Annex B Natural Values Assessment

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ECOSYSTEM SERVICES

EPBC 2023/09666

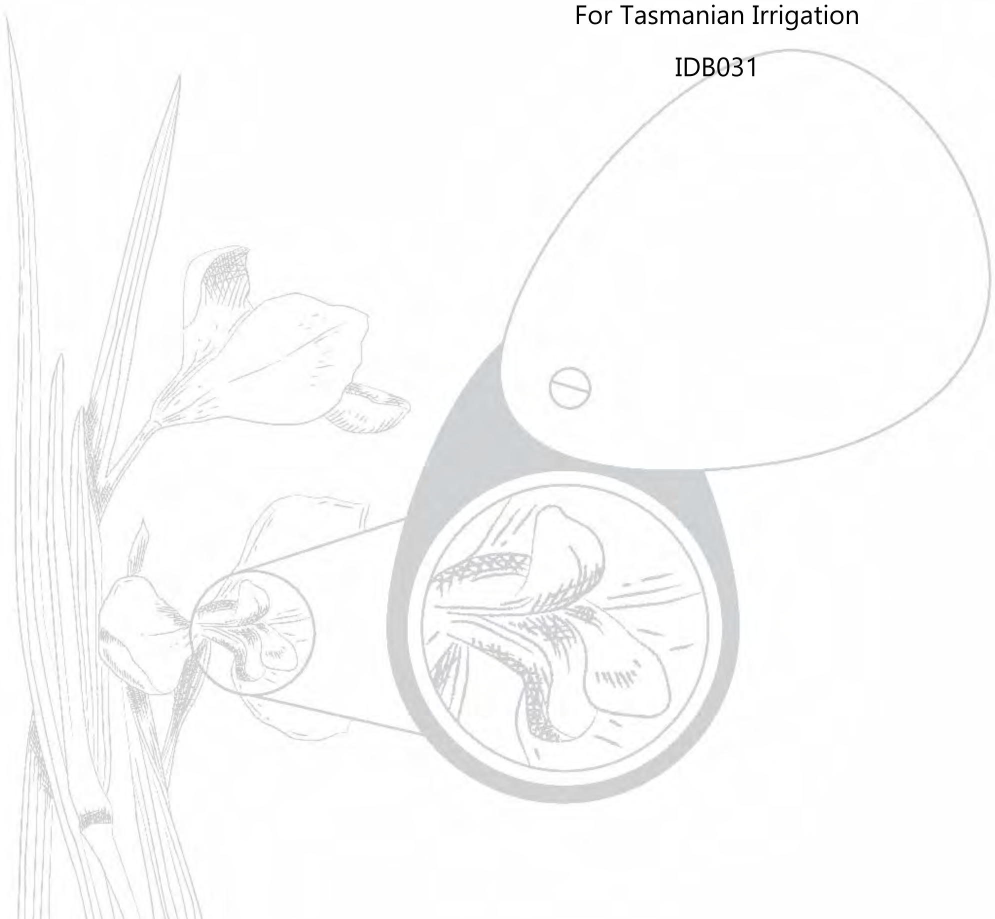
Sassafras – Wesley Vale Irrigation Scheme Augmentation

NATURAL VALUES ASSESSMENT

28th May 2025

For Tasmanian Irrigation

IDB031



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FILE CONTROL

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Document Version	Date	Author / Comment
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Version 1.5	28/05/2025	Minor update to Section 4.2.3.1 by Jared Parry Delivered to client by Jared Parry.

EXECUTIVE SUMMARY

Tasmanian Irrigation (TI) are proposing the construction and operation of the Sassafras - Wesley Vale Irrigation Scheme Augmentation (SWISA). The purpose of the SWISA project is to service the increase in demand for the current Sassafras - Wesley Vale Irrigation Scheme (SWIS) water. High-surety water sourced from the Mersey River, with Lake Parangana ensuring reliability during low flows, is currently supplied to several regions in northwest Tasmania, supporting crops such as poppies, cereals, pyrethrum, and vegetables. The SWISA will provide an almost three-fold increase in water supply capacity from 5,660 ML under SWIS to 14,860 ML per season.

The construction of the SWISA involves refitting the Great Bend pump station, constructing new infrastructure, and decommissioning the aged assets. The new distribution pipeline will consist of the Saggers Hill balance tank and 104 km of distribution pipe to 132 property outlets. The SWISA will service 163 properties which have purchased SWISA water, equating to a scheme Operational Area of 11,862 ha. Of the 163 SWISA properties, 130 are properties of existing SWIS customers.

This report primarily addresses potential impacts of the SWISA to natural values listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBCA) or Tasmanian *Threatened Species Protection Act 1995* (TSPA).

