Hexham Wind Farm Pty Ltd

Hexham Wind Farm

Soil and Landform Assessment

July 2025

Confidential

Question today
Imagine tomorrow
Create for the future

Hexham Wind Farm
Soil and Landform Assessment

Hexham Wind Farm Pty Ltd

WSP
Level 11, 567 Collins St
Melbourne VIC 3000

Tel: +61 3 9861 1111
Fax: +61 3 9861 1144
wsp.com

Rev	Date	Details
6	17 August 2025	Comments addressed

	Name	Date	Signature
Prepared by:	Conor McCarthy	August 2025	CMcCarthy
Reviewed by:	David Annan	August 2025	

WSP acknowledges that every project we work on takes place on First Peoples lands.
We recognise Aboriginal and Torres Strait Islander Peoples as the first scientists and engineers and pay our respects to Elders past and present.

Table of contents

List of tables

List of plates

List of figures

List of appendices

1 Introduction

1.1 Purpose

Hexham Wind Farm Pty Ltd (Hexham Wind Farm) has engaged WSP Australia Pty Ltd (WSP) to undertake geotechnical, environmental and hydrogeological consulting services to support Hexham Wind Farm's Environment Effects Statement (EES), for the proposed Hexham Wind Farm (the Project). The wind farm is proposed to be located in southwest Victoria, and is roughly bounded by the towns of Hexham, Caramut, Ellerslie and Minjah.

The scoping requirements for the Hexham Wind Farm EES (DTP 2024) set out the specific matters to be investigated and documented. This assessment addresses the scoping requirements for the project that are relevant to the soil and landform assessment as part of the EES, as required under the Environment Effects Act 1978. The report also supports the planning permit application for the Project, as required under the Planning and Environment Act 1987.

1.2 Background

1.2.1 Site description

The proposed HWF project area is located about 15 km west of Mortlake, as shown in Figure 1. The site has maximum dimensions of about 19 km (north-south) and 15 km (east-west) with a total area of about 16,000 ha.

The project area is mostly occupied by open farm paddocks with associated boundary fencing and some farm buildings and dams. The current land use is predominantly grazing (cattle and sheep) along with some cropping. Native vegetation is largely restricted to roadside reserves with small, isolated areas on private land.

Roads on or within the boundary of the site include the Hamilton Hwy (north boundary), Woolsthorpe-Hexham Rd (eastern boundary in the north of the site, crosses through the middle of the site), Hexham-Ballangeich Rd (eastern boundary for part of the south of the site), Gordons Ln (southern boundary), Grassmere-Hexham Rd (southwestern boundary) and Warrnambool-Caramut Rd (part of the western boundary in the north of the site). Numerous minor lanes and farm roads are also present within the HWF site area.

The Hopkins River runs in a north-south direction outside the eastern boundary of the site, forming the site boundary for one short section approximately 2 km long. Numerous other watercourses pass through the site, including Mustons Creek, Limestone Creek, Drysdale Creek, Lyall Creek and a number of smaller unnamed watercourses.

1.2.2 Proposed development

Based on information provided to WSP by Hexham Wind Farm ('250429_Project_Description_for_Specialists_Rev4_with quarry desc'- see Appendix B), the proposed development includes:

- Up to 106 wind turbine generators (WTGs).
  - The proposed WTGs will have a maximum tip height of 260 m, maximum rotor diameter up to 190 m and minimum tip height of 40 m.
- Approximately 151.3 km of new site access tracks, and upgrades to 16.7 km of existing farm access tracks.
- Creation or improvement of up to 11 access points from public roads.
- Up to 5 permanent anemometry (meteorological) masts.
- Approximately 85 km of underground cabling trenches with up to 119 km of cable.
- Approximately 22 km of internal overhead cables.

  - The linear length of the overhead cabling route is to be around 22 km long as a significant portion will be strung on parallel lines of poles.
- An on-site terminal station to facilitate connection to the existing Moorabool to Heywood 500 kV transmission line located within the southern part of the project site.
- An on-site battery energy storage system (BESS).
- Temporary infrastructure including construction compounds, wind turbine component laydown areas and concrete batching plants.
- An operations and maintenance (O&M) facility.
- A temporary on-site quarry is being investigated for the purposes of providing aggregate materials for access tracks and hardstand areas.

The approximate location of the proposed WTGs and associated infrastructure, based on the information provided to us by Hexham Wind Farm, is shown on Figure 1, from the data pack '250506_HXM_Infrastructure_WTGv183.2'.

1.3 Aims of the Assessment

The aims of the assessment are listed below:

- Assess the surface topography (landform), surrounding land use and likely subsurface conditions at the site, relevant to the proposed HWF.
- Identify and describe the soil and rock types encountered including descriptions of rock composition, strength and weathering and rock mass properties;
- Identify past uses of the site that may have impacted upon its contamination status.
- Identify potential areas of acid sulfate soils.
- Highlight key geotechnical and contamination considerations for the proposed development, and identify potential geotechnical, contamination or hydrogeological constraints on development.
- Identify and assess potential effects on the project on soil stability, erosion and the exposure and disposal of any waste or hazardous soils.
- For the constraints identified, provide advice on possible mitigation of adverse impacts.
- Assess the impacts that may result from the proposed geotechnical, environment and hydrogeological works as part of an environment effects statement (EES), as required under the Environment Effects Act 1978.

2 Environment Effects Statement Scoping Requirements

The following evaluation object is relevant to the soil and landform assessment:

– *To maintain the functions and values of aquatic environments, surface water and groundwater quality and stream flows and avoid adverse effects on protected environmental values.*

The aspects from the scoping requirements relevant to the soil and landform evaluation objective are shown in, as well as the location where these items have been addressed in this report.

Table 2.1 EES Scoping Requirements

Category	Requirement relevant to soil and landform assessment	Sections addressing this requirement
Key Issues	Potential for the project to have a significant effect on hydrology and affect existing sedimentation and erosion processes leading to land and aquatic habitat degradation.	Appendix B: Hydrology and hydrogeology
	Potential for the project to have a significant effect on surface water and/or groundwater and its environmental values and use, including through the temporary on-site quarry.	Hydrogeological impacts are addressed in Section 4.1.2.2, Section 4.1.2.7 Appendix B: Hydrology and hydrogeology
	Potential for the project to have significant impact on wetland systems, including, but not limited to, Seasonal Herbaceous Wetlands (EPBC Act listed community), and the ability for wetland systems to support habitat for flora species listed under the FFG Act and EPBC Act.	Appendix B: Hydrology and hydrogeology Appendix D: Flora and Fauna
Existing Environment	Characterise the groundwater (including depth quality and availability to license/ use) and surface water environments and drainage features in the project area.	The existing groundwater environment is described in Section 3.9 Appendix B: Hydrology and hydrogeology
	Characterise the wetland systems in and around the project site and the type, distribution and condition of wetlands that could be impacted by the project, having regard to terrestrial and aquatic habitat and habitat corridors or linkages.	Appendix B: Hydrology and hydrogeology Appendix D: Flora and Fauna
	Characterise geology, geomorphology, landforms and soil types, structures and chemistry in the study area and identify the potential location of acid sulphate soils, including hydrological requirements and their acceptable limits for change.	Sections: 3.2,3.3, 3.4

Category	Requirement relevant to soil and landform assessment	Sections addressing this requirement
Likely Effects	Assess the potential effects of the project on surface water and groundwater environments and associated environmental values and use, including surface water and groundwater flow and quality. This needs to include consideration of effects associated with establishment of project roads and transmission lines.	Hydrogeological impacts are addressed in Section 4.1.2.2, 4.1.2.7 Appendix B: Hydrology and hydrogeology
	Identify and assess potential effects of the project on soil stability, erosion and the exposure and disposal of any waste or hazardous soils.	Soil stability and erosion for earthworks are addressed in Section 4.1.1 Hazardous soils and waste, (including contaminated soils, acid sulfate soils and saline and sodic soils) are discussed in Sections: 4.1.3.1, 4.1.3.2,4.1.3.6.
Design and Mitigation	Identify proposed measures to mitigate any potential effects, including any relevant design features or preventative techniques to be employed during construction.	Sections: 4.1.2
Performance	Describe proposed measures to manage and monitor effects on catchment values and identify likely residual effects and identify if further management is required.	Appendix B: Hydrology and hydrogeology
	Describe contingency measures for responding to unexpected impacts on catchment values and hydrology, including resulting from the potential for accidental spills and disturbance of acid sulphate soils (ASS).	Section 4.1.2.2 describes measures to minimise disturbance of ASS. Appendix B: Hydrology and hydrogeology

2.1 Methodology

2.1.1 General

The assessment comprised a desktop review together with a site walkover undertaken by an experienced geotechnical practitioner.

2.1.2 Information reviewed

As part of the desktop review, we reviewed relevant aspects of the following documents:

- Historical information:
  - Historical aerial photographs of the site from 1947 and satellite images from 2006 and 2020.
- Environmental Protection Authority (EPA) Database including:
  - EPA Priority Sites register.
  - EPA Environmental Audit records.
  - Records of active and historical landfills.

  - Records of EPA licensed sites.
- Published geological and geomorphological information:
  - Geological Survey of Victoria (GSV): 1:250,000 scale 'Colac' mapsheet, Edition 2 (1996).
  - Geological Survey of Victoria (GSV): 1:100,000 scale 'Willaura' mapsheet, Edition 1 (2000).
  - GSV Victorian Seamless Geology, 1:250,000 (2014).
  - Geomorphological Units (GMU 250), Glenelg-Hopkins Catchment Management Region (CMR).
  - CSIRO – ASRIS Acid Sulfate Soils Probability Maps.
  - Agriculture Victoria – Victorian Resources Online – Salinity Provinces in the Glenelg-Hopkins CMR.
- Published environmental information:
  - Bureau of Meteorology (BoM) Groundwater Dependent Ecosystems (GDE) Atlas.
- Planning scheme:
  - Moyne Shire Council (MSC) Planning Scheme including clause 13.04-2S 'Erosion and landslip: key strategies to prevent inappropriate development in unstable areas or areas prone to erosion', clause 13.04-3S 'Salinity: key strategy to prevent inappropriate development in areas affected by groundwater salinity', clause 14.02-2S 'Water quality: key strategy to discourage incompatible land use', clause 35.07 'Farming Zone' and 'Schedule to Clause 35.07 Farming Zone', 52.32 'Wind Energy Facility' and 'Schedule to Clause 52.32 Wind Energy Facility'.

We also reviewed information on the Department of Energy, Environment and Climate Action (DEECA) 'GeoVic' and the Visualising Victoria's Groundwater (VVG) websites.

2.1.3 Site walkover

The site walkover was performed on 1 and 2 March 2023 by an associate engineering geologist from WSP. During the walkover, the proposed sites of numerous WTGs and site infrastructure were visited, and photographs of site features were taken. Selected photographs taken during the site visit are presented in Appendix A and the photo locations are shown in Figure 4.

2.1.4 Impact Assessment

Soil and landform impacts will be considered for the construction, operation and decommissioning phases of the windfarm. Where appropriate, the assessment will provide guidance on how to comply with regulatory limits or standards, or actions that need to be taken to meet these standards. The assessment will also outline potential mitigation measures to eliminate, reduce or manage the potential impacts identified. For each impact, the magnitude, extent and duration of the impact will be detailed where appropriate. The significance rating for each residual effect, those effects that cannot be mitigated or avoided, will be made for each impact with the criteria shown in Table 2.2

Table 2.2 Impact significance rating criteria

Very Low	Low	Medium	High
Residual impacts are negligible or very minor. Very unlikely to have an impact on the project or environment.	Residual impacts are minor. Unlikely to have a major impact on the project or environment. Potential for minor loss of productivity/time during construction.	Residual impacts are significant enough that they may or may not result in environmental degradation, construction issues, major loss of productivity/time, or other negative impacts to the project.	Residual impacts are major and are likely to result in environmental degradation, construction issues, major loss of productivity/time, or other negative impacts to the project.

3 Existing Conditions

3.1 Planning scheme

The MSC planning scheme indicates the site is located in a Farming Zone (FZ). We understand the purpose of the FZ is primarily to ensure that non-agricultural uses do not adversely affect the use of land for agriculture. Furthermore, the schedule to the FZ indicates that a permit is required for earthworks which change the rate of flow or the discharge point of water across a property boundary and earthworks which increase the discharge of saline groundwater.

Clause 52.32 of the MSC planning scheme includes a requirement that an environmental management plan (EMP) that indicates rehabilitation and monitoring requirements is submitted as part of the design response for proposed wind energy facilities. We expect this EMP would need to include requirements relating to management of excavated soils including erosion, dust control and surface water runoff controls and would be prepared in conjunction with other design documents at a later stage. An agricultural impact assessment will also be undertaken as part of the social and economic environmental impact assessment (Appendix I).

3.2 Topographic setting

The topographic setting of the site is illustrated by the surface level contours presented in Figure 1. The following comments relate to the topography of the site:

- Site slopes are typically very gentle with the land almost flat at the majority of locations for proposed WTGs and associated infrastructure (see Photo A1). Slopes greater than 10 degrees are only present in some stream and creek banks. Locally the banks of the Hopkins River and some creeks reach slope angles of 20 to 30 degrees. The ground surface elevation within the site varies between about RL 150 m AHD in the northwest to about RL 100 m AHD in the southeast near the Hopkins River.
- Numerous creeks and streams pass through the site. The main surface drainage features in the northern half of the site are Mustons Creek and Limestone Creek, both of which drain into the Hopkins River which runs in a north-south direction beyond the eastern site boundary. The main surface drainage features in the southern half of the site are Drysdale Creek and Lyall Creek which drain into the Merri River well to the south of the site, near Grassmere.
- Catchment dams and swales have been constructed in some natural drainage paths for agricultural purposes.

3.3 Geology

3.3.1 Regional geology

The 1:250,000 Victorian Seamless Geology (2014) is shown in the project area in Figure 2. This shows the surface geology in the project area primarily consists of basalt of the Pliocene to Pleistocene (late Tertiary to Quaternary) aged Newer Volcanic Group. This is described as ‘basalt flows having minor scoria and ash and fluvial sediments, including sheet flows and valley flows and intercalated gravel, sand and clay.’ In the eastern and southeastern parts of the site, closer to the Hopkins River, Pliocene aged material of the Brighton Group (listed as Hanson Plain Sand on the GSV 1:250,000 Colac mapsheet, this naming has been superseded) is present at the surface. This is described as gravel, sand and silt: with variably calcareous to ferruginous sandstones and coquinas. It is inferred that where the basalt is present at the surface it is underlain by the Brighton Group.

In the northeastern part of the site, Quaternary aged alluvial terrace deposits are mapped. These are described as gravel, sand and silt: variably sorted and rounded, generally unconsolidated, alluvial floodplain deposits. Additionally, throughout the site there are numerous areas where Quaternary aged alluvium, as well as swamp and lake deposits, have been mapped.

Below the Newer Volcanic Group and Brighton Group, a significant thickness of Heytesbury Group material is expected to be present, although not mapped at the surface in the project area. The Heytesbury Group in this location is likely to consist of the Miocene aged Port Campbell Limestone, predominantly calcarenite and minor calcilutite, overlying Gellibrand Marl, comprising calcareous silty clay and clayey silt. In the north of the site, Cambrian aged granite and amphibolite (metamorphosed volcaniclastic sandstone) are expected to underlie the Heytesbury Group materials, but at a depth unlikely to impact the project.

3.3.2 Near surface materials

With reference to Figure 2, there are four predominant geological units that are expected to be present close to the surface at the site, these are provided in Table 3.1. The recent alluvial units have been combined into a single unit, Unit 1, as the engineering properties are expected to be generally similar.

Table 3.1 Anticipated near surface geological units

Age	Unit reference	Map symbol	Description
Quaternary alluvium (Holocene)	Unit 1	Qra	Fluvial soil - Gravel, sand, silt and clay (creek and river deposits)
		Qm1	Paludal soil - Clay, silt and sand (swamp and marsh deposits)
		Ql2	Lacustrine soil - Clay, silt and sand (lake deposits)
Quaternary terrace alluvium (Pleistocene to Holocene)	Unit 2	Qa2	Alluvial terrace soil – Gravel, silt and sand (floodplain deposits)
Newer Volcanics (Pliocene to Pleistocene)	Unit 3	Neo	Basalt lava flows with minor tuff and scoria and occasional intercalated sediments.
Brighton Group (Pliocene)	Unit 4	Nb	Gravel, sand and silt, with variably ferruginous to calcareous sandstones and coquinas.

Most of the site is expected to be underlain by basalt of Unit 3. Peck et al. (1992) explains that the Newer Volcanics Group has been formed by volcanic activity during the last 4.6 million years. The lava flows are distributed radially from each eruption point, building up a series of overlapping layers. These are generally thin layer flows ranging from 0.5 m to 10 m thick, with most being no greater than about 5 m thick.

Groundwater bore logs from the VVG website indicate weathered basalt varies between about 1 m and 30 m thick and comprises multiple flows with different degrees of weathering. The basalt is predominantly approximately 10 m to 20 m thick. The basalt is generally underlain by clay or sand (inferred Brighton Group), and marl and limestone (of the Heytesbury Group) to a significant depth. Towards the boundary between where basalt is mapped and the Brighton Group is mapped, it is expected the thickness and quality of basalt rock will be reduced.

Basalt is not expected to be present in the southeastern part of the site, closer to the Hopkins River. In the southeastern corner, the Brighton Group is expected to comprise red sands, clays and gravels with potential ferricrete and calcrete nodules and bands. One groundwater bore in this area indicates about 20 m of this material before encountering calcareous material, with limestone encountered at approximately 27 m depth. Approximately five WTGs are located where the Brighton Group has been mapped.

In the northeastern part of the site, the basalt is expected to be overlain by quaternary terrace alluvium. One groundwater bore in this area indicates clay to a depth of 11 m overlying a very thin layer of basalt which is underlain by yellow clay (inferred Brighton Group). Approximately 15 WTGs are likely to be located in areas where terrace alluvium is mapped. It is noted that older geological maps described this material as part of the Brighton Group. Although the presence of basalt below the soil in this area suggests the terrace alluvium interpretation is more accurate, there is the potential that the terrace alluvium may be directly underlain by Brighton Group material, with no basalt present.

There is recent alluvium associated with the numerous creeks running across the site area, as well as with the Hopkins River. Additionally, quaternary swamp and lake deposits occur across the site. Approximately five WTGs are located in areas where quaternary alluvial or lake deposits are mapped, close to the Hopkins River. Additionally, numerous site access roads traverse areas where swamp and alluvial deposits have been mapped.

3.3.3 Weathering

Due to the fluid flowing nature of the lava, air and water vapour is trapped during solidification resulting in small voids (known as vesicles) which may be filled with secondary minerals such as calcite or quartz (known as amygdales). Vesicles and amygdales are common on the upper and lower boundaries of lava flows while the centre of the flow typically includes molten lava which cools relatively slower, often forming vertical columns which are typically hexagonal. The joints between the columns allows for complex weathering profiles which often results in high strength corestones surrounded by soil or weathered rock. This is illustrated in Plate 1. Sub-horizontal palaeosols (relict soil layers) may also be present between basaltic flows of different ages.

