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# Appendix B

Flood, erosion and sediment run-off impact assessment

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## Gelliondale Wind Farm

### FLOOD, EROSION AND SEDIMENT RUN-OFF IMPACT ASSESSMENT

July 2025

*alluvium*



Alluvium recognises and acknowledges the unique relationship and deep connection to Country shared by Aboriginal and Torres Strait Islander people, as First Peoples and Traditional Owners of Australia. We pay our respects to their Cultures, Country and Elders past and present.

*Artwork by Melissa Barton. This piece was commissioned by Alluvium and tells our story of caring for Country, through different forms of waterbodies, from creeklines to coastlines. The artwork depicts people linked by journey lines, sharing stories, understanding and learning to care for Country and the waterways within.*

This report has been prepared by Alluvium Consulting Australia Pty Ltd for Accent Environmental under the contract titled 'Gelliondale Wind Farm flood, erosion and sediment run-off impact assessment'.

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# Contents

|          |                                                                               |           |
|----------|-------------------------------------------------------------------------------|-----------|
| <b>1</b> | <b>Executive summary .....</b>                                                | <b>1</b>  |
| <b>2</b> | <b>Introduction .....</b>                                                     | <b>2</b>  |
| 2.1      | <i>Project layout.....</i>                                                    | 3         |
|          | Corner Inlet Ramsar site .....                                                | 5         |
| 2.2      | <i>Existing conditions.....</i>                                               | 6         |
|          | Waterways .....                                                               | 6         |
|          | Topography.....                                                               | 6         |
|          | Soils .....                                                                   | 8         |
|          | Geology .....                                                                 | 9         |
|          | Land use .....                                                                | 10        |
| 2.3      | <i>Ramsar wetland.....</i>                                                    | 10        |
| <b>3</b> | <b>Risk event definition.....</b>                                             | <b>16</b> |
|          | Consideration of project phases.....                                          | 16        |
| 3.1      | <i>Specific impact pathways.....</i>                                          | 16        |
|          | Altered flow regimes .....                                                    | 16        |
|          | Altered sediment delivery regime .....                                        | 17        |
|          | Mobilisation and delivery of contaminated material .....                      | 17        |
| <b>4</b> | <b>Risk assessment .....</b>                                                  | <b>19</b> |
| 4.1      | <i>Risk assessment methodology .....</i>                                      | 19        |
| 4.2      | <i>Assessment to understand likelihood .....</i>                              | 20        |
|          | Hydrological assessment.....                                                  | 20        |
|          | Hydraulic assessment.....                                                     | 21        |
|          | Sediment erosion and delivery analysis .....                                  | 28        |
| 4.3      | <i>Likelihood matrix .....</i>                                                | 31        |
| 4.4      | <i>Consequences rating .....</i>                                              | 37        |
|          | Ecological impact assessment .....                                            | 37        |
|          | Consequence matrix .....                                                      | 37        |
| <b>5</b> | <b>Inherent risk rating (pre-mitigation) .....</b>                            | <b>43</b> |
| <b>6</b> | <b>Recommendations for mitigation and monitoring measures.....</b>            | <b>45</b> |
| <b>7</b> | <b>Residual risk rating (post-mitigation) .....</b>                           | <b>47</b> |
| <b>8</b> | <b>Conclusion on the likelihood, significance and extent of impacts .....</b> | <b>54</b> |
| <b>9</b> | <b>References .....</b>                                                       | <b>55</b> |

## Figures

|                                                                                                                                                         |   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| Figure 1. Site overview of the Action Area in which the project is planned, neighbouring major waterways, and location of the Corner Inlet Ramsar site. | 4 |
| Figure 2. Location of proposed works to construct the Gelliondale Wind Farm.                                                                            | 5 |
| Figure 3. Location of waterways throughout and around the Gelliondale Wind Farm.                                                                        | 6 |
| Figure 4. Location of roadways within and around the Gelliondale Wind Farm.                                                                             | 7 |

|                                                                                                                                                                                               |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Figure 5. <i>Topography of the Action Area in which the project is planned and surrounding area highlighting the location of the Albert and Jack Rivers' floodplains.</i>                     | 7  |
| Figure 6. <i>Location of mapped prospective acid sulphate soils within and around the Action Area in which the project is planned.</i>                                                        | 9  |
| Figure 7. <i>Soils according to the Australian Soil Classification system within and surrounding the Action Area in which the project is planned.</i>                                         | 9  |
| Figure 8. <i>Geology of Action Area in which the project is planned and surrounding area.</i>                                                                                                 | 10 |
| Figure 9: <i>Location of the Corner Inlet Ramsar site in relation to the Action Area outlined in black (source: Corner Inlet Ramsar site Ecological Character Description (DSEWPC 2011)).</i> | 12 |
| Figure 10: <i>Hydraulic modelling study area</i>                                                                                                                                              | 22 |
| Figure 11: <i>Existing condition hydraulic model set up</i>                                                                                                                                   | 23 |
| Figure 12: <i>Proposed condition hydraulic model set up</i>                                                                                                                                   | 24 |
| Figure 13: <i>20% AEP Maximum Flood Depth (m) – Developed Conditions</i>                                                                                                                      | 25 |
| Figure 14: <i>2 EY Maximum Flood Depth (m) – Developed Conditions</i>                                                                                                                         | 26 |
| Figure 15: <i>20% AEP Afflux Map</i>                                                                                                                                                          | 26 |
| Figure 16: <i>2 EY AEP Afflux Map</i>                                                                                                                                                         | 27 |
| Figure 17: <i>20% AEP Maximum Ponding Duration – Developed Conditions</i>                                                                                                                     | 27 |
| Figure 18: <i>2 EY Maximum Ponding Duration – Developed Conditions</i>                                                                                                                        | 28 |
| Figure 19. <i>Locations where access tracks will cross existing waterways within the project site and waterways within 500 m of an access track.</i>                                          | 29 |
| Figure 20: <i>20% maximum flow velocity – Developed Conditions</i>                                                                                                                            | 30 |
| Figure 21: <i>20% Bed Shear Stress – Developed Conditions</i>                                                                                                                                 | 31 |

## Tables

|                                                                                                                                                                                                  |    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Table 1: Sections of report addressing PER objectives                                                                                                                                            | 2  |
| Table 2. <i>List of key threats and their potential impacts on wetlands identified by Australia's DSEWPC (2011).</i>                                                                             | 5  |
| Table 3: Ramsar criteria met at Corner Inlet (adapted from Ramsar Site Information Sheet V. 1.6 4 February 2020) <a href="https://rsis.ramsar.org/ris/261">https://rsis.ramsar.org/ris/261</a> ) | 13 |
| Table 4: Summary of Critical Components, Processes and Services/Benefits of the Corner Inlet Ramsar Site (source: Corner Inlet Ramsar site Ecological Character Description (DSEWPC 2011))       | 15 |
| Table 5: <i>Risk likelihood (extracted from DCCEEW, 2024)</i>                                                                                                                                    | 19 |
| Table 6: <i>Risk Consequence (extracted from DCCEEW, 2024)</i>                                                                                                                                   | 19 |
| Table 7: <i>Risk Rating (extracted from DCCEEW, 2024)</i>                                                                                                                                        | 20 |
| Table 8: Estimated peak surface runoff discharge within project site                                                                                                                             | 20 |
| Table 9: <i>Summary of access tracks crossing existing waterways</i>                                                                                                                             | 30 |
| Table 10: <i>Risk likelihood summary matrix</i>                                                                                                                                                  | 32 |
| Table 11. Consequence matrix                                                                                                                                                                     | 38 |
| Table 12: Residual risk rating                                                                                                                                                                   | 47 |

# 1 Executive summary

The Gelliondale Wind Farm (the Project) is a proposed wind energy facility located in Victoria, approximately 210 kilometres southeast of Melbourne, in South Gippsland, within the Wellington Shire. The Project is situated along the South Gippsland Highway, approximately seven kilometres southwest of Yarram, three kilometres west of Alberton, and eight kilometres east of Welshpool.

The Project comprises 13 wind turbine generators (WTGs) with rotor diameters of 164 metres, and maximum/minimum tip heights of 210 and 40 metres above natural ground level respectively. The Project also contains hardstand areas adjacent to each WTG, meteorological masts, construction compounds and operation and maintenance areas. The Project features approximately 14 kilometres of unsealed tracks and underground cabling, linking the WTGs to a centralised substation, with ancillary 40MW Battery Energy Storage System (BESS) and direct link to the existing 66kV transmission line crossing the site. The Action Area within which the Project is planned has a total area of 1,622 hectares, while the exact Project Footprint is 38.2 hectares.

The construction, operation and decommissioning of the Gelliondale Wind Farm has been declared a Controlled Action under the *Environmental Protection and Biodiversity Conservation Act 1997* (Cth), to be assessed through the preparation of a Public Environment Report (PER). The project proponent is Alberton Renewable Energy Pty Ltd, a subsidiary of Synergy Wind Pty Ltd. The Project is proposed to be constructed over 12-18 months, operate for 35 years, and then either be decommissioned or repowered with replacement WTGs.

This report assesses the potential environmental impacts of the project on local hydrological processes, sediment transport, and the nearby Corner Inlet Ramsar site, which is a wetland of international significance.

A risk-based assessment framework was applied to evaluate potential environmental impacts systematically. This approach identified key risk events, assessed their likelihood and consequences, and determined the residual risk following the implementation of mitigation measures. By integrating hydrological modelling, sediment transport analysis, and ecological impact assessments, the framework ensured a thorough and adaptive evaluation of risks associated with the project.

The findings indicate that the project's impact on hydrology will be minimal, with negligible changes to runoff patterns and flow regimes. The proposed development increases impervious surface areas only slightly, accounting for 1.2% of the Action Area in which the project is planned and 0.03% of the total Corner Inlet catchment. Consequently, peak runoff volumes and flow magnitudes are unlikely to significantly affect the surrounding waterways or the Ramsar wetland. Sediment mobilization and delivery risks are primarily associated with construction and decommissioning activities and to a lesser degree with maintenance activities during operation. While localized sediment runoff is expected, the volume transported to waterways and the Ramsar site will remain far below natural baseline levels.

This assessment report also highlights the potential for disturbance of Acid Sulfate Soils (ASS), but the likelihood of adverse effects on water quality is low with the implementation of effective management and monitoring measures. Ecologically, the project's impacts on critical habitats, including seagrass beds, mangroves, and saltmarshes, are anticipated to be minor. These habitats, which support diverse flora and fauna, are expected to remain largely unaffected provided that sediment and erosion controls are properly implemented and monitored throughout the project's lifecycle.

To mitigate risks, this assessment report recommends the adoption of relevant environmental management plans and procedures including an overarching Environmental Management Plan (EMP), supported by a Soil and Water Management Plan (SWMP) and an Erosion and Sediment Control Plan (ESCP), which mandate strict adherence to standard industry practices for the effective management and monitoring of environmental values related to soil and water.

In conclusion, the Gelliondale Wind Farm is expected to have minimal environmental impacts with the implementation of standard, industry practice management and monitoring measures.

## 2 Introduction

The Gelliondale Wind Farm (the Project) is a proposed wind energy facility located in Victoria, approximately 210 kilometres southeast of Melbourne, in South Gippsland, within the Wellington Shire. The Project is situated along the South Gippsland Highway, approximately seven kilometres southwest of Yarram, three kilometres west of Alberton, and eight kilometres east of Welshpool.

The Project comprises 13 wind turbine generators (WTGs) with rotor diameters of 164 metres, and maximum/minimum tip heights of 210 and 40 metres above natural ground level respectively. The Project also contains hardstand areas adjacent to each WTG, meteorological masts, construction compounds and operation and maintenance areas. The Project features approximately 14 kilometres of unsealed tracks and underground cabling, linking the WTGs to a centralised substation, with ancillary 40MW Battery Energy Storage System (BESS) and direct link to the existing 66kV transmission line crossing the site. The Project will require upgrades to local roads and the clearing of 1.244 hectares of native vegetation, as well as ancillary signage and fire safety design requirements. These works collectively form part of the proposed 'action' to be assessed as part of the PER.

The Action Area within which the project is planned has a total area of 1,622 hectares, while the exact Project Footprint is 38.2 hectares. The Project is proposed to be constructed over 12-18 months, operate for 35 years, and then either be decommissioned or repowered with replacement WTGs. The project proponent is Alberton Renewable Energy Pty Ltd, a subsidiary of Synergy Wind Pty Ltd.

The construction, operation and decommissioning of the Gelliondale Wind Farm has been declared a Controlled Action under the *Environmental Protection and Biodiversity Conservation Act 1997* (Cth), to be assessed through the preparation of a Public Environment Report (PER).

According to the Delegate of the Minister (17 October 2023), the project has potential to have a significant impact on the following Matters of National Environmental Significance (MNES) that are protected under the Part 3 of the EPBC Act:

- The ecological character of a declared Ramsar wetland, i.e. Coner Inlet Ramsar site
- Listed threatened species and communities
- Listed migratory species.

A hydrological and sediment impact assessment identifying risk impact pathways and associated risk assessment to surrounding waterways and the nearby Corner Inlet Ramsar site (arising from altered hydrological, ecological, and geomorphic processes within the study area) was undertaken by Alluvium Consulting (Alluvium) for the project. This report outlines the parameters of the hydrological and sediment impact assessment and addresses the following PER objectives outlined in Table 1

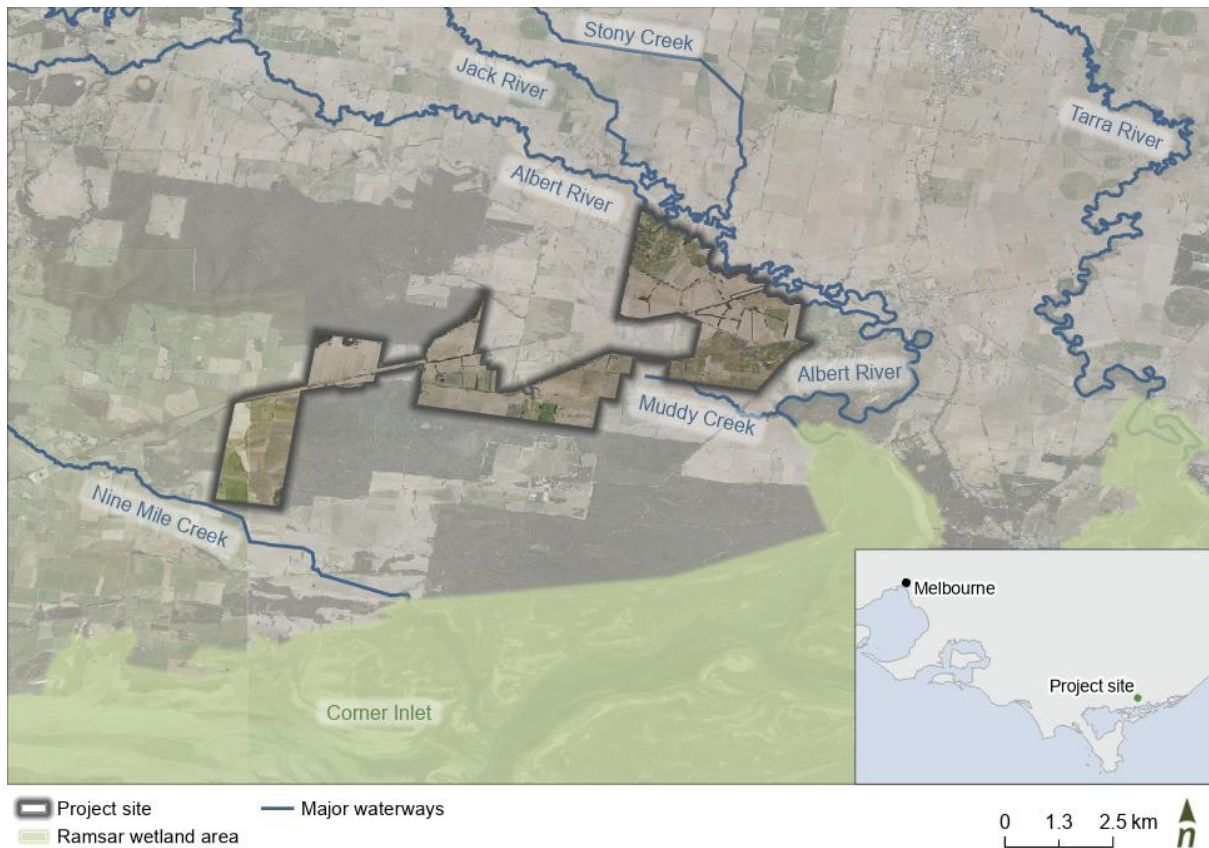
**Table 1: Sections of report addressing PER objectives**

| PER objective                                                                                                            | Relevant section within the report    |
|--------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| PER objective <ul style="list-style-type: none"><li>• 6.1 b</li></ul>                                                    | Section 4.2                           |
| PER objective <ul style="list-style-type: none"><li>• 7.1 a</li><li>• <b>7.1 b v</b></li><li>• <b>7.1 b vi</b></li></ul> | Section 2.1, Section 2.2, Section 2.3 |

|                                                                                                                                      |                                                  |
|--------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|
| PER objective <ul style="list-style-type: none"> <li>• 7.3 a,</li> <li>• 7.3 b i to iii</li> <li>• 7.3 c</li> <li>• 7.3 d</li> </ul> | Section 2.2, Section 3.1, Section 4.2, Section 9 |
| PER objective <ul style="list-style-type: none"> <li>• 7.4</li> </ul>                                                                | Section 4.2, Section 4.4, Section 6              |
| PER objective <ul style="list-style-type: none"> <li>• 8.1 a, b, c</li> </ul>                                                        | Section 3.1, Section 2.1                         |
| <b>PER objective</b> <ul style="list-style-type: none"> <li>• <b>8.1 g and i</b></li> </ul>                                          | Section 4.2, Section 6                           |
| PER objective <ul style="list-style-type: none"> <li>• 8.1 j</li> </ul>                                                              | Section 4.2, Section 4.4, Section 5              |
| PER objective <ul style="list-style-type: none"> <li>• 9 a</li> </ul>                                                                | Section 6, Section 7                             |

## 2.1 Project layout

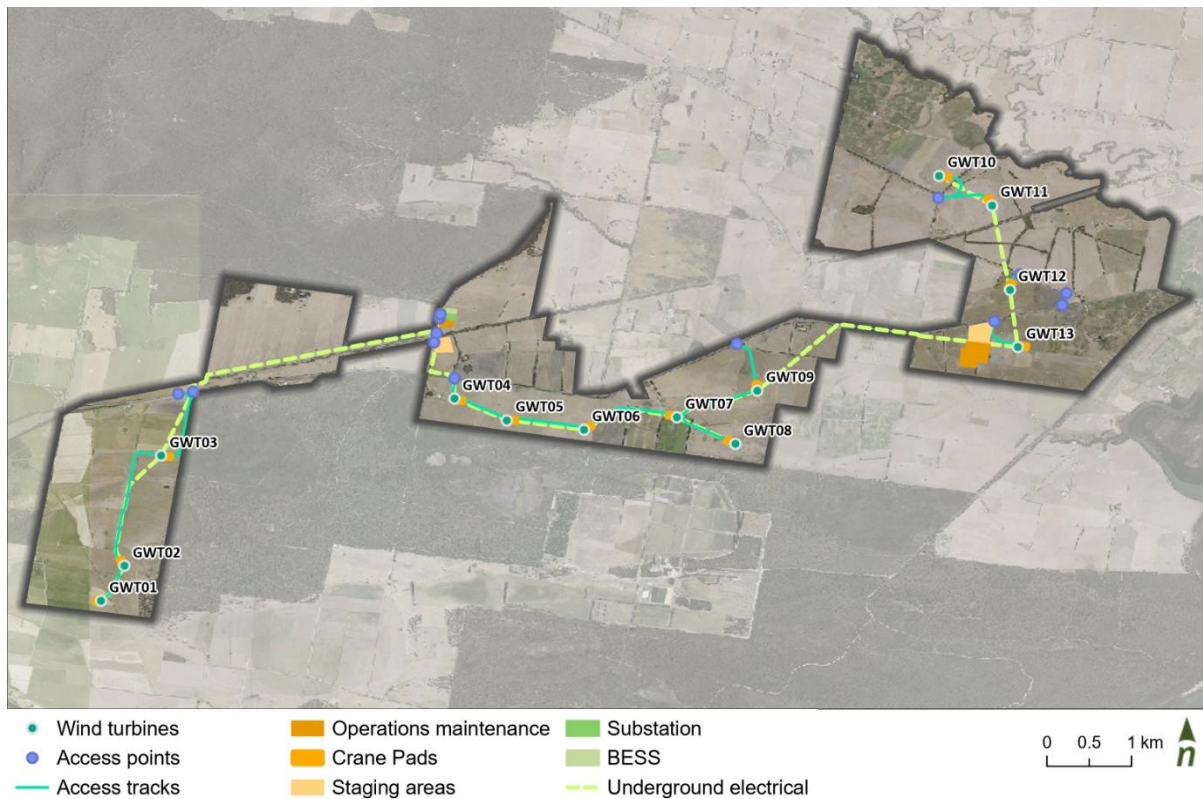
The Action Area within which the project is planned is approximately 1622 ha of cleared agricultural land within the district of Gelliondale in southeastern Victoria. A series of waterways, including the Albert and Jack Rivers, and Nine Mile and Muddy Creeks run alongside the perimeter of the Action Area before flowing into the Corner Inlet Ramsar site located to the south (Figure 1).