Natural values surveys of potential construction impact areas were carried out in 2022/23. The following EPBC Act listed natural values were recorded:

- *Eucalyptus ovata* forest: within the surveyed area, eight patches of *Eucalyptus ovata* forest (TSP Act listed) were confirmed forest totalling 11.33 ha. Of these patches, four patches qualify as the EPBCA listed forest Tasmanian forests and woodlands dominated by black gum or Brookers gum (*Eucalyptus ovata / E. brookeriana*) totalling 6.19 ha.
- Spotted-tail quoll (*Dasyurus maculatus maculatus*): captured by camera traps at 12 locations. One active den was confirmed. Suitable denning habitat was mapped within the Construction Corridor.
- Tasmanian devil (*Sarcophilus harrisii*): captured on camera traps at 19 locations. One active maternal den was confirmed. Suitable denning habitat was mapped within the Construction Corridor.
- Swift parrot (*Lathamus discolor*): an area of 22.72 ha of potential breeding and/or foraging habitat in addition to 211 breeding and/or foraging trees was mapped within the surveyed area. The Project Area overlaps with the swift parrot northwest breeding area.
- Tasmanian masked owl (*Tyto novaehollandiae castanops*): an area of 5.48 ha of potential breeding habitat in addition to 66 breeding trees was mapped within the surveyed area.
- Tasmanian wedge-tailed eagle (*Aquila audax fleayi*): eleven eagle nests were recorded within the Project Area. Four nests are within 500 m of the Construction Corridor and one nest with within 1000 m and within line of site of the Construction Corridor.
- Central north burrowing crayfish (*Engaeus granulatus*): entirety of the Project Area is within the core range of this species, and as the habitat availability for this species has been so greatly reduced, any suitable habitat is of significant value. Burrowing crayfish were recorded throughout the surveyed area and while the species' identity was not confirmed, the precautionary approach was taken to assume central north burrowing crayfish presence.
- Green and gold frog (*Litoria raniformis*): recorded at 63 sites within the Project Area, a sevenfold increase in records within 5 km of the Project Area. Green and gold frogs were confirmed present in 36 of 44 breeding habitat areas identified within the Project Area, and confirmed absent in one, leading to the conclusion that green and gold frogs are likely to use any available breeding habitat within the Project Area.
- Blue-winged parrot (*Neophema chrysostoma*): an area of 6.64 ha of potential breeding habitat in addition to 167 breeding trees was mapped within the surveyed area.

In addition, the following TSPA listed natural values were recorded:

- *Persicaria decipiens* (slender waterpepper): total of 4,492 m^2 was recorded within the surveyed area
- White-bellied sea eagle (*Haliaeetus leucogaster*): eleven eagle nests were recorded within the Project Area. Four nests are within 500 m of the Construction Corridor and one nest with within 1,000 m and within line of site of the Construction Corridor.

In order to reduce the impact of the SWISA on significant natural values, the pipeline alignment has been modified repeatedly to avoid known locations of natural values. As such, the current proposed alignment represents the culmination of a thorough and rigorous process of iterative improvement that minimises environmental impacts to the greatest extent practicable without fundamentally compromising scheme operation. Further impact mitigation strategies are outlined in the project's Construction Environmental Management Plan (CEMP) and Operational Environmental Management Plan (OEMP).

Due to the potential impact to EPBC Act listed MNES, the project has been assessed as a controlled action, with a request for additional information (RFAI) requested by DCCEEW on 12/02/2024. The project will be assessed through the submission of preliminary documentation, which this report will inform. The assessment requires an assessment of significant residual impacts to MNES by the project. In addition to the above MNES, the following MNES that are likely to occur within the Project area and may be impacted by the project were assessed (the Australian grayling is not covered by this report):

- Tasmanian white gum (*Eucalyptus viminalis*) wet forest;
- *Caladenia caudata* (tailed spider orchid);
- *Caladenia tonellii* (robust fingers);
- *Cassinia rugata* (wrinkled dollybush);
- Eastern quoll (*Dasyurus viverrinus*); and
- Eastern barred bandicoot *(Perameles gunnii gunnii)*.

After pipeline design modification to avoid all occurences of natural values where possible, and in consideration of mitigation measures to be undertaken during construction and during the lifetime of the operation of the scheme, it has been concluded that there will be no significant residual impact to any MNES. There is also no likely significant residual impact to TSP Act listed species.

Thirteen declared weeds were recorded or are known from the Project Area. Chytrid fungus is assumed to be present within the Project Area. Measures to mitigate the impact of these weeds and disease to MNES are discusssed.

No European heritage or Indigenous heritage sites are likely to be impacted by the project, and have been assessed in a separate document.

The only reserve area that will be impacted by the construction and operation of SWISA is the Warrawee Conservation Area. The Tasmanian Parks and Wildlife Service has been consulted regarding this aspect and the Reserve Activity Assessment process has commenced.

Five geoconservation sites listed on the Tasmanian Geoconservation database are present within in the Project Area, however no sites are within 3.3 km of the Construction Corridor and will not be impacted by the construction and operation of the SWISA.

Across the entire SWISA Project Area, the potential for exposure of acid sulfate soil is considered to be low to very low risk.

The legislative implications of the project are considered and a number of permits will be required under various State legislation to conduct impact mitigation protocols and to remove one threatened flora species that the construction of the SWISA will impact.