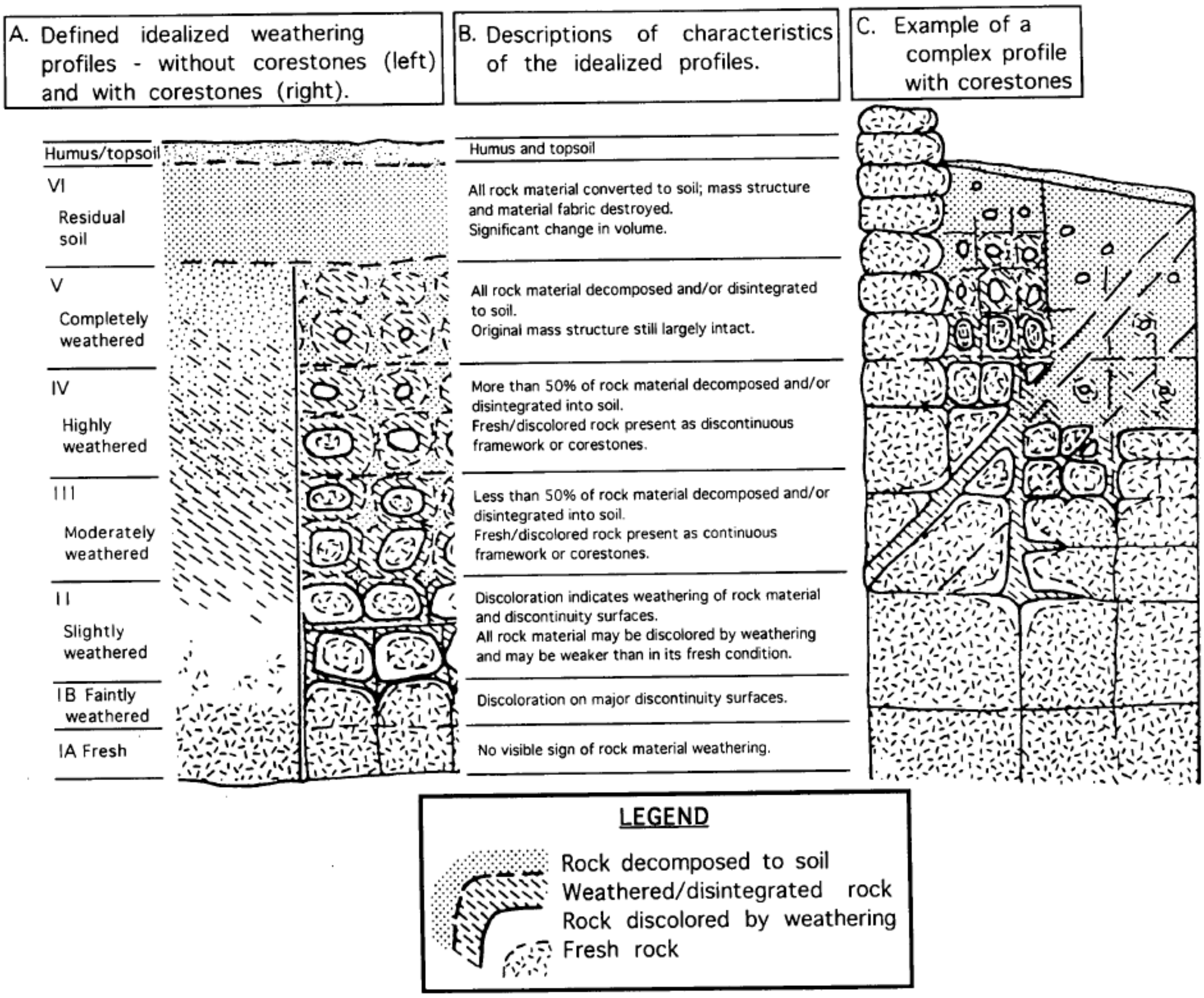


Plate 1: Typical weathering profile for basalt (sourced from Lambe, 1966)

The weathering of the newer volcanics as described above results in a layer of residual basaltic clay overlying weathered rock. The depth of weathering can vary greatly (up to 3 or 4 m vertically) over short distances. The residual soils are typically classified as high plasticity clay and often contain basalt corestones as depicted in Plate 1 and shown in Photo A5. Residual basaltic clay is typically susceptible to volume changes in response to moisture changes.

Due to the time span over which the basalt lava flows have taken place, interflow weathering can occur resulting in layers of residual soil in-between basalt flows.

Regolith mapping of the Western Plains by Joyce (1999) indicates that this site is within the Dunkeld Terrain Unit. This is generally formed by moderate aged basalt flows within the Newer Volcanics Province (1-3 million year old) which has allowed time for limited weathering to occur. This produces a landform dominated by plains with gilgai (small ephemeral lakes). The regolith description of this Terrain Unit has been split into two subunits, for earlier flows within the unit and for later (more recent) flows.

Based on the description of landform, the later flows appear to be more relevant to this site. Regolith in this subunit is described as ‘hard pedal red to grey mottled-yellow duplex soils 1 to 2 m deep with abundant iron pisolites in subsoil & gilgai surfaces, with rounded corestones at depth over weathered basalt on gently undulating plains.’

Groundwater bore logs from the VVG website indicates the residual basaltic clay profile is commonly about 2 m thick. During the site visit, basalt was occasionally observed at the surface (see Photos A2 and A3), generally in, or near, the slopes of creeks and swamps. The observations from the site visit, combined with the groundwater bore logs, are generally consistent with the regolith description in Joyce (1999).

3.4 Landform and Soil

3.4.1 Landform

The Victorian Geomorphology Framework (VGF) is a spatial framework that consists of a three-tier hierarchical system of land unit descriptions and divisions. The project site area is located in the Western Plains (WP) ‘tier one’ division which is made up of three distinct sub-divisions:

- 6.1 Volcanic plains.
- 6.2 Sedimentary plains.
- 6.3 Hills and low hills.

Three geomorphological units have been mapped within the study area, as shown in Figure 6. These are described in Table 3.2. The geomorphic mapping is generally consistent with the geological mapping and the associated geological units listed in Table 3.2.

Table 3.2 Landform units (GMU250) mapped within the study area

GMU250 code	Landform description	Location within project site	Geological unit(s)	Predominant soil type
6.1.3	Volcanic derived plains with poorly developed drainage and shallow regolith	Across the majority of the site	Unit 3	Vertosols
6.1.5	Volcanic derived terraces, floodplains and lakes, swamps and lunettes and their deposits	Minor areas near Mustons Creek and Immigrants Lane	Units 1 & 2	Sodosols
6.2.4	Sedimentary derived plains and plains with low rises.	Minor area in southeastern area of site near Ross Lane	Unit 4	Kandosols

3.4.2 Soil Types

The major soil types, from the Australian Soil Classification system (Isbell, 2021), as shown in Table 3.3, are:

- Vertosols: clay soils with shrink/swell properties that display strong cracks when dry and have slickensides and/or lenticular structural aggregates at depth.
- Sodosols: soils with strong texture contrast between the A and B horizons. The subsoil is sodic but not strongly acidic.
- Kandosols: soils lacking strong texture contrast, with massive or only weakly structure B horizons, and are not calcareous throughout.

Susceptibility of the soil types to different types of erosion, as listed in the GMU250 dataset, are summarised in Table 3.3.

Table 3.3 Soil type susceptibility to forms of erosion

	Rill erosion	Gully erosion	Landslip	Wind erosion
Vertosols	Moderate	Low	Very low	Low
Sodosols	Low	Moderate	Low	Low
Kandosols	Moderate	Low	Very low	Moderate

During the site visit, no signs of rills, gullies or dispersive soils were observed in sloping areas near the Hopkins River or the various creeks in the proposed HWF area. Nevertheless, given the identified susceptibility of soils to erosion proposed earthworks will need to consider measures to mitigate erosion and sediment migration risk.

3.4.3 Acid Sulfate Soils

The CSIRO Acid Sulfate Soils Probability map of the site is shown in Figure 7. It indicates generally a "low probability of occurrence" with localised areas of "high probability of occurrence," noting that both of these ratings are provided with "very low confidence." The areas of high probability are associated with lakes or swamps. No major proposed infrastructure, including the proposed quarry location, intersects these locations.

Soil observed in mapped swamp, lake and alluvial deposits during the site visit are considered to be high potential acid sulfate soils, however soils derived from the weathering of basalt are considered very low risk.

3.4.4 Soil Salinity

According to Victorian Resources Online (VRO) by Agriculture Victoria, the proposed site is located entirely within Salinity Province 81, Mortlake Caramut, in the Glenelg Hopkins Catchment Management Region (CMR). Plate 2 shows recorded salinity areas in the project area. Comparison with Figure 2 shows that these generally align with areas with mapped Unit 1 materials, such as swamps, lakes and along water courses. Photo A12 shows potential salinity in a swampy area near WTG T84.

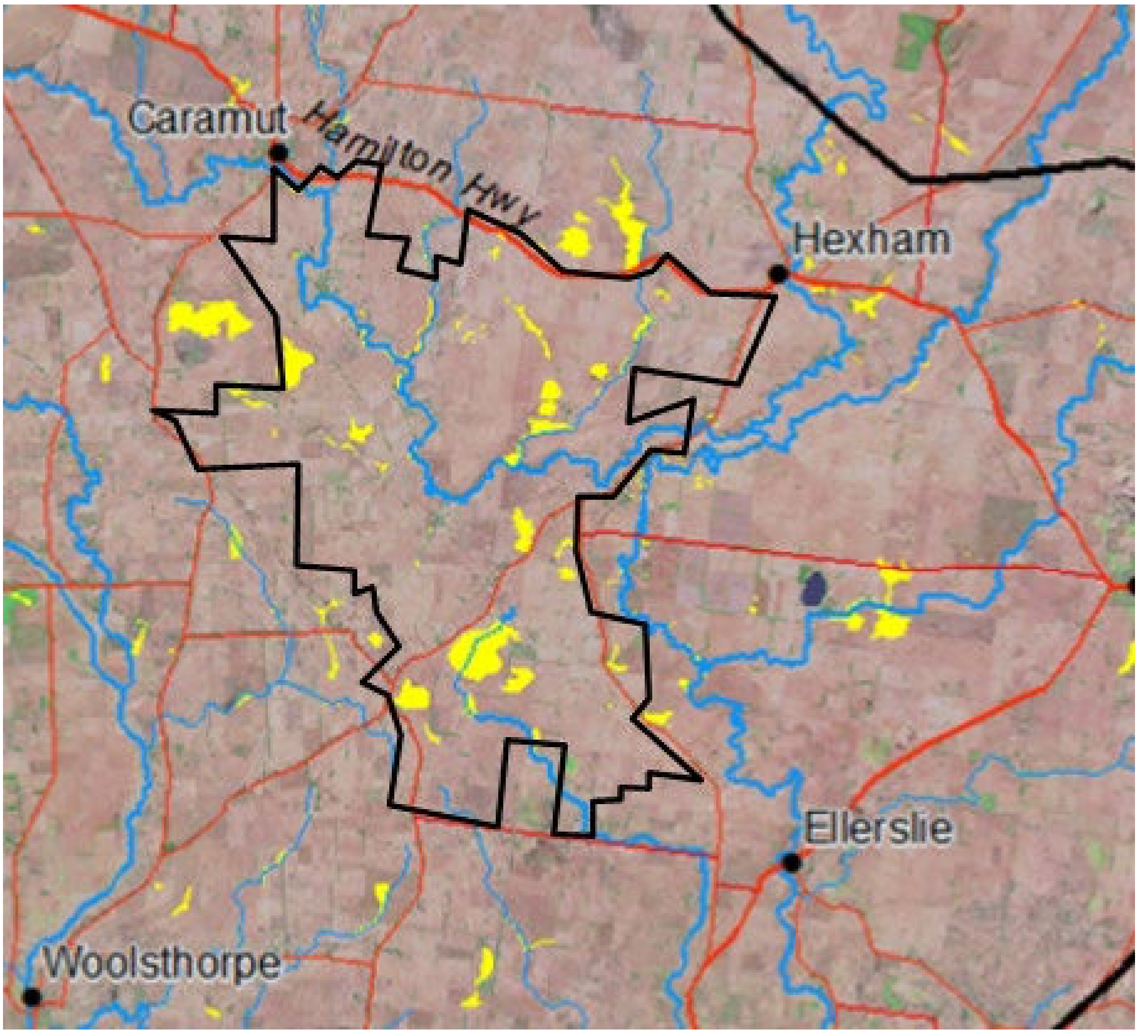


Plate 2: Soil salinity from VRO (recorded salinity areas in yellow) with approximate project site boundary in black.

3.5 Sites of Geological Significance

There is one geologically significant feature within the site boundary. It is associated with an additional geological unit mapped within the site boundary with the symbol Nep1 on Figure 2. There is no infrastructure proposed where this material has been mapped, however, WTG T79 is approximately 50 m from the mapped boundary. The unit is part of the Newer Volcanic Group but consists of tuff rather than basalt. The unit is described as ‘tuff rings: pyroclastic base surge and fall deposits consisting of ash, lapilli, scoria, volcanic bombs and calcareous lithic fragments.’ There are three lake deposits associated with the feature, although only the most southern appears to be perennial.

The geologically significant feature is described as ‘maars surrounded by tuff rings and containing lake deposits in their craters’ and is listed as a feature of regional significance on the GeoVic website.

3.6 Earthquake

A review of earthquake records on the GeoVic website indicates there have been earthquakes with magnitude up to 2.7 within about 20 km of the proposed HWF. Figure 3.2(A) of Australian Standard AS1170.4:2024 ‘Structural design actions, Part 4: Earthquake actions in Australia’ indicates that the hazard factor (z) for the study area is 0.08, which is the lowest in Victoria.

3.7 Tenements

The GeoVic website does not list any active or historical quarries within the site boundaries. One petroleum exploration borehole was drilled near Woolsthorpe in 1968 and another south of Caramut in 1990. One base metals exploration borehole was drilled north of Caramut in 1994.

Several active minerals and petroleum tenements overlap within the site boundaries, these are listed in Table 3.4.

Table 3.4 Active tenements in study area

Tenement number	Type	Owner	Expiry date	Material
EL006869	Exploration Licence	Westrock Minerals Pty Ltd	26/04/2025	Base metals
EL007985	Exploration Licence	Mitre Hill Pty Ltd	Not Listed	Rare earth elements; base metals
EL007994	Exploration Licence	Mitre Hill Pty Ltd	Not Listed	Rare earth elements; base metals
EL5512	Exploration Licence	Mallee Mining Pty Ltd	13/07/2024	Base metals; gold
PEP175	Exploration Permit	Mirboo Ridge Pty Ltd	30/06/2027	Petroleum

3.8 Surface Hydrology

The GeoVic website indicates that the site is not located within a designated catchment area or water supply protection area.

3.9 Groundwater

3.9.1 Groundwater Management Areas

The GeoVic website indicates that the entire site is located within the South West Limestone Groundwater Management Area (SWL GMA). The SWL GMA includes the Port Campbell Limestone but excludes the overlying Quaternary and upper Tertiary aquifers (Unit 3 and Unit 4).

3.9.2 Aquifer Units

The main hydrostratigraphic units in the project area and their properties are summarised in Table 3.5.

Table 3.5 Summary of regional hydrogeological units

Unit	Thickness (m)	Aquifer type	Typical salinity (mg/L)	Typical bore yield (L/sec)
Newer Volcanics Basalt	Up to 25	Unconfined and confined fractured basalt aquifer	1001 – 3500	Less than 1.5
Brighton Group	10 to 40	Unconfined and confined sand aquifer	1001 – 3500	Less than 1.6
Port Campbell Limestone	20 to 80	Semi-confined limestone aquifer	1001 – 3500	1 to 25

Sources: Southern Rural Water, South West Victoria Groundwater Atlas, National Water Commission

J Leonard, Victoria's Groundwater Resource: A Summary, Geological Survey of Victoria, 1988

3.9.3 Groundwater Levels

Groundwater levels in the project area estimated as part of state-wide mapping of groundwater levels as part of the Victorian Aquifer Framework are shown in Figure 5. This indicates that the depth to groundwater across the project area is likely to be predominantly less than 10 m below ground level (m bgl). Groundwater is likely to discharge to the main surface water channels, so the depth to groundwater would be shallow in the lower parts of valleys around the rivers and creeks, locally increasing up to 20 m bgl in the upper reaches of valley slopes where there is greater relief.

A search of registered boreholes on the VVG website was undertaken to identify the monitoring wells for which long term groundwater level monitoring data may be available. Four boreholes in the vicinity of the site were identified. The depths to groundwater observed in the bores are shown in Plate 3. The legend notes the aquifer in which the well screens are located.

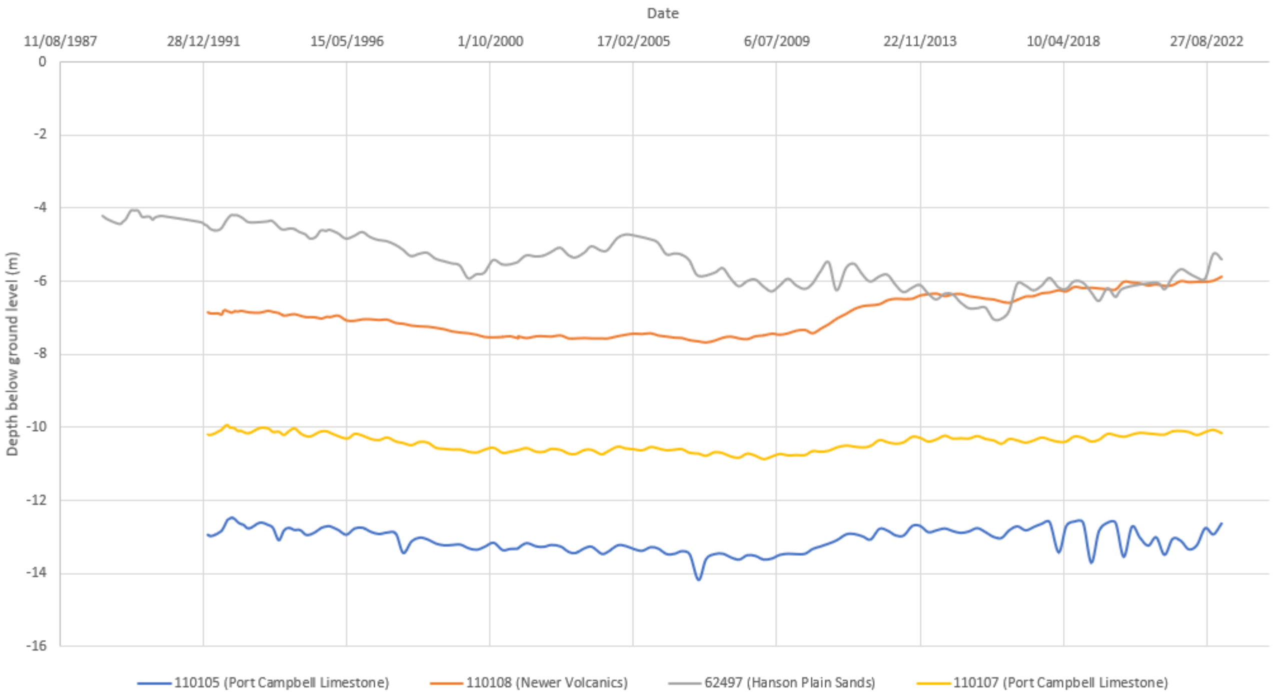


Plate 3: Groundwater depths at registered wells

Bore 110108 is located about 3 km east of Minjah and is 14 m deep. The screened interval is not recorded, however, the bore is entirely within the Newer Volcanics, so is assumed to be screened within this unit. The depth to groundwater has varied between about 6 m bgl and 7.5 m bgl over the monitoring period from 1992 to present.

Bore 62497 is located in Ellerslie, approximately 200 m east of the Hopkins River, is 30.48 m deep and screened from 17.10 m bgl to 18.29 m bgl, within the Brighton Group. The depth to groundwater has varied between about 4 m bgl and 7 m bgl over the monitoring period from 1988 to present.

Bore 110105 is located about 2 km northeast of Caramut, is 80 m deep and screened from 36 m bgl to 78 m bgl, within the Port Campbell Limestone. Bore 110107 is located about 3 km east of Minjah, is 70 m deep and screened from 58 m bgl to 70 m bgl, also within the Port Campbell Limestone. Groundwater in these bores has been between 10 m bgl and 14 m bgl over the monitoring period from 1993 to present.

3.9.4 Groundwater receptors

Aquatic groundwater dependent ecosystems (GDE) are mapped along the various rivers, creeks and swamp areas within the project area (see Figure 3). This indicates that the rivers, creeks and most of the swamps are likely to be receptors of groundwater discharge, and associated ecosystems rely on the surface expression of the groundwater. Terrestrial groundwater dependent ecosystems are mapped in scattered locations across and surrounding the project area. These areas have the potential for vegetation to be reliant on sub-surface groundwater. Much of the GDE mapping is based on remote sensing data and would require confirmation on the ground.