**Figure 1.** Site overview of the Action Area in which the project is planned, neighbouring major waterways, and location of the Corner Inlet Ramsar site.

The south-eastern boundary of the Action Area in which the project is planned is 1.1km from the nearest point of Corner Inlet Ramsar site, i.e. near the junction of Albert River and Muddy Creek. The nearest project infrastructure, the WTG number 13 (GWT13, Figure 2), to the same point is 1.9km.

The proposed works include the construction of 13 WTGs, the BESS, the substation, underground cabling, access tracks and spaces for operations and maintenance. Additional temporary structures will be constructed to support the proposed works including crane pads and construction compounds. Figure 2 shows the location of the proposed works and supporting structures in relation to the Action Area in which the project is planned. The location of the proposed works in relation to roads and waterways can be found in Figure 3 and Figure 4.



**Figure 2.** Location of proposed works to construct the Gelliondale Wind Farm.

#### Corner Inlet Ramsar site

The Corner Inlet Ramsar site is a large, tidally dominated embayment located in the southeastern region of Gippsland in Victoria and is downstream of multiple waterways that surround the Project site (Figure 1). The inlet consists of submerged sand and mud flats with developed seagrass beds, large sand islands, and a network of deep channels that aid the movement of tides (DSEWPC 2011). The site's large area and diverse aquatic, wetland and terrestrial habitats support a diverse range of flora and fauna species, including migratory bird populations and several nationally threatened and endangered species (Yates et al. 2015).

Australia's Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) identified the key threats to Corner Inlet's ecological character (2011). Some of the key threats and their impacts to wetlands are summarised in Table 2 (further details can be found in section 2.3 and full details can be found in DSEWPC 2011).

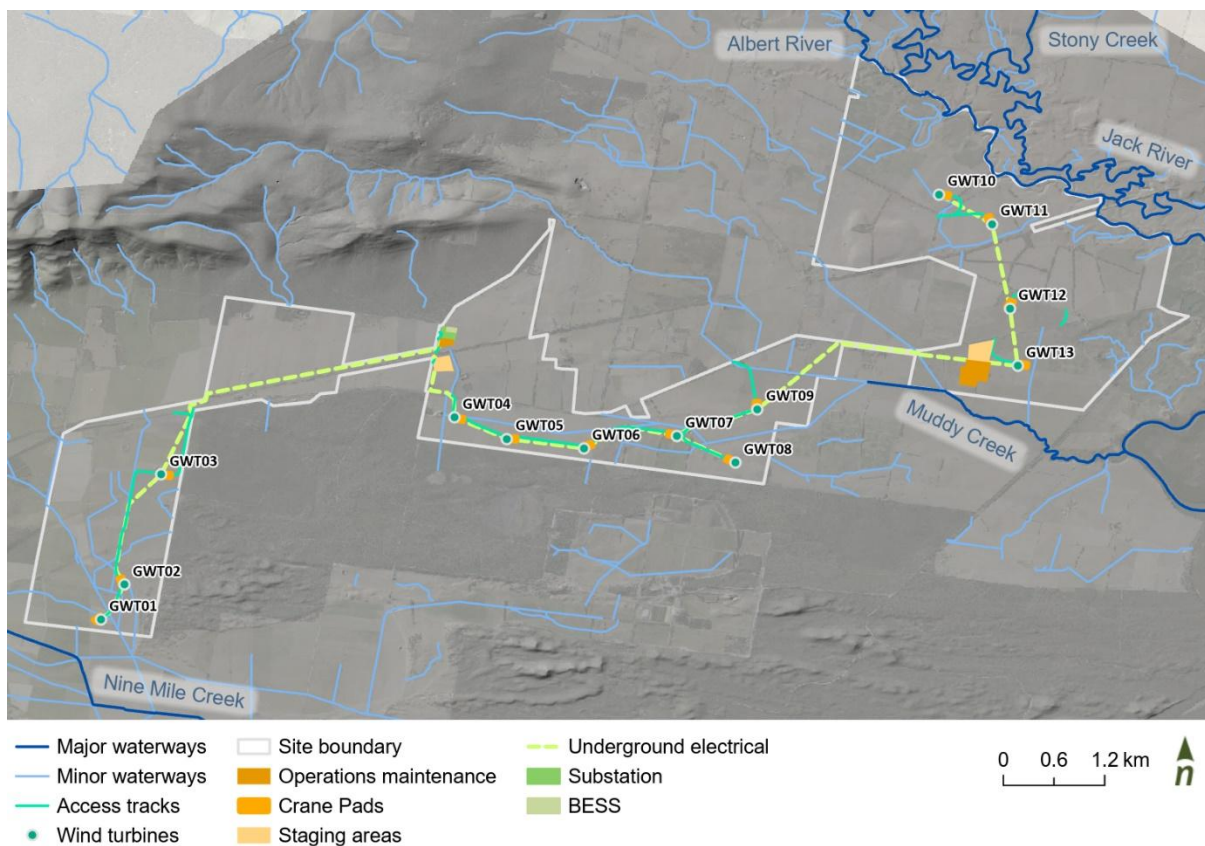
**Table 2.** List of key threats and their potential impacts on wetlands identified by Australia's DSEWPC (2011).

| Key threat                                                                    | Potential impact to wetlands                                                                                                                          |
|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| Modified flow regimes                                                         | Changes to environmental processes relying on rivers, including fish spawning and migration                                                           |
| Pollutant (sediment and nutrient) inputs affecting water quality              | Loss of seagrasses and their ecological functions, increases in algae, changes in biological assemblages                                              |
| Future infrastructure development                                             | Removal of vegetation and habitats, changes to water quality and hydrodynamics, changes to surface and groundwater flow paths                         |
| Disturbance of contaminated material (such as acid sulphate soils or similar) | Reduced water quality, fish kills, impaired ecosystem functions                                                                                       |
| Climate change                                                                | Reduction in freshwater species, reduction in fauna habitat, increased fire risk, increased likelihood and magnitude of disturbance from storm surges |

## 2.2 Existing conditions

### Waterways

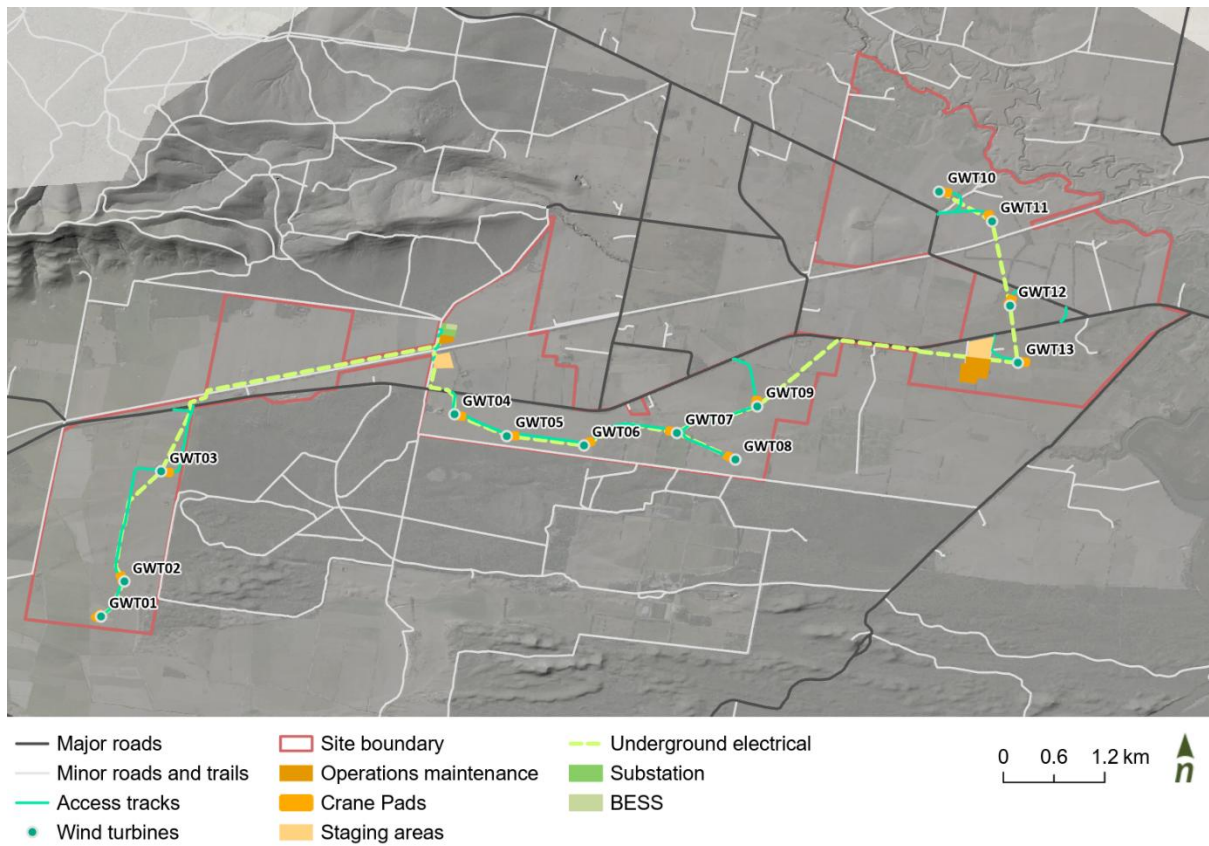
Mapped waterways that cross or flow adjacent to the Action Area in which the project is planned are shown in Figure 3. Major waterways that flow in close proximity to the Action Area and into the Corner Inlet Ramsar site, include Nine Mile Creek to the west, Muddy Creek to the southeast, and the Albert River to the east of the Action Area. Stony Creek and the Jack River converge approximately 550 m outside of the northeastern perimeter of the Action Area before joining the Albert River approximately 4 km downstream to the east of the Action Area. Numerous smaller waterways exist throughout the Action Area in which the project is planned and surrounding areas including a network of streams flowing from higher elevations to the north of the Action Area and a series of farm drains and dams that can be found throughout the agricultural lands. Many of the smaller waterways that cross the Action Area appear to have been artificially straightened, essentially converting these flow paths to efficient farm drains.



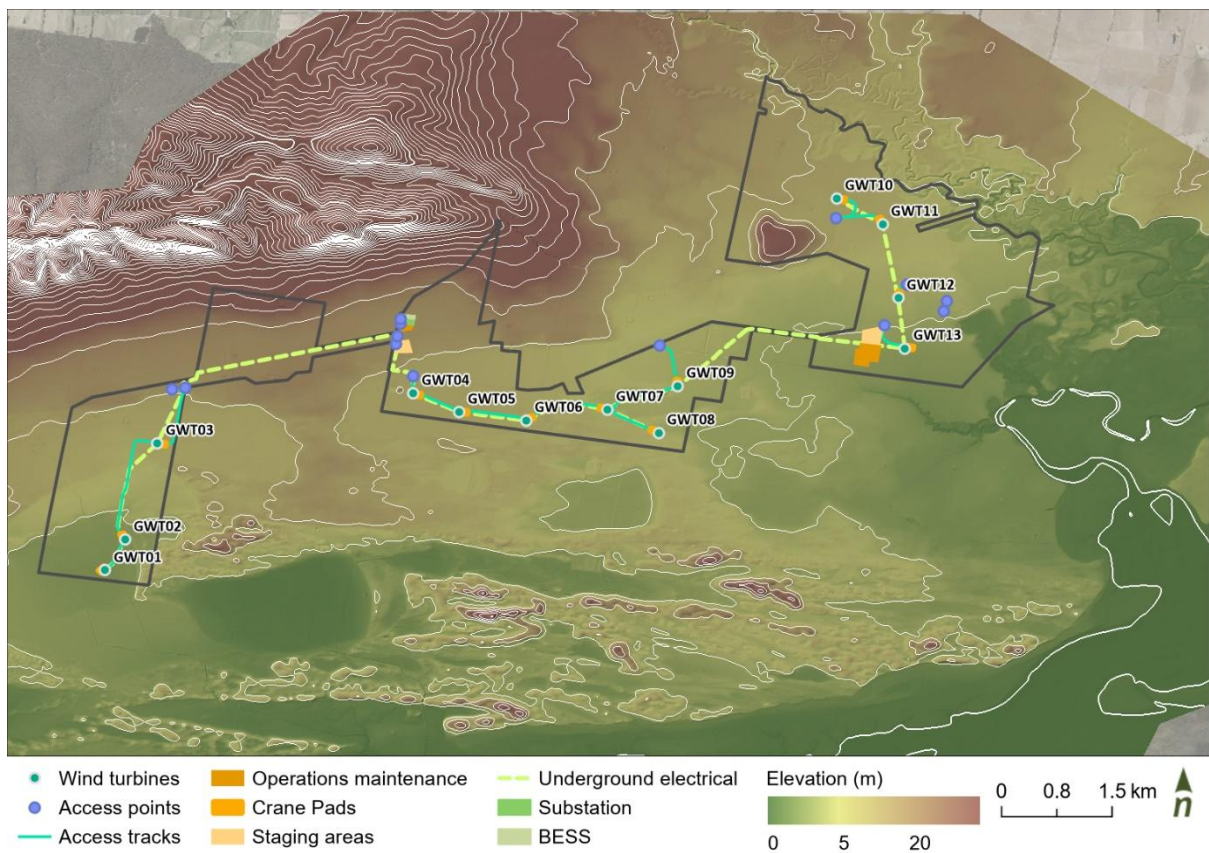
**Figure 3.** Location of waterways throughout and around the Gelliondale Wind Farm.

### Topography

The topography of the Action Area in which the project is planned is largely flat at low elevation with a general decreasing elevational trend from northwest to southeast (Figure 5). Elevations are greatest to the northwest of the Action Area where the Strzelecki Ranges reach their southern extent. Elevations decrease to the east of the Action Area within the Albert and Jack Rivers' floodplains, which extend into the eastern boundaries of the Action Area.



**Figure 4.** Location of roadways within and around the Gelliondale Wind Farm.



**Figure 5.** Topography of the Action Area in which the project is planned and surrounding area highlighting the location of the Albert and Jack Rivers' floodplains.

## Soils

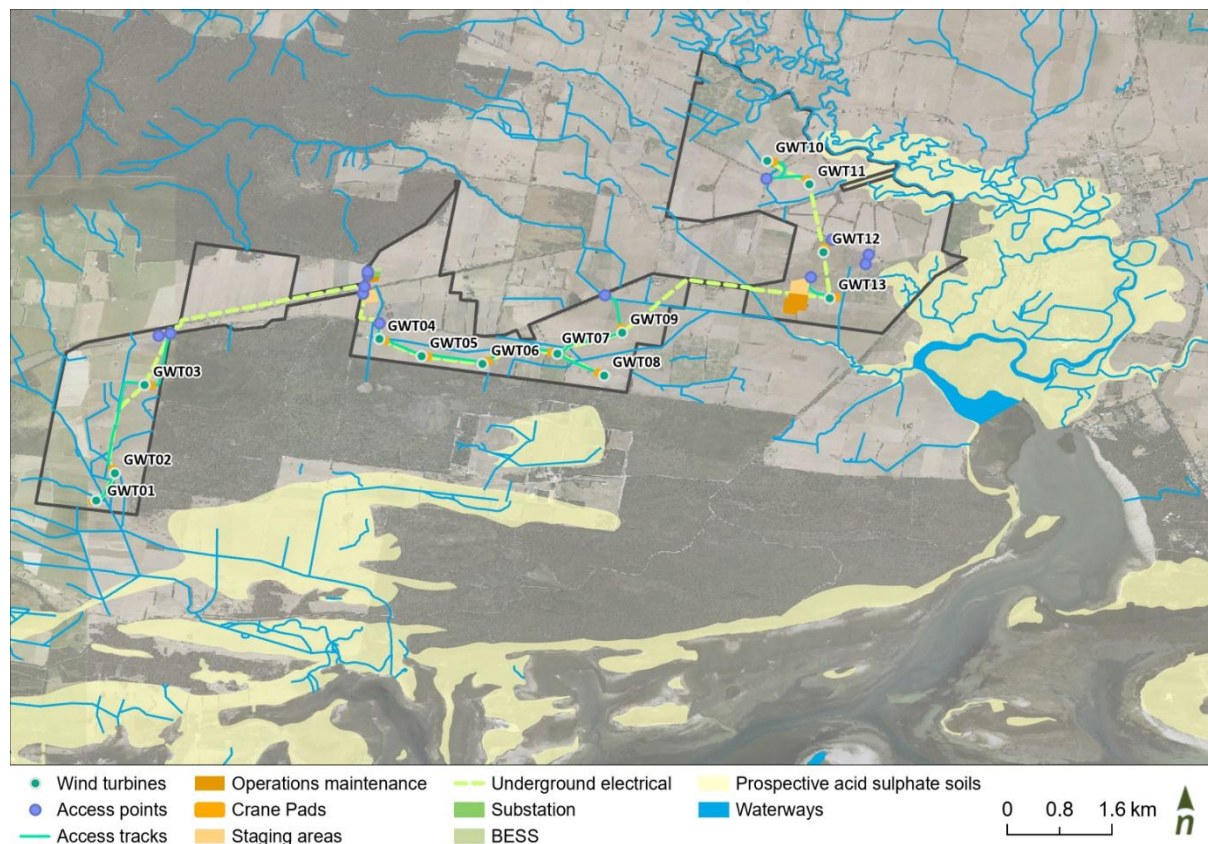
The soils expected within the Action Area in which the project is planned are found in Figure 7 below and primarily show Vertosols and Sodosols<sup>1</sup>.

Acid sulphate soils (ASS) are naturally occurring in coastal sediments in Victoria and are largely benign when left undisturbed. However, if disturbed, these soils can interact with atmospheric oxygen to produce sulfuric acid, which can have detrimental environmental impacts including reduced water quality, acidification of water and soils, dissolution and corrosion, and fish kills. The state of Victoria has mapped areas of land potentially containing ASS based on coastal geomorphology, past sea levels, and soil sampling (Figure 6).

These potential ASS(PASS) have been identified in the floodplains of the Albert and Jack Rivers and Muddy Creek and throughout the coastal zone to the south of the Action Area in which the project is planned. Figure 6 shows PASS can be expected within the Action Area but are not likely to be identified within the Project Footprint (i.e. low to extremely low probability of disturbance due to construction activity).

