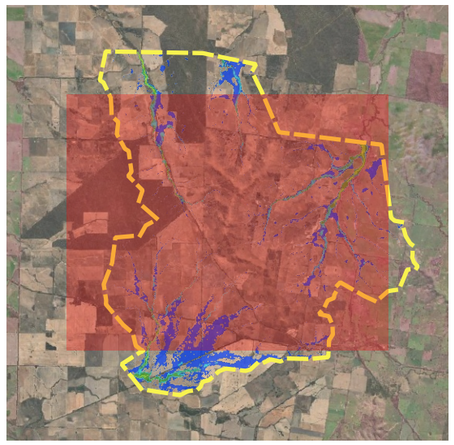
Legend

- Proposed wind turbines
- Proposed access tracks
- Existing roads
- TUFLOW model extent

Peak Flood Hazard Category

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



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0 1,900 3,800 m

A3 1:50,000

Date: 09/03/2023 Job No: P510504 EPSG:7854

Navarre Wind Farm Flood Study (West)

Appendix C.6 - 1% AEP Event - Hazard

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