There are numerous registered bores within the project area with extractive uses including water supply, stock and domestic, irrigation, and commercial/industrial. Some bores would extract from the deeper Port Campbell Limestone aquifer, but many shallower domestic and stock bores would rely on the water table aquifers of the Newer Volcanics and Brighton Group.

3.9.5 Groundwater quality

State-wide mapping indicates shallow groundwater in the project area is likely to have salinity ranging from 1,001 mg/L to 3,500 mg/L total dissolved solids (TDS).

A review of information on groundwater quality in the project area was undertaken using the information provided on VVG. Approximately 32 wells were identified with chemical data available within the site boundary. The available information was collected between the 1960's and 1990's. A summary of the available data from a selection of 14 wells is provided in Table 3.6. These wells have been selected to provide good coverage of the site area and representation of the groundwater quality. The selected well locations are shown in Figure 5.

The data indicates that salinity is generally within the range provided in the state-wide mapping, between 1,001 mg/L and 3,500 mg/L, with occasional readings above that range. With reference to the *Environmental Reference Standard* (ERS) this places the groundwater salinity as predominantly Segment B (1,201 mg/L to 3,100 mg/L) into Segment C (3,101 mg/L to 5,400 mg/L). These Segments may both be suitable for all purposes other than potable water supply. Segment C is also likely to be unsuitable for irrigation.

The pH, chloride and sulfate concentrations indicate non-aggressive groundwater conditions, with reference to *AS2159-2009: Exposure classification for steel and concrete piles*. Considering the age and coverage of the data, it is recommended to confirm groundwater chemistry within the project area if structures are likely to intersect groundwater, particularly near areas of mapped soil salinity (Section 3.4.4).

Table 3.6 Summary of chemistry from registered wells

Well ID	Date Recorded	Screen Interval (m)	Aquifer *	pH	EC (µS/cm)	Total Soluble Salts (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
54488	07/11/1962	*Unknown*	*Unknown*	8.0	-	4,142	2,120	279
66995	28/01/1996	18.3 to 21.3	Newer Volcanics	8.2	10,000	6,365	3,300	440
66997	30/01/1989	19.2 – 21.3	Newer Volcanics	8.2	6,600	3,732	1,900	210
66998	07/02/1991	27.4 – 38.1	Port Campbell Limestone	7.8	4,700	2,496	1,300	90
89336	13/08/1971	18.3 – 22.9	Newer Volcanics	8.0	2,976	1,735	642	-
89337	22/04/1973	25.0 – 32.3	Brighton Group	8.4	6,489	3,874	1,800	240
89340	13/02/1983	30.0 – 48.0	Port Campbell Limestone	8.2	4,200	2,306	1,200	90
109259	16/05/1972	25.9 – 26.8	Newer Volcanics	8.4	5,906	3,508	1,761	-

Well ID	Date Recorded	Screen Interval (m)	Aquifer *	pH	EC (µS/cm)	Total Soluble Salts (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
109263	08/01/1981	*Unknown*	*Unknown*	8.0	4,130	2,545	1,068	88
109274	27/06/1980	6.7 – 24.4	Newer Volcanics	7.9	4,750	3,081	1,275	105
109279	05/01/1982	6.1 – 11.5	Newer Volcanics	7.6	6,000	3,543	1,740	230
109281	22/07/1982	6.0 – 24.4	Newer Volcanics	8.7	1,900	1,137	458	29
109287	20/06/1987	19.8 – 25.9	Newer Volcanics	8.3	4,300	2,608	1,100	120
111609	15/11/1991	45.0 – 48.0	Port Campbell Limestone	7.4	3,900	2,202	1,100	67

*Aquifers were not recorded in bore details, inferred using recorded screen depth and drillers' logs.

3.10 Contamination

The proposed infrastructure layout including towers, tower bases, cabling, roads, set down and operational areas were reviewed in relation to recent (2006, 2020) and historical (1947) land use.

3.10.1 Aerial photograph review

The 1947 aerials were sourced from Department of Energy, Environment and Climate Action (DECCA)[1]. Photographs were available at 1:15,840 scale and covered the entire development area.

The 1947 aerial images show the development area to be cleared farmland, with the drainage lines (creeks) and swampy areas being dominant features. Two farm properties (comprising multiple buildings and ancillary activities) were observed - one in the northwest and one in the centre of the development area – which are still present today. Neither complex is close to proposed HWF infrastructure. Limited areas of potential cropping were noted.

No significant changes in land use were noted between 1947 and satellite images in 2006. Areas of potential cropping were noted in the northeast of the development area in particular and one of the creeks had been dammed creating an open water body in the centre north of the development area.

The review of 2020 satellite images again indicated similar land use, but with more evidence of potential cropping in paddocks located close to, or along creek lines, especially in the northeast and through the centre of the site around one of the historical farm properties.

Based on the desktop review and limited site inspection, land use predominantly comprises cleared paddocks for stock grazing (sheep, cattle), with some areas that appear to be cropped. Inspected areas appeared fallow at the time of inspection and crop types within the region are not established at this time.

Wind farm infrastructure is located within cleared paddocks with access tracks to the towers located along existing tracks, or fence lines. A review of the recent satellite images did not identify any significant farm infrastructure within the vicinity of proposed structures that might be sources of potential contamination.

1 http://mapshare.vic.gov.au/webmap/historical-photomaps/

3.10.2 EPA records

A review of EPA records was completed through the Victorian Government's 'Victoria Unearthed' online database, which includes records of:

- Completed statutory environmental audits (i.e. sites previously identified as being potentially contaminated and requiring assessment for redevelopment)
- EPA licensed sites
- Former landfills
- Priority Sites, being sites that have been identified to EPA as having known contamination and that EPA has determined requires ongoing investigation, management and/or clean up
- Sites with a groundwater quality restricted use zone, which indicates residual contamination of groundwater from historical site practices that limits use of groundwater for one or more environmental values
- Site with an environmental audit overlay, indicating potential for contamination from current or historical activities.

No relevant records were identified within the proposed development area.

4 Impact Assessment

4.1 Key Soil and Landform Impacts

4.1.1 Impact Pathways

This section investigates the likely impact pathways of identified activities associated with the construction, maintenance and decommissioning of the proposed wind farm.

The impact pathways relevant to the HWF project are modifications to soil, modifications to landforms and topography and impacts to groundwater. A summary of the impact pathways is described in Table 4.1 below.

Table 4.1 Summary of potential Impact Pathways for HWF development

Activity	Impact Pathway	Land Use Impact
Earthworks including topsoil stripping, grading for roads etc.	Upper soil horizons disturbed and exposed to rain and wind resulting in increased erosion risk.	Soil loss through erosion, increased sedimentation in watercourses and reduced land productivity.
	Disturbance & compaction of surface and sub-surface soil can alter surface water flow.	Decreased agricultural productivity and potential for waterlogging of paddocks.
Cut & Fill earthworks for access roads, hardstands, cable trenches and quarrying.	Alteration of topography.	Permanent landform change effecting long term land use suitability for agriculture.
	Disturbance & compaction of surface and sub-surface soil can alter surface water flow.	Decreased agricultural productivity and potential for waterlogging of paddocks.
Concrete washout, diesel & fuel storage, waste material handling.	Contaminants enter soil profile and require remediation.	Temporary or long term loss of land use for agriculture.
Importation of fill materials.		
Dewatering for construction purposes during construction phase.	Acidification of groundwater from potential acid sulphate soils which may discharge into nearby groundwater dependent ecosystems.	Temporary or potentially permanent impact to local groundwater resources in terms of quantity and quality e.g. agricultural bores and stock water.

4.1.2 Design Mitigation

The assessment has shown that the proposed development and associated infrastructure has the potential to impact the landscape. Although specific designs have not yet been provided to WSP, based on our understanding of the proposed infrastructure and similar infrastructure constructed as part of other wind farm developments in Victoria, there is a number of controls or project design methods that can be adopted in order to mitigate likely impacts. The following section discusses these design mitigation measures with a summary provided in Table 4.4

4.1.2.1 Soil disturbance and erosion from construction activities

Detailed design for the proposed wind farm will need to consider the potential for the works to disturb soils at the site and increase erosion. The potential for soils to erode is generally based on the grading of the soil (i.e. the proportion of clay, silt, sand and gravel) and its organic content. Silt and fine sands are typically more readily eroded than clays, coarse sands or gravels. Well-vegetated soils are typically less susceptible to erosion.

Based on the materials observed during the site visit (mainly basaltic clay soils), and our experience on other sites with basaltic clay soils, it is considered that the soils encountered on the site are likely to have low susceptibility to erosion.

The topsoil may be susceptible to erosion following stripping of vegetation. We note that the potential for erosion to occur also depends on environmental factors such as exposure to wind or surface water runoff.

Environmental Protection Authority Victoria publication number 275 (dated May 1991) "Construction Techniques for Sediment Pollution Control" should be referred to for advice on measures to reduce sediment transport on construction sites and we recommend that this is consulted in preparation of construction management plans in this regard.

Care will need to be taken with the construction and maintenance of sediment control measures to ensure their continued performance through the life of the project.

With regards to likely earthworks issues, we provide the following general comments:

- Given the flat slopes at the site, construction of access roads and hardstand areas is unlikely to generate high cut and fill batters. We expect that the final surface level of these areas will need to be above the surrounding ground surface level to maintain freeboard above design flood levels and to assist with surface drainage controls.
- The residual basaltic clay may contain corestones, or 'floaters', of basalt. Where these are encountered and must be removed from within the clay, the result can be over-excavation. This can be particularly problematic for detailed excavations such as WTG footings and trenches.
- The residual basaltic clay typically contains extensive, slickensided fissures which are unfavourable for stability. Batter angles generally flatter than 2H:1V are required resulting in greater footing excavation area and larger quantity of excavated material. This is also the case for weaker soils in Unit 1 and Unit 2 materials. If batters higher than about 4 m are required, benches may need to be incorporated into the batter design.
- The Unit 4 Brighton Group materials are not expected to support temporary batters steeper than about 1H:1V and benches are likely to be necessary where batters are higher than about 4 m.
- Assuming the adoption of good construction practices such as erosion protection of exposed cut and fill batter slopes, drainage controls and the implementation of silt fences where required, erosion of cut and fill batters is not considered to be a significant issue for the proposed HWF, taking into account the shallow site slopes.
- The availability of water for construction purposes (e.g. moisture conditioning of fill and dust control) is not expected to be a significant issue provided water can economically be obtained from nearby sources. We recommend testing of groundwater wells to assess yields that can be achieved from groundwater bores. Noting that the site is within a Groundwater Management Area, which places a limit on yields from the Port Campbell Limestone aquifer.
- Stockpiling of excavated materials, including topsoil, should consider stability of the stockpile, potential for run-off, sedimentation, and appropriate erosion protection and/or bunding.
- Stripped surfaces should be revegetated back to a standard similar to the surrounding natural landscape.

4.1.2.2 Acidification of groundwater through transport of acid sulfate soils

The Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils by the Department of Sustainability and Environment (DSE 2010) describes the steps to manage potential acid sulfate soils (PASS) and actual acid sulfate soils (AASS). This involves investigation of soil as well as surface and groundwater to assess the hazard. The guidelines provide requirements for sampling frequency to be undertaken in the investigation, with reference to EPA Bulletin 655.1 'Acid Sulfate Soil and Rock.' Where the hazard is found to be low or medium, management is considered possible using standard practices. Where the hazard is found to be high, earthworks within that area should be avoided.

Based on the CSIRO Acid Sulfate Soils Probability map of the site, as shown in Figure 7, there is currently no proposed infrastructure in areas of a "high likelihood of PASS or AASS". However, there are some locations within the proposed development where access tracks and underground cabling infrastructure will have to pass through areas with Unit 1 materials which may result in a high hazard that cannot be avoided. Site-specific investigations and soil testing at these locations will confirm whether this high hazard exists in areas mapped as Unit 1. The guidelines require for a high hazard situation that careful management is documented in an Environmental Management Plan (EMP) which includes an Acid

Sulfate Soil Management Plan (ASSMP). Best practice management strategies for acid sulfate soils are described in Section 10 of the DSE 2010 guidelines.

Risks associated with construction works within areas of PASS and AASS are most likely to arise from:

- Stockpiling of PASS and AASS that may result in acid runoff impacting on surface waters.
- Dewatering for construction purposes leading to acidification of groundwater which may discharge to nearby GDEs.

Dewatering, if required, will be limited in duration and extent to localised footprints associated with construction of tower footings and areas of shallow cable trenching which, with their greater lateral coverage of the designated windfarm footprint, are more likely to traverse any areas of PASS and AASS. The temporary periods of dewatering will limit the potential for oxidation of sulfides in areas of underlying PASS and AASS soils and following construction groundwater levels would be expected to rebound to former static levels, re-submerging PASS and AASS soils. Construction methods that reduce the need for dewatering or minimize the extent of drawdown around the excavations should be employed in areas where both shallow groundwater and PASS/AASS is confirmed via testing. As part of any future preliminary site investigation works, groundwater analysis will be required to test for potential acid sulfate soil contamination in the groundwater. Ongoing monitoring of groundwater quality during the construction phase will also be required. If dewatering is required in areas where acid sulfate soils have been identified through testing, the ASSMP should include appropriate strategies to manage any associated risks.

If PASS/AASS material is required to be excavated, extended periods of stockpiling of such soils may allow for sulfides within the soils to oxidise with resultant acidic runoff impacting nearby waterways or surrounding lands. Typical construction methods employed for managing excavated PASS/AASS (where immediate reinstatement is not possible) include placement of excavated soils within a dedicated storage pad that allows for treatment of soils (liming to increase acid neutralizing capacity in the event of acid generation) and the capture and treatment of acidic runoff. Excavated PASS soils may potentially be reused for backfilling of trench excavations following treatment to ensure no ongoing net release of acid (and verification of treatment efficacy), and subject to geotechnically suitability. Where treatment is not practicable onsite and excavated PASS/AASS soils need to be disposed off-site, they would be classified as WASS with a waste code of N123. This WASS will need to be treated and disposed of at an L08 registration site, which is permitted to receive WASS - disposal off-site is considered the least preferred method of disposal.

A site that is licensed to receive waste acid sulfate soils would need to be identified resulting in transport of soils offsite. During the detailed design stage, especially for trenching, the presence and depth profile of PASS/AASS should be considered, and where practicable, designs adjusted to minimize disturbance of PASS/AASS consistent with principles of the Environment Protection Act 2017 (prevention, and the waste management hierarchy (avoidance)).

The proposed quarry is not located in an area identified as potential acid sulfate soils, as indicated in Figure 7, and the underlying basaltic soils and rock are not considered potential acid sulfate material. Once details of the proposed quarry location are confirmed it is recommended that an acid sulfate soil risk assessment be completed in order to identify any potential risks associated with its construction. Groundwater is mapped as being in the order of 5-10 m below ground level, and extraction of resources may require active dewatering under a Take and Use license from Southern Rural Water. It is noted that there is a Groundwater Dependent Ecosystem (GDE) to the northwest of the proposed quarry area; while this is not mapped as an area of potential acid sulfate soils, other GDEs within the wider HWF area are aligned with mapped acid sulfate soils. Further review of the site conditions is therefore recommended, especially if dewatering at the quarry site has a potential to impact on this GDE through groundwater drawdown and resultant exposure and acidification of sulfidic material, if present.

A detailed hydrogeological assessment associated with quarry dewatering is to be completed as part of Take and Use license application submitted to Southern Rural Water. The assessment will be required to demonstrate acceptable interaction with surrounding extractive users and GDEs for license approval. Site-specific soil testing at the quarry site will also be required to confirm the absence of PASS soils as indicated in Figure 7.

4.1.2.3 Impacts of Saline & Sodic soil transportation

Salinity issues can arise following development works if the works disturb natural groundwater flows (e.g. installation of retaining walls or cutting/ and terracing land). Salts are typically higher at depth in the soil, but changes in the groundwater flows that lead to surface seepage can mobilise salts to the surface where they accumulate as water evaporates. Infrastructure projects can also cause localised salinity issues to soil and surface water if, through poor soil management, saline subsoils are placed at the surface.

The presence of sodic/dispersive soils can also be of concern to infrastructure projects as poor management can lead to the development of tunnel and surface erosion resulting in an increased risk to the micro-topography that may result in landform degradation and increased sediment export.

In almost all cases, tunnel and surface erosion results from the surface disturbance of soil (such as during development of a precinct) though removal of stabilising vegetation and, where excavation occurs, allowing rainwater or stormwater to come into contact with dispersible subsoils. Changes to hydrology, including concentrating flow in culverts, runoff from hardstand areas, ponding of rainfall and land contouring further increase the risk of tunnel erosion. Typical activities that increase the risk of exposing dispersive subsoils to rainfall and stormwater include:

- the removal of topsoil,
- soil excavation and ground profiling works,
- trenching and supply of services,
- road and culvert construction, and
- the construction of dams and detention basins.

Increased run-off from developed land can lead to downstream environmental harm by:

- Increased sediment loading (and reduced water quality) in receiving water bodies, and
- Changes in stream hydrology (e.g. increased flow volumes or intensity) leading to bank instability and increased erosion risks in waterways.

In summary, the key hazards arising from development in areas of saline and sodic dispersive soils relate to surface erosion, damage to buildings, damage to infrastructure, and negative impacts to waterways. It is important to note that hazards can manifest in the short term (e.g. during construction phase) and the long term (e.g. loss of topsoil, channel instability and longer term water quality).

In Victoria, sodic soils are generally managed as a problem of agriculture, where routine management is required to maintain agricultural productivity of soils and limit adverse impacts such as erosion (e.g. application of gypsum, vegetation and slope management).

As erosion can impact surface waters, Catchment Management Authorities (CMAs) in affected areas have an interest in influencing land use (including revegetation of riparian zones) to minimise sediment loading in waterways and manage environmental water quality. Planning provisions in Victoria also require Planning Authorities to ensure waterways are protected and enhanced.

Salinity and sodicity are often discussed together as they are commonly a related concern. The other main reason they are related is that saline soil is not ideal for establishment of most vegetation and so is often bare and therefore prone to erosion. In addition, sodium can cause soil to disperse (rather than flocculate) increasing the inherent risk of erosion of these soils. When fresh water comes into contact with sodic soil, the soil can disperse, and the particles can then be transported in overland flow. Therefore, when saline and sodic soils are found together there is an increased risk of erosion.

Based on the findings of the desktop study and site walkover, the impact related to saline and sodic soil risk (surface soil) is considered to be low.

Most of the project area is grazing or cropping land on basalt plains and generally showed minimal evidence of surface erosion. The proposed locations of the turbines are away from the soils that have been identified as presenting a higher erosion risk (low lying swampy areas).

The main soil types are however, identified as having low to moderate risk of erosion and so it will be important that any potential impact is managed during the development phase of works. Typical advice for reducing risk includes minimisation of surface disturbance, installation of appropriate sediment controls during the works and ensuring site rehabilitation works are carried out post-construction (placement of non-saline, non-sodic topsoil and re-establishment of vegetation).

It is recommended that a soil and erosion management plan be developed for the project to ensure that the works are carried out with due consideration to this environmental issue. Further assessment of salinity and sodicity during detailed ground investigations is also recommended to confirm the findings of the desktop study and site walkover.

4.1.2.4 Modification to landform

As discussed in Section 3.2, site slopes are typically very gentle and flat at the majority of locations for proposed WTGs and associated infrastructure so we expect modifications to the existing landform to be relatively minor. The construction of the associated infrastructure (e.g. internal access tracks, buildings etc.) may require cut and fill activities and these earthworks could result in long term changes to micro-topography which could affect pasture usability.