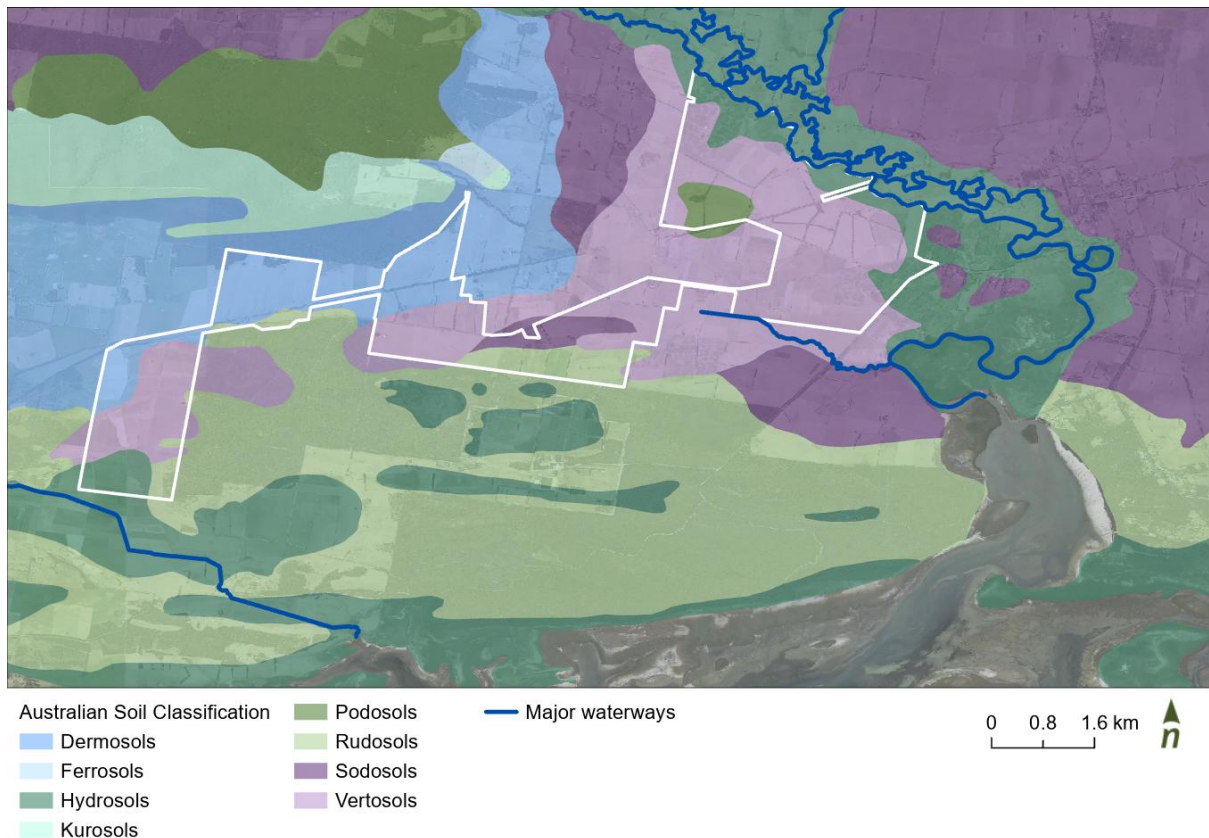
Soil pH screening results, undertaken by GHD (2024) and summarised in the contamination assessment completed by Accent Environmental (2024), indicate that ASS could be present in the natural soils from 0 mBGL to 2.0 mBGL across the Project Footprint. Accordingly, there is a low to moderate likelihood that construction activities associated with the project may disturb ASS, although the associated magnitude and risk of impact is considered low (refer to section 4).

Given the common nature of ASS in many coastal areas, management practices are widely available to ensure minimal impact to the environment should these soils be encountered. It is recommended that any construction and decommissioning works are carried out in accordance with Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils (the BPMG) (DSE 2010). Recommendations for respective management plans and procedures are provided in Section 6.



<sup>1</sup> Sodosols are dispersive by nature, and appropriate management measures will be included in a Soil and Water Management Plan and associated management procedures.

**Figure 6.** Location of mapped prospective acid sulphate soils within and around the Action Area in which the project is planned.



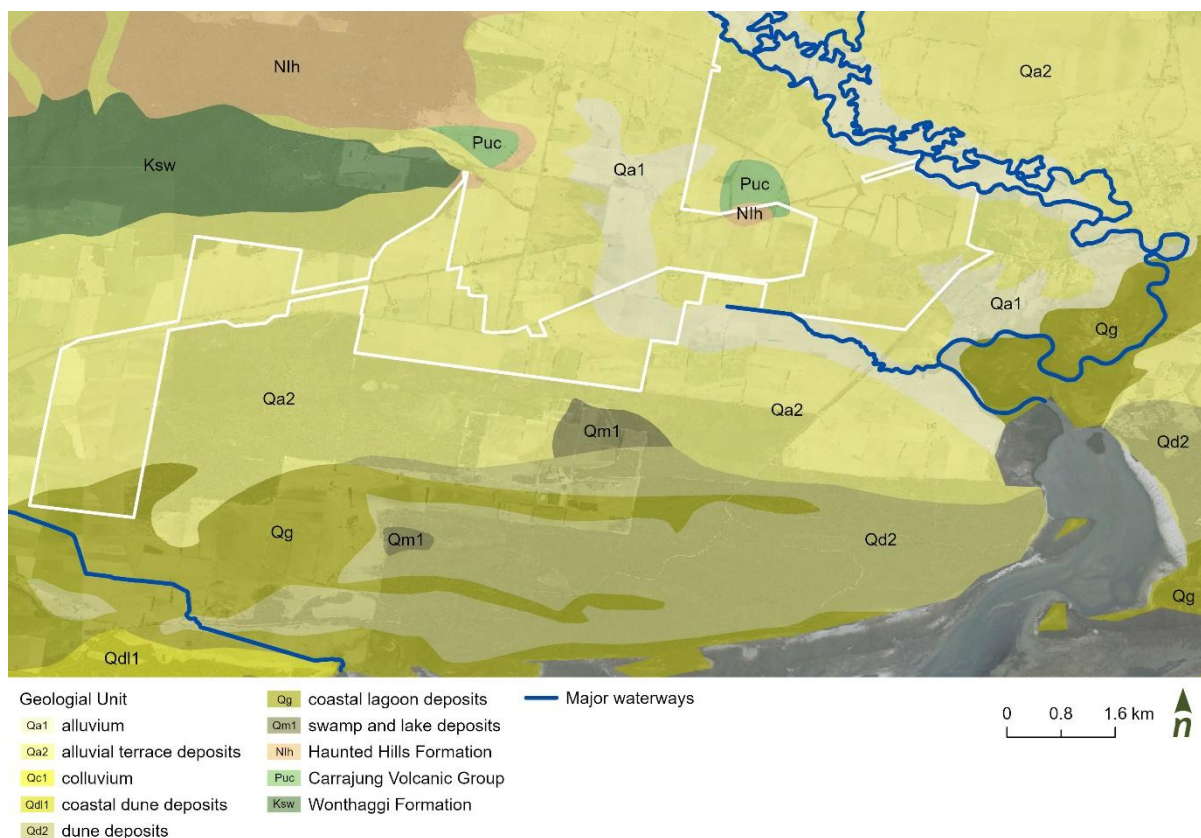
**Figure 7.** Soils according to the Australian Soil Classification system within and surrounding the Action Area in which the project is planned.

### Geology

The underlying geology within and around the Action Area in which the project is planned mainly consists of modern fluvial and coastal sediments (Figure 8). Pockets of older formations can be found outcropping in areas of higher elevation around the project site, including (Yates et al. 2015):

- the Pleistocene-aged Haunted Hills formation consisting of poorly sorted alluvium sediments
- the Early Paleogene-aged Carrajung Volcanic Group consisting of tuffs and basalts
- the Early Cretaceous-aged Wonthaggi Formation (part of the larger Strzelecki Group) consisting of fluvial sediments with reworked tuffaceous material.

These older formations are associated with kurosol, podosol and ferrosol soils found in the regions surrounding the Action Area in which the project is planned.



**Figure 8.** *Geology of Action Area in which the project is planned and surrounding area.*

### Land use

Land use within the Action Area in which the project is planned is currently used for mixed farming and grazing purposes with historical aerial imagery showing little change in land usage within the Action Area between 1965 – 2024. Whilst it is acknowledged that farming practices may have led to site contamination, if present these impacts would likely be relatively minor in nature and very localised in extent.

A site of potential contamination is a former Briquette Plant, which operated between 1934 and 1950. Little documentation exists regarding the operating practices at the time. As the plant operated at a time when there was little consideration of environmental matters, it is possible that the operation of the plant may have led to contamination of that site. However, the site is located outside of the Project Footprint, and it will not be altered by the proposed works during construction, operation or decommissioning of the project.

The Action Area and Project Footprint have no other known presence of contaminated land or historical land uses that could have created contaminant by-product.

Additional detail regarding historic land use and the potential for those land uses to have generated sources of contaminants can be found in Gelliondale Wind Farm and BESS contamination report (Accent Environmental, 2024).

## 2.3 Ramsar wetland

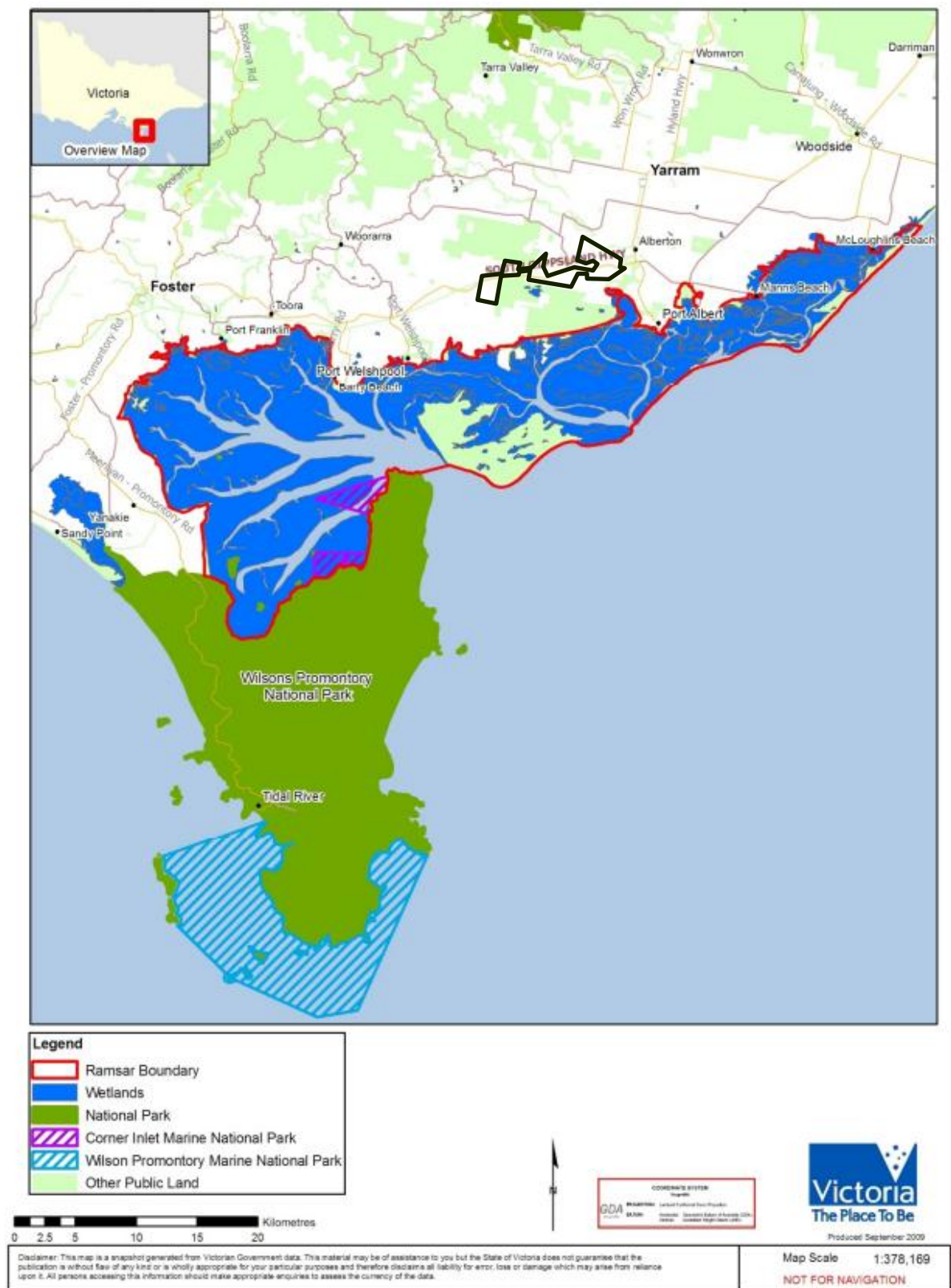
Corner Inlet is a large tide-dominated embayment consisting of a submerged plain covered by sand or mud flats with well-developed seagrass beds, and large sand islands. Deeper channels support efficient tidal exchange over the flats and the areas between islands. This large area supports a diversity of habitats which in turn support internationally significant populations of a number of aquatic and semi-aquatic species. The inlet has been listed as a Wetland of International Significance under the Ramsar Convention since 1982 (DSEWPC 2011).

The combined catchments that discharge into the Corner Inlet are approximately 2100 km<sup>2</sup> in size. These catchments are comprised of predominantly privately owned land and have largely been cleared of their native

vegetation for agricultural purposes (dairying and grazing) and, to a lesser extent, plantation forestry. The Albert-Jack River catchment is the largest compared to the other Corner Inlet sub-catchments and is silt-dominated with the highest mean annual flow. Rainfall and subsequent streamflow can be highly variable across the Corner Inlet catchment area over time; however, high stream flows from large rainfall events are relatively infrequent and short-lived. These high stream flow events can lead to large sediment and nutrient loads being delivered to the inlet and play an important role in the lifecycle of some species (e.g., fish migration) (DSEWPC 2011).

The main rivers draining into Corner Inlet are relatively short with small contributing catchments. Therefore, the rivers respond rapidly to high rainfall events, discharging large flows with high concentrations of nutrients and sediment loads into the inlet, which in turn can impact water quality (e.g., turbidity) in the inlet (DSEWPC 2011). A water quality assessment performed by South Gippsland Water in 2002 showed the main streams entering Corner Inlet, including the Albert River, exhibited moderate to good water quality. Smaller contributing streams, on the other hand, largely had poor water quality (South Gippsland Water 2002). However, the impact of the water quality of the inflowing streams on the water quality of the wider inlet has not been quantified. It is also important to note that tidal exchange and flushing are high in Corner Inlet, which likely helps reduce the risk of widespread water quality degradation across the inlet. Dryland agriculture contributes the greatest nutrient loads to the Corner Inlet across its entire catchment, with other nutrient sources coming from plantation forests and sewage treatment plants in the catchments (Water Technology 2008). A geomorphic assessment conducted by Alluvium in 2008 found approximately 10% of the Albert-Jack River catchment was used for forestry, and because the forestry plantations were located in the steep headwaters of the upper catchments with limited vegetated buffers, they had a high likelihood of producing significant volumes of hillslope runoff (Zavadil 2008). In addition to land use in the upper catchment, Alluvium found the greatest sediment source in the Albert-Jack River catchment was widescale channel incision in the mid catchment. Historically, an estimated 600,000 m<sup>3</sup> of fine-grained sediments have been generated by the Albert-Jack River catchment from channel incision, much of which is expected to have reached Corner Inlet (Zavadil 2008). The largest risk for future fine-grained sediment sources in the Albert-Jack River catchment was determined to be from potential future avulsion (channel abandonment and new channel formation) of the Jack River in the lower catchment (Zavadil 2008).

Modelling conducted by Water Technology in 2008 showed that the main streams discharging into Corner Inlet, including the Albert River, produce nutrient loads that are significant enough to influence nearby seagrass beds at their outlets in the inlet. However, direct linkages between fluvial water quality inputs and species impacts are unknown due to limited quantitative data in the inlet.



**Figure 9:** Location of the Corner Inlet Ramsar site in relation to the Action Area outlined in black (source: Corner Inlet Ramsar site Ecological Character Description (DSEWPC 2011)).

The site currently meets criteria 1, 2, 4, 5, 6 and 8 of the nine possible Ramsar criteria definitions. This was re-assessed and published in the Corner Inlet Ramsar Information Sheet with descriptions below in Table 3.

Table 3: Ramsar criteria met at Corner Inlet (adapted from Ramsar Site Information Sheet V. 1.6 4 February 2020) <https://rsis.ramsar.org/ris/261>

| Criterion | Criterion definition                                                 | Justification of the criterion at Corner Inlet                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------|----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1         | Representative, rare or unique natural or near-natural wetland types | <p>Corner Inlet plays a substantial hydrological role in the natural functioning of a major coastal system through its protection from oceanic swells providing habitat for wetland development, receiving and channelling the flow of rivers and creeks within the South Gippsland Basin. Corner inlet functions in a near natural way and contains good representatives of Ramsar Wetland types B (marine sub-tidal aquatic beds), G (intertidal mud, sand or sand flats), H (intertidal marshes) and I (intertidal forested wetlands).</p> <p>The site's intertidal mudflats are likely to represent the most extensive in the bioregion and the saltmarsh and mangrove habitats are in good condition. The site's Posidonia beds are among the largest in the bioregion.</p>                                                                                                                                                                                                                                                                                                                          |
| 2         | Rare species and threatened ecological communities                   | The Corner Inlet Ramsar Site supports seven species of threatened Palaeartic migratory waders and the hooded plover as well as the Australian Grayling.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 4         | Support during critical life cycle stage or in adverse conditions    | Over 35 waterbirds listed under international migratory agreements have been recorded within the Ramsar site. This number includes species that, in Australia, are residents (e.g. eastern great egret) and vagrant seabirds for which the site does not provide significant habitat (e.g. albatross species). There are 26 species of Palaeartic migratory shorebirds, 16 of which are regularly supported (in two thirds of seasons) by the Corner Inlet Ramsar Site. The extensive mudflats and intertidal marshes provide both feeding and high tide roost sites for these species. In addition, over 20 species of wetland dependent bird species have been recorded breeding within the site. The site is specifically important for beach-nesting species: Australian pied oystercatcher ( <i>Haematopus longirostris</i> ), Australian fairy tern ( <i>Sternula nereis nereis</i> ), Caspian tern ( <i>Hydroprogne caspia</i> ), crested tern ( <i>Thalasseus bergii</i> ) and hooded plover ( <i>Thinornis rubricollis</i> ). These species use the beaches and islands within the site annually |
| 5         | >20,000 waterbirds                                                   | Average annual maximum shorebird count = 31416 Counts of shorebirds have been consistently > 20,000 every year since 1981, except 2015, when total maximum shorebird count was 19,000 (data from BirdLife Australia). These counts do not include the substantial numbers of other waterbird species that are supported within the site. For example, between 1987 and 1992, when comprehensive counts of waterbirds were undertaken at the site, there were between 5000 and 10,000 non-wader species, including substantial numbers of black swan ( <i>Cygnus atratus</i> ) and chestnut teal ( <i>Anas castanea</i> ).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 6         | >1% waterbird population                                             | The recent review uses a standard baseline period (1981-1994) and has found that nine species met the criterion for this period and that eight species meet this criterion over the period 1981 to 2015 (DAWE 2020)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

|   |                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|---|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8 | Fish spawning grounds, etc | <p>Corner Inlet provides important habitats, feeding areas, dispersal and migratory pathways, and spawning sites for numerous fish species of direct and indirect fisheries significance. These fish have important fisheries resource values both within and external to the site. Important fisheries species commonly found within the Ramsar site are not found exclusively in any one habitat type during any part of their life cycle. Rather, these species have relatively plastic habitat requirements and are typically found in a variety of habitat types. Many species spend their juvenile stages in shallow protected waters, particularly around seagrass and mangroves, whereas most species tend to spawn in coastal and marine waters. Adults of most species tend to utilise a variety of habitats in the site. Corner Inlet is recognized as an important pupping area for school shark (<i>Galeorhinus galeus</i>). Dusky flathead (<i>Platycephalus fuscus</i>) and river garfish (<i>Hyporhamphus regularis</i>) spawn in estuaries near seagrass and/or shoals and black bream (<i>Acanthopagrus butcheri</i>) is thought to spawn in upper estuaries near the fresh and brackish water interface.</p> |
|---|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

The Ramsar criteria supported by the Ecological Character Descriptions for Corner Inlet are defined by Critical Components such as wetland mega-habitat types (seagrass, intertidal sand or mud flats, mangroves, saltmarshes and permanent shallow marine water), Critical Processes such as waterbird breeding, hydraulic and hydrological processes and Critical Services/Benefits such as supporting nationally important threatened fauna species, recreation and tourism values (Table 4).