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LIST OF ACRONYMS & ABBREVIATIONS

Excluding TASVEG Mapping Units, measurement units and abbreviations defined within figures or tables

AHO	Aboriginal Heritage Officer
AHR	Aboriginal Heritage Register
AHT	Aboriginal Heritage Tasmania
CAR	Comprehensive, Adequate and Representative
CEMP	Construction Environmental Management Plan
CFEV	Conservation of Freshwater Ecosystem Values
CHM	Canopy Height Model
CHMA	Cultural Heritage Management Australia
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CNBC	Central North Burrowing Crayfish
DBH	Diameter at Breast Height
DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water
DEM	Digital Elevation Model
DEMCHM	Digital Elevation Model Canopy Height Model
DFTD	Devil Facial Tumour Disease
DICL	Ductile Iron Concrete Lined
EOI	Expressions of Interest
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
Farm WAP	Tasmanian Irrigation Farm Water Access Plan
FPA	Forest Practices Authority
GIS	Geographic Information System
GPS	Global Positioning System
HVAC	Heating, Ventilation, and Air Conditioning
ICV	Integrated Conservation Value
IUCN	International Union for Conservation of Nature
JANIS	Joint Australian New Zealand National Forest Policy Statement Implementation Sub-committee
MNES	Matters of National Environmental Significance
NBES	North Barker Ecosystem Services
NC Act	Tasmanian *Nature Conservation Act 2002*
NRE	Department of Natural Resources and Environment (Tasmania)
NVA	Natural Values Atlas Database
NWI	National Wilderness Inventory
OEMP	Operational Environmental Management Plan
PAD	Potential Archaeological Deposit
PBFD	Psittacine Beak and Feather Disease
PC	*Phytophthora cinnamomi*
PMSR	Protected Matters Search Report
PWS	Parks and Wildlife Service (Tasmania)
RAA	Reserve Activity Assessment
RFA	Regional Forests Agreement
RFAI	Request for Additional Information
SCADA	Supervisory Control and Data Acquisition
SPIBA	Swift Parrot Important Breeding Area

SPRAT	Species Profile and Threats Database
SWIS	Sassafras – Wesley Vale Irrigation Scheme
SWISA	Sassafras – Wesley Vale Irrigation Scheme Augmentation
THR	Tasmanian Heritage Register
TI	Tasmanian Irrigation
TSP Act	Tasmanian *Threatened Species Protection Act 1995*
UDP	Unanticipated Discovery Plan
WoNS	Weeds of National Significance

1 INTRODUCTION AND BACKGROUND

1.1 REPORT AIMS

This report aims to provide a detailed assessment of impacts due to the construction and operation of the proposed Sassafras - Wesley Vale Irrigation Scheme Augmentation (SWISA). This report will meet the requirements of the Department of Natural Resources and Environment (NRE) *Guidelines for Natural Values Surveys – Terrestrial Development Proposals*[1]. Relevant Matters of National Environmental Significance (MNES) are also addressed within the appropriate sections to provide adequate information to address the Department of Climate Change, Energy, the Environment and Water (DCCEEW) Request for Additional Information (RFAI) that was issued on the 12/02/2024 (EPBC 2023/09666).

This report will also inform the impact mitigation strategies that will be outlined in the project's Construction Environmental Management Plan (CEMP) and Operational Environmental Management Plan (OEMP). The intention of these documents it to detail a structured plan for both construction and operation of the SWISA to adequately protect MNES and provide detailed measures to ensure compliance with any State and Commonwealth permits and approvals.

1.2 PROJECT TERMINOLOGY

Project Area – This is the Project Area for the purposes of the Natural Values Assessment and is not equivalent to the Construction Project Area referred for assessment under the EPBCA. The Project Area is defined as a 5 km buffer of the proposed pipeline alignment. This area has been generated in lieu of a defined irrigation district (unavailable at the time of Assessment). The 5 km buffer excludes entirely aquatic areas (i.e. Bass Strait), however estuarine areas such as Port Sorell are included due to the presence of vegetated islands. The purpose of the Project Area is to provide context for the impacts which occur within the Construction Corridor.

The Project Area is also used to determine the level of risk to MNES associated with the operation of the scheme (i.e. likelihood of an MNES to occur within 5 km of the pipeline). Due to nature of the operational phase, the level of risk cannot be conclusively quantified at this stage; however, where MNES have been identified as present, these are considered when assessing operational impacts and relevant mitigation measures. Each individual property will be assessed independently prior to the application of SWISA water.

Survey Area – The Survey Area is the combined extent of all ground vegetation, flora, fauna, and fauna habitat surveys for all alignment options considered during the design process. Typically, the Survey Area is a 50 m buffer (100 m corridor width) of pipeline alignment(s) and 100 m buffer around the pump stations and a balance tank site as provided by TI prior to field surveys. Additional surveys to determine presence of fauna species (including green and gold frog and dasyurid species) and eagle nests within the Operational Area were undertaken beyond the Survey Area but within the Project Area.