Some of the construction methods available to mitigate impacts to the existing landform include:

Adopt shallow footing for WTG construction

- In our experience the preferred footing alternative for WTGs in Victoria is usually an octagonal shallow mass concrete footing, founding between about 1.5 to 3.5 m depth and with a maximum plan dimension of about 20 to 30 m. Piled footings are generally only adopted where the ground support conditions are unsatisfactory for shallow footings at the design founding level. The average vertical pressure imposed beneath the footings is usually relatively low. However, higher pressures are imposed beneath the edge of these footings when resisting overturning loads. The mass of the footing also assists to resist the relatively high overturning loads.
- Excavations for many of the proposed WTGs may encounter groundwater. If groundwater levels at a WTG location are above the proposed founding depth, the dimensions of a shallow mass concrete footing would need to be increased to account for increased uplift pressure. The groundwater depth should be thoroughly investigated during site specific investigations. This would include installation of groundwater monitoring wells into several boreholes with regular monitoring.

Adopt raised engineered fill platform for lightly-loaded structures

- Construction required for lightly-loaded structures built as part of the proposed HWF will depend on design requirements such as design loads and settlement/ground movement tolerances. It is understood that lightly-loaded structures are typically constructed following placement of an engineered fill platform to raise the surface above design flood levels as well as providing a level surface.
- WSP anticipate that temporary site offices will generally have a high tolerance to reactive ground movements, but elements of the terminal station or BESS may not. High plasticity soils associated with the Unit 3 Newer Volcanics are potentially highly reactive and significant shrink-swell movements can be expected due to seasonal changes in the moisture content of the soil. These reactive movements (shrink and swell of the soils) can impact lightly loaded structures and can present challenges for foundation stability and require alternative geotechnical design options (e.g. piling) which could result in more pronounced impacts or changes to the existing landforms.

4.1.2.5 Rehabilitation and long-term land use

If access roads, turbine pads and laydown areas are not rehabilitated or managed appropriately, compacted or degraded soils may persist and reduce agricultural productivity in the medium to long term. Also to be considered is the ongoing access for turbine maintenance which could necessitate permanent road construction, requiring long-term erosion and drainage management strategies.

When the quarry is decommissioned, consideration should be given to minimisation of soil erosion and runoff, which may lead to degradation of surrounding landform. Decommissioning will need to be considered in accordance with the appropriate Victorian Legislation and Earth Resources Guidelines and codes of practice set out by DEECA, including the Mineral Resources (Sustainable Development) Act 1990 [2] and Geotechnical Guidelines for Terminal and Rehabilitated Slopes[3]. These guidelines recommend adopting a progressive rehabilitation approach where worked areas are progressively rehabilitated while new quarry sections are opened. Materials can be stripped from the new areas and placed directly on the worked areas that are being rehabilitated, this process is illustrated in Plate 4.

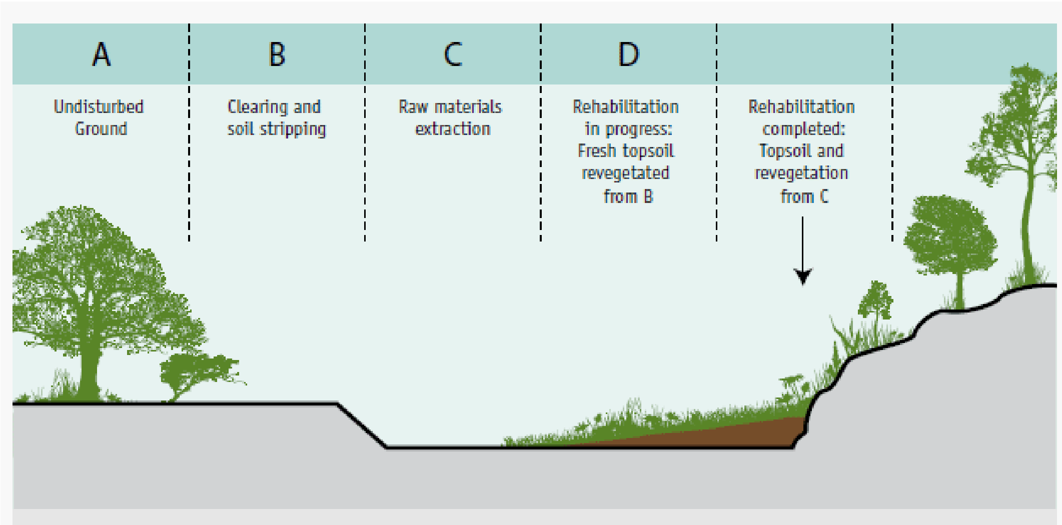


Plate 4: Progressive quarry rehabilitation, extracted from the Code of Practice for Small Quarries

If rehabilitation of the quarry requires placing of waste below the long-term groundwater table, please note that an A18 permit may be required under the Environment Protection Regulations 2021.

It is recommended that all slopes should be reduced to a 1V:3H gradient or less upon quarry closure or otherwise adopt artificial stabilising techniques, such as the use of geotextile mats or benching. The guidelines state that the best erosion prevention at a site is the establishment of vegetation on a stable landform. While vegetation is being re-established other erosion controls may need to be implemented, such as coir matting or drainage.

Notwithstanding the above commentary, the desk study has not identified any reasons that might prevent the quarry being operated and rehabilitated in accordance with the relevant state government guidelines. It is noted that the GeoVic website identifies a former basalt quarry immediately west of Hexham which can no longer be identified in the landform using current satellite and aerial imagery, indicating successful remediation.

4.1.2.6 Soil contamination potential

The use of concrete (turbine bases), fuels and lubricants (for machinery) introduces a risk of soil contamination from spills or leaks during construction. Temporary lay down areas used by plant & machinery in the construction of the wind

[2] Victorian legislation, 1990, the Mineral Resources (Sustainable Development) Act

[3] Earth Resources Regulations, 2020, Geotechnical guidelines for terminal and rehabilitated slopes

turbines, and on-site re-fueling zones pose particular risks if spill management and bunding controls are not in place. Other potential sources for soil contamination during the construction phase period include: cement slurry discharge at the concrete batching plant washout bays: localised contamination and soil pH imbalance from a thermal runaway event at the BESS facility; long-term site contamination caused by inadequate screening of imported fill or gravel to be used as engineered fill for the construction of temporary lay-down areas and hardstands.

Any soils that are deemed contaminated during the construction phase are defined as Industrial Wastes and will require characterisation in accordance with EPA Publications 1827.2, 1828.3 and managed in accordance with the Victorian Government 'Fill Determination'[4] for offsite disposal purposes, especially if soils are proposed to be transported across property boundaries for re-use on other parts of the development. It is noted that if soils are found to contain naturally elevated contaminants such as metals, EPA will be required to designate that contamination as 'naturally occurring' and transport of that soil to other geological settings within the development area may not be appropriate.

The following mitigation control measures can be implemented to help minimise or remove the impacts discussed above including:

- Implementation of appropriate spill prevention and containment measures like bunded fuel storage areas and spill kits at all active work zones.
- Designated lines washout areas at the concrete batching plants that are a minimum set distance (> 50 m) from a water way or drain.
- Routine soil inspections during construction; pH and EC spot testing in high-risk areas.
- The requirement of geotechnical and chemical certification for any imported soil or aggregate.
- The installation of silt fences and sediment basins to combat erosion and assist with sediment control.

4.1.2.7 Alteration of drainage and surface water flow

The schedule to the MSC FZ indicates that potential hydrological constraints on development principally relate to the potential for earthworks to change the rate of flow or the discharge point of water across a property boundary or to increase the discharge of saline groundwater.

Given the generally flat slopes of the site and the proposed locations of WTGs and associated infrastructure away from surface drainage paths, we consider it unlikely that earthworks associated with the proposed HWF will have a significant impact on surface drainage characteristics. However, drainage provisions will need to be provided in the detailed design of access roads and other proposed infrastructure.

The potential for earthworks or construction works to increase the discharge of saline groundwater (i.e. to have a significant impact on the net rate of water infiltration into the ground or evaporation from the ground) is considered to be low, taking into consideration that the proposed development is unlikely to include significant vegetation clearance works and that the use of water for construction works is likely to be small compared to current water usage for farming purposes.

Indications are that groundwater chemistry is not aggressive to steel or concrete structures, although this is based on outdated and sparse information, so should be confirmed during site investigations. Areas of mapped soil salinity may be associated with saline groundwater discharge and more aggressive soil and groundwater conditions. Soil disturbance and drainage modification in these areas would need to be managed to avoid increasing the salinized areas or causing saline runoff from disturbed soil. If these areas cannot be avoided for wind farm infrastructure, further investigation of soil and groundwater conditions is recommended. Where present, saline soil and groundwater would need to be considered in an EMP.

---

[4] Victorian Government, 2021. *Specifications Acceptable to the Authority for Receiving Fill Material.* Victoria Government Gazette No. S 301 Friday 18 June 2021

Groundwater quality is indicated to be potentially suitable for any use other than potable water, although testing on some bores found groundwater that is also unsuitable for irrigation. Potential bore yields from the aquifers that underlie the site are highly variable. In highly fractured areas of Unit 3 or sandier areas of Unit 4 yields can be much higher than the typical values reported in Table 2.5. If groundwater is proposed to be used for construction activities, further investigation would be required to measure the groundwater yield and quality that could potentially be gained.

The entire project is within the SWL GMA, which applies to the Port Campbell Limestone. Permission to extract groundwater from this aquifer would need to be sought from Southern Rural Water (SRW), subject to availability within the Permissible Consumptive Volume (PCV). From the SWL Local Management Plan (LMP), as at 2016 the SWL GMA had over 90% of the PCV allocated and Rule 8.2 of the LMP describes that trade shall be the primary mechanism to increase access to groundwater. Short-term licences may be granted for small volume extraction, up to 15 ML/year for projects.

Additionally, new groundwater extraction bores shall not be permitted within 200 metres of an identified waterway or potential GDE (as determined by SRW). Shallower aquifers (i.e. the Newer Volcanics and the Brighton Group) are not included in any GMA, so no PCV is in force. Applications for groundwater extraction are still required and would be assessed for potential interference to any nearby groundwater user. Any application for groundwater extraction would also need to consider potential effects on surface water stream flow and associated ecosystems.

4.1.3 Residual effects

Following the development of the design measures discussed in Section 4.1.2, an assessment of residual effects and impacts was completed describing the potential changes to soil and land form use brought about by the construction, operation and decommissioning of the wind farm and rating the significance of these residual effects according to Table 4.2 and Table 4.3.

Table 4.2 Impact significance criteria for soil and landform impacts

Negligible	Low	Medium	High	Very High
Projects results in negligible changes to soil and landform: — Has a negligible or temporary impact on the current or future utility of the resource	Project results in minor/isolated changes to soil and landform: — Has a minor impact on the current or future utility of the resource	Project results in changes to current soil and landform: — Has a medium term adverse effect on current or future utility of the resource	Project results in significant changes to soil and landform: — Has a long term adverse effect on the current or future utility of the resource	Project results in extensive changes to soil and landform: — Has a permanent adverse impact on the current or future utility of the resource

Table 4.3 Criteria for description of magnitude, extent, duration and sensitivity

Value	Significance		
	Low	**Moderate**	**High**
Magnitude	Soil/landform unaltered	Some effect on soil/landform but recovery expected	Effect has a permanent and adverse effect on the soil/landform
Extent	Localised effect (e.g. effect on a single turbine location)	May extend across most of the project footprint	Potential to extend beyond the project site boundary
Duration	Temporary	Short-term effect	Medium to long term/permanent
Severity	No degradation of soil/landform	Minor/temporary degradation of soil/landform	Significant/permanent degradation of soil/landform

The following section assesses the likely residual effects to soil and landform assets assuming design measures discussed in Section 4.1.2 are implemented. A summary of the residual effects is presented in Table 4.4.

4.1.3.1 Soil erosion & Sediment risk

Although the topography of the site of the proposed HWF is of generally low relief, if vegetation and topsoil is stripped and the sub-surface soils are left exposed for long periods during construction, localised slopes and existing drainage lines may be prone to erosion. Wind erosion may also be a risk during particularly dryer periods.

Erosion has the potential to have a high significance if no controls are on place. It may have an effect that has a permanent and adverse effect on the soil/landform and has the potential to extend beyond the project site boundary due to sediment transport.

If erosion and sediment controls are put in place in line with good industry practice, the significance would be reduced as the magnitude of the effect is assessed to some effect on soil/landform but recovery expected and the extent is likely to be within the project footprint.

Noting that the potential impacts to surface soils from site clearing were assessed to be localised (to access tracks and hardstands that are under construction at that time), for a moderate duration (expected to be over several weeks/months) and of low severity. Therefore, the significance of this impact was assessed to be **low to medium**.

4.1.3.2 Soil disturbance and compaction

The clay soils that are typically found at the site and discussed in Section 3.4.2, include cracking clay soils (Vertosols) that are highly susceptible to compaction under heavy construction traffic, particularly in wetter periods. In general, construction of turbine foundations and hardstands, internal access tracks and cable trenches will cause a moderate disturbance to the soil profile, particularly to the productive topsoil layer which is beneficial for pasture and cropping management. Also, any stockpiling of topsoil that is removed prior to the placing of any engineered fill layers will need to be subject to proper handling processes if the intention is to re-use the topsoil post remediation.

Soil disturbance and compaction effects are assessed to be localised to areas of focused earthworks (e.g. hardstands and access tracks) and last for the duration of the project only (if proper remediation procedures are created and implemented). The severity of the degradation of the topsoil is dependent on proper handling procedures being followed (including stripping, stockpiling and reinstatement of topsoil post remediation). If good construction procedures are in place and followed correctly, the significance of this impact was assessed to be **low**.

4.1.3.3 Impacts of Saline & Sodic soil transportation

The residual impacts of saline and sodic soils transportation, even after mitigation, can still pose risks to the landform, soil function, and long-term landscape stability. These impacts may persist due to the inherent properties of the soils found at the site. Based on the findings of the desktop study and the site walkover, there was minimal evidence of existing erosion throughout the site, therefore if long term site rehabilitation plans are in place including the installation of appropriate sediment controls, the magnitude of the impact is assessed to be low. Any potential impact will likely be localised to areas that present a higher erosion impact risk (e.g. low-lying swamp areas). Considering the above, the significance of this impact was assessed to be **low.**

4.1.3.4 Landform modification

The construction of long term infrastructure associated with the wind farm (e.g. access tracks, hardstands, WTG's and office structures) will present moderate visual and functional landform change that may affect land beyond the extent of the project site footprint (e.g. access tracks intersecting with local roads), resulting in a medium long term effect, but with minimal degradation to the overall terrain which is relatively flat and no large scale earthworks are expected. Considering the existing terrain topography, the significance of this impact was assessed to be **low**.

4.1.3.5 Altered surface drainage

Access roads and hardstands may disrupt natural drainage patterns, particularly in wetter months of the year and may have a higher impact in lower lying areas as well as areas prone to seasonal waterlogging. Compaction of the sub-surface soil could reduce permeability and lead to increased surface runoff. Proper design of culverts and crossfalls, and appropriate surface shaping will minimize flow disruption with any impacts assessed to be localised (to access tracks and hardstands), for a medium duration (life of the project) with small changes in hydrology that may persist (low to moderate severity). Therefore, the significance of this impact was assessed to be **low to medium**.

4.1.3.6 Contamination risks from construction materials

The use of concrete (turbine bases) and fuels or lubricants (for machinery) introduces a risk of soil contamination from spills or leaks during construction. Imported materials can also pose a risk of contamination. Temporary laydown areas and refuelling zones pose particular risks.

Contamination has the potential to have a moderate significance if no or minimal controls are on place. It may have some effect with recovery expected, generally be localized with moderate severity.

If spill management, bunding and waste controls are in place to prevent long term contamination, the magnitude of this residual risk has been assessed to be low, the impact will be localised to laydown and refueling areas, limited in extent to the life of the project and therefore, the significance of this impact was assessed to be **negligible to low**.

4.1.3.7 Acidification of groundwater through dewatering

During construction, the need for dewatering can increase the transport of PASS/AASS soils so it is essential that construction methods that reduce the need for dewatering or minimize the extent of drawdown around the excavations should be employed in areas where both shallow groundwater and PASS/AASS is confirmed via testing.

There is currently no proposed infrastructure in areas of a "high likelihood of PASS or AASS". However, there are some locations within the proposed development where access tracks and underground cabling infrastructure will have to pass through areas with Unit 1 materials which may result in a high hazard that cannot be avoided. Given the localized effect (specific locations where tracks cross high risk zones) and despite controls in place there may still be some minor disturbance of PASS/AASS and changes may persist near dewatering discharge points, so the magnitude of this impact has been assessed as moderate, localised to the areas where PASS/AASS have been identified as a potential hazard for the life of the project and the decommissioning stage. The significance has been assessed to be **low to medium**.

4.2 Regional Catchment Strategy 2021-2027

The Regional Catchment Strategy (RCS) (2021-2027) is the most recent RCS developed by the Victorian State Government as required by the Catchment and Land Protection Act 1994 and is the overarching plan for integrated catchment management within each of the 10 Catchment Management Authorities. The proposed project site is located in the Glenelg Hopkins Catchment Management Authority (GHCMA).

The RCS identifies a number of key focus areas that should be considered for the proposed Hexham Wind Farm including:

- Water security: water security is a key driver for capital investment and land use change in the region. Major threats to surface water and groundwater include pollution from construction activities and increased soil salinity.
- Soil management: the GHCMA has extensive agricultural industries operating in the region which include horticulture, cropping, dairy and livestock and so proper management of the soil is a key focus of the RCS. Construction activities associated with the Hexham Wind Farm should consider the potential for works to disturb soils and increase soil erosion.

Table 4.4 Impact Assessment Summary Table

Impact Area	Impact pathway	Project phase	Mitigation and management measures	Residual impact (considering magnitude, extent and duration)	Significance rating and justification
Soil	Upper soil horizons disturbed and exposed to rain and wind resulting in increased erosion.	Construction	— Implementation of erosion and sediment control (ESC) plan. — Stockpiling of excavated materials, including topsoil, should consider stability of the stockpile, potential for run-off, sedimentation, and appropriate erosion protection and/or bunding. — Stripped surfaces should be revegetated back to a standard similar to the surrounding natural landscape. — Adoption of good construction practices such as erosion protection of exposed cut and fill batter slopes, drainage controls and the implementation of silt fences where required — Moisture conditioning of fill and dust control.	Potential to cause a moderate disturbance to soil but if erosion and sediment controls are put in place, the potential impacts to surface soils from site clearing were assessed to be localised (to access tracks and hardstands that are under construction at that time), for a moderate duration (expected to be over several weeks/months) and of low severity.	**Low to medium** Considering the assumption that erosion and sediment controls will be in place and impacts to be localised. The significance of this impact was assessed to be low to medium.

Impact Area	Impact pathway	Project phase	Mitigation and management measures	Residual impact (considering magnitude, extent and duration)	Significance rating and justification
Soil	Disturbance & compaction of surface and sub-surface soil can alter surface water flow	Construction	— Implementation of erosion and sediment control (ESC) plan. — Stockpiling of excavated materials, including topsoil, should consider stability of the stockpile, potential for run-off, sedimentation, and appropriate erosion protection and/or bunding. — Stripped surfaces should be revegetated back to a standard similar to the surrounding natural landscape. — Adoption of good construction practices such as erosion protection of exposed cut and fill batter slopes, drainage controls and the implementation of silt fences where required — Construction of infrastructure to occur in dryer months of the year to avoid trafficability issues with the reactive clays.	Soil disturbance and compaction effects are assessed to likely be localised to areas of focused earthworks (e.g. hardstands and access tracks) and last for the duration of the project only (if proper remediation procedures are created and implemented); the severity of the degradation of the topsoil is also dependent on proper remediation procedures being followed (including stripping, stockpiling and reinstatement of topsoil post remediation).	**Low** If remediation procedures are in place and followed correctly, the significance of this impact was assessed to be low.