Table 4: Summary of Critical Components, Processes and Services/Benefits of the Corner Inlet Ramsar Site (source: Corner Inlet Ramsar site Ecological Character Description (DSEWPC 2011))

| Critical Components                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Critical Processes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Critical Services/Benefits                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>C1.</b> Several key <b>wetland mega-habitat types</b> are present:</p> <ul style="list-style-type: none"> <li>• seagrass</li> <li>• intertidal sand or mud flats</li> <li>• mangroves</li> <li>• saltmarshes</li> <li>• permanent shallow marine water</li> </ul> <p><b>C2.</b> Abundance and diversity of <b>waterbirds</b></p>                                                                                                                                                                                                              | <p><b>P1.</b> <b>Waterbird breeding</b> is a key life history function in the context of maintaining the ecological character of the site, with important sites present on the sand barrier islands</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <p><b>S1.</b> The site supports <b>nationally threatened fauna species</b> including:</p> <ul style="list-style-type: none"> <li>• orange-bellied parrot</li> <li>• growling grass frog</li> <li>• fairy tern</li> <li>• Australian grayling</li> </ul> <p><b>S2.</b> The site supports <b>outstanding fish habitat values</b> that contribute to the health and sustainability of the bioregion</p> |
| Supporting Components                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Supporting Processes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Supporting Services/Benefits                                                                                                                                                                                                                                                                                                                                                                         |
| <p>Important <b>geomorphological features</b> that control habitat extent and types include:</p> <ul style="list-style-type: none"> <li>• sand barrier island and associated tidal delta system</li> <li>• the extensive tidal channel network</li> <li>• mudflats and sandflats.</li> </ul> <p><b>Invertebrate megafauna</b> in seagrass beds and subtidal channels are important elements of biodiversity and control a range of ecosystem functions.</p> <p>The <b>diverse fish communities</b> underpin the biodiversity values of the site</p> | <p><b>Climate</b>, particularly patterns in temperature and rainfall, control a range of physical processes and ecosystem functions</p> <p>Important <b>hydraulic and hydrological processes</b> that support the ecological character of the site includes:</p> <ul style="list-style-type: none"> <li>• Fluvial hydrology. Patterns of inundation and freshwater flows to wetland systems</li> <li>• Physical coastal processes. Hydrodynamic controls and marine inflows that affect habitats through tides, currents, wind, erosion and accretion.</li> <li>• Groundwater. For those wetlands influenced by groundwater interaction, the level of the groundwater table and groundwater quality.</li> </ul> <p><b>Water quality</b> underpins aquatic ecosystem values within wetland habitats. The key water quality parameters for the site are salinity, turbidity, dissolved oxygen and nutrients</p> <p>Important <b>biological processes</b> include nutrient cycling and food webs.</p> | <p>The site supports <b>recreation and tourism values</b> (scenic values, boating, recreational fishing, camping, etc.) that have important flow-on economic effects for the region.</p> <p>The site provides a range of values important for <b>scientific research</b>, including a valuable reference site for future monitoring.</p>                                                             |

### 3 Risk event definition

The proposed changes in land use within the Project Footprint have the potential to modify the **susceptibility** of the project area to runoff, erosion and mobilization of contaminants and the **connectivity** between areas where runoff, sediment and contaminants are generated and the waterways that feed the Ramsar wetland.

The following events have been identified as potential overarching risks that may be encountered as a result of construction, operation and decommissioning activities for the Gelliondale Wind Farm. Within these events sit specific impact pathways which describe the specific hydrologic, geomorphic, and ecological mechanisms or processes by which changes to the Project Footprint may translate into impacts on receiving waterways and the Corner Inlet Ramsar site. These specific impact pathways are described in section 3.1 below and can be summarised as follows<sup>2</sup>.

- **Altered flow regime** due to an increase in impervious land cover in the Project Footprint. This may lead to an increase in the magnitude or frequency of runoff from the Action Area in which the project is planned to Corner Inlet wetland and/or surrounding waterways (including Jack and Albert Rivers and Nine Mile Creek)
- **Altered sediment delivery regime** to surrounding waterways (including Jack and Albert Rivers, and Nine Mile Creek) and/or Corner Inlet wetland due to the disturbance and/or exposure of soils or material stockpiles (temporary, mostly confined to construction and decommissioning phases), unsealed farm roads (temporary, mostly confined to construction phase) and all-weather access roads (ongoing, applicable to all project phases).
- **Mobilisation and delivery of contaminated material** (such as acid sulphate soils or contaminated soils due to historic land use) to surrounding waterways (including Jack and Albert Rivers, and Nine Mile Creek) and/or Corner Inlet wetland due to land disturbance as a result of construction or maintenance works during operation.

#### Consideration of project phases

Changes in susceptibility and connectivity predominantly occur during the construction and decommissioning phases where modifications to land are greatest (e.g. transport of material, construction, upgrades or decommissioning of temporary and/or permanent structures, construction, upgrade or closure of roads).

Changes may also occur during the operational phase once construction is complete (e.g., vehicle tracking for maintenance and maintenance works). However, potential impacts during operation are considered minor in comparison to construction and decommissioning works. The access roads are built to a higher standard than usual farm tracks to retain all-weather access. The roads will be routinely used for all maintenance activities and are expected to be also used by the landowners and will be maintained to preserve trafficability.

Accordingly, the construction and decommissioning phases have primarily been considered within this assessment.

### 3.1 Specific impact pathways

#### Altered flow regimes

The development of the Gelliondale Wind Farm will increase impervious<sup>3</sup> areas within the Project Footprint through the construction of access tracks, crane pads, construction laydown areas, foundations and other hardstand areas, and other project structures (Refer to Figure 2 for proposed changes). An increase in impervious area will increase run off during storm events, which leads to an increase in the magnitude and frequency of flows discharged into receiving environments. This increase in runoff from the Project Footprint

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<sup>2</sup> Note, this assessment report is specifically focused on surface water contamination.

<sup>3</sup> In this context impervious refers to both sealed areas that are 100% impervious and disturbed compacted soil that have much greater imperviousness than existing, undisturbed soils.

and Action Area in which the project is planned could lead to the following hydrologic changes in receiving waterways and wetlands:

- Increase in peak flows entering waterways during storm events or increasing the frequency of flows of a nominated Annual Exceedance Probability (AEP).
- Increase in total annual volume of runoff entering waterways and the Ramsar wetland.

The above changes in runoff patterns have the potential to trigger the following secondary impacts:

- Increased erosion of the bed and banks of waterways resulting in loss of in-stream habitat.
- Change in quantity or quality of instream, riparian or wetland habitat.
- Changes to salinity within receiving waterways and wetland affecting flora and fauna habitat

Impact pathway related to altered flow regimes relate to PER objectives:

- 6.1b
- 7.3 b
- 7.3 c
- 8.1

#### **Altered sediment delivery regime**

Installation and/or upgrade of roads, construction areas, project structures and temporary material stockpiles will increase the area of exposed sediment within the Project Footprint (refer to Figure 2 for proposed changes). These newly exposed areas of soil have the potential to be scoured by runoff and then transported to receiving environments. Much of the sediment that is exposed will be fines (silts and clays) which are transported in suspension. Coarser material (sand sized sediment and larger) is less readily transported via overland flow and is more readily deposited in receiving environments (and hence has a limited impact on water quality). The impacts of increased fine sediment delivery include:

- Increase in sediment laden runoff entering waterways during storm events.
- An increase in the total annual volume of sediment entering waterways and the Ramsar wetland.
- Increased sediment deposition within receiving waterways resulting in loss of stream habitat.
- Change in the quantity or quality of habitat as a result of increased deposition or turbidity.

Impact pathway related to altered sediment delivery regimes relate to PER objectives:

- 7.1
- 7.3 b
- 7.3 c
- 8.1

#### **Mobilisation and delivery of contaminated material**

Development of the Gelliondale Wind Farm is expected to temporarily disturb land to facilitate the construction of all-weather access roads, crane pads and construction laydown areas, foundations and other hardstand areas and other project structures (refer to Figure 2 for proposed changes). Works may lead to physical disturbance of contaminated sediment (e.g. disturbance of acid sulphate soils and/or localised contaminated soils as a result of historical farming practises). The impact pathway for disturbance of contaminated sediment is identical to that of other sediment exposed as a result of construction activities with delivery of contaminated material to receiving waterways or the Ramsar wetland having the potential to alter water chemistry and water quality, leading to adverse effects on flora and fauna. The likelihood of this type of mobilisation and delivery of contaminated material is expected to be low with appropriate construction management measures in place.

Works may also lead to in-situ contamination (e.g. chemical spill, fuel leakage) which may occur in a more localised fashion but have the potential to alter water chemistry and water quality within receiving waterways or the Ramsar wetland, leading to adverse effects on flora and fauna. Impacts and delivery of this type of contamination depends on a range of parameters (such as density and amount of material, type and amount of

vegetation within waterway). The likelihood of this type of mobilisation and delivery of contaminated material is expected to be low with appropriate management measures in place.

Impact pathway related to mobilisation and delivery of contaminated material relate to PER objectives

- 7.3 a
- 7.3 b
- 7.3 c
- 8.1

## 4 Risk and impact assessment

### 4.1 Risk and impact assessment methodology

The qualitative risk assessment methodology outlined in Environmental Management Plan Guidelines (DCCEEW, 2024) has been used to determine the likelihood, consequence of risks associated with construction of the Gelliondale Wind Farm. Descriptions of likelihood and consequence rating scales are provided in Table 5 and Table 6, respectively.

Also, the expected scale of the risk event has been described in terms of the expected change in hydrology and sediment delivery. The expected scale of change is described to contextualise the risk event and to further assess the significance and extent of potential impacts, i.e. in the case that the risk event materialises.

Combinations of both consequence and likelihood have been used to provide a risk rating (Table 7). The risk rating has been used to screen and determine high risks, their potential impacts and their appropriate management measures.

**Table 5:** *Risk likelihood (extracted from DCCEEW, 2024)*

| Qualitative measure of likelihood | How likely is it that this event/issue will occur  |
|-----------------------------------|----------------------------------------------------|
| Highly likely                     | Is expected to occur in most circumstances         |
| Likely                            | Will probably occur during the life of the project |
| Possible                          | Might occur during the life of the project         |
| Unlikely                          | Could occur but considered unlikely or doubtful    |
| Rare                              | May occur in exceptional circumstances             |

**Table 6:** *Risk Consequence (extracted from DCCEEW, 2024)*

| Qualitative measure of consequences | What will be the consequence/result if this issue does occur rating                                      |
|-------------------------------------|----------------------------------------------------------------------------------------------------------|
| Minor                               | Minor incident of environmental damage that can be reversed                                              |
| Moderate                            | Isolated but substantial instances of environmental damage that could be reversed with intensive efforts |
| High                                | Substantial instances of environmental damage that could be reversed with intensive efforts              |
| Major                               | Major loss of environmental amenity and real danger of continuing                                        |
| Critical                            | Severe widespread loss of environmental amenity and irrecoverable environmental damage                   |

The qualitative assessment of the expected significance and extent of potential impacts is included in Table 10 and Table 11. A significance assessment of the identified potential impacts against the Significant Impact Guidelines 1.1 (DCCEEW, 2013) was carried out in Table 13.

**Table 7: Risk Rating (extracted from DCCEEW, 2024)**

| Likelihood    | Consequence |          |        |        |          |
|---------------|-------------|----------|--------|--------|----------|
|               | Minor       | Moderate | High   | Major  | Critical |
| Highly Likely | Medium      | High     | High   | Severe | Severe   |
| Likely        | Low         | Medium   | High   | High   | Severe   |
| Possible      | Low         | Medium   | Medium | High   | Severe   |
| Unlikely      | Low         | Low      | Medium | High   | High     |
| Rare          | Low         | Low      | Low    | Medium | High     |

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## 4.2 Assessment to understand likelihood and potential impacts

Hydrological and hydraulic desktop assessments were completed by Alluvium to understand the likelihood of impact pathways prior to any mitigation measures. Summary of likelihood ratings assigned to each risk event, and the expected magnitude of that risk event can be found in Table 10. An overview of our desktop analysis used to arrive at those likelihood ratings is outlined below.

### Hydrological assessment

Our qualitative hydrologic assessment considered the absolute and relative change in impervious land cover resulting from The Project, as this is proportional to the magnitude of the increase in runoff from the site.

The Action Area in which the project is planned is approximately 1622 Ha and makes up approximately 2.4% of the total Corner Inlet Wetland catchment area (67,193 Ha)<sup>4</sup>. The development of Gelliondale Wind Farm is expected to increase impervious area within the Project Footprint by approximately 19.3 Ha. This change in impervious cover is a 1.2% increase within the Action Area in which the project is planned and only 0.03% increase in the total impervious area of the Corner Inlet Wetland catchment. This increase in impervious area comprises of construction of access roads (0.3% increase based on 5m road width), construction of crane pads (0.3% increase), construction of operation and maintenance areas (0.5% increase), construction of Substation and BESS (0.1% increase). Location of these structures are found in Figure 2.

Estimated peak surface run off discharge within the project site was compared with both the pre-development and development case using the rational method equation and following design parameters case (refer to Table 8).

- Site area =1622 Ha
- Mean annual rainfall (based on rainfall station 85151 located at Yarram Airport)<sup>5</sup> = 631.5 mm/year
- Fraction impervious co-efficient of 0.8 (for impervious areas) and 0.2 (pervious areas)

**Table 8: Estimated peak surface runoff discharge within project site**

|                          |                                            |
|--------------------------|--------------------------------------------|
| Pre-developed (baseline) | Developed (with increased impervious area) |
|--------------------------|--------------------------------------------|

<sup>4</sup> DEPI (2013) Corner Inlet Ramsar Site Boundary Description Technical Report. Department of Environment and Primary Industries, East Melbourne, Victoria.

<sup>5</sup> BOM rainfall update (<http://www.bom.gov.au/climate/rainfall/>). Accessed November 2024

|            |            |
|------------|------------|
| 0.064 m3/s | 0.066 m3/s |
|------------|------------|

Construction of the Gelliondale Wind Farm is not expected to greatly impact the baseline surface flow patterns of the project site and the greater wetland catchment itself. These relatively small changes in impervious surface cover indicate the surface hydrology of the site and the wider Ramsar wetland will be minimally impacted.

### Hydraulic assessment

A TUFLOW hydraulic model has been developed to map overland flow paths that may link disturbed areas within the site to existing waterways that feed runoff to the surrounding rivers and the Ramsar wetland. Three rainfall annual exceedance probability (AEP) events were selected for modelling. The three events were chosen to capture events that range between relatively frequent events through to larger, less frequent events. The events modelled are listed below:

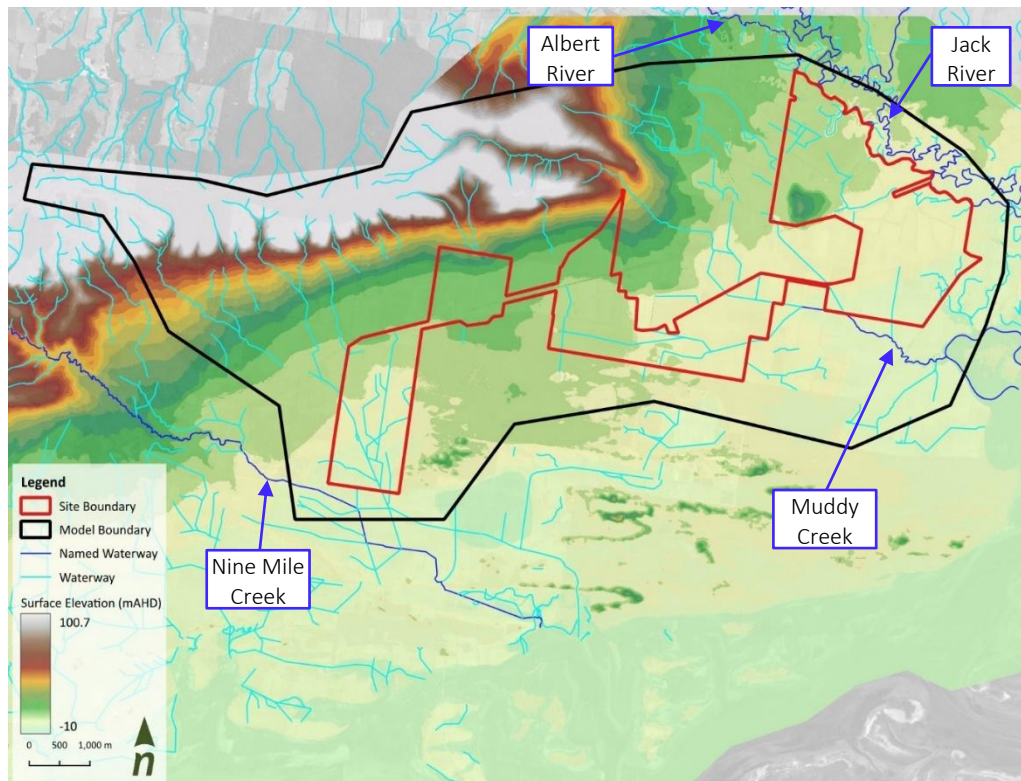
1. 2EY (86% AEP). This rainfall event can be expected to occur on average twice per year and captures more frequent events.
2. 50% AEP was chosen as a middle ground event as it has a 50% chance of occurring in any given year or can be expected to occur once every five years on average.
3. 20% AEP event was selected as a larger, rarer event, as it has a 20% chance of occurrence in any given year or can be expected, on average, to occur once every two years. The 20% AEP event is believed to be the upper limit or most extreme event that is still reasonably likely to occur during a migratory period..

A 2-Dimensional (2D) TUFLOW hydraulic model was built to determine the extent, depth and duration of inundation within the study area arising from each of the modelled rainfall events (Figure 10). A direct rainfall modelling approach utilising rainfall hyetographs has been applied directly to the model grid within the contributing catchment. It should be noted that the hydrologic and hydraulic models developed for this study focus on the surface water flooding within the site shown in Figure 10. Thus riverine flooding from the nearby Jack and Albert Rivers, and Nine Mile Creek have been excluded.

An assessment was carried out to understand how the extent, depth and duration of inundation within the study area may be impacted by the proposed project construction. This assessment is not a complete flood study, and the modelling results presented here are not suitable for design purposes. The intent of the modelling presented herein is to estimate the extent to which rainfall runoff (rather than flow spilling from the larger rivers to the east and southwest of the site) ponds at the site during the 2EY, 50% AEP and 20% AEP events.

The following data has been supplied and used in the development of the hydraulic model:

- 1m LiDAR with 0.10 m vertical accuracy. LiDAR capture was completed on 9 March 2024, and the data was provided by the project applicant.
- Land use data accessed from Victorian Land Use Information System 2016.
- Proposed infrastructure GIS information provided by the project applicant.