Irrigation District – The Sassafras Wesley Vale Irrigation District under s176 of the Water Management Act 1999 (Tas), covering an area of 18,000ha.

Operational Area – The Operational Area includes all land within properties that may purchase SWISA water within the Irrigation District. It also represents the boundaries for the application of the Operational Environmental Management Plan (OEMP).

Construction Corridor – The Construction Corridor represents the impact area of construction activities including both permanent impact areas (e.g. buildings, access roads, and other minor infrastructure such as scour valves and property outlets) and temporary impacts to land that will be reinstated post construction (such as the pipeline alignment and temporary laydown areas). The Construction Corridor is nominally a 30 m corridor around the pipeline alignment plus any permanent infrastructure and

[1] Department of Primary Industries, Parks, Water & Environment (2019)

temporary construction impact areas. The Construction Corridor represents the maximum extent of the construction impact area and has been minimised in areas containing natural values to reduce impact.

Assessment of direct impacts to natural values due to construction are based on the Construction Corridor.

Construction Project Area– The Construction Project Area represents the limits of the area in which construction can be moved outside the approved Construction Corridor due to unforeseen circumstances. This area is equivalent to the Survey Area and any deviation from the approved Construction Corridor impact area within the Construction Project Area will not require additional survey. However, any change will require assessment of potential to impact MNES and can only proceed if there is no change or a reduction in the quantum of impact to MNES. If there is potential to increase the net impact on an MNES, approval from the regulator will be sought.

The Construction Project Area represents the boundary for the application of the Construction Environmental Management Plan (CEMP).

Avoidance Area – The Avoidance Area is the areas of verified natural values that will not be impacted by the Construction of the SWISA.

Exclusion Zones– Areas containing identified values and required buffer within which no works are permitted. Exclusion zones will not be impacted by construction or maintenance activities. These must be appropriately field delineated and flagged.

1.3 Project Background

In 2011-12, TI commissioned the Sassafras Wesley Vale Irrigation Scheme (SWIS) by repurposing infrastructure from the former Wesley Vale Paper Mill. The scheme, enhanced with new pipelines and booster pump stations, currently delivers 5,660 ML of high-surety water annually to 99 irrigators across several regions in northwest Tasmania, supporting crops such as poppies, cereals, pyrethrum, and vegetables. Water is sourced from the Mersey River, with Lake Parangana ensuring reliability during low flows.

Due to the success of SWIS and increased demand, TI initiated the preferred option design for the SWISA in 2021, launching water sales in 2022. This plan involves refitting the Great Bend pump station, constructing new infrastructure, and decommissioning the aged Wesley Vale Paper Mill assets. The augmented scheme will increase capacity to 14,860 ML per season, serving 132 irrigators.

The existing SWIS was assessed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (EPBC 2010/5327).

The TI project team has designed the final alignment using historical knowledge, inputs from landowners, planning consultants, and ecologists. To date, the project design has been through several iterations from the original concept design. The design changes have incorporated avoidance of MNES and other natural values, and incorporated planning advice, landowner feedback, and heritage advice.

Under the SWIS, water is sourced from the Great Bend pump station and services the Sassafras, Harford, Thirlstane, Moriarty, Wesley Vale, Northdown, Pardoe, and East Devonport areas in Northern Tasmania. The significant level of agricultural activity within the region coupled with high forecast demand has highlighted the need for upgrades to the irrigation scheme. For SWISA, TI proposes several upgrades to the existing SWIS infrastructure and construction of the following components:

1. **Distribution pipeline:** consisting of 104 km of distribution pipe to 132 property outlets;
2. **Pump stations:** to be located at the Great Bend and Sassafras Pump Stations adjacent to the Mersey River. The two stations will draw water from the Mersey River to be pumped throughout the distribution pipeline.
3. **Balance tanks:** Saggers Hill Balance Tank to be intergrated into the pipeline network.

1.3.1 Description of components and activities

1.3.1.1 Pre-construction

Following informal discussions with irrigators, TI developed a preliminary design to upgrade the Great Bend pump station, duplicate some pipelines to increase water delivery by 1,300 ML, and install interconnects for better tradability. However, a formal Expression of Interest (EOI) survey revealed interest in an additional 5,745 ML of water from 28 existing and 33 new irrigators. Follow-up phone surveys confirmed this demand, and future growth expectations led the Irrigator Representative Committee to recommend a 20 % reserve capacity. This informed the Preferred Option Design.

Various concepts were explored at this stage. Given the fully utilised summer water resources in the Mersey River, initial investigations focused on additional water sources. One option was constructing a storage dam filled from the existing water licence and additional winter water, to be released during summer. Three locations—Bonnies Creek, Parramatta Creek, and the Franklin Rivulet—were considered. Alternatively, upgrading the Parangana Dam outlet and negotiating with Hydro Tasmania to purchase additional water was evaluated. The cost-benefit analysis favoured the Parangana option due to its lower costs and minimal social and environmental impacts.