Impact Area	Impact pathway	Project phase	Mitigation and management measures	Residual impact (considering magnitude, extent and duration)	Significance rating and justification
Soil	Soil Contamination from earthworks activities	Construction, operation	— Implementation of appropriate spill prevention and containment measures like bunded fuel storage areas and spill kits at all active work zones. — Designate washout areas at the concrete batching plant that are a minimum set distance (> 50 m) from a water way or drain. — Routine soil inspections during construction; pH and EC spot testing in high-risk areas. — The requirement of geotechnical and chemical certification for any imported soil or aggregate. — The installation of silt fences and sediment basins to combat erosion and assist with sediment control.	Temporary laydown areas and refueling zones pose particular risks; however, if spill management, bunding and waste controls are in place to prevent long term contamination, the magnitude of this residual risk has been assessed to be negligible to low, the impact will be localised to laydown and refueling areas, limited in extent to the life of the project.	**Negligible to Low** Through planning and implementation of controls, the significance of this impact was assessed to be negligible to Low.
Soil	Impacts of Saline & Sodic soil transportation	Construction, operation and post closure	— Minimisation of surface disturbance. — Installation of appropriate sediment controls during the works; and — Ensuring site rehabilitation works are carried out post-construction (placement of non-saline, non-sodic topsoil and re-establishment of vegetation).	Magnitude of this risk is assessed to be low due to the minimal evidence of erosion throughout the site; any potential risk will be localised to areas presenting a higher erosion risk (low lying swampy areas).	**Low** Based on the findings of the desktop study and site walkover, the impact related to saline and sodic soil risk (surface soil) is considered to be low.

Impact Area	Impact pathway	Project phase	Mitigation and management measures	Residual impact (considering magnitude, extent and duration)	Significance rating and justification
Soil	Soil erosion and disturbance from decommissioning of quarry	Post closure - Rehabilitation and long-term land use	— Consideration should be given to minimisation of soil erosion and runoff, which may lead to degradation of soil. — Adopting a progressive rehabilitation approach where worked areas are progressively rehabilitated while new quarry sections are opened. — Materials to be stripped from the new areas and placed directly on the worked areas that are being rehabilitated. — The establishment of vegetation on a stable landform to avoid erosion	Quarry rehabilitation is relatively common in Australia with previous examples of successful rehabilitation in Victoria – therefore we assess the magnitude of the impact to be low, as long as a quarry rehabilitation plan is in place; the potential impact is limited to the extent of the quarry and the timeframe for decommissioning.	**Low**
Landform	Modification to landforms from construction of WTG and associated infrastructure	Construction, operation and post closure	— Adopt shallow mass concrete footings for WTG locations as opposed to deeper piled footings. — Buildings to be constructed following the placement of an engineered fill platform reducing the need for deep excavations.	The construction of permanent infrastructure associated with the wind farm will present moderate visual and functional landform change that may affect land beyond the extent of the project site footprint resulting in a medium long term effect, but with minimal degradation to the overall terrain which is relatively flat and no large scale earthworks are expected.	**Low** Considering the existing terrain topography, the significance of this impact was assessed to be low.

Impact Area	Impact pathway	Project phase	Mitigation and management measures	Residual impact (considering magnitude, extent and duration)	Significance rating and justification
Landform	Modification to landforms from decommissioning of quarry	Post closure - Rehabilitation and long-term land use	— It is recommended that all slopes should be reduced to a 1V:3H gradient or less upon quarry closure or otherwise adopt artificial stabilising techniques, such as the use of geotextile mats or benching	As previously stated, quarry rehabilitation is common in Australia so magnitude is assessed as being low.	**Low** The Geovic website identifies a former basalt quarry immediately west of Hexham which can no longer be identified in the landform using current satellite and aerial imagery, indicating successful remediation.

Impact Area	Impact pathway	Project phase	Mitigation and management measures	Residual impact (considering magnitude, extent and duration)	Significance rating and justification
Groundwater	Acidification of groundwater through PASS	Construction	— Site-specific investigations and soil testing at locations deemed a hazard potential. — Localised dewatering restricted to the WTG locations which are not in areas mapped as high risk of PASS. — Temporary periods of dewatering will limit the potential for oxidation of sulfides in areas of underlying PASS and AASS soils and following construction groundwater levels would be expected to rebound to former static levels, re-submerging PASS and AASS soils. — Ongoing monitoring of groundwater quality during the construction phase along with the implementation of appropriate strategies to manage risks associated with areas identified as having PASS/AASS. — Placement of excavated soils within a dedicated storage pad that allows for treatment of soils (liming to increase acid neutralizing capacity in the event of acid generation) and the capture and treatment of acidic runoff. — If excavated PASS/AASS soils need to be disposed off-site, they would be classified as WASS with a waste code of N123. This WASS will need to be treated and disposed of at an L08 registration site, which is permitted to receive WASS	Despite controls in place there may still be some minor disturbance of PASS/AASS and changes may persist near dewatering discharge points, so the magnitude of this impact has been assessed as moderate, localised to the areas where PASS/AASS have been identified as a potential hazard for the life of the project and the decommissioning stage.	**Low to Medium** Ongoing monitoring of groundwater quality during and post construction phase will assist with identifying hazard areas. There are currently no proposed infrastructure in areas of a "high likelihood of PASS or AASS".

Impact Area	Impact pathway	Project phase	Mitigation and management measures	Residual impact (considering magnitude, extent and duration)	Significance rating and justification
Groundwater	Altered surface drainage through compaction of soil	Construction and operation	— Drainage provisions to be provided in the details design of access roads and other proposed infrastructure. — Proper design of culverts and crossfalls, and appropriate surface shaping in accordance with good industry practice. — Limit construction periods to dryer parts of the year to avoid surface run-off and waterlogging.	Design will minimize flow disruption with any impacts assessed to be localised (to access tracks and turbine pads), for a medium duration (life of the project) with small changes in hydrology that may persist (low to moderate severity).	**Low - Medium** The significance of this impact was assessed to be low to medium.

5 Conclusion

Based on the findings of this assessment, the impact significance ratings for the residual soil, landform and groundwater impacts are considered to be negligible to medium providing the following measures are in place:

- A site-specific geotechnical investigation is undertaken to aid in detailed design of founding conditions, excavation conditions, subgrade preparation, earthworks, and the proposed quarry location.
- A site-specific investigation to potentially assess acid sulphate soils and groundwater acidity, as well as further assessment of the salinity and sodicity of the soils and groundwater, including at the proposed quarry location.
- A more detailed review of land uses, and soil testing to assess potential soil contamination.
- Appropriate environmental management plans are in place, such as an Acid Sulfate Soil Management Plan (ASSMP), a soil and erosion management plan for saline and sodic soils, and a soil management plan for potentially contaminated soil reuse and disposal options.
- Mitigation measures outlined in Section 4.1.2 and Table 4.4 are adhered to so that environmental impacts are managed, such as, but not limited to, soil and erosion run-off, acid generation, negative groundwater impacts, and contaminated soils.
- Appropriate design and construction methods are implemented with input and oversight from the relevant professional expertise where required.
- Quarry decommissioning in accordance with industry guidelines.

6 Limitations

This Report is provided by WSP Australia Pty Limited (*WSP*) for Hexham Wind Farm Pty Ltd (*Client*) in response to specific instructions from the Client and in accordance with WSP's proposal dated 14 February 2023 and agreement with the Client dated 14 February 2023 (*Agreement*).

Permitted purpose

This Report is provided by WSP for the purpose described in the Agreement and no responsibility is accepted by WSP for the use of the Report in whole or in part, for any other purpose (*Permitted Purpose*).

Qualifications and assumptions

The services undertaken by WSP in preparing this Report were limited to those specifically detailed in the Report and are subject to the scope, qualifications, assumptions and limitations set out in the Report or otherwise communicated to the Client.

Except as otherwise stated in the Report and to the extent that statements, opinions, facts, conclusion and / or recommendations in the Report (*Conclusions*) are based in whole or in part on information provided by the Client and other parties identified in the report (*Information)*, those Conclusions are based on assumptions by WSP of the reliability, adequacy, accuracy and completeness of the Information and have not been verified. WSP accepts no responsibility for the Information.

WSP has prepared the Report without regard to any special interest of any person other than the Client when undertaking the services described in the Agreement or in preparing the Report.

Use and reliance

This Report should be read in its entirety and must not be copied, distributed or referred to in part only. The Report must not be reproduced without the written approval of WSP. WSP will not be responsible for interpretations or conclusions drawn by the reader. This Report (or sections of the Report) should not be used as part of a specification for a project or for incorporation into any other document without the prior agreement of WSP.

WSP is not (and will not be) obliged to provide an update of this Report to include any event, circumstance, revised Information or any matter coming to WSP's attention after the date of this Report. Data reported and Conclusions drawn are based solely on information made available to WSP at the time of preparing the Report. The passage of time; unexpected variations in ground conditions; manifestations of latent conditions; or the impact of future events (including (without limitation) changes in policy, legislation, guidelines, scientific knowledge; and changes in interpretation of policy by statutory authorities); may require further investigation or subsequent re-evaluation of the Conclusions.

This Report can only be relied upon for the Permitted Purpose and may not be relied upon for any other purpose. The Report does not purport to recommend or induce a decision to make (or not make) any purchase, disposal, investment, divestment, financial commitment or otherwise. It is the responsibility of the Client to accept (if the Client so chooses) any Conclusions contained within the Report and implement them in an appropriate, suitable and timely manner.

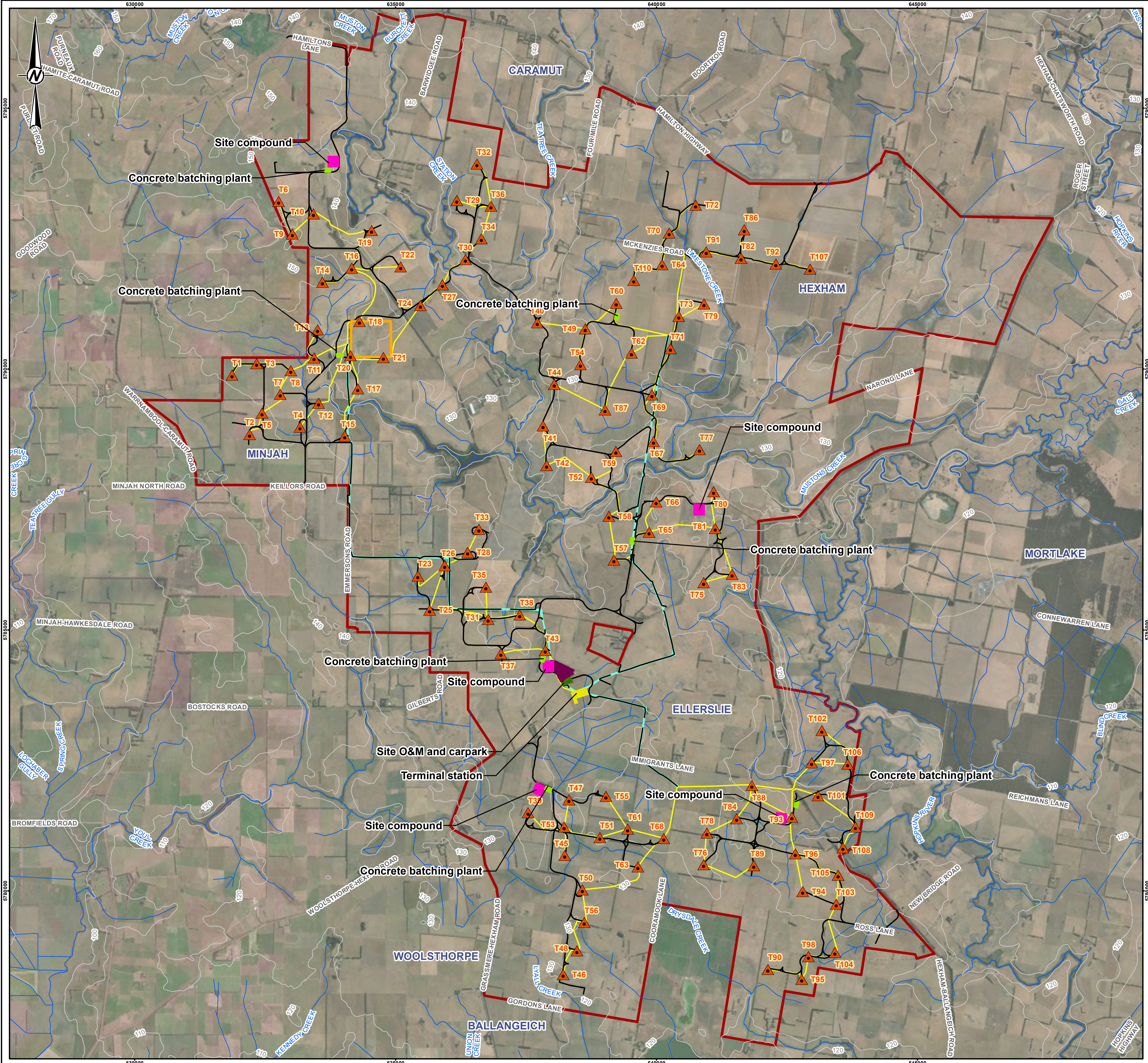
In the absence of express written consent of WSP, no responsibility is accepted by WSP for the use of the Report in whole or in part by any party other than the Client for any purpose whatsoever. Without the express written consent of WSP, any use which a third party makes of this Report or any reliance on (or decisions to be made) based on this Report is at the sole risk of those third parties without recourse to WSP. Third parties should make their own enquiries and obtain independent advice in relation to any matter dealt with or Conclusions expressed in the Report.

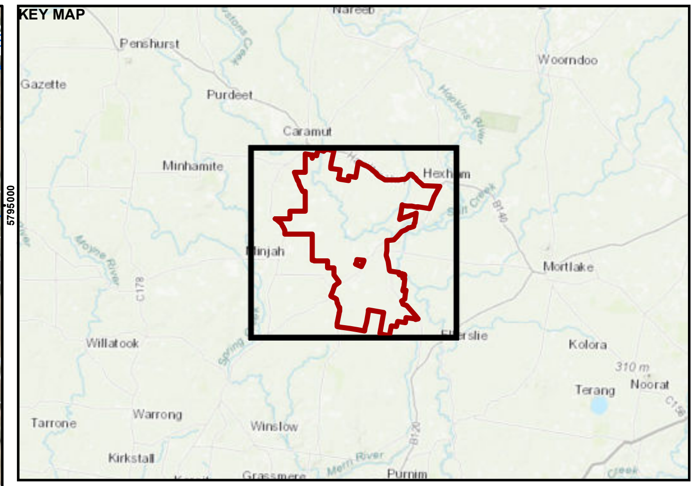
Disclaimer

No warranty, undertaking or guarantee whether expressed or implied, is made with respect to the data reported or the Conclusions drawn. To the fullest extent permitted at law, WSP, its related bodies corporate and its officers, employees and agents assumes no responsibility and will not be liable to any third party for, or in relation to any losses, damages or expenses (including any indirect, consequential or punitive losses or damages or any amounts for loss of profit, loss of revenue, loss of opportunity to earn profit, loss of production, loss of contract, increased operational costs, loss of business opportunity, site depredation costs, business interruption or economic loss) of any kind whatsoever, suffered on incurred by a third party.

Bibliography

- Department of Sustainability and Environment (October 2010). Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulfate Soils
- Earth Resources Regulations (2010). Code of Practice for Small Quarries
- Earth Resources Regulations (2020). Geotechnical guidelines for terminal and rehabilitated slopes
- EPA (1991) Publication 275. Construction techniques for sediment pollution control
- EPA (2009) Publication 665.1. Acid sulfate soil and rock
- EPA (2021). Waste classification assessment protocol. Publication 1827.2
- EPA (2024). Waste disposal categories – characteristics and thresholds. Publication 1828.3
- Lambe, P.C. (1996). Landslides: Investigation and Mitigation, Chapter 19 – Residual Soils, ISBM 030906208X
- Leonard, J. (1988). Victoria's Groundwater Resource: A Summary, Geological Survey of Victoria, Unpublished Report 1988/13
- Peck, W. A., Neilson, J. L., Olds, R. J., Seddon, K.D. (1992). Engineering Geology of Melbourne, A. A. Balkema Publishers, 1992
- Joyce (1999). A New Regolith Landform Map of the Western Victorian Volcanic Plains, Victoria, Australia.
- Isbell R. F. (2021). The Australian Soil Classification, 3rd edition, CSIRO Publishing
- Southern Rural Water (May 2016). South West Limestone Local Management Plan.
- Southern Rural Water. South West Victoria Groundwater Atlas, National Water Commission
- Victorian Government (2017). Environmental Protection Act
- Victorian Government (2021a). Environmental Reference Standard. Victorian Government Gazette No. S 245 Wednesday 26 May 2021
- Victorian Government (2021 – 2027) Regional Catchment Strategy (RCS) - https://rcs.vic.gov.au/
- Victorian Government, (2021b). *Specifications Acceptable to the Authority for Receiving Fill Material.* Victoria Government Gazette No. S 301 Friday 18 June 2021





LEGEND

- Watercourse
- Contours 10m
- Site access tracks
- U/G cable
- Overhead trasmission line
- Wind turbines
- Hexham wind farm boundary
- Proposed Quarry
- Site O&M and carpark
- Concrete Batching Plant
- Site compound
- Temporary construction site office & compound
- Terminal station

0 1,000 2,000 3,000 4,000 5,000

1:72,500 METRES

NOTE(S)
1. PROJECTION: GDA2020 MGA ZONE 54

REFERENCE(S)
1. AERIALIMAGERY SOURCED FROM ESRI ONLINE IMAGERY BASEMAP.
2. ROAD AND PROPERTY INFORMATION, SOURCED FROM VICMAP 14/05/2016
3. KEY MAP SOURCED FROM ESRI ONLINE BASEMAPS.