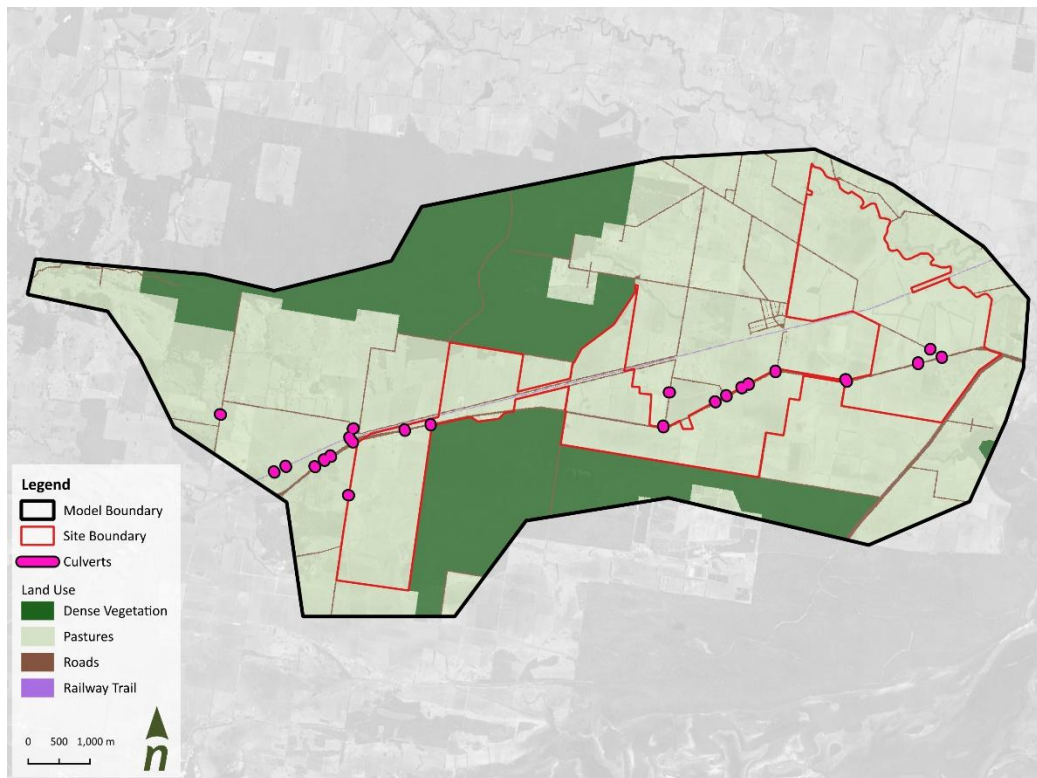


**Figure 10:** Hydraulic modelling study area

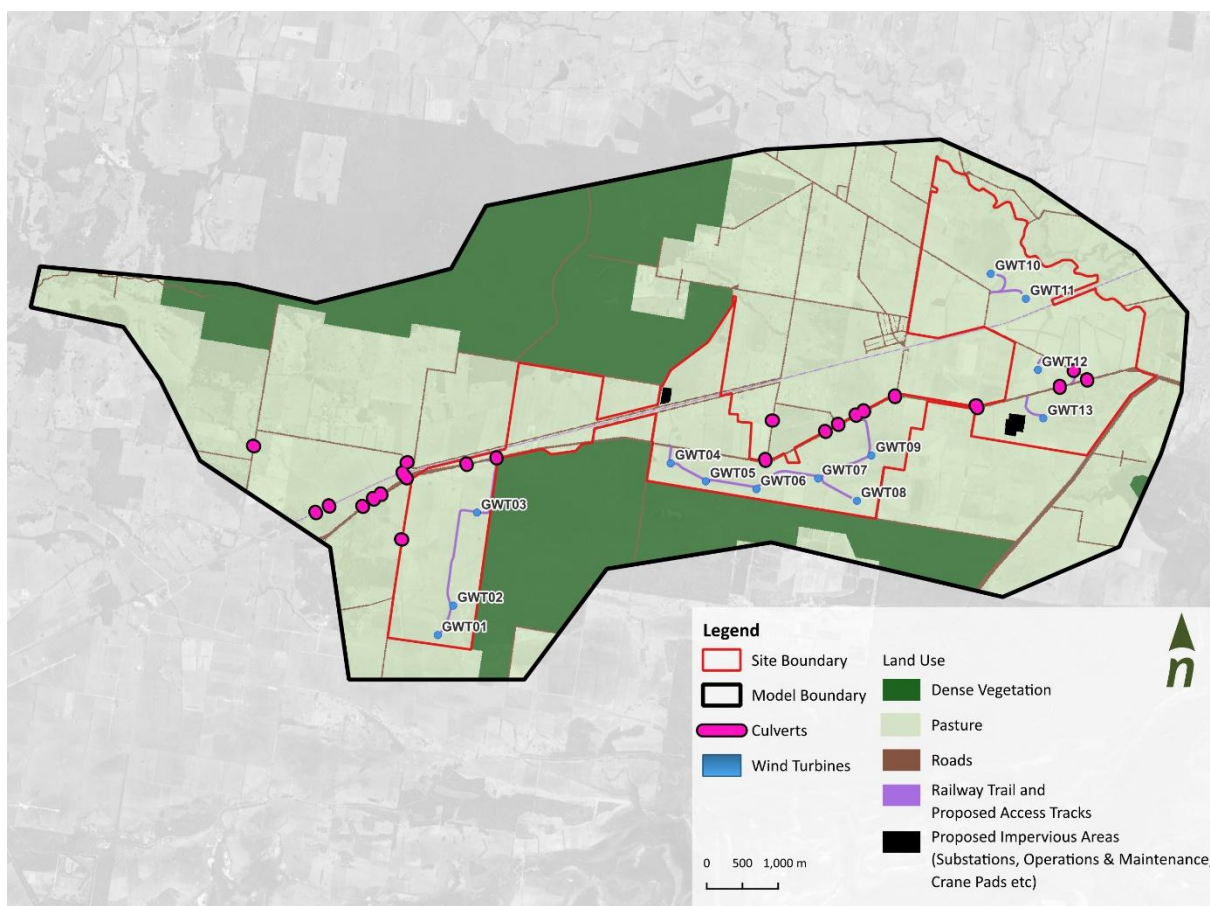
An 8 m grid cell resolution was adopted and is considered appropriate for the purposes of this study as it is a large catchment area, and therefore, this grid cell size allows a balance between providing enough topographic detail and keeping the model run times manageable. If the grid cell size was reduced, more of the topographic detail would be picked up from the LiDAR, however the model run times would be increased significantly. Given the nature of this assessment, an 8m grid was considered to provide adequate detail on the catchment topography. No calibration has been undertaken due to a lack of historical flow and level data which would be required to undertake a model calibration or validation at the site.

A baseline model scenario was developed which adopts current catchment land use and topographic conditions (Figure 11). From a review of the topographic information and initial modelling results, it was evident that there were many locations where culverts needed to be included within the model to allow flow to pass under roads and access tracks. Without these culverts within the model, water was ponding in a lot of locations that, in reality, it wouldn't as the culverts under roads allow the water to flow from one area to another. Aerial imagery was reviewed to confirm the locations of culverts, and where culverts were identified, topographic information was utilised to make assumptions about the size and invert levels of these culverts. Figure 11 shows the location of each of these culverts and the existing conditions model setup.

A developed scenario model was then configured, adopting the proposed development envelopes provided by Synergy Wind, which outlines the extent of the proposed wind turbines, substation, BESS, access tracks and other project infrastructure to enable a comparison with the existing results (Figure 12). The proposed works were incorporated into the model through changes to Manning's 'n' and imperviousness. It was also assumed that the wind turbines would be located on a platform and therefore where the turbines are proposed, ground levels have been raised 300mm to ensure the potential diversion of flow around the turbines is captured in the developed conditions model. For the purposes of this modelling, it was assumed that the proposed access tracks would remain at the existing ground elevation. The impact of raising access tracks on flood hazard within and off the project site are typically addressed in the detailed design phase. The purpose here is to understand the broad scale changes in runoff and sediment delivery potential, not to undertake a detailed flood hazard assessment- which is addressed in other assessment reports supporting the planning application of this project.



**Figure 11:** Existing condition hydraulic model set up



**Figure 12:** *Proposed condition hydraulic model set up*

### **Critical Storm Durations**

The critical duration of each design event is defined as the duration that results in the highest median peak flow rate of the associated temporal pattern ensembles. Overall, 270 different TUFLOW simulations were run to establish the critical duration under baseline conditions (9 storm durations and 10 temporal patterns for 3 AEPs). The critical duration for each modelled AEP is:

- 02EY: 360 minutes, TP04
- 50% AEP: 540 minutes, TP01
- 20% AEP: 540 minutes, TP09

The same critical durations and temporal patterns were run for developed conditions to enable a direct comparison in flood levels and estimate any impacts on flood levels.

### **Losses**

Losses from the ARR2019 Data Hub have been adopted for this assessment. The losses applied in each AEP and duration combination also consider the storm duration (initial losses interpolate to 0 for durations under 1 hour) and the preburst rainfall depth is considered as well. This assessment has adopted the 75<sup>th</sup> percentile preburst as per the ARR2019 Data Hub guidance for Loss Zone 3 in Victoria<sup>6</sup>.

### **Flood Impact Assessment**

Generally, there are two potential mechanisms by which development within the study area could have an impact on flood risk.

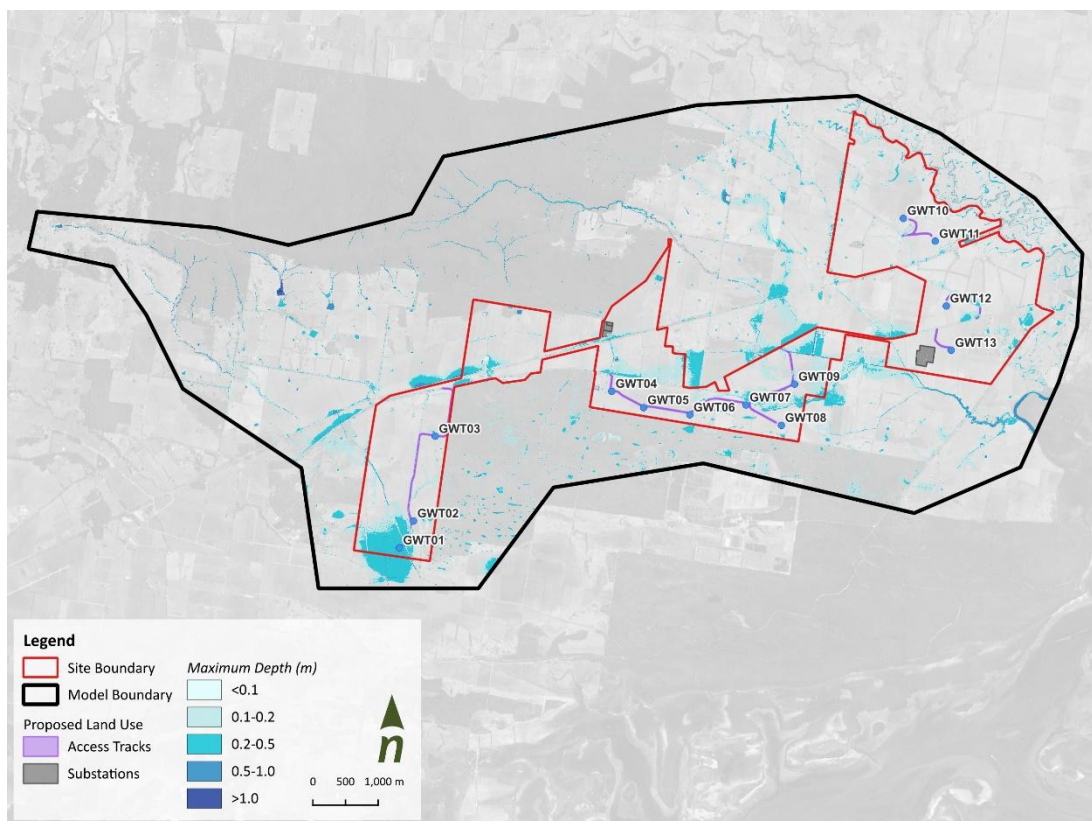
<sup>6</sup> ARR Loss Regions within Victoria. <http://www.arrlossregionmap.com.s3-website-ap-southeast-2.amazonaws.com/>

- Impacts on flood levels due to the proposed development obstructing flows, OR
- Impacts on flood levels due to the study area yielding additional runoff due to development.

The wind turbines on the site are not anticipated to significantly increase catchment imperviousness. Typically, the only increases are due to impermeable areas due to development such as access tracks, site buildings and site infrastructure on pads (substations, BESS etc).

The developed case scenario was configured in the 2D model with adjusted hydraulic roughness within the project footprint (the area that will be disturbed) representing the wind turbines and site infrastructure. The new roads, site buildings and site infrastructure have also had their land use updated to reflect their fully impervious land use.

Figure 13 to Figure 18 demonstrate that there is generally negligible change in flood levels and extent as a result of the proposed development. There is some localised increase in water levels due to the proposed substations, but this impact is only seen within the immediate vicinity of those structures. Figure 17 and Figure 18 demonstrate that the ponding duration for the 20% AEP and 2EY events for the proposed development. There is negligible change in ponding durations between the existing and design conditions.