Several options were considered for the scheme itself. The feasibility of repairing and upgrading the existing SWIS was examined but discarded due to the age and condition of the assets, funding ineligibility, and the necessity for a new scheme. The preferred option design underwent four iterations in 2021, leading to a final design launched to stakeholders. This design closely followed the existing SWIS alignment, upgrading the Great Bend pump station with new electricals, additional pumps, a new balance tank, and new pipelines, with most distribution network pipelines replaced and new sections installed for better trading. Despite being feasible, a review in early 2022 highlighted challenges such as landowner opposition, suburban encroachment, and the inefficiency of the reservoir's location.

As a result, the Saggers Hill loop option was developed, proposing a new rising main, balance tank, and trunk main alignment. The higher elevation at Saggers Hill allowed for gravity-fed distribution, requiring only one balance pump station. This new alignment also improved tradability within the loops. After stakeholder consultation, this option was chosen as the preferred option and moved to the business case stage. The final version will deliver 14,860 ML of water over a 150-day season (99.1 ML/day). The Business Case was approved on 1 May 2023, allowing TI to proceed to detailed design and construction readiness, pending full funding, which was secured in May 2023.

1.3.1.2 Detailed design, permits, and approvals

Detailed design commenced in earnest following the business case and budgetary approvals in mid-2023. Tasmanian Irrigation engaged with its design partners, GHD and Pinion Advisory, to develop the preferred option to the issued for tender stage. Concurrently, TI commenced or enhanced the conduct of environmental and heritage surveys, in preparation for applying for Local, State, and Commonwealth Government permits and approvals.

Detailed design was progressed through 30, 50, 85, and 100 percent design states, before a final issued for tender design stage to confirm the suitability of the entire package for tendering. During the detailed design, the fundamental concepts of the preferred option did not change substantially. The major source of changes was instead due to increased environmental data, which saw the pipeline alignment modified repeatedly to reduce impacts on environmental and heritage values. The alignment presented later in this submission represents the culmination of a thorough and rigorous process of iterative improvement, and TI firmly believes that is minimises environmental impacts to the greatest extent practicable without fundamentally compromising scheme operation.

In addition to the EPBC referral, this project is subject to approvals by the Tasmanian State Government (Reserve Activity Assessment, for sections in the Warrawee Conservation Area, water licencing for additional take from the River Mersey, and permits to take threatened species), and the Latrobe and Devonport local councils (development applications). Application for all of these commenced during the detailed design phase, however most are not expected to be finalised until after a determination has been made under the EPBC Act.

To support the detailed design and these approvals, particularly this EPBC referral, TI and its consultants have completed a wide range of desktop and field surveys. These have included:

- Natural values assessment, including:
  - Alignment field walks (multiple rounds in different seasons);
  - Eagle nest surveys;
  - Green and gold frog surveys;
  - Central north burrowing crayfish surveys;
  - Camera trapping of likely devil and quoll dens;
  - Habitat tree surveys assessments (swift/blue-winged parrots and masked owls); and
  - Australian grayling surveys.
- Asbestos survey and management plan;
- Flood risk assessment;
- Soil and water management plan;
- Geotechnical investigations;
- Asset location;
- Coatings assessments (Great Bend pump station);
- Aboriginal heritage survey;
- European heritage survey;
- Structural assessments;
- Forest practices plan;
- Noise monitoring; and
- Landowner access agreements.

1.3.1.3 Construction

The project essentially consists of four major components:

- Great Bend pump station;
- Saggers Hill balance tanks;
- Sassafras booster pump station; and
- Delivery pipeline network.

Great Bend pump station

The Great Bend pump station is a brownfield site from the late 1960's, built for the Wesley Vale Paper Mill. The building is structurally sound and can be serviceable for another century with some remediation. However, significant modifications are needed for the augmented scheme.

The main change involves replacing the two existing vertical turbine pumps with four new 710 kW multistage vertical turbine pumps to meet SWISA's increased flow rates and head requirements. The pump station was designed to house four pumps, but only two were installed, so minimal adjustments are needed. A new inlet manifold, scour valve, and surge anticipation valve are also required. The pumps will be integrated into TI's supervisory control and data acquisition (SCADA) system for remote operation and alarm monitoring.

The current pumps are direct-on-line, while the new pumps will have independent variable speed drives. These larger pumps and new drives will increase power requirements, necessitating an upgrade of the high and low voltage (HV/LV) electrical switching gear, including replacing the three existing transformers with a single 3 MVA transformer kiosk, new HV reclosers, and metering. TasNetworks will replace the existing wooden HV pole with a new super pole.

The new variable speed drives and pumps will generate more heat, so a heating, ventilation, and air conditioning (HVAC) system will be installed to cool the pump and switch rooms. Cool air will be ducted from two external HVAC units through internal ducts.

Several structural modifications will improve accessibility, safety, and longevity. New doors will be installed for better access and emergency exits, and existing doors will be updated. A ships-style staircase to the wet well will be replaced with a contemporary staircase and landing. Cracks will be repaired, and concrete structures will be coated for additional protection. The second screen well will be opened, with new bar screens and penstocks installed in both screen wells, replacing the existing ones. The hydraulic system for the screens and penstocks will be replaced with electric winch systems.