CLIENT
HEXHAM WIND FARM PTY LTD

PROJECT
HEXHAM WIND FARM SOIL AND LANDFORM ASSESSMENT

TITLE
SITE LOCATION MAP

CONSULTANT

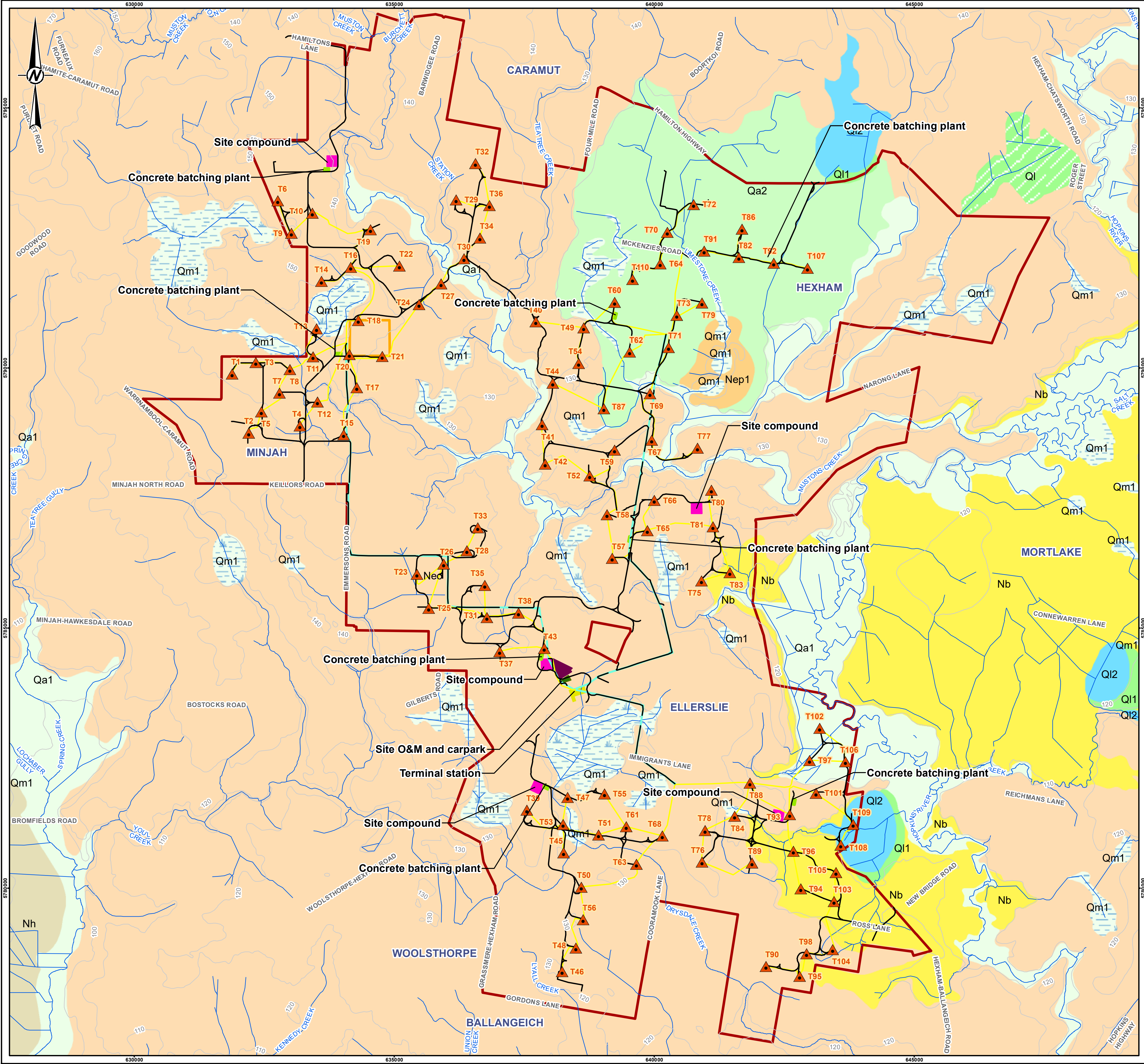
wsp

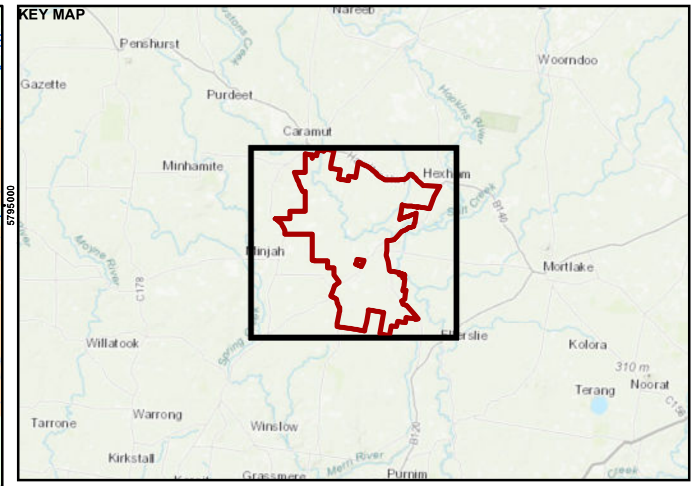
YYYY-MM-DD	13/06/2025
DESIGNED	AN
PREPARED	AN/JE
REVIEWED	DBA
APPROVED	DBA

PROJECT NO.	CONTROL	REV.	FIGURE
PS135848	00001-R	4	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3

25mm





LEGEND

- Wind turbines
- Watercourse
- Contours 10m
- Site access tracks
- U/G cable
- Overhead trasmission line
- Hexham wind farm boundary
- Site O&M and carpark
- Concrete Batching Plant
- Site compound
- Temporary construction site office & compound
- Terminal station
- Proposed Quarry

Geology

- Brighton Group(Nb): generic
- Newer Volcanic Group - basalt flows (Neo): generic
- Newer Volcanic Group - tuff rings (Nep1): generic
- Heytesbury Group (Nh): generic
- Alluvium(Qa1): generic
- Alluvial terrace deposits (Qa2): generic
- Lunette and lake deposits (Ql1): generic
- Lunette deposits (Ql1): generic
- Lake deposits (Ql2): generic
- Swamp and lake deposits (Qm1): generic

0 1,000 2,000 3,000 4,000 5,000

1:72,500 METRES

NOTE(S)
1. PROJECTION: GDA2020 MGA ZONE 54

REFERENCE(S)
1. AERIALIMAGERY SOURCED FROM ESRI ONLINE IMAGERY BASEMAP.
2. ROAD AND PROPERTY INFORMATION, SOURCED FROM VICMAP 14/05/2016
3. KEY MAP SOURCED FROM ESRI ONLINE BASEMAPS.

CLIENT
HEXHAM WIND FARM PTY LTD

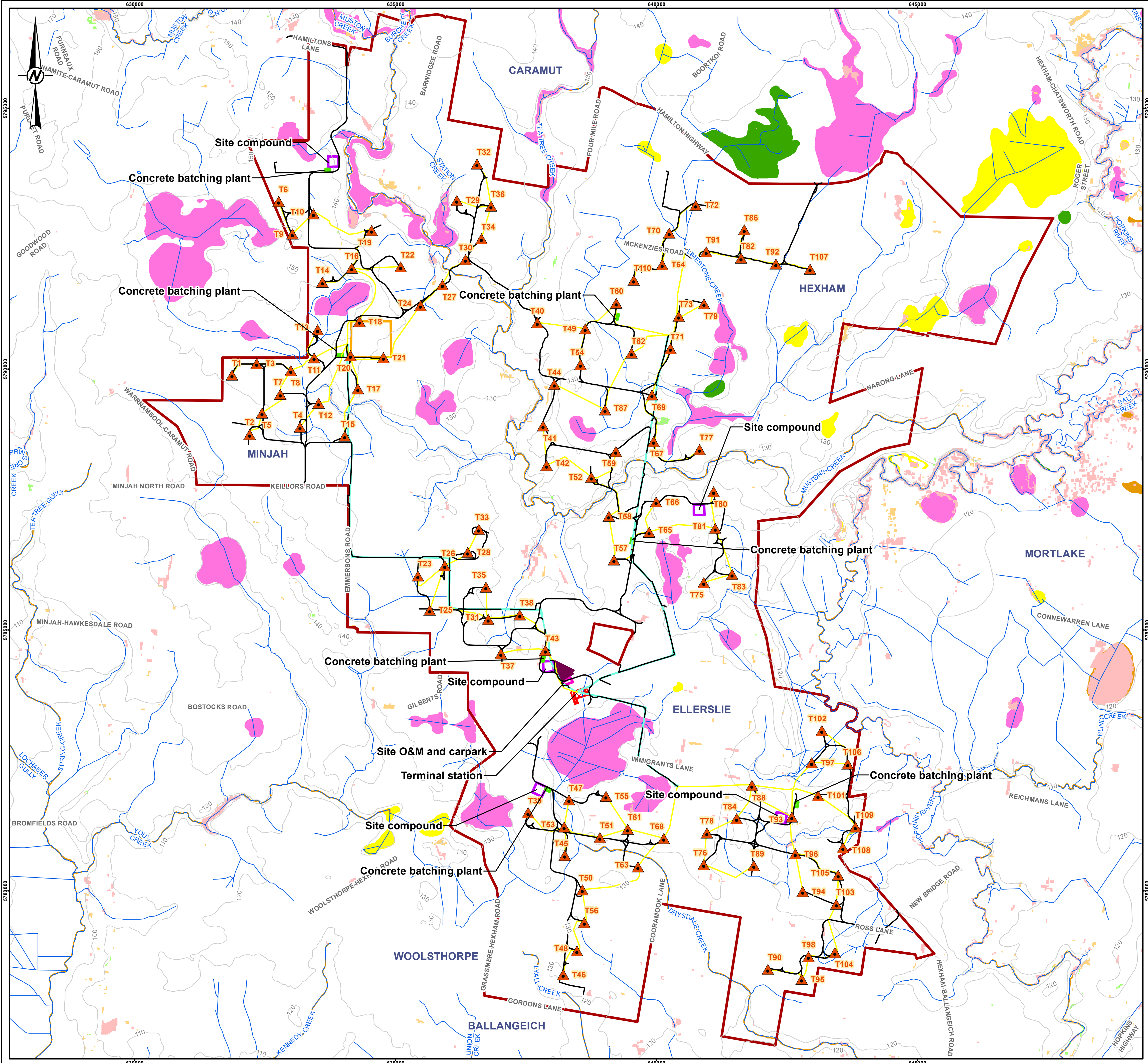
PROJECT
HEXHAM WIND FARM SOIL AND LANDFORM ASSESSMENT

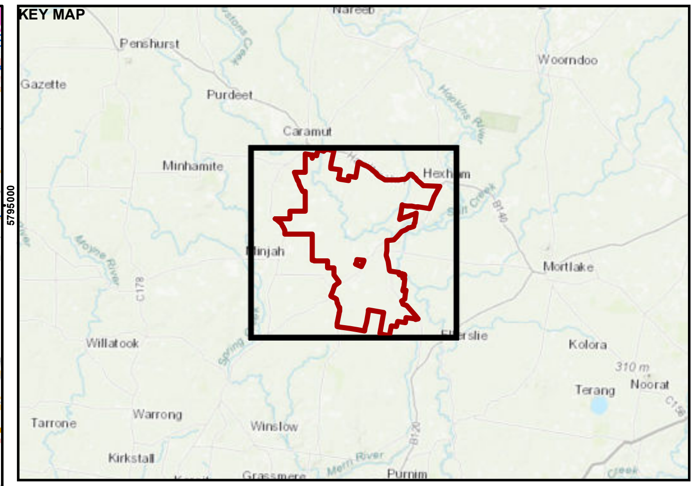
TITLE
GEOLOGY

CONSULTANT

YYYY-MM-DD	20/06/2025
DESIGNED	AN
PREPARED	AN/JE
REVIEWED	DBA
APPROVED	DBA

PROJECT NO.	CONTROL	REV.	FIGURE
PS135848	00001-R	4	2





LEGEND

- Watercourse
- Contours 10m
- Site access tracks
- U/G cable
- Overhead trasmission line
- Wind turbines
- Hexham wind farm boundary
- Proposed Quarry
- Site O&M and carpark
- Concrete Batching Plant
- Site compound
- Temporary construction site office & compound
- Terminal station

Groundwater Dependent Ecosystem

Aquatic

- Low potential GDE
- Moderate potential GDE
- High potential GDE
- Unclassified potential GDE

Terrestrial

- Low potential GDE
- Moderate potential GDE
- High potential GDE

0 1,000 2,000 3,000 4,000 5,000

1:72,500 METRES

NOTE(S)
1. PROJECTION: GDA2020 MGA ZONE 54

REFERENCE(S)
1. AERIALIMAGERY SOURCED FROM ESRI ONLINE IMAGERY BASEMAP.
2. ROAD AND PROPERTY INFORMATION, SOURCED FROM VICMAP 14/05/2016
3. KEY MAP SOURCED FROM ESRI ONLINE BASEMAPS.

CLIENT
HEXHAM WIND FARM PTY LTD

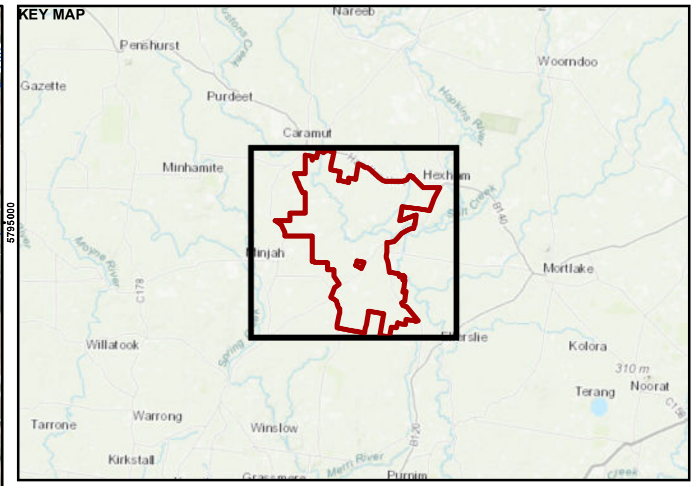
PROJECT
HEXHAM WIND FARM SOIL AND LANDFORM ASSESSMENT

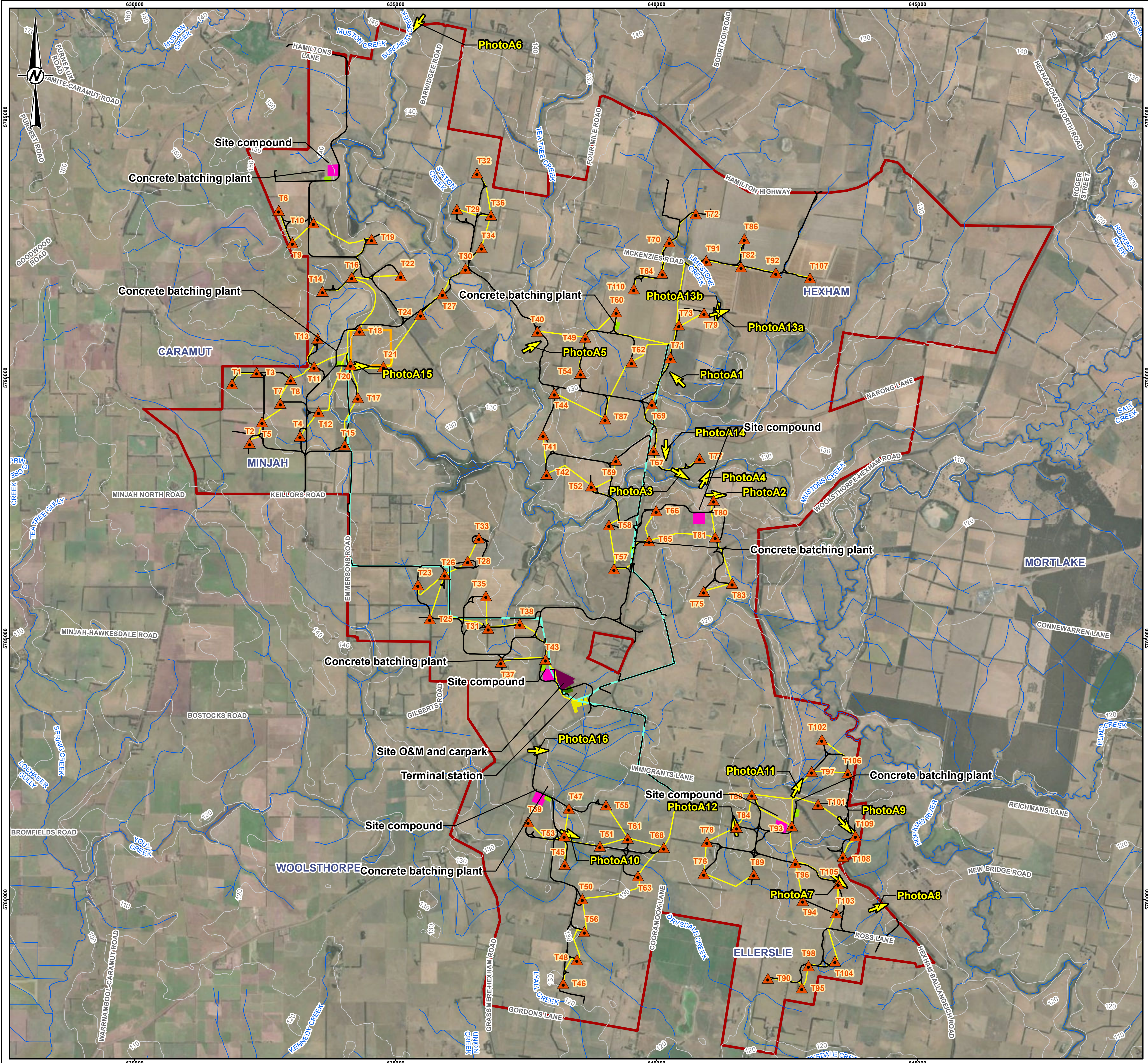
TITLE
GROUNDWATER DEPENDENT ECOSYSTEMS

CONSULTANT

YYYY-MM-DD	13/06/2025
DESIGNED	AN
PREPARED	AN/JE
REVIEWED	DBA
APPROVED	DBA

PROJECT NO.	CONTROL	REV.	FIGURE
PS135848	00001-R	4	3





LEGEND

- Wind turbines
- Site photo location
- Site access tracks
- Watercourse
- Contours 10m
- U/G cable
- Overhead trasmission line
- Hexham wind farm boundary
- Site O&M and carpark
- Concrete Batching Plant
- Site compound
- Temporary construction site office & compound
- Terminal station
- Proposed Quarry

0 1,000 2,000 3,000 4,000 5,000

1:72,500 METRES

NOTE(S)
1. PROJECTION: GDA2020 MGA ZONE 54

REFERENCE(S)
1. AERIALIMAGERY SOURCED FROM ESRI ONLINE IMAGERY BASEMAP.
2. ROAD AND PROPERTY INFORMATION, SOURCED FROM VICMAP 14/05/2016
3. KEY MAP SOURCED FROM ESRI ONLINE BASEMAPS.

CLIENT
HEXHAM WIND FARM PTY LTD

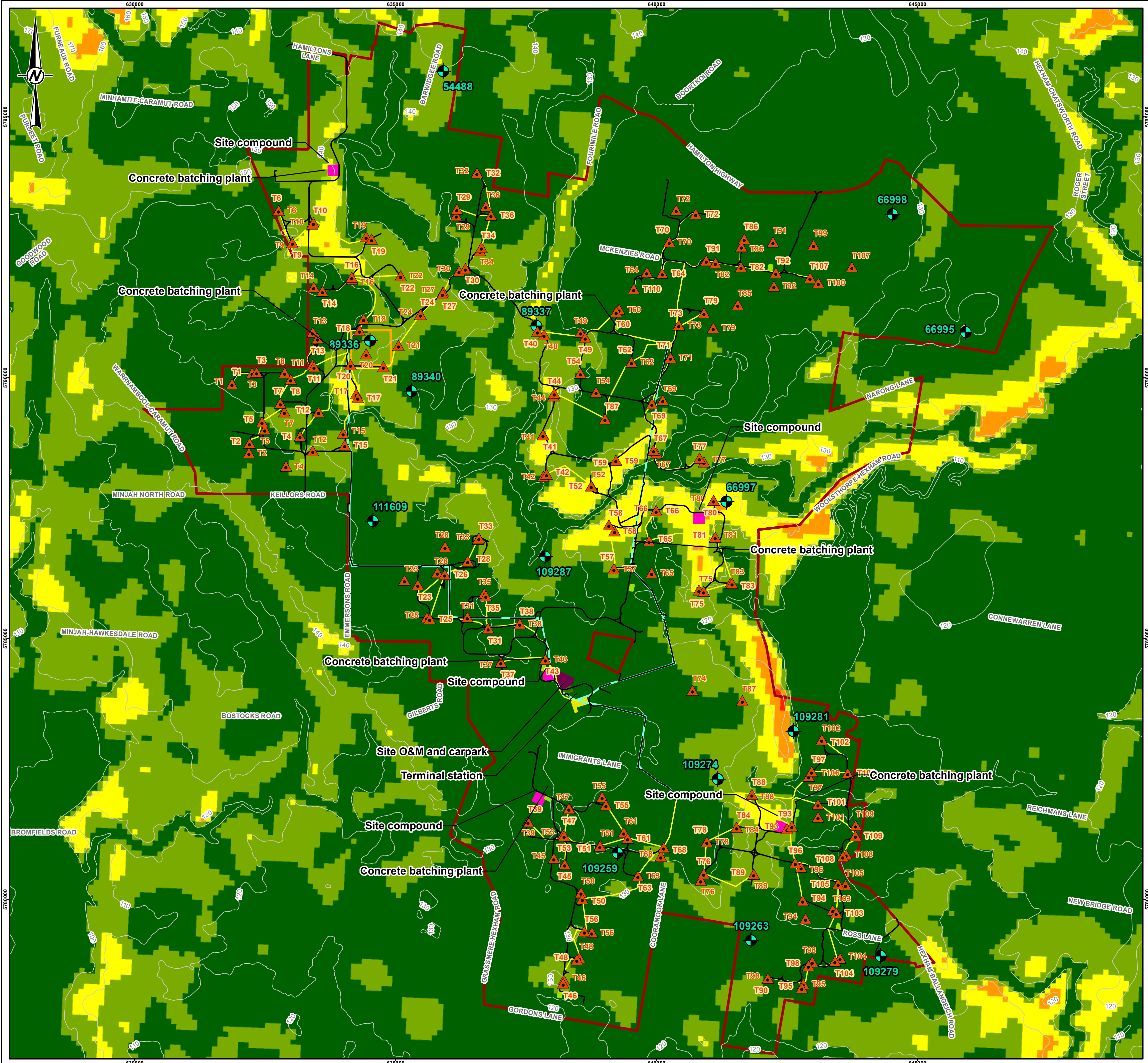
PROJECT
HEXHAM WIND FARM SOIL AND LANDFORM ASSESSMENT

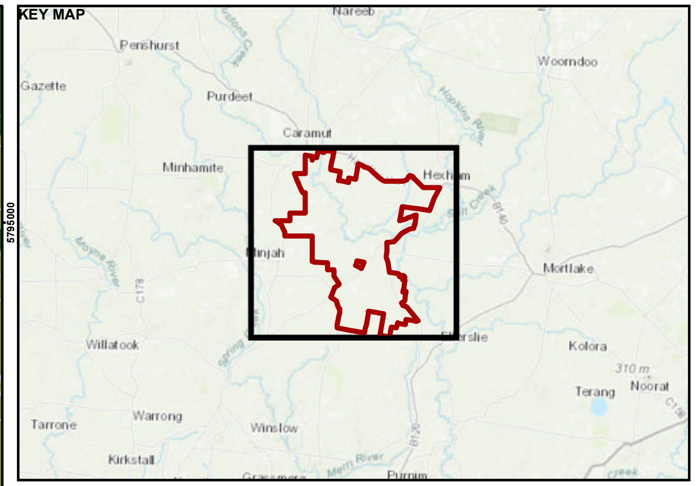
TITLE
SITE PHOTO LOCATIONS

CONSULTANT		
wsp	YYYY-MM-DD	13/06/2025
	DESIGNED	AN
	PREPARED	AN/JE
	REVIEWED	DBA
	APPROVED	DBA

PROJECT NO.	CONTROL	REV.	FIGURE
PS135848	00001-R	4	4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A3





LEGEND

- Groundwater well
- Wind turbines
- Site access tracks
- Contours 10m
- U/G cable
- Overhead trasmission line
- Hexham wind farm boundary
- Proposed Quarry
- Site O&M and carpark
- Concrete Batching Plant
- Site compound
- Temporary construction site office & compound
- Terminal station

Watertable depth

- 0 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 25

0 1,000 2,000 3,000 4,000 5,000

1:72,500 METRES

NOTE(S)
1. PROJECTION: GDA2020 MGA ZONE 54

REFERENCE(S)
1. AERIALIMAGERY SOURCED FROM ESRI ONLINE IMAGERY BASEMAP.
2. ROAD AND PROPERTY INFORMATION, SOURCED FROM VICMAP 14/05/2016
3. KEY MAP SOURCED FROM ESRI ONLINE BASEMAPS.