**Figure 13:** 20% AEP Maximum Flood Depth (m) – Developed Conditions

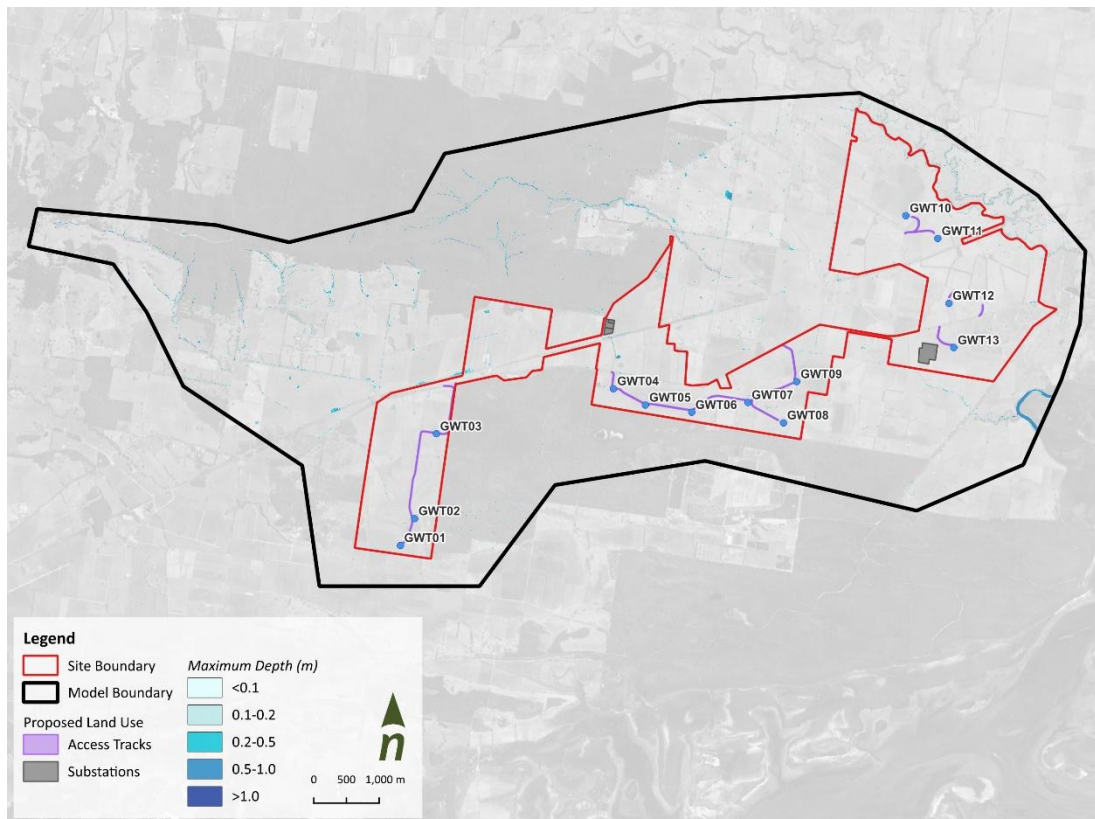


Figure 14: 2 EY Maximum Flood Depth (m) – Developed Conditions

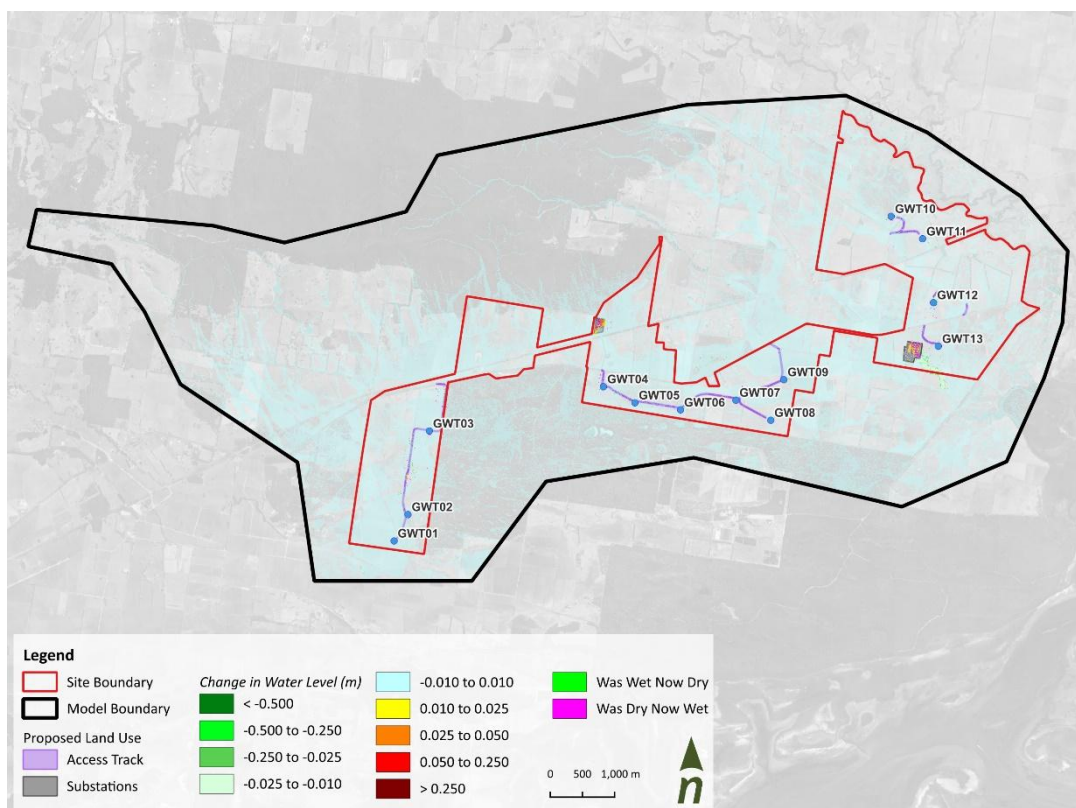


Figure 15: 20% AEP Afflux Map

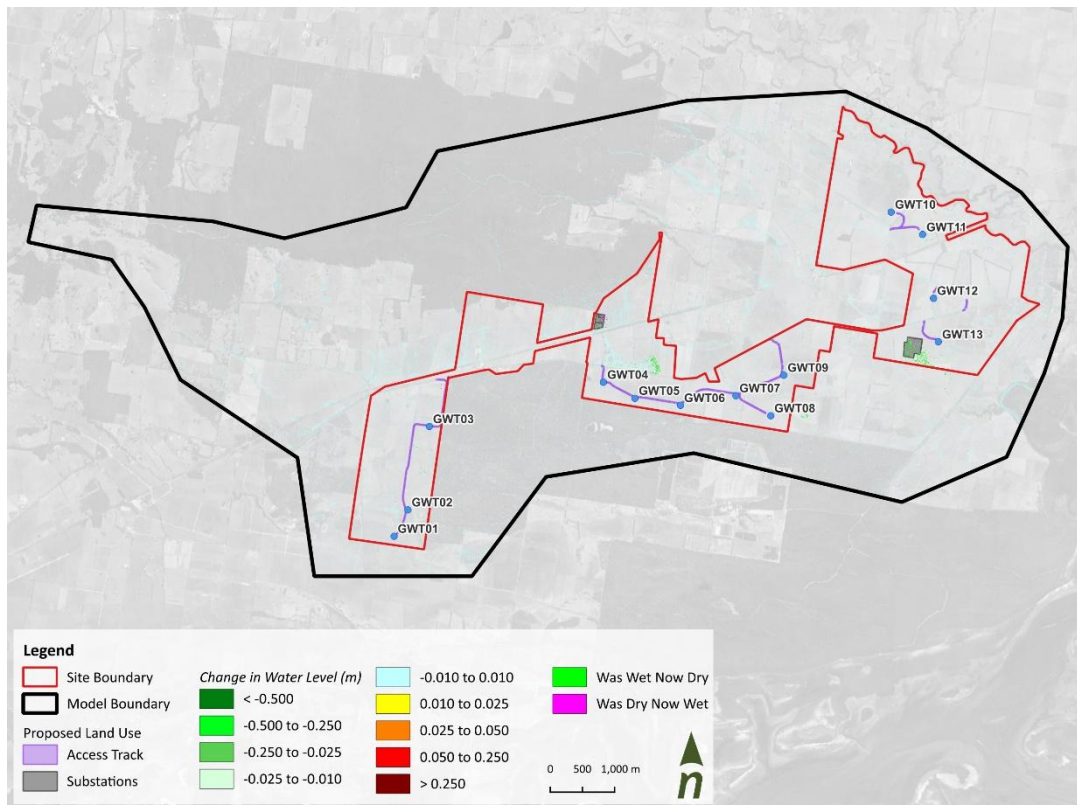


Figure 16: 2 EY AEP Afflux Map

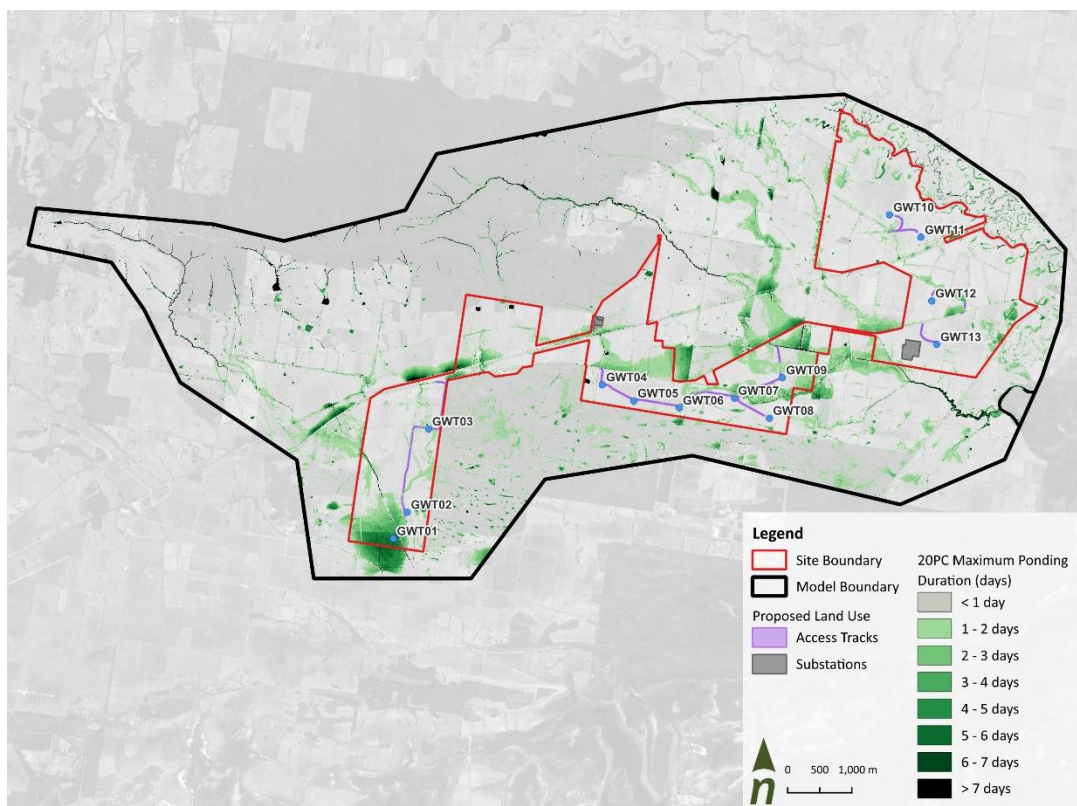
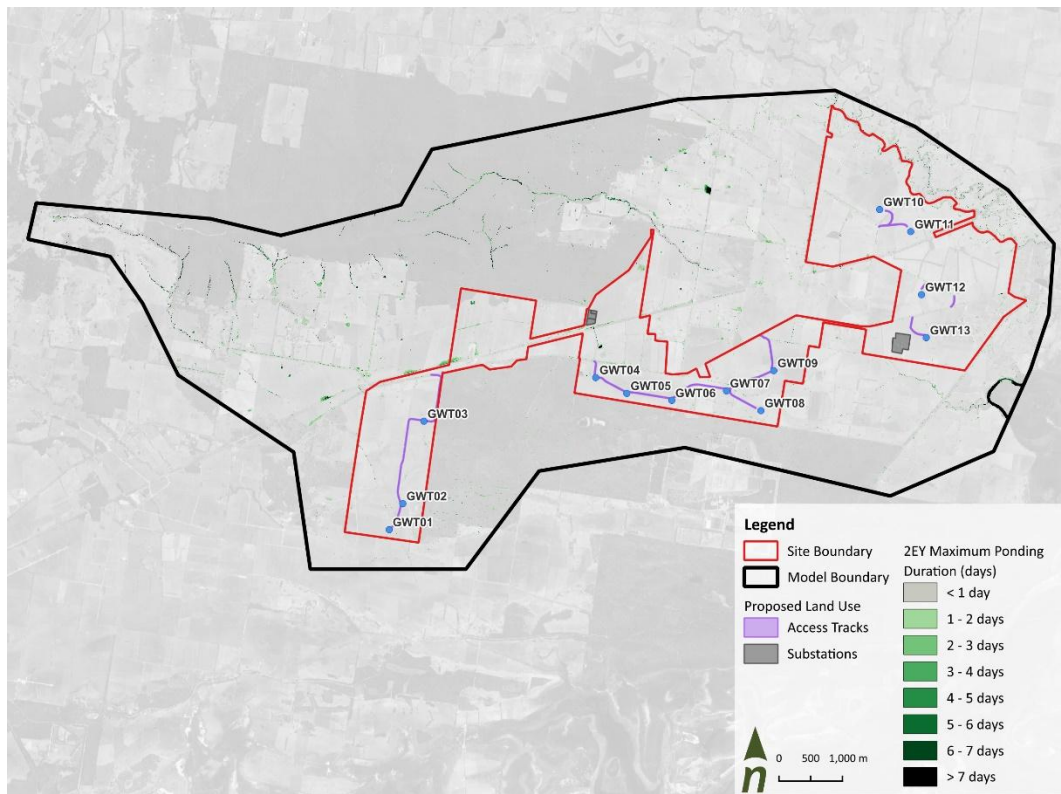


Figure 17: 20% AEP Maximum Ponding Duration – Developed Conditions



**Figure 18:** 2 EY Maximum Ponding Duration – Developed Conditions

### Hydrology inputs

For this study a direct-rainfall (or rain-on-grid) approach has been adopted to apply inflows to the hydraulic model. With this approach, rainfall is applied directly to the Digital Elevation Model (DEM) of the entire catchment area which is inclusive of the study area.

For this assessment, the 2EY (86%), 50% and 20% AEP events were modelled. To determine the storm durations which were critical to the site, a wide range of durations were simulated. For this study storm durations ranging from 90 minutes to 24 hours have been run.

The Australian Rainfall & Runoff (ARR) 2019 guidelines contain the currently adopted methods for hydrologic flow estimation including updates to rainfall intensities, rainfall losses and temporal patterns. Part of this approach is to use an ensemble of temporal patterns (ten patterns for each storm duration) to allow for the conveyance and storage characteristics of the catchment to be represented.

### Sediment erosion and delivery analysis

Distances between new unsealed access tracks to existing waterways and locations of tracks crossing existing waterways were extracted to assess the degree of hydrologic connectivity between potential sediment sources and waterways that would transport mobilised sediment to the Ramsar wetland. Receiving waterways were split into major waterways (included Muddy Creek, Nine Mile Creek and the Albert River) and minor waterways (which include swales and small farm drains that cross the site and feed the major waterways). The proposed access tracks were further split into separate segments (13 segments in total labelled 'A-M' in **Error! Reference source not found.**). Desktop assessment found these tracks crossed minor waterways at 13 locations (labelled '1-13' in **Error! Reference source not found.**), providing a potential entrance point for sediment into receiving waterways. The distances between each access track segment and the closest minor and major waterways can be found in **Error! Reference source not found.**.

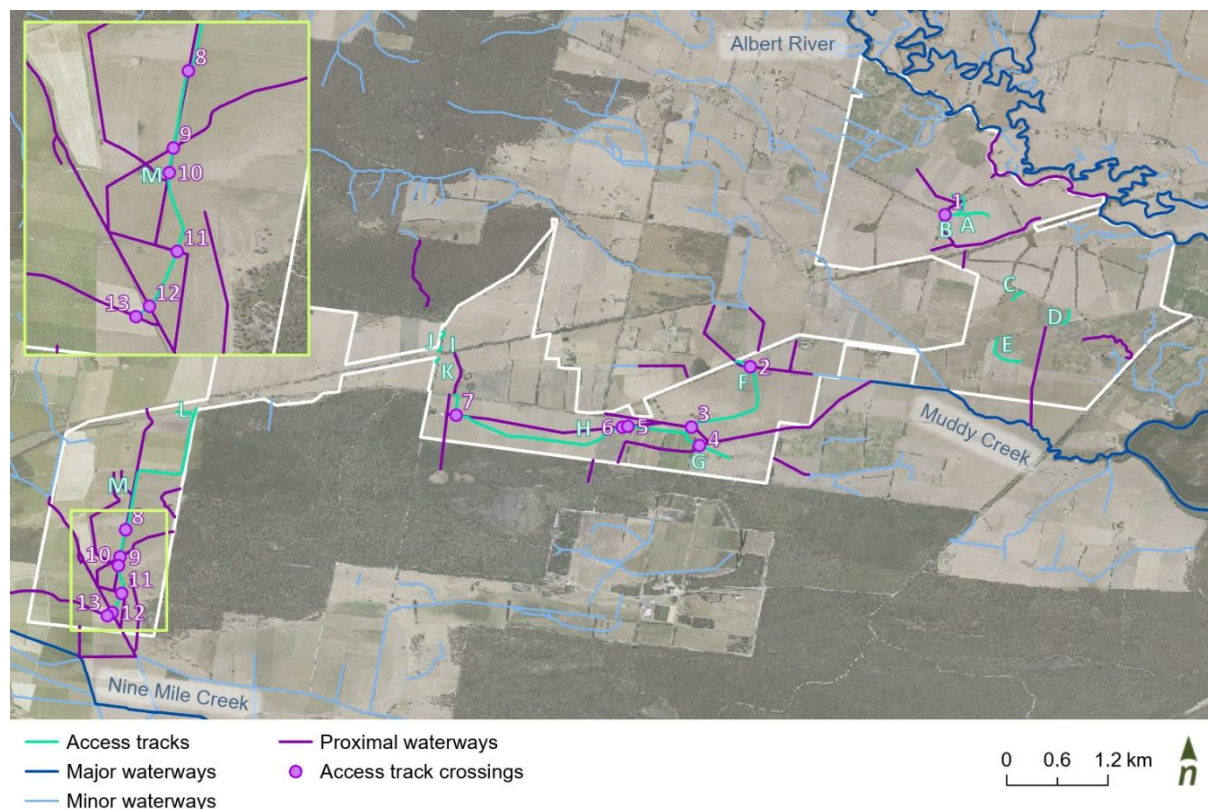
The degree of hydrologic connection between sediment sources and minor and major waterways varies across the sites, and with the size of rain event considered. Coarse sediment mobilised is likely to be re-deposited in the shallow swales that cross the site. Even if coarse sediment (i.e. sand) is delivered to receiving waterways,

the low volumes are dwarfed by the volume of sand being transported by the larger rivers that feed the Corner Inlet wetland. Fine sediment mobilised and delivered to waterways is easily transported and will quickly be transported to the Ramsar wetland. Therefore, the main sediment delivery risk associated with development is the delivery of fine (silt and clay) sized sediments in quantities that are orders of magnitude lower than the natural delivery rates of the receiving waterways.

In addition to the consideration of hydrologic connectivity described above, the susceptibility of existing flow paths to scour by runoff was assessed by comparing the shear resistance of waterway bed and banks and the shear stress applied by runoff. The units of shear resistance and shear stress are  $\text{N/m}^2$ . Scour can be expected when the shear stress generated by runoff exceeds shear resistance of the underlying material. Maximum bed shear stress and flow velocity values were extracted for the entire modelled area for each AEP event modelled.

Flow velocities (for the developed conditions) of both major and minor waterways within the Action Area in which the project is planned area were low indicating low potential for scour and low rates of sediment transport (**Error! Reference source not found.**). The mobilisation of fine sediment in excess of baseload conditions are not expected due to this low velocity as sediment will drop out and settle prior to reaching the Ramsar wetland. The change in bed shear stress (BSS) generated by the new infrastructure associated with the Project was negligible. The modelled BSS along runoff paths within the Project site (for the developed conditions) was between  $10 - 20 \text{ N/m}^2$  (**Error! Reference source not found.**). This magnitude of shear stress is below that required to scour established and healthy pasture grasses (which have a shear stress threshold between  $34 - 45 \text{ N/m}^2$  (DEECA, 2024)). Therefore, scour of sediment from minor waterways and the much smaller overland flow paths that feed them is unlikely.

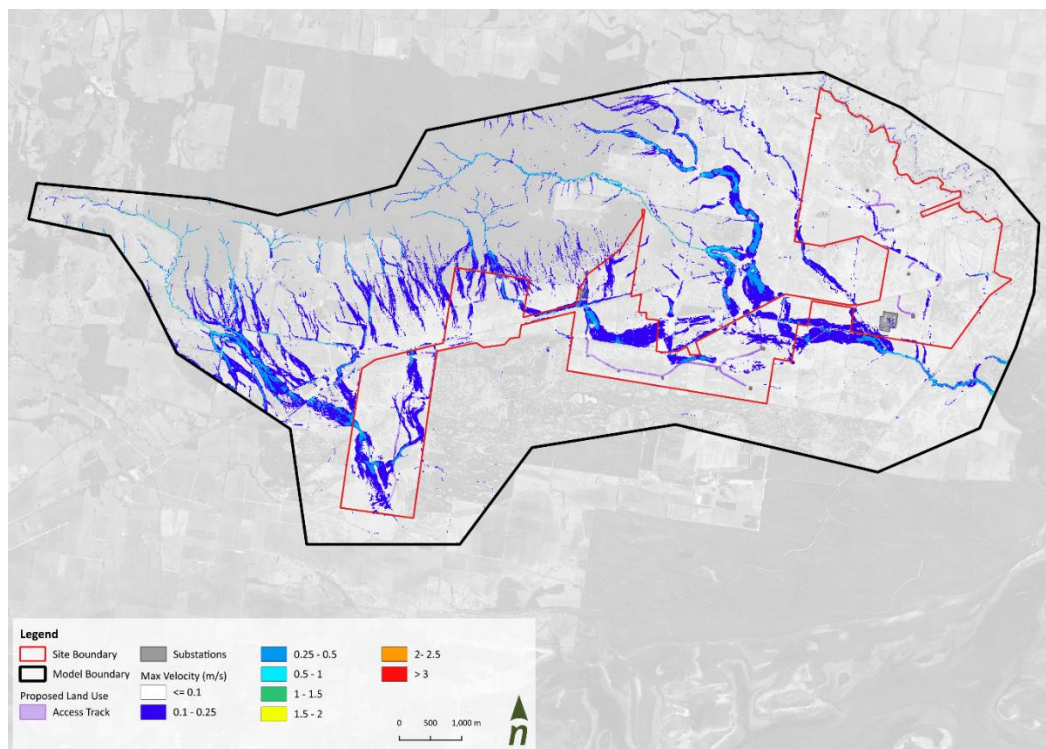
Some localised sediment run off and subsequent transport to existing minor and then major waterways is likely given the nature of construction works. However, the total area of freshly exposed soil that is susceptible to scour by runoff is limited and represents a small increase over and above that already exposed within the wider Ramsar wetland catchment. Further, the natural variability in sediment exposure and delivery to waterways is likely to be greater than that induced by the Project. A single debris flow in the upper, forested section of the catchment above the Project site or a bank erosion event in one of the major waterways would deliver (at least) an order magnitude more sediment to the major waterways and the Ramsar wetland than the material liberated from access roads and construction pads within the project site.



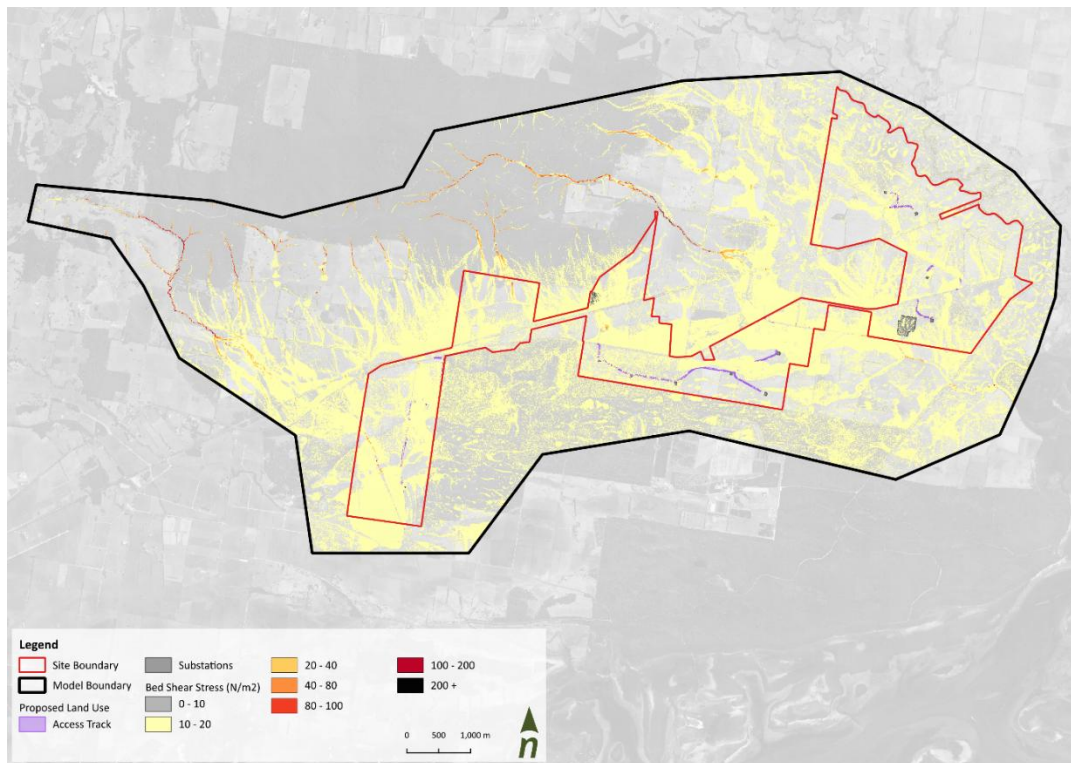
**Figure 19.** Locations where access tracks will cross existing waterways within the project site and waterways within 500 m of an access track.