The pump station is near the river's edge with a rock wall to the north that has become unsafe. This wall will be remediated using a batter and bench approach to reduce rock fall risk, ensuring safety for personnel and assets.

Saggers Hill balance tank

The Saggers Hill balance tank will act to smooth scheme demand and regulate pump duty cycles. With a usable volume of 2.1 ML, when full it will be able to supply the scheme at full demand for 30 minutes. It has a diameter of 24 m, a height of 6 m, and will be constructed from steel panels. The Saggers Hill balance tank will be constructed on a greenfield site in pastureland on Saggers Hill, approximately 3 km from the Great Bend pump station, and close to the Sassafras booster pump station on Native Plains Road. A 3 x 3 x 2.4 m precast concrete shed will provide shelter for the electrical and control services. A lockable caged ladder will provide access to the roof for maintenance.

To facilitate vehicular access to the site, particularly for maintenance, a 5 m wide compacted gravel hardstand will be constructed around the circumference of the tank, surrounded by a 2.1 m high security fence, with a 4.2 m wide access gate. Access to the site will be from Native Plains Road, via a new 4 m wide gravel access road, with several farm gates to control access and allow for landowner movement around the property.

Sassafras booster pump station

The Sassafras booster pump station is located at the base of the Sassafras line and provides additional head to supply it. The booster pump station is located just west of Native Plains Road, on the same access road as the Saggers Hill balance tank. It consists of a 9 x 8.5 m Colourbond clad steel frame shed on a concrete slab. The Sassafras booster pump station is accessed by via a 4.5 x 3.5 m Colourbond roller door, or a 2.1 x 0.92 m pedestrian access door. The site is surrounded by a 2.1 m high security fence, penetrated by both a 2.1 x 6 m double gate, and a 2.1 x 3 m single gate. A compacted gravel hardstand around the perimeter of the building, 4 m wide on the east and 1.5 m wide on the west, allows for vehicular and pedestrian access respectively, including to an external meter panel.

Internally, the pump station houses five pumps, four main pumps, and a fifth smaller pump for low flow conditions. Together, these will provide a flow rate of 137 L/s, providing 41 m of additional head. These will be mounted on a skid. The site will be cooled by an HVAC system.

Pipeline network

Water will be delivered via a pipeline network approximately 104 km long. The construction corridor is typically 30 m wide but narrows where necessary to protect environmental or heritage sites. The pipeline crosses several watercourses, mainly irrigation ditches and drains, with no major watercourses crossed. Where threatened species like the green and gold frog or central north burrowing crayfish are present, horizontal directional drilling will be used to avoid disturbing the watercourse.

Water from the Great Bend pump station enters a ductile iron concrete lined (DICL) rising main, 900 mm in diameter, and follows Devil Road in the Warrawee Conservation Area. At the northern edge of the conservation area, the pipeline turns east through Forico plantation forestry. After 2.7 km, the DICL pipe transitions to a 1,000 mm high-density polyethylene pipe, reaching the Saggers Hill balance tank shortly thereafter, where a flow meter is installed.

Past the Saggers Hill balance tank, the pipeline branches: the 450 mm Sassafras line continues east through the Sassafras booster pump station, supplying water to 19 customers, while the 1,000 mm trunk main continues north with branches, loops, and spurs as needed. Flow meters are installed on each line after branching. The main zones are Moriarty loop, Wesley Vale loop, Northdown line, and Latrobe line. Additional flow meters are located at key points.

Air valves to prevent air entrainment are placed periodically along the pipeline, usually at high points, housed in gravel-lined concrete pits. Isolation valves are at the beginning of most lines, allowing sections of the pipeline to be drained for maintenance without shutting down the entire network.

To supply water to irrigators, 132 property outlets will be connected to the network. These include reconnections, upgrades, and new outlets. Each outlet typically features a riser from the distribution line, filters, a meter for billing, electrical equipment, and various valves for operation and maintenance. The size of the outlets varies based on the water volume purchased by the irrigator, affecting the flow rate. Outlets are housed in metal sheds to prevent condensation and frost accumulation.

The proposal will require excavation along the route of the distribution pipeline, including several aquatic crossing points. The works will occur largely through private land, with minor components to be undertaken within the Warrawee Conservation Area and within private production timber plantation. Excavation in the form of trenching will occur only within the proposed Construction Corridor. Trenching width varies depending on the diameter of pipe required, ranging from 1 m to 5 m depending if it is a single trench or dual trench. The depth of the trench is expected to vary from 1 m to 3.5 m, with an average depth of 1.5 m. The width of the the Construction Corridor will vary along the length of the pipeline depending on the pipeline diameter and environmental constraints present. A minimum impact corridor of 6 m and a maximum of 30 m (including direct impacts such as disturbance to tree roots) is anticipated. An indicative example of a construction corridor is displayed in Figure 1.