CLIENT
HEXHAM WIND FARM PTY LTD

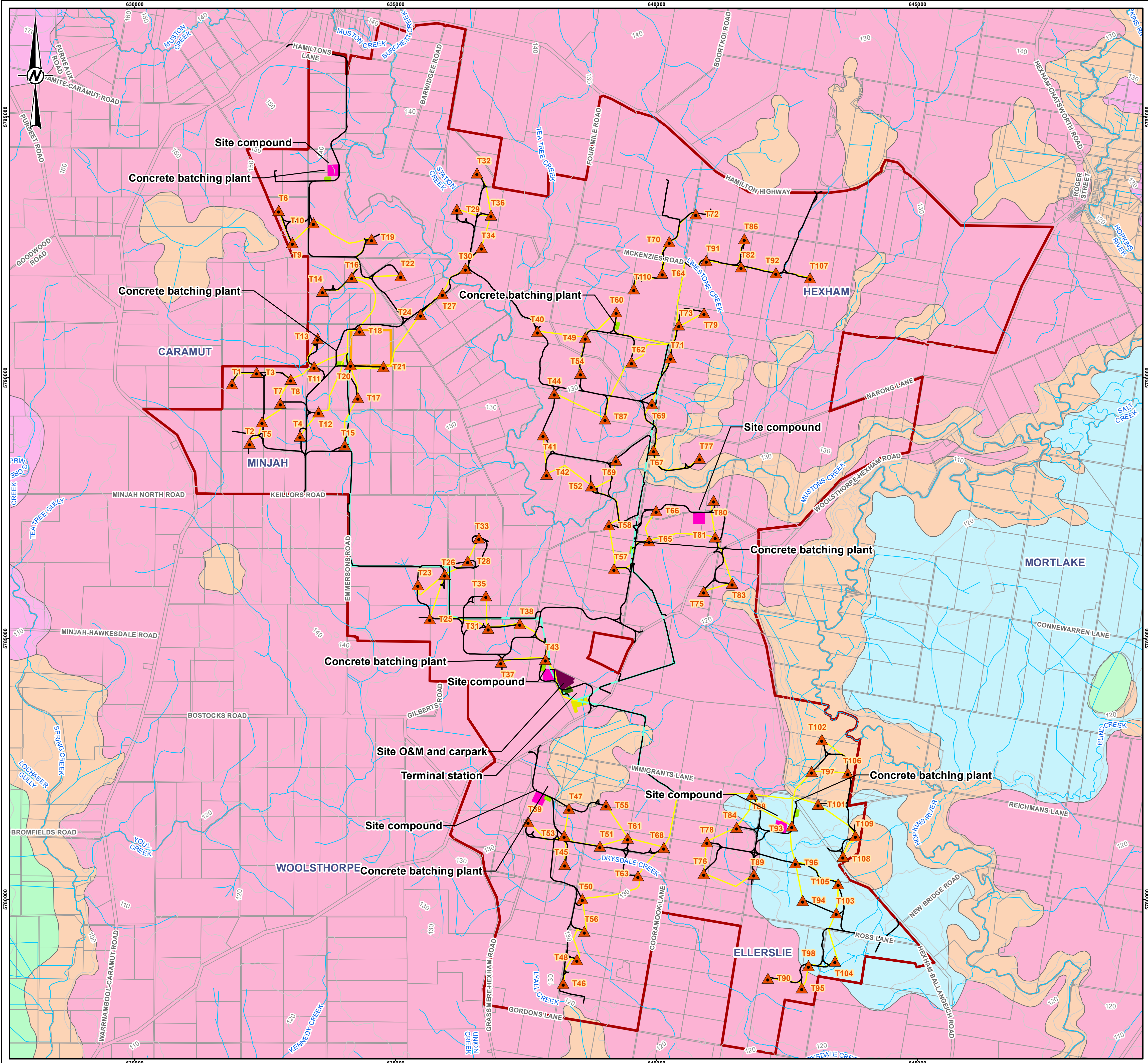
PROJECT
HEXHAM WIND FARM SOIL AND LANDFORM ASSESSMENT

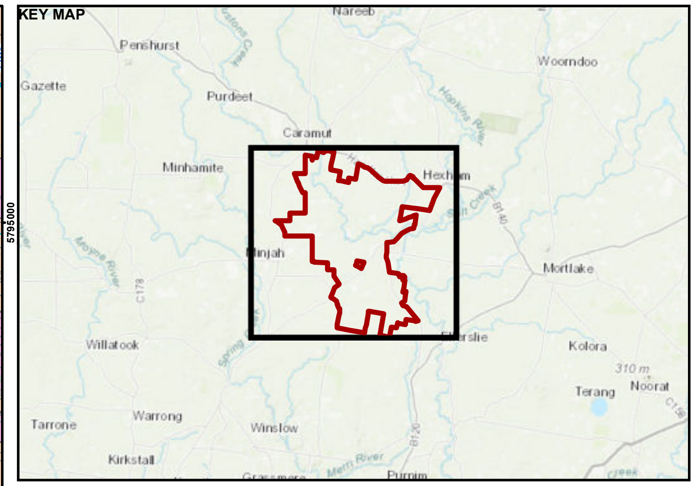
TITLE
WATERTABLE DEPTH

CONSULTANT

YYYY-MM-DD	13/06/2025
DESIGNED	AN
PREPARED	AN/JE
REVIEWED	DBA
APPROVED	DBA

PROJECT NO.	CONTROL	REV.	FIGURE
PS135848	00001-R	4	5





LEGEND

- Cadastral parcel
- Hexham wind farm boundary
- Wind turbines
- Site access tracks
- Watercourse
- Contours 10m
- U/G cable
- Overhead trasmission line
- Site O&M and carpark
- Concrete Batching Plant
- Site compound
- Temporary construction site office & compound
- Terminal station
- Proposed Quarry

Geomorphological Units

- 6.1.3
- 6.1.4
- 6.1.5
- 6.2.1
- 6.2.4
- Waterbody

0 1,000 2,000 3,000 4,000 5,000
1:72,500 METRES

NOTE(S)
1. PROJECTION: GDA2020 MGA ZONE 54

REFERENCE(S)
1. AERIALIMAGERY SOURCED FROM ESRI ONLINE IMAGERY BASEMAP.
2. ROAD AND PROPERTY INFORMATION, SOURCED FROM VICMAP 14/05/2016
3. KEY MAP SOURCED FROM ESRI ONLINE BASEMAPS.

CLIENT
HEXHAM WIND FARM PTY LTD

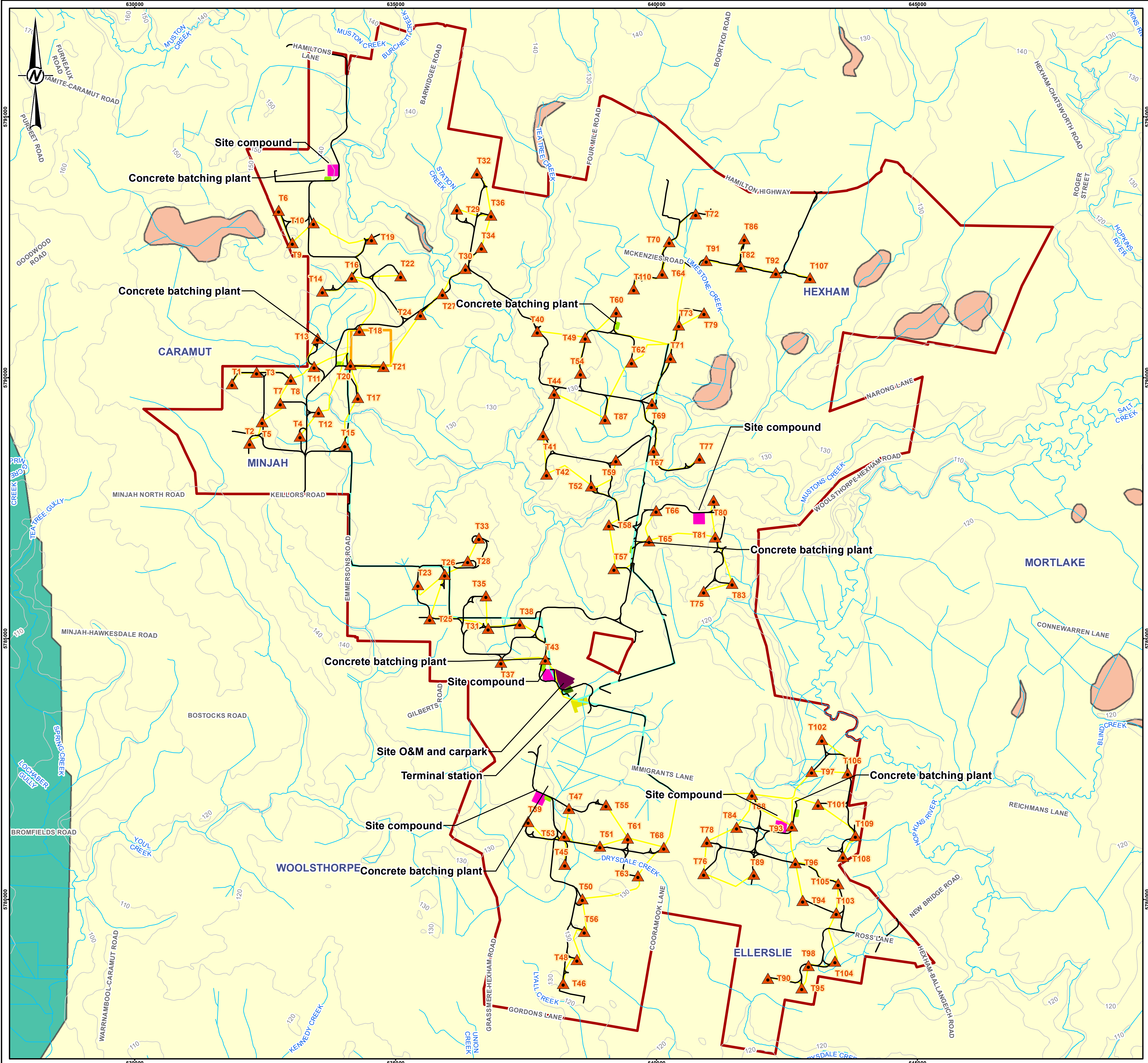
PROJECT
HEXHAM WIND FARM SOIL AND LANDFORM ASSESSMENT

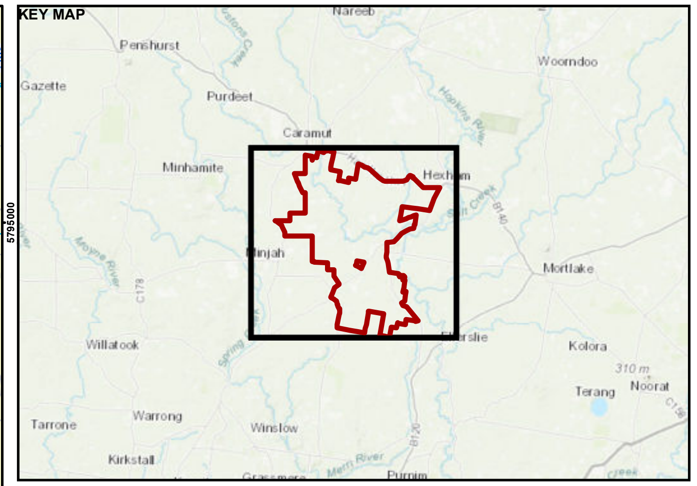
TITLE
GEOMORPHOLOGICAL UNITS

wsp

YYYY-MM-DD	13/06/2025
DESIGNED	AN
PREPARED	AN/JE
REVIEWED	DBA
APPROVED	DBA

PROJECT NO.	CONTROL	REV.	FIGURE
PS135848	00001-R	4	6





LEGEND

- Wind turbines
- Site access tracks
- Watercourse
- Contours 10m
- U/G cable
- Overhead trasmission line
- Hexham wind farm boundary
- Site O&M and carpark
- Concrete Batching Plant
- Site compound
- Temporary construction site office & compound
- Terminal station
- Proposed Quarry

ASS risk, probability and confidance

- A4 High Probability/Very Low Confidence
- B4 Low Probability/Very Low Confidence
- C4 Extremely Low Probability/Very Low Confidence

0 1,000 2,000 3,000 4,000 5,000

1:72,500 METRES

NOTE(S)
1. PROJECTION: GDA2020 MGA ZONE 54

REFERENCE(S)
1. AERIALIMAGERY SOURCED FROM ESRI ONLINE IMAGERY BASEMAP.
2. ROAD AND PROPERTY INFORMATION, SOURCED FROM VICMAP 14/05/2016
3. KEY MAP SOURCED FROM ESRI ONLINE BASEMAPS.

CLIENT
HEXHAM WIND FARM PTY LTD

PROJECT
HEXHAM WIND FARM SOIL AND LANDFORM ASSESSMENT

TITLE
ACID SULFATE SOIL RISK

CONSULTANT

wsp

YYYY-MM-DD	13/06/2025
DESIGNED	AN
PREPARED	AN/JB
REVIEWED	DBA
APPROVED	DBA

PROJECT NO.	CONTROL	REV.	FIGURE
PS135848	00001-R	4	7

Appendix A

Selected Site Photographs

Predominant landform in the area - flat basaltic plains near WTG T71. No rock outcrop suggests residual basaltic clay is the surficial material, inferred to be underlain by basalt rock.

wsp	CLIENT	Hexham Wind Farm Pty Ltd	PROJECT	PS135848 Hexham Wind Farm Soil and Landform Assessment
	DATE	15/03/2023		
	DESIGNED	DFS	TITLE	Appendix A - Site Photographs Photo A1
	REVIEWED	DBA		

Basalt outcrop at surface at location of proposed WTG T80. This was not widely encountered during the site visit. Could potentially be corestones (or 'floaters') in a soil matrix.

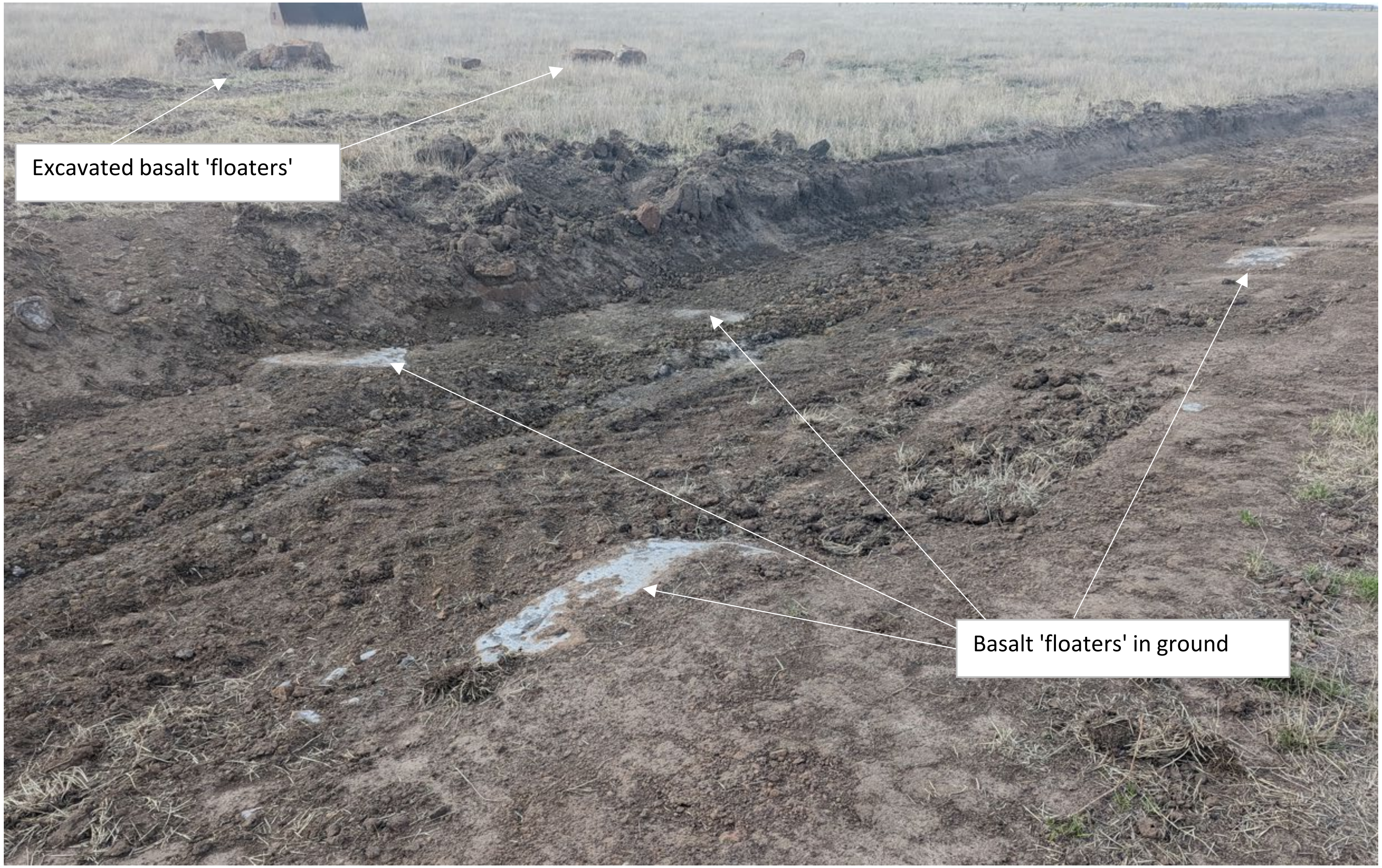
wsp	CLIENT	Hexham Wind Farm Pty Ltd	PROJECT	PS135848 Hexham Wind Farm Soil and Landform Assessment
	DATE	15/03/2023		
	DESIGNED	DFS	TITLE	Appendix A - Site Photographs Photo A2
	REVIEWED	DBA		