**Table 9:** Summary of access tracks crossing existing waterways

| Access track segment | Number of waterway crossings along access track segment | Distance to closest minor waterway (m) | Distance to closest major waterway (m) | Closest major waterway | Distance to junction point between major waterway and Corner Inlet wetland (m) |
|----------------------|---------------------------------------------------------|----------------------------------------|----------------------------------------|------------------------|--------------------------------------------------------------------------------|
| A                    | 0                                                       | 9                                      | 433                                    | Albert River           | 3150                                                                           |
| B                    | 1                                                       | 0                                      | 473                                    | Albert River           | 3150                                                                           |
| C                    | 0                                                       | 445                                    | 1159                                   | Albert River           | 2050                                                                           |
| D                    | 0                                                       | 170                                    | 1102                                   | Albert River           | 1600                                                                           |
| E                    | 0                                                       | 151                                    | 609                                    | Muddy Creek            | 1360                                                                           |
| F                    | 1                                                       | 0                                      | 1062                                   | Muddy Creek            | 3600                                                                           |
| G                    | 1                                                       | 0                                      | 1592                                   | Muddy Creek            | 4000                                                                           |
| H                    | 4                                                       | 0                                      | 1108                                   | Muddy Creek            | 4000                                                                           |
| I                    | 0                                                       | 174                                    | 3989                                   | Muddy Creek            | 6400                                                                           |
| J                    | 0                                                       | 112                                    | 394                                    | Muddy Creek            | 6400                                                                           |
| K                    | 0                                                       | 154                                    | 4006                                   | Muddy Creek            | 6400                                                                           |
| L                    | 0                                                       | 381                                    | 2991                                   | Nine Mile Creek        | 5120                                                                           |
| M                    | 6                                                       | 0                                      | 530                                    | Nine Mile Creek        | 3700                                                                           |



**Figure 20:** 20% maximum flow velocity – Developed Conditions



**Figure 21:** 20% Bed Shear Stress – Developed Conditions

### 4.3 Likelihood and potential impact matrix

Using the insights from the hydrologic, hydraulic and sediment erosion and delivery analyses described in the preceding sections, likelihood ratings were assigned to each risk event, and the expected significance and extent of potential impacts of each risk event was described, i.e. for the hypothetical case that the respective risk event would materialise.

Both the event magnitude and likelihood ratings are summarised in Table 10. Overall, the magnitude of changes triggered by each risk event are low, meaning that the Project will cause minimal change to hydrologic and sediment transport processes. Similarly, the likelihood of the risk event occurring are either unlikely or possible.

**Table 10:** *Risk likelihood summary matrix*

| Risk event                                                                                                                                                      | Expected scale of changes due to risk event / expected impact                                                                                                                                                                                                                              | Likelihood | Relevant PER objective                | Comment on expected significance and extent of potential impacts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Increase in peak flows entering waterways during storm events or increasing the frequency of a flows of a nominated Annual Exceedance Probability (AEP).</b> | Small scale/Low - Given the negligible catchment changes to impervious surface cover and the size of the Action Area in which the project is planned in relation to the wider catchment, we expect the change in the magnitude of flows for a given AEP event are likely to be very small. | Unlikely   | 6.1 b<br>7.3 b iii<br>8.1             | <p>The Action Area in which the project is planned is approximately 1622 Ha and makes up approximately 2.4% of the total Corner Inlet Wetland catchment area (67,193 Ha). The development of Gelliondale Wind Farm is expected to increase impervious area within the Action Area by approximately 19.3 Ha (i.e. 1.2% increase in impervious area within the Action Area and 0.03% increase impervious area within the wider Corner Inlet Wetland catchment area).</p> <p>Construction of the Gelliondale Wind Farm will have negligible impacts on baseline surface flow patterns of the Action Area in which the project is planned and the greater wetland catchment itself.</p> <p>The location of the project immediately upstream of the junction with the Ramsar wetland means that the peak runoff generated from the Action Area in which the project is planned is likely to be delivered to the waterways and the Ramsar site well before the larger flood peaks generated by the wider catchment. In this case, the peak flow emanating from the Action Area will not increase peak flow for the catchment.</p> |
| <b>Increase in total annual volume of runoff entering waterways and the Ramsar wetland.</b>                                                                     | Given the negligible catchment changes to impervious surface cover and the size of the Action Area in which the project is planned in relation to the wider catchment, we expect any increase in the total volume of runoff entering the receiving environment to be very small.           | Possible   | 6.1 b<br>7.3 b ii<br>7.3 b iii<br>8.1 | <p>There are negligible increases in flood levels, flood extents and ponding within the study area as a result of construction of the Gelliondale Wind Farm (refer to Figure 13 and Figure 18). Given the extent of works in relation to the size of the wider catchment area, the increase in annual volume is expected to be minimal compared to the total volume generated by the wider catchment.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

| Risk event                                                                                             | Expected scale of changes due to risk event / expected impact                                                                                                                                                                                   | Likelihood | Relevant PER objective    | Comment on expected significance and extent of potential impacts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Increased erosion of the bed and banks of waterways resulting in loss of in-stream habitat.</b>     | The expected bed shear stresses are lower than recommended thresholds and therefore is not expected to mobilise sediment. Magnitude of loss of in-stream habitat is low.                                                                        | Unlikely   | 6.1 b<br>7.3 c<br>8.1     | The expected Bed Shear Stress (BSS) for pre-developed and developed (post wind farm construction works) is in the range 10 – 20 N/m <sup>2</sup> ( <b>Error! Reference source not found.</b> ). This is lower than the threshold limit of 34-45 N/m <sup>2</sup> for native grasses, which are broadly representative of the pasture grasses within the project site (DEECA, 2024). Flow velocities within waterways are also low ( <b>Error! Reference source not found.</b> ) meaning erosion of both bed and bank material (via mobilisation of sediment) due to changes in hydraulic regime are not expected. |
| <b>Change in extent of local inundation at the junction between waterways and Corner Inlet wetland</b> | Given the expected changes to peak flow within the major waterways are very low to negligible, we expect the magnitude of change in inundation to also be minimal.                                                                              | Unlikely   | 6.1 b<br>7.3 b iii<br>8.1 | There are negligible increases in flood levels, flood extents and ponding within the study area as a result of construction of the Gelliondale Wind Farm (refer to Figure 13 to Figure 18). Given the extent of works in relation to the wider catchment area, an increase in inundation is not expected at the junction between waterways and Corner Inlet wetland.                                                                                                                                                                                                                                              |
| <b>Change in quantity or quality of instream, riparian or wetland habitat.</b>                         | Given the changes in peak and cumulative runoff entering waterways are small, and the minimal change in inundation extent, we expect corresponding change in instream, riparian or wetland habitat to also be very small.                       | Unlikely   | 7.3 b i<br>8.1            | There are negligible changes in flow regimes, runoff volumes and inundation volumes within the study area as a result of construction of the Gelliondale Wind Farm. Consequently, changes in quantity or quality of instream, riparian or wetland habitat are not expected.                                                                                                                                                                                                                                                                                                                                       |
| <b>Changes to salinity within receiving waterways and wetland affecting habitat</b>                    | Given the negligible catchment changes to impervious surface cover and the size of the Action Area in which the project is planned in relation to the wider catchment, we expect the changes in the magnitude of flows and volume of freshwater | Unlikely   | 7.3 b i<br>8.1            | The very small changes in peak and cumulative flow volumes flows entering waterways from the Action Area in which the project is planned mean that changes in salinity, which would require either a major source of saline water or the substantial and ongoing dilution of saltwater, are highly unlikely.                                                                                                                                                                                                                                                                                                      |

| Risk event                                                                                                  | Expected scale of changes due to risk event / expected impact                                                                                                                                                                                                                                                                                                    | Likelihood | Relevant PER objective              | Comment on expected significance and extent of potential impacts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                             | run-off for a given AEP event are likely to be very small.                                                                                                                                                                                                                                                                                                       |            |                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Increase in sediment laden runoff entering waterways during storm events and/or more frequent events</b> | In the wider catchment context, the proposed development areas are a small fraction of the total wetland catchment area meaning the change in the total area of sediment exposed (which could potentially be scoured and then transported to waterways) is also small. The increase in the total volume of fine sediment entering waterways would be very small. | Possible   | 7.3 b iii<br>7.3 c<br>8.1           | Proposed access tracks cross waterways within the Project Footprint at select locations. Though these works are in localised areas, it is noted that without proper mitigation these works are likely to be source points of sediment run off, in particular during the construction phase of the Gelliondale Wind Farm.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Changes to sediment volumes entering wetland during storm events and/or more frequent events</b>         | Given the negligible catchment changes to impervious surface cover and the size of project site in relation to the wider catchment, we expect the change in sediment generation and subsequent mobilisation for a given AEP event are likely to be very small.                                                                                                   | Unlikely   | 7.3 b i<br>7.3 b ii<br>7.3 c<br>8.1 | The average distance from a proposed access track within the Project Footprint to Corner Inlet wetland is approximately 3917m, with topography relatively flat. Expected flow velocities within receiving waterways are low, indicating low energy sediment transport system ( <b>Error! Reference source not found.</b> ). The volume of sediment that could potentially be mobilised and delivered to the wetland is likely to be orders of magnitude lower than the natural rate of sediment delivery under baseline conditions. For example, the erosion of a single meander bend in one of the major rivers feeding the waterway (a natural and widespread process) is likely to release substantially more fine sediment than the small areas of exposed soil on the project site. |
| <b>Increased sediment deposition within receiving waterways</b>                                             | Given that the total additional volume of sediment delivered to waterways, and eventually the Ramsar site, is very low and                                                                                                                                                                                                                                       | Unlikely   | 7.3 b iii<br>7.3 c                  | Some localised sediment run off and subsequent deposition is likely given the nature of the works. The proposed works are not likely to                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

| Risk event                                                                                                                    | Expected scale of changes due to risk event / expected impact                                                                                                                        | Likelihood | Relevant PER objective    | Comment on expected significance and extent of potential impacts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>resulting in loss of stream habitat</b>                                                                                    | the fact that this sediment is likely fine grained and prone to remain in suspension, the depth and areal extent of deposition would be negligible.                                  |            | 8.1                       | increase fine sediment depositions within the receiving environments to a level where a visible loss of stream habitat could be noticed.                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Change in quantity of habitat as a result of altered sediment delivery regime</b>                                          | The expected bed shear stresses and velocities are low and therefore is not expected to mobilise sediment. Magnitude of loss of in-stream habitat due to sediment deposition is low. | Unlikely   | 7.1 b i<br>7.3 c<br>8.1   | Some localised sediment run off and subsequent deposition is likely given the nature of the works. However, entrance into waterways is localised and expected flow velocities within waterways are low indicating low energy sediment transport systems with low potential for fine sediment dispersion. The proposed works are not likely to increase fine sediment depositions within the receiving environments to a level where a visible loss of stream habitat could be noticed.                                                           |
| <b>Increase in mobilisation of sediment within receiving waterways resulting in increased turbidity and affecting habitat</b> | The expected bed shear stresses and velocities are low and therefore is not expected to mobilise sediment. The scale of loss of in-stream habitat due to increased turbidity is low. | Unlikely   | 7.3 b iii<br>7.3 c<br>8.1 | The receiving waterways are predominantly vegetated with native grasses with an expected shear stress threshold limit of 34-45 N/m <sup>2</sup> (DEECA, 2024). The expected Bed Shear Stress (BSS) for both existing (pre wind farm construction works) and developed (post wind farm construction works) is in the range 10 – 20 N/m <sup>2</sup> which is lower than this threshold.<br><br>Construction works are unlikely to alter the erosion potential of receiving environments to a level where clear loss of stream habitat is noticed. |

| Risk event                                                | Expected scale of changes due to risk event / expected impact                                                                                                                                                                                                                                                                        | Likelihood | Relevant PER objective | Comment on expected significance and extent of potential impacts                                                                                                                                                                                                                                                       |
|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Mobilisation and delivery of contaminated material</b> | The scale of this risk depends on the extent of contaminated soil or ASS exposed by construction works and the connectivity of those areas and receiving waterways. Acid Sulphate Soil testing and runoff management that will be employed during construction mean that the scale of any contaminant transport is limited in scale. | Possible   | 7.3 a<br>7.3 c<br>8.1  | The likely occurrence of ASS within the Action Area in which the project is planned and possible occurrence of ASS within the Project Footprint (and other possible contaminants bound to soil exposed by erosion or construction activities) means that their disturbance and then delivery to waterways is possible. |

## 4.4 Assessment to understand consequences and potential impacts

### Ecological impact assessment

The consequence of each risk event generated by the proposed development was assessed for consequence to the Limits of Acceptable Change of the Critical Components, Processes and Services/Benefits (Table 4 and DSEWPC, 2011) below:

- Seagrass extent
- Mangrove forest extent
- Saltmarsh extent
- Shallow subtidal waters
- Inlet waters (intertidal flats)
- Abundance of waterbirds
- Waterbird breeding
- Threatened species
- Fish abundance

Assessment of the consequence drew from threat descriptions in the Corner Inlet Ramsar Site Ecological Character Description (DSEWPC, 2011), the Corner Inlet Marine National Park Management Plan (Parks Victoria, 2005) and the Corner Inlet Ramsar Site Information Sheet (RSIS 2020). Further elucidation of the relationship of the threats assessed in this report and the Limits of Acceptable Change to the Ecological Character Descriptions of the Corner Inlet Ramsar site, as reasonably practicable, should be developed to inform further studies and monitoring as required to ensure that the proposed windfarm development poses an acceptable risk to the Ramsar site.

In most cases the consequence was assessed as minor due to the relatively small changes in hydrology and sediment delivery expected from the construction, operation and decommissioning of the project. However, the consequence of small changes to some habitats, such as increased turbidity to seagrass beds, may be significant. This, and other threats assessed as minor, when compounded with other threats, may pose a greater threat to habitats than expected, whether those compounded threats come from changes within the study area, climate change or other development and land use changes in the catchment. Standard mitigation measures such as on-site drainage and erosion control and establishment of a supporting Construction Environmental Management Plan (CEMP) and an Operation Environmental Management Plan (OEMP) provide additional assurance that the risk of sediment delivery to the Ramsar wetland will be minor.

Additional monitoring and inspection of the effectiveness of drainage and sediment control measures and the delivery of exposed soils to waterways draining the site can be undertaken as part of routine operations during construction and operation of the wind farm. Key elements for such monitoring and inspection measures are provided in Section 6.

### Consequence and potential impact matrix

Using the expected scale of the risk event in terms of changes to hydrologic and sediment delivery processes that drive each risk event and the review of Ramsar site ecological character description, consequence ratings were assigned to each risk event. Consequence ratings and supporting rationale are provided in Table 11.

Table 11. Consequence matrix

| Risk event                                                                                                                                               | Consequence | Comment on expected significance and extent of potential impacts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Increase in peak flows entering waterways during storm events or increasing the frequency of a flows of a nominated Annual Exceedance Probability (AEP). | Minor       | <p>The increase in flow is expected to be low and unlikely with expected changes to magnitude of flows for a given AEP event are likely to be very small.</p> <p>High flow events occur naturally, induced by high rainfall events. These flows vary between one and six orders of magnitude and revert to their normal dry weather flow within a week (DSEWPC, 2011). The changes in high flow events are expected to be negligible to the naturally occurring patterns of high flows.</p> <p>High flow events occur naturally, and the ecology is adapted to these events, which can cause a complete flushing of the estuarine reaches of the rivers and make them completely fresh, playing an important role as lifecycle triggers for various species, for example, facilitating fish migration (DSEWPC, 2011).</p> <p>Sediment and nutrient loads discharged during high flow events might be detrimental to critical components, processes and services/benefits of the Ramsar site, which have been assessed separately.</p> |
| Increase in total annual volume of runoff entering waterways and the Ramsar wetland.                                                                     | Minor       | <p>Given the negligible catchment changes to impervious surface cover and the size of the Action Area in which the project is planned in relation to the wider catchment, we expect the increase in the magnitude of runoff volumes entering receiving environment to be very small.</p> <p>The increases in flood levels, extents and ponding within the Action Area in which the project is planned because</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

| Risk event                                                                                      | Consequence | Comment on expected significance and extent of potential impacts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------------------------------------------------------------------------------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                 |             | of construction of the Geliondale Wind Farm are expected to be negligible. The very small increases to annual volume will make little difference to overall annual runoff, which is highly variable year to year, therefore unlikely to be detrimental to critical components, processes or benefits of the Ramsar site.                                                                                                                                                                                                                                                                                                                                                |
| Increased erosion of the bed and banks of waterways resulting in loss of in-stream habitat.     | Minor       | The expected bed shear stresses are lower than recommended thresholds and therefore is not expected to mobilise sediment. Magnitude of loss of in-stream habitat is assessed as low.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Change in extent of local inundation at the junction between waterways and Corner Inlet wetland | Minor       | An increase in inundation is not expected at the junction between waterways and Corner Inlet wetland. If a measurable increase in inundation at the junction were to occur, it may have an impact on tidal inundation regimes for critical components such as mangrove and saltmarsh extent, inlet waters (intertidal flats), beach nesting birds and other biota dependent on these systems. For example, reduced time soft sediments are exposed during low tide, reducing the available feeding time for migratory shorebirds. Because these species have a very tight energy budget, any decrease in time available to feed could have an impact on their survival. |
| Change in quantity or quality of instream, riparian or wetland habitat.                         | Minor       | Due to the very small magnitude and low likelihood of expected changes in flow regimes, runoff volumes and inundation volumes due because of construction works within the project site, reduction in quality and quantity of instream, riparian or wetland habitat is not expected.                                                                                                                                                                                                                                                                                                                                                                                    |

| Risk event                                                                                                  | Consequence | Comment on expected significance and extent of potential impacts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------------------------------------------------------------------------------------------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Changes to salinity within receiving waterways and wetland affecting habitat</b>                         | Minor       | A combination of salinity, tidal influence and submergence influence the distribution of seagrass meadows. Water quality underpins aquatic ecosystem values within wetland habitats. The key water quality parameters for the site are salinity, turbidity, dissolved oxygen and nutrients. Seagrass declines have been recorded in Corner Inlet with the exact cause unknown, but water quality may be a factor (RSIS 2020).                                                                                                                                                                                                                                                                                                                                                      |
| <b>Increase in sediment laden runoff entering waterways during storm events and/or more frequent events</b> | Minor       | <p>Seagrass, mangrove, and saltmarsh habitats are vulnerable to increased sedimentation. However, due to the relatively flat topography of the area, water flow and sediment transport systems are expected to be low, and the mobilisation of fine sediment beyond baseline conditions is not anticipated. As a result, direct impacts to these communities are likely to be minimal.</p> <p>Although declines in saltmarsh, mangroves, and seagrass have been recorded in Corner Inlet, the exact cause remains unknown. Sedimentation is not currently considered a key factor in these declines; however, any future increases in sedimentation could negatively affect the condition and extent of these ecosystems, potentially triggering cascading ecological effects.</p> |
| <b>Changes to sediment volumes entering wetland during storm events and/or more frequent events</b>         | Minor       | Increase in sediment volumes during storm events would likely cause temporary increases in turbidity. The ecological impact of these events varies depending on the intervals and severity of occurrence. Increases in water turbidity is a threatening process for seagrass, and the extent and condition of seagrass in the Corner Inlet has declined with reasons unknown but suggested to be related to water quality. The expected flow velocities                                                                                                                                                                                                                                                                                                                            |

| Risk event                                                                                                                    | Consequence | Comment on expected significance and extent of potential impacts                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------------------------------------------------------------------------------------------------------------------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                               |             | within the receiving waterways are low, and the mobilisation of fine sediment in excess of baseload conditions are not expected, therefore it is unlikely to have a significant impact on ecological assets.                                                                                                                                                                                                                                                                                                            |
| <b>Increased sediment deposition within receiving waterways resulting in loss of stream habitat</b>                           | Moderate    | Sediment deposition can affect distribution and vegetation patterns of mangroves and saltmarshes by providing new substrate or smothering of mangrove pneumatophores and herbaceous saltmarsh plants. Sediment deposition is also known to impact the condition and extent of seagrass beds. Localised sediment runoff and subsequent deposition is likely given the nature of proposed works.                                                                                                                          |
| <b>Change in quantity of habitat as a result of altered sediment delivery regime</b>                                          | Minor       | Sediment deposition can affect distribution and vegetation patterns of seagrass, mangroves and saltmarshes by providing new substrate or smothering of mangrove pneumatophores and herbaceous saltmarsh plants, and smothering seagrass beds (Parks Victoria 2005, .Localised sediment runoff and subsequent deposition is likely given the nature of construction works but are not likely to increase fine sediment depositions within the receiving environment to a level where there is a visible loss of habitat. |
| <b>Increase in mobilisation of sediment within receiving waterways resulting in increased turbidity and affecting habitat</b> | Moderate    | Water quality underpins aquatic ecosystem values within wetland habitats. The key water quality parameters for the site are salinity, turbidity, dissolved oxygen and nutrients. Increased sediment loads lead to increased water column turbidity resulting in lower light levels reaching benthic microalgae living on the sediment surface and seagrass meadows (Parks Victoria 2005, WGCMA 2014). Though it was not explicitly identified,                                                                          |

| Risk event                                         | Consequence | Comment on expected significance and extent of potential impacts                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------------------------------------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                    |             | <p>changes in availability of benthic microalgae may reduce the habitat suitability of the site for waterbirds. Seagrass declines have been recorded in Corner Inlet with evidence suggesting that cause may be from an increase in turbidity and nutrient levels. Though the fine sediment dispersal is likely to be low, any additional pressure to the seagrass community will likely contribute to its already degraded extent (Parks Victoria 2005, DSEWPC 2011).</p>  |
| Mobilisation and delivery of contaminated material | Minor       | <p>Increased acidity of inflows to wetland habitats would have deleterious effects on exposed aquatic biota and habitat of the aquatic ecosystems of the Ramsar site (RSIS 2020). Because the proportional runoff from the windfarm site is small compared with the volume of runoff from the wider Corner Inlet catchment, any increase in acidity is expected to be diluted to the point where the consequence is not expected to pose a threat to the Ramsar values.</p> |