The process of construction, consisting of excavation and re-filling, will be completed on a local scale within a one to three day period in most cases (with discrete sections open for up to a maximum of two weeks), meaning construction related disturbance timeframes are very low. Trenches will typically be open for a length of 1-200 m, with a maximum trench length of 500 m.

As a means of avoiding impacts to aquatic and riparian dwelling MNES fauna, pipe crossings of permanent water courses where habitat values are present will be installed using horizontal directional drilling. Investigations into horizontal directional drilling options have been a targeted focus of the engineering and design team as a key mitigation measure in order to reduce the environmental impact of the construction of the pipeline.

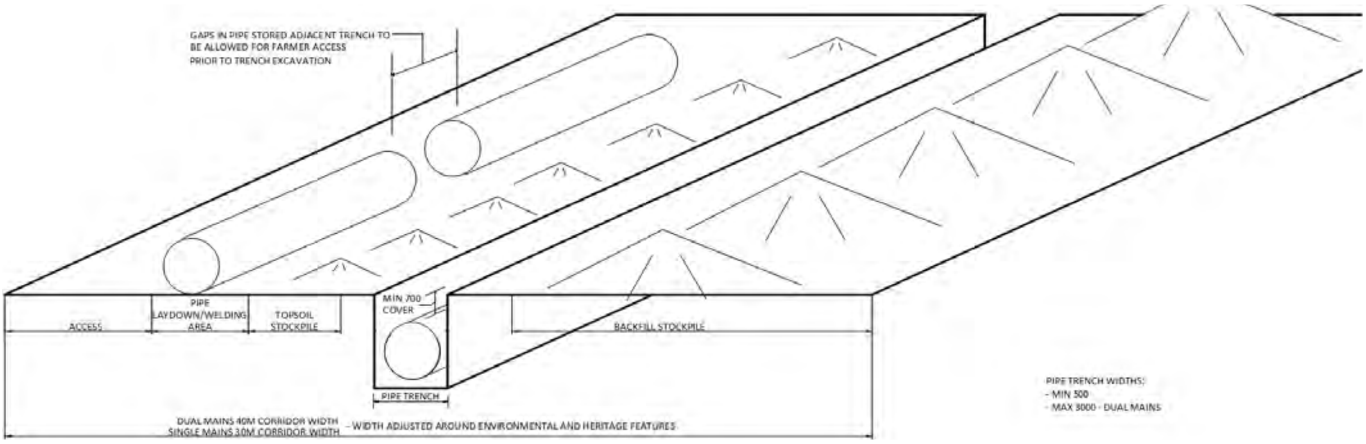


Figure 1: Indicative drawing of a typical construction corridor layout

The proposal may impact on the environment in the following ways:

- **Clearance of native vegetation** within the expanded footprint directly and indirectly impacting native flora and fauna through the removal of vegetation including sheltering and foraging habitat. For example, the clearing of forest and farm paddocks may reduce foraging habitat for browsing mammals, carnivorous marsupials, and raptors and impact directly on plant species and communities.
- **Ground excavation** removing habitat elements, vegetation, and soil, resulting in direct and indirect impacts on plants and animals within and near the disturbance footprint through the removal of potential food and shelter resources, noting that the disturbance is largely temporary. The associated noise pollution from ground excavation may disrupt the breeding cycle of nearby fauna.
- **Fauna mortality** as a result of roadkill from increased traffic volumes during construction activies may occur.
- **Introduction of weeds and pathogens** entering and spreading thoughout the construction site and broader landscape as a result of earthworks and poor hygiene management. The introduction of weeds and pathogens has potential to displace, outcompete and/or contribute to the mortality of native flora and fauna species.
- **Soil erosion and runoff** resulting from construction activities entering surrounding waterways and reduce habitat quality for aquatic species.
- **Altered hydrology regimes** as a result of the proposed infrastructure and increased water usage may occur and has potential to impact on soil erosion, salinity, surface hydrology (e.g farm ditches and damp areas) and aquatic and terrestrial species within the irrigation district. This may have flow-on effects for threatened flora and fauna species and threatened vegetation communities which have niche habitat requirements.

Parangana outlet

As mentioned above, the additional water required for the augmented scheme will be purchased from Hydro Tasmania, to be released from the Parangana Dam, approximately 1.5 days of flow above Great Bend. Parangana dams the River Mersey, with most of water stored in Lake Parangana diverted west through pipelines to the Lemonthyme Power Station, and then into Lake Cethana and the River Forth. To maintain the environmental flows (e-flow) in the River Mersey, however, Hydro Tasmania is required by the NRE to release water through an outlet valve, which usually runs through a mini-hydro scheme. The water released to the existing SWIS scheme under the Deed of Agreement also comes through that existing e-flow valve.

The infrastructure at Parangana Dam is quite aged, however, and the existing e-flow valve cannot be relied upon to supply the flow rates required by TI for full SWISA allocation. Therefore, TI is negotiating with Hydro Tasmania to share the costs of redeveloping the dam outlet. This design has not been finalised; however, the objective is that TI should have its own outlet pipe, controlled via SCADA, which will allow the scheme operator to ensure the required volume of water is released at such a time as to ensure the necessary volume of water is flowing past Great Bend pump station when it is required. This outlet will be subject to a Hydro Tasmania override, for safety and maintenance purposes.