Basalt rock outcrop in the upper slopes of the Mustons Creek valley, close to proposed site access track and underground cable between WTGs T67 and T77.

wsp	CLIENT	Hexham Wind Farm Pty Ltd	PROJECT	PS135848 Hexham Wind Farm Soil and Landform Assessment
	DATE	15/03/2023		
	DESIGNED	DFS	TITLE	Appendix A - Site Photographs Photo A3
	REVIEWED	DBA		

Slope instability on north bank of Mustons Creek east of proposed location of WTG T77. Valley slope angles are locally up to 30°. No rock outcrop visible in this bank. Slope instability was not observed in other parts of the creek valley.

wsp	CLIENT	Hexham Wind Farm Pty Ltd	PROJECT	PS135848 Hexham Wind Farm Soil and Landform Assessment
	DATE	15/03/2023		
	DESIGNED	DFS	TITLE	Appendix A - Site Photographs Photo A4
	REVIEWED	DBA		



Example of basalt 'floaters' in residual clayey soil matrix exposed in drainage works occurring on a farm, close to proposed location of WTG T40. Excavated boulders were predominantly tabular, very high strength, and up to 1.5 m long.

wsp	**CLIENT**	Hexham Wind Farm Pty Ltd	**PROJECT**	PS135848 Hexham Wind Farm Soil and Landform Assessment
	DATE	15/03/2023		
	DESIGNED	DFS	**TITLE**	Appendix A - Site Photographs Photo A5
	REVIEWED	DBA		

Road cutting on Hamilton Hwy adjacent to Burchett Creek crossing at northwestern site boundary. This shows an example of excavation conditions where basalt rock is close to surface.

wsp	CLIENT	Hexham Wind Farm Pty Ltd	PROJECT	PS135848 Hexham Wind Farm Soil and Landform Assessment
	DATE	15/03/2023		
	DESIGNED	DFS	TITLE	Appendix A - Site Photographs Photo A6
	REVIEWED	DBA		

View of gently sloping ground towards the Hopkins River, slope angle approximately 5°. Mapped geology in this location is Brighton Group. Photo taken close to site of proposed WTG T105.

wsp	CLIENT	Hexham Wind Farm Pty Ltd	PROJECT	PS135848 Hexham Wind Farm Soil and Landform Assessment
	DATE	15/03/2023		
	DESIGNED	DFS	TITLE	Appendix A - Site Photographs Photo A7
	REVIEWED	DBA		

Sandy soil exposed in a swale drain east of proposed WTGs T103 and T105. Consistent with mapped geology showing Brighton Group. Soil is a silty sand with inferred medium dense to dense relative density.

wsp	CLIENT	Hexham Wind Farm Pty Ltd	PROJECT	PS135848 Hexham Wind Farm Soil and Landform Assessment
	DATE	15/03/2023		
	DESIGNED	DFS	TITLE	Appendix A - Site Photographs Photo A8
	REVIEWED	DBA		

View towards wide subtle depression mapped as quaternary lake deposits. Elevation difference is 2 m to 3 m, slope angle is less than 5°. Surface soil changes are consistent with mapped geology, changing from tertiary sands upslope to alluvial type clay in the depression.

wsp	CLIENT	Hexham Wind Farm Pty Ltd	PROJECT	PS135848 Hexham Wind Farm Soil and Landform Assessment
	DATE	15/03/2023		
	DESIGNED	DFS	TITLE	Appendix A - Site Photographs Photo A9
	REVIEWED	DBA		

Swamp soil deposit adjacent to propsed WTG T153. Underground cable and site access road proposed to cross the deposit. Soil is dark grey high plasticity clay with high dry stiffness, but inferred to lose stiffness rapidly with saturation.

WSP	**CLIENT**	Hexham Wind Farm Pty Ltd	**PROJECT**	PS135848 Hexham Wind Farm Soil and Landform Assessment
	DATE	15/03/2023		
	DESIGNED	DFS	**TITLE**	Appendix A - Site Photographs Photo A10
	REVIEWED	DBA		

Creek alluvium deposit close to proposed WTG T97. Proposed site access road and underground cable pass through this location. Soil is dark grey, high plasticity clay. Very dessicated. Similar to swamp/lake deposits but may have higher plasticity based on disturbance.

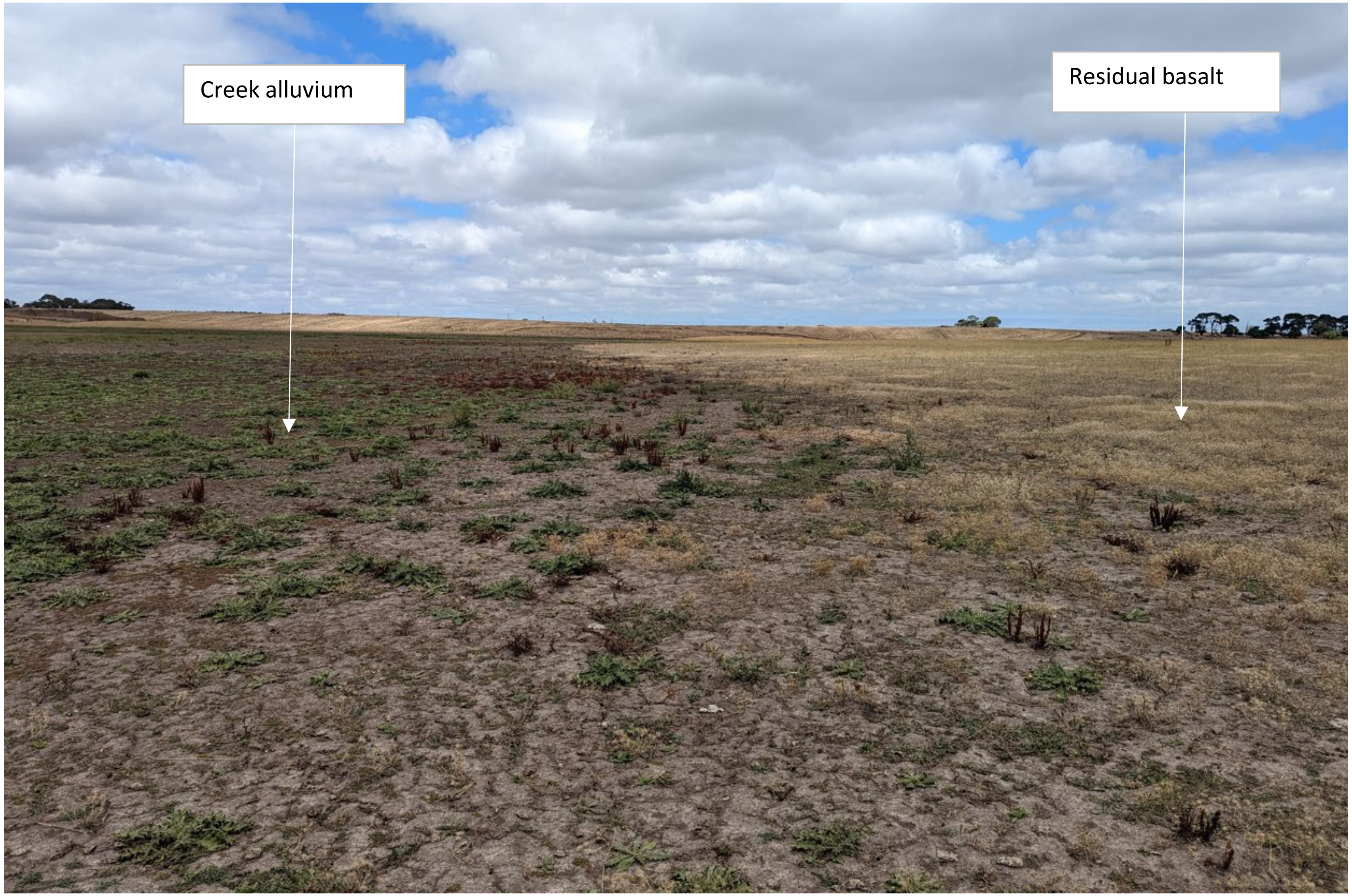
wsp	CLIENT	Hexham Wind Farm Pty Ltd	PROJECT	PS135848 Hexham Wind Farm Soil and Landform Assessment
	DATE	15/03/2023		
	DESIGNED	DFS	TITLE	Appendix A - Site Photographs Photo A11
	REVIEWED	DBA		

Swamp deposit adjacent to proposed WTG T84. Soil is similar to other swamp deposits but shows a pale grey/white crust at the surface, a potential indicator of salinity.

wsp	**CLIENT**	Hexham Wind Farm Pty Ltd	**PROJECT**	PS135848 Hexham Wind Farm Soil and Landform Assessment
	DATE	15/03/2023		
	DESIGNED	DFS	**TITLE**	Appendix A - Site Photographs Photo A12
	REVIEWED	DBA		

Comparison of terrace alluvium (left) and creek alluvium (right), photos taken about 25 m apart, north of proposed WTG T79 and west of Limestone Creek.

wsp	**CLIENT**	Hexham Wind Farm Pty Ltd	**PROJECT**	PS135848 Hexham Wind Farm Soil and Landform Assessment
	DATE	15/03/2023		
	DESIGNED	DFS	**TITLE**	Appendix A - Site Photographs Photo A13
	REVIEWED	DBA		



Noticeable change in soil type and vegetation at edge of inferred creek alluvium. Generally across the site the mapped geology boundaries were consistent with site observations. Photo taken about 50 m east of proposed location of WTG T67.

CLIENT	Hexham Wind Farm Pty Ltd	PROJECT	PS135848 Hexham Wind Farm Soil and Landform Assessment
DATE	15/03/2023		
DESIGNED	DFS	TITLE	Appendix A - Site Photographs Photo A14
REVIEWED	DBA		

An internal farm road close to proposed WTG T20. Gravel roads in the area were generally in good condition, noting that the site visit was undertaken in early March after a relatively dry January and February.

wsp	CLIENT	Hexham Wind Farm Pty Ltd	PROJECT	PS135848 Hexham Wind Farm Soil and Landform Assessment
	DATE	15/03/2023		
	DESIGNED	DFS	TITLE	Appendix A - Site Photographs Photo A15
	REVIEWED	DBA		

Western end of Immigrants Lane, near intersection with Woolsthorpe-Hexham Road. Existing gravel roads in the area appear to be generally constructed with basalt or scoria gravel.

wsp	CLIENT	Hexham Wind Farm Pty Ltd	PROJECT	PS135848 Hexham Wind Farm Soil and Landform Assessment
	DATE	15/03/2023		
	DESIGNED	DFS	TITLE	Appendix A - Site Photographs Photo A16
	REVIEWED	DBA		

Appendix B

Hexham Wind Farm project description

Document revision:

Revision	Date	Issued to specialists	
Rev1	12 Dec 2022	Not issued	
Rev1.1	17 Feb 2023	Not issued	
Rev1.2	23 Feb 2023	Not issued	
Rev1.3	02 Mar 2023	Not Issued	
Rev2	02 Mar 2023	Issued	
Rev2.1	24 July 2024	Issued	Marshall Day
Rev3	27 July 2024	Issued	Umwelt
Rev 4	30 April 2025	Issued	All consultants

Hexham Wind Farm project description

Hexham Wind Farm Pty Ltd (the proponent) is developing the proposed Hexham Wind Farm (the project) in Moyne Shire, Victoria. The project will harness strong and reliable winds to generate renewable energy through the construction and operation of up to 106 wind turbines generators and would operate for a period of at least 25 years following a two-year construction period. The wind farm would generate approximately 2,559 gigawatt hours (GWh) of renewable electricity each year. Electricity produced by the project would be fed through underground and overhead cables to a new on-site terminal station, where it would be exported to the national electricity network via the Moorabool to Heywood 500 kilovolt transmission line.

The project extends across approximately 16,000 hectares of private and public land located between the townships of Hexham, Caramut and Ellerslie in south-western Victoria. The main land use within the project site is agricultural (predominantly cattle and sheep grazing, along with some cropping). Much of the area has been cleared of native vegetation with remnant vegetation largely restricted to roadside reserves and along watercourses, with small, isolated areas on private land.

Around 151 kilometres of new access tracks, including upgrades to around 16.7 kilometres of existing access tracks within the project site, would be required to provide for construction and maintenance access from the public road network to each wind turbine and supporting infrastructure. These access tracks can also be used by emergency vehicles and by landowners for their farming operations.

Other project infrastructure would include:

- a 200 Megawatt (MW) /800 Megawatt-hour (MWh) battery energy storage system (BESS)
- an operations and maintenance (O&M) facility, consisting of site offices and amenities
- up to five meteorological masts, to be in place for the life of the project
- a main temporary construction compound, consisting of office facilities, amenities and car parking. Four additional temporary construction compounds are also planned
- up to 26 temporary staging areas.

A temporary on-site quarry is being investigated for the purposes of providing aggregate materials for access tracks and hardstand areas, and to minimise traffic movements on local roads during construction. If an on-site quarry is not deemed viable, aggregate material would be supplied from one or more nearby quarries. Potential quarries that have been investigated to supply the necessary raw materials required include Mt

Shadwell Quarry, Mt Napier Quarry, Tarrone Quarry, Gillear Sand and Limestone Quarry and/or Camperdown quarries). All quarries have good access to the project site via major arterial roads.

Within 12 months of wind turbines permanently ceasing to generate electricity (assuming the turbines are not repowered), the wind farm would be decommissioned. This would include removing all above ground equipment, restoration of all areas associated with the project, unless otherwise useful to the ongoing management of the land, and post-decommissioning revegetation with pasture or crop (in consultation with and as agreed with the landowner).

Short project description

The proposed Hexham Wind Farm (the project) comprises up to 106 wind turbines and associated permanent and temporary infrastructure, including:

- Hardstand areas, with a temporary hardstand area of 90 metres x 320 metres and a permanent hardstand area of 25 metres x 25 metres around each wind turbine
- Approximately 151.3 kilometres of site access tracks, of which 16.7 kilometres is existing access tracks
- Creation or improvement of up to 11 access points from public roads
- Up to five permanent anemometry masts
- Approximately 85 kilometres of underground cabling trenches with up to 119 kilometres of cable
- Approximately 22 kilometres of internal overhead cables connecting wind turbine clusters to the on-site terminal station.
- An on-site terminal station to facilitate connection to the existing Moorabool to Heywood 500 kilovolt transmission line located within the southern part of the project site, owned and operated by Ausnet Services
- Battery storage of up to 200 megawatts
- Temporary infrastructure including construction compounds, wind turbine component laydown areas and, concrete batching plants
- An operations and maintenance facility to provide office, storage and maintenance facilities.

Table 1 Summary of the Project's main features [NOTE: technical studies can pick and choose from the following to include in relevant study reports]

Project's main features	Details
Location	The project is approximately 15 kilometres west of Mortlake and approximately 15 kilometres north-east of Woolsthorpe in the Moyne Shire of south-west Victoria. The closest townships are Hexham, Caramut and Ellerslie, located approximately 3 kilometres north-east, 4 kilometres north-west and 3 kilometres south-west, respectively. The road network that borders and runs through the project area includes Hamilton Highway to the north, Woolsthorpe-Hexham Road and Hexham-Ballangeich Road to the east, Warrnambool-Caramut Road to the west and Gordons Lane to the south.
Setting	Agricultural is the predominant land use in the project area consisting mostly of grazing (cattle and sheep) along with some cropping. Native vegetation is largely restricted to roadside reserves with small, isolated areas on private land. Numerous indigenous scattered trees exist throughout the local area.
Landowners	14 landowner families with project infrastructure on their land.
Wind turbines and hardstand areas	Up to 106 with a maximum tip height of 260 metres, maximum rotor diameter up to 190 metres and minimum tip height of 40 metres.

Project's main features	Details
	Maximum tower base width of between 5 and 6 metres. Blade length of up to 93 metres. Each wind turbine would have an adjacent hardstand area of around 6,500 square metres, which equates to 70 hectares for all project wind turbines.
Wind farm capacity	Around 721 MW
Annual generation	Approximately 2,559 GWh per year
Construction footprint	5599.5 hectares (or around 3.7% of the project site)
Operational footprint	148.7 hectares (or around 0.9% of the project site)
Construction period	Approximately 24 months
Electrical reticulation	Approximately 119 kilometres of 33 kilovolt electricity cable laid in approximately 85 kilometres of trenches about one metre below the ground. The work area width for the excavator to operate and for stockpiling of soil would be about eight metres wide for all trenches assuming up to four cables are housed in each trench. Approximately 49.1 kilometres of overhead powerlines lines to connect wind turbines to the new on-site terminal station. The distribution voltage is expected to be 33 kilovolts. (although 132 kilovolts and 220 kilovolts are alternative options), with the overhead dual circuit distribution line consisting of either single or parallel pole line (i.e., single poles up to 26 metres high, with conductor circuits on each side). The overall linear length of the overhead cabling route would be around 22 kilometres.
On-site terminal station	Electricity generated by the project would be distributed by underground and overhead cables to the proposed new onsite terminal station located adjacent to the existing Moorabool to Heywood 500 kilovolt transmission line. On-site terminal station with a footprint of approximately 7.3 hectares in size.
Permanent met masts	Up to five permanent meteorological masts are proposed, to be in place for the life of the project. A single-lane access track roughly four meters in width would be constructed to provide access.
Operations and maintenance facility	An operations and maintenance facility would be located adjacent to the on-site terminal station and BESS providing office, storage, and maintenance facilities. Nominally 90 metres by 200 metres.
Staging areas and passing lanes	26 staging areas up to 300 metres x 15 metres in length. Several passing lanes of 25 metres in length.
Site access and access tracks	Approximately 134.6 kilometres of new internal access track and upgrades to approximately 16.7 kilometres of existing access track (i.e., a total of around 151.3 kilometres of access tracks). The final access tracks would be 9 metres wide (inclusive of drainage, where required) and a maximum 120 metre turning radius. The construction footprint of access tracks would be around 20 metres wide. Eleven site access points are proposed from two arterial and five local council roads, being: • Up to two access points from Hamilton Highway • one access point from Warrnambool-Caramut Road • four access points from Woolsthorpe-Hexham Road • one access point from Keillors Road • three access points from Hexham-Ballangeich Road
Battery Energy Storage System (BESS)	An on-site battery energy storage facility with a is proposed to be located adjacent to the on-site terminal station. A name plate capacity 200 megawatt

Project's main features	Details
	The BESS would consist of a series of 20-foot containerised batteries with transformers, high voltage AC (HVAC) coolers and other electrical plant. The BESS would be sited on a hardstand area of up to 3 hectares (nominally 413 metres x 67 metres).
Temporary components	A main temporary construction compound would be located within the project site and include office facilities, amenities, and car parking (8 hectares). Four additional temporary construction compounds are also planned (200m x 200m). Seven noise compliant concrete batching plants would be established to supply concrete for the wind turbine foundations, the on-site terminal station, and the BESS (around 50m x 100m each)
Temporary onsite quarry	The proposed quarry is in the western portion of the project area. The work authority area is 52.3 hectares with an approximate extraction area of 21.5 hectares, a material stockpile area of approximately 8.6 hectares and an area of approximately 0.5 hectares for amenities and light vehicle parking. The remaining area will be used for stockpiling overburden and for groundwater management infrastructure.
Life	A minimum 25-year operating life is expected, following a period of up to three years of pre-development and construction activities. Pre-development would include detailed design and early works, where permitted.
Decommissioning	Within 12 months of wind turbines permanently ceasing to generate electricity, the wind farm would be decommissioned. This would include removing all above ground equipment, restoration of all areas associated with the project, unless otherwise useful to the ongoing management of the land, and post-decommissioning revegetation with pasture or crop (in consultation with and as agreed with the landowner).