## 5 Inherent risk rating (pre-mitigation)

| Risk event                                                                                                                                               | Baseline likelihood rating | Baseline consequence rating | Inherent risk rating |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|-----------------------------|----------------------|
| Increase in peak flows entering waterways during storm events or increasing the frequency of a flows of a nominated Annual Exceedance Probability (AEP). | Unlikely                   | Minor                       | Low                  |
| Increase in total annual volume of runoff entering waterways and the Ramsar wetland.                                                                     | Possible                   | Minor                       | Low                  |
| Increased erosion of the bed and banks of waterways resulting in loss of in-stream habitat.                                                              | Unlikely                   | Minor                       | Low                  |
| Change in extent of local inundation at the junction between waterways and Corner Inlet wetland                                                          | Unlikely                   | Minor                       | Low                  |
| Change in quantity or quality of instream, riparian or wetland habitat.                                                                                  | Unlikely                   | Minor                       | Low                  |
| Changes to salinity within receiving waterways and wetland affecting habitat                                                                             | Unlikely                   | Minor                       | Low                  |
| Increase in sediment laden runoff entering waterways during storm events and/or more frequent events                                                     | Possible                   | Minor                       | Low                  |
| Changes to sediment volumes entering wetland during storm events and/or more frequent events                                                             | Unlikely                   | Minor                       | Low                  |

| Risk event                                                                                                             | Baseline likelihood rating | Baseline consequence rating | Inherent risk rating |
|------------------------------------------------------------------------------------------------------------------------|----------------------------|-----------------------------|----------------------|
| Increased sediment deposition within receiving waterways resulting in loss of stream habitat                           | Unlikely                   | Moderate                    | Low                  |
| Change in quantity of habitat as a result of altered sediment delivery regime                                          | Unlikely                   | Minor                       | Low                  |
| Increase in mobilisation of sediment within receiving waterways resulting in increased turbidity and affecting habitat | Unlikely                   | Moderate                    | Low                  |
| Mobilisation and delivery of contaminated material                                                                     | Possible                   | Minor                       | Low                  |

## 6 Recommendations for mitigation and monitoring measures

The inherent risks posed to waterways, that may receive runoff from the Action Area in which the project is planned, and Corner Inlet wetland have been assessed as low.

Implementation of appropriate mitigation and monitoring measures, many of which are standard industry practice in the construction and maintenance of any form of floodplain development, will provide assurance that these risks will remain low throughout the project, including construction, operation and decommissioning phases.

In accordance with PER objective 9, the following management and monitoring measures are recommended:

- Develop appropriate Environmental Management Plan (EMP), Construction Environmental Management plan (CEMP) and Operation Environmental Management Plan (OEMP) that set out the environmental management system and mandate adequate management procedures for the Gelliondale Wind Farm. These management plans should incorporate relevant sub-plans:
  - o Soil and Water Management Plan that outlines the regulatory requirements, approval conditions, management responsibilities and procedures to maintain or if possible, enhance environmental values related to soil and water.
  - o Erosion and Sediment Control Plan (ESCP) to outline procedures and processes to capture and manage excess sediment generated from construction and other activities. The ESCP will map locations of exposed soil and list the location of infrastructure such as drainage, silt fences, sediment settling ponds and discharge zones (where water and sediment is dispersed onto the floodplain).
  - o Acid Sulphate Soils Management Plan (in accordance with Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils (DSE 2010)). The plan shall include the following hierarchy for managing Waste Acid Sulfate Soil (WASS):
    - avoid disturbance
    - minimise disturbance
    - prevent oxidation
    - treat onsite to reduce or neutralise acidity
    - offsite reuse or disposal.
- Develop appropriate monitoring and inspection plan to assess and if necessary adapt the effectiveness of management measures and/or project infrastructure including:
  - o Regular inspections of areas of exposed soils and/or stockpiles
  - o Regular inspections of prescribed protection measures, e.g. upholding of minimum buffer distances, timely rehabilitation and/or revegetation of exposed soils
  - o Regular inspections of relevant infrastructure, e.g. drainage, silt fences, sediment settling ponds and discharge zones (where water is dispersed into the floodplain)
  - o Regular inspections of changes to bank and bed vegetation along with any signs of erosion
  - o Ad-hoc inspections triggered by storm events (e.g. 25 mm or greater within 24 hours) or other events to assess effectiveness of management and protection measures, relevant infrastructure
  - o Water quality monitoring as required (on-site and in adjacent waterways) if contaminated runoff is suspected to occur or might have occurred and/or significant spills or leakages have occurred.

The monitoring and inspection plan should, as a minimum:

- Include clear responsibilities and reporting requirements
- Include clear outcome and performance parameters, thresholds, spatial and temporal requirements of the monitoring and inspection
- Include parameters, frequency, durations of water quality monitoring (as required)
- Include clear training and induction requirements for responsible staff

- Include relevant templates, checklists and references to applicable guidelines and standards to assess and confirm effectiveness of management measures.

The monitoring and inspection plan should outline or make reference to conditions under which effectiveness of mitigation measures / environmental controls need to be assessed, when works on-site need to be stopped in response to changes in parameters and what action is required to rectify changes.

## 7 Residual risk rating (post-mitigation)

Table 12: Residual risk rating

| Risk                                                                                                                                                     | Inherent risk rating (pre-mitigation) | Risk mitigation measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Post-mitigation likelihood rating | Post-mitigation consequence rating | Residual risk rating |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|------------------------------------|----------------------|
| Increase in peak flows entering waterways during storm events or increasing the frequency of a flows of a nominated Annual Exceedance Probability (AEP). | Low                                   | <ul style="list-style-type: none"> <li>- Establish relevant environmental management plans and procedures to minimise runoff</li> <li>- Minimise impervious areas through design considerations</li> <li>- Minimise runoff through appropriate drainage and sediment retention design</li> <li>- Appropriate road drainage design including appropriate drain spacing to minimise hydrologic connection between roads and waterways</li> <li>- Establish monitoring and inspection plans to assess the effectiveness of mitigation measures</li> </ul> | Unlikely                          | Minor                              | Low                  |
| Increase in total annual volume of runoff entering waterways and the Ramsar wetland.                                                                     | Low                                   | <ul style="list-style-type: none"> <li>- Same as above</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Possible                          | Minor                              | Low                  |
| Increased erosion of the bed and banks of waterways resulting in loss of in-stream habitat.                                                              | Low                                   | <ul style="list-style-type: none"> <li>- Establish relevant environmental management plans and procedures to minimise runoff</li> <li>- Include assessment of bed and banks erosion parameters in regular inspections</li> </ul>                                                                                                                                                                                                                                                                                                                       | Unlikely                          | Minor                              | Low                  |

| Risk                                                                                            | Inherent risk rating (pre-mitigation) | Risk mitigation measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Post-mitigation likelihood rating | Post-mitigation consequence rating | Residual risk rating |
|-------------------------------------------------------------------------------------------------|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|------------------------------------|----------------------|
|                                                                                                 |                                       | <ul style="list-style-type: none"> <li>- Periodic post-event inspections to identify newly scoured channel during construction and operations</li> <li>- Complete localised erosion control works if required. Scale of works will depend on size and type of erosion.</li> </ul>                                                                                                                                                                                                                                                                      |                                   |                                    |                      |
| Change in extent of local inundation at the junction between waterways and Corner Inlet wetland | Low                                   | <ul style="list-style-type: none"> <li>- Establish relevant environmental management plans and procedures to minimise runoff</li> <li>- Minimise impervious areas through design considerations</li> <li>- Minimise runoff through appropriate drainage and sediment retention design</li> <li>- Appropriate road drainage design including appropriate drain spacing to minimise hydrologic connection between roads and waterways</li> <li>- Establish monitoring and inspection plans to assess the effectiveness of mitigation measures</li> </ul> | Unlikely                          | Minor                              | Low                  |
| Change in quantity or quality of instream, riparian or wetland habitat.                         | Low                                   | <ul style="list-style-type: none"> <li>- Establish relevant environmental management plans and procedures to minimise runoff</li> <li>- Include habitat assessment parameters into regular inspections and report immediately on any visible changes</li> </ul>                                                                                                                                                                                                                                                                                        | Unlikely                          | Minor                              | Low                  |

| Risk                                                                                                 | Inherent risk rating (pre-mitigation) | Risk mitigation measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Post-mitigation likelihood rating | Post-mitigation consequence rating | Residual risk rating |
|------------------------------------------------------------------------------------------------------|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|------------------------------------|----------------------|
|                                                                                                      |                                       | <ul style="list-style-type: none"> <li>- Consult with relevant authorities on any changes</li> <li>- Undertake ecological restoration works as required</li> </ul>                                                                                                                                                                                                                                                                                                                                                                 |                                   |                                    |                      |
| Changes to salinity within receiving waterways and wetland affecting habitat                         | Low                                   | <ul style="list-style-type: none"> <li>- Establish relevant environmental management plans and procedures to minimise runoff</li> <li>- Establish water quality modelling and monitoring plan, including measures to assess instream salinity levels either within the Action Area in which the project is located should a large change in salinity be noticed or reported.</li> </ul>                                                                                                                                            | Unlikely                          | Minor                              | Low                  |
| Increase in sediment laden runoff entering waterways during storm events and/or more frequent events | Low                                   | <ul style="list-style-type: none"> <li>- Establish relevant environmental management plans and procedures to minimise runoff</li> <li>- Minimise impervious areas through design considerations</li> <li>- Minimise runoff through appropriate drainage and sediment retention design</li> <li>- Appropriate road drainage design including appropriate drain spacing to minimise hydrologic connection between roads and waterways</li> <li>- Establish monitoring and inspection plans to assess the effectiveness of</li> </ul> | Possible                          | Minor                              | Low                  |

| Risk                                                                                         | Inherent risk rating (pre-mitigation) | Risk mitigation measures                                                                                                                                                                                                                                                                                                                                                                                            | Post-mitigation likelihood rating | Post-mitigation consequence rating | Residual risk rating |
|----------------------------------------------------------------------------------------------|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|------------------------------------|----------------------|
|                                                                                              |                                       | mitigation measures within the Action Area in which the project is located                                                                                                                                                                                                                                                                                                                                          |                                   |                                    |                      |
| Changes to sediment volumes entering wetland during storm events and/or more frequent events | Low                                   | - Same as above                                                                                                                                                                                                                                                                                                                                                                                                     | Unlikely                          | Minor                              | Low                  |
| Increased sediment deposition within receiving waterways resulting in loss of stream habitat | Low                                   | <ul style="list-style-type: none"> <li>- Same as above</li> <li>- Establish water quality modelling and monitoring plan, focusing on turbidity levels as required should visible losses of stream habitat be identified, within the Action Area in which the project is located</li> <li>- Undertake ecological restoration works as required</li> </ul>                                                            | Unlikely                          | Moderate                           | Low                  |
| Change in quantity of habitat as a result of altered sediment delivery regime                | Low                                   | <ul style="list-style-type: none"> <li>- Establish relevant environmental management plans and procedures to minimise runoff</li> <li>- Minimise runoff through appropriate drainage and sediment retention design</li> <li>- Include habitat assessment parameters into regular inspections and report immediately on any visible changes</li> <li>- Undertake ecological restoration works as required</li> </ul> | Unlikely                          | Minor                              | Low                  |

| Risk                                                                                                                   | Inherent risk rating (pre-mitigation) | Risk mitigation measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Post-mitigation likelihood rating | Post-mitigation consequence rating | Residual risk rating |
|------------------------------------------------------------------------------------------------------------------------|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|------------------------------------|----------------------|
| Increase in mobilisation of sediment within receiving waterways resulting in increased turbidity and affecting habitat | Low                                   | <ul style="list-style-type: none"> <li>- Same as above</li> <li>- Establish water quality modelling and monitoring plan, focusing on turbidity levels as required should visible losses of habitat be identified, within the Action Area in which the project is located</li> <li>- Undertake ecological restoration works as required</li> </ul>                                                                                                                                                                                                                                                             | Unlikely                          | Moderate                           | Low                  |
| Mobilisation and delivery of contaminated material                                                                     | Low                                   | <ul style="list-style-type: none"> <li>- Avoid or minimize disturbance if possible</li> <li>- Establish relevant environmental management plans and procedures to minimise runoff</li> <li>- Minimise runoff through appropriate drainage and sediment retention design</li> <li>- Establish specific management plan and procedures that incorporate guidance outlined in Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulphate Soils (the BPMG) (DSE 2010)</li> <li>- Establish monitoring and inspection plans to assess the effectiveness of mitigation measures</li> </ul> | Unlikely                          | Minor                              | Low                  |

## 8 Significant impact assessment

Table 13: Significant impact assessment

| Risk                                                                                                                                                     | Potential impact                                                                                                       | Magnitude / intensity | Duration   | Extent                 | Significant impact to Corner Inlet Wetland |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-----------------------|------------|------------------------|--------------------------------------------|
| Increase in peak flows entering waterways during storm events or increasing the frequency of a flows of a nominated Annual Exceedance Probability (AEP). | Increase of peak water flow / increase of sediment and nutrient loads (in Action Area in which the project is located) | Minor                 | Short-term | Local                  | No                                         |
| Increase in total annual volume of runoff entering waterways and the Ramsar wetland.                                                                     | Increase in annual water flow volumes (in Action Area in which the project is located)                                 | Minor                 | Short-term | Local                  | No                                         |
| Increased erosion of the bed and banks of waterways resulting in loss of in-stream habitat.                                                              | Degradation or loss of in-stream habitat (in Action Area in which the project is located)                              | Minor                 | Short-term | Local                  | No                                         |
| Change in extent of local inundation at the junction between waterways and Corner Inlet wetland                                                          | Increase in downstream inundation levels                                                                               | Minor                 | Short-term | Local / not measurable | No                                         |
| Change in quantity or quality of instream, riparian or wetland habitat.                                                                                  | Degradation or loss of downstream, in-stream, riparian or wetland habitat                                              | Minor                 | Short-term | Local                  | No                                         |
| Changes to salinity within receiving waterways and wetland affecting habitat                                                                             | Decreases to downstream salinity levels                                                                                | Minor                 | Short-term | Local / not measurable | No                                         |

| Risk                                                                                                                   | Potential impact                                                                   | Magnitude / intensity | Duration   | Extent                 | Significant impact to Corner Inlet Wetland |
|------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-----------------------|------------|------------------------|--------------------------------------------|
|                                                                                                                        |                                                                                    |                       |            |                        |                                            |
| Increase in sediment laden runoff entering waterways during storm events and/or more frequent events                   | Increase in sediment laden runoff (in Action Area in which the project is located) | Minor                 | Short-term | Local                  | No                                         |
| Changes to sediment volumes entering wetland during storm events and/or more frequent events                           | increase of downstream sediment and nutrient loads                                 | Minor                 | Short-term | Local / not measurable | No                                         |
| Increased sediment deposition within receiving waterways resulting in loss of stream habitat                           | Degradation or loss of downstream, in-stream habitat                               | Minor                 | Short-term | Local / not measurable | No                                         |
| Change in quantity of habitat as a result of altered sediment delivery regime                                          | See above                                                                          | Minor                 | Short-term | Local / not measurable | No                                         |
| Increase in mobilisation of sediment within receiving waterways resulting in increased turbidity and affecting habitat | See above                                                                          | Minor                 | Short-term | Local / not measurable | No                                         |
| Mobilisation and delivery of contaminated material                                                                     | Increased acidity or toxicity of water flow                                        | Minor                 | Short-term | Local                  | No                                         |

## 9 Conclusion on the likelihood, significance and extent of impacts

Overall, the expected magnitude of changes triggered by the risk events and potential impacts analysed in this assessment report are low, meaning that the project will likely cause minimal changes only to hydrologic and sediment transport processes. Accordingly, it is unlikely that the project would have any significant hydrology or water quality related impacts to the ecological values of the Corner Inlet wetland.

The findings indicate that the project's impact on hydrology will be minimal, with negligible changes to runoff patterns and flow regimes. The proposed development increases impervious surface areas only slightly, accounting for 1.2% of the Action Area in which the project is planned and 0.03% of the total Corner Inlet catchment. Consequently, peak runoff volumes and flow magnitudes are unlikely to significantly affect the surrounding waterways or the Ramsar site.

Sediment mobilization and delivery risks are primarily associated with construction and decommissioning activities and to a lesser degree with maintenance activities during operation. Some localised sediment runoff and subsequent transport to existing minor and then major waterways is likely given the nature of the proposed works. However, the total area of freshly exposed soil that is susceptible to scour by runoff is limited and represents a small increase over and above that already exposed within the wider Corner Inlet wetland catchment. While localized sediment runoff is expected, the volume transported to waterways and the Ramsar site will remain far below natural baseline levels.

Further, the natural variability in sediment exposure and delivery to waterways is likely to be greater than that induced by the project. A single debris flow in the upper, forested section of the catchment above the Action Area in which the project is planned or a bank erosion event in one of the major waterways would deliver (at least) an order magnitude more sediment to the major waterways and the Corner Inlet wetland than the material liberated from the Project Footprint.

The average distance of proposed access tracks within the Project Footprint to Corner Inlet wetland is approximately 3917m, with topography relatively flat. Expected flow velocities within receiving waterways are low, indicating low energy sediment transport system (**Error! Reference source not found.**). The volume of sediment that could potentially be mobilised and delivered to the wetland is likely to be orders of magnitude lower than the natural rate of sediment delivery under baseline conditions. For example, the erosion of a single meander bend in one of the major rivers feeding the waterway (a natural and widespread process) is likely to release substantially more fine sediment than the small areas of exposed soil on the project site.

Flow velocities (for the developed conditions) of both major and minor waterways within the study area were low indicating low potential for scour and low rates of sediment transport (**Error! Reference source not found.**). The mobilisation of fine sediment in excess of baseload conditions are not expected due to this low velocity as sediment will drop out and settle prior to reaching the Ramsar wetland.

The inherent risk of increased acidity or toxicity of inflows, caused by ASS or other contaminated runoff from the Action Area in which the project is planned, to wetland habitats is low. In theory respective inflows could have deleterious effects on exposed aquatic biota and habitat of the aquatic ecosystems of the Ramsar site (RSIS 2020). However, proportional runoff from the windfarm site is small compared with the volume of runoff from the wider Corner Inlet catchment, so that any increase in acidity or toxicity is expected to be diluted to the point where the consequence is not expected to pose a threat to the Ramsar values.

Therefore, diligent implementation of appropriate management and monitoring measures, many of which are standard industry practice in the construction and maintenance of any form of floodplain development, is of relative importance for this project and will provide assurance that residual risks will remain low throughout the project lifecycle including construction, operation and decommissioning phases.

In conclusion, the Gelliondale Wind Farm is expected to have minimal environmental impacts with the implementation of standard, industry practice management and monitoring measures.

## 10 References

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