1.3.2 Operation

Following the commissioning of the scheme, control will be handed over to the TI Operations team. The scheme is being designed to operate for the next century. The scheme will operate on a 150-day summer water season from November to March, and a reduced capacity 215-day winter water season of 7,800 ML from April to October.

1.3.2.1 Routine maintenance

Routine and emergency maintenance will be required periodically to ensure the reliability of the scheme. Emergency maintenance is inherently difficult to predict, however, TI's experience operating SWIS, and its other schemes around Tasmania, allows a high degree of certainty around the frequency requirements for routine maintenance. The required routine maintenance tasks and their frequencies for each scheme component are detailed in Table 1.

Table 1: Routine maintenance schedule for SWISA assets

Asset	Item	Task	Frequency	Unit
Great Bend pump station	Pumps	Lubrication	3	months
	Inlet screen	Inspect and clean	4	months
	Switchboard	Replace filters	6	months
	Pump station	Weed/Vegetation management	6	months
	HVAC	Filter clean	6	months
	SAV	Inspect and test	1	years
	Transformer	Service and oil check	1	years
	Instruments	Inspect, clean, calibrate	1	years
	Pumps	Thrust bearing change	2	years
	HVAC	Service	3	years
	Wet well	Cleanout	8	years
Saggers Hill balance tank	Balance tank	Weed/vegetation management	6	months
	Isolation valves	Function test	1	years
	Instruments	Inspect, clean, calibrate	1	years
	Balance tank	Internal inspection	3	years
	Balance tank	Integrity assessment	10	years

Asset	Item	Task	Frequency	Unit
	Balance tank	Internal clean	10	years
Sassafras booster pump station	Pumps	Lubrication	3	months
	Switchboard	Replace filters	6	months
	HVAC	Filter clean	6	months
	Pump station	Weed/vegetation management	6	months
	Isolation valves	Function test	1	years
	Instruments	Inspect, clean, calibrate	1	years
	HVAC	Service	3	years
Distribution network and property outlets	Air valves	Inspect and clean	1	years
	Isolation valves	Function test	1	years
	Flow meter	Inspect and calibrate	1	years
	PO	Inspect and maintain	1	years
	PO	Meter verification	1	years
	Pipeline	Scour line for snails	3	years

Whilst TI will have day-to-day operational control of the Parangana outlet for water release, all routine and emergency maintenance will be conducted by HT, due to the interaction of the outlet with their other infrastructure.

1.3.2.2 Irrigation

Irrigation water will be used by Irrigators for a variety of purposes, but predominantly filling dams or direct irrigation of crops. To control how and where TI water is being employed, and its environmental impact, every irrigator must have an approved Farm Water Access Plan (Farm WAP). The Farm WAP is a control measure that is embedded with the OEMP. The provision of water by TI is subject to compliance with the Farm WAP, which is audited regularly by TI Environmental Compliance Officers. Failure to abide by the terms of a Farm WAP can see an Irrigator's water entitlement suspended or revoked.

1.3.2.3 Tasmanian Irrigation Farm Water Access Plan

Prior to water distribution, individual irrigators must meet with TI staff to confirm a Farm Water Access Plan area[2], to collect data such as water licences and Tasmanian Natural Values Atlas (NVA) records, and any existing farm plans. Further to this, the Farm WAP process is completed by having prequalified consultants conducting soil and biodiversity assessments. The consultants then provide TI with the completed Farm WAP for quality assurance processes and is then verified by the irrigator.

[2] Tasmanian Irrigation (2024b)

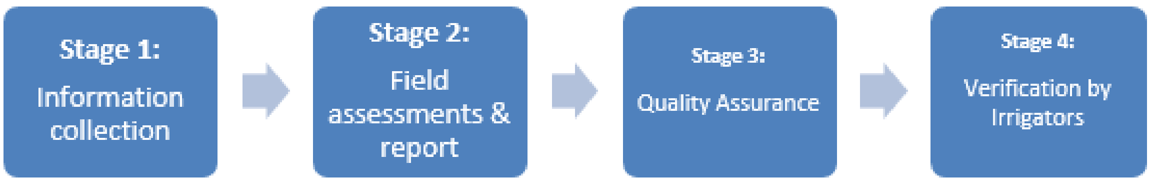
<u>What is a Farm WAP?</u>

Farm WAPs guide the sustainable application of water to ensure the long-term viability of land for agricultural production. They also help manage potential risks to natural values and include maps for use on irrigated properties. Farm WAPs are a condition of Federal and State Government approval for all Tasmanian Irrigation built schemes. The SWISA includes the requirement to have a Farm WAP covering all land and dams that TI water is applied to. The main purpose of Farm WAPs is to identify and manage:

- Risks to soil health on the irrigated properties,
- Risks to watercourse and groundwater in the receiving environment from the application of water, and
- Natural values on each irrigated property.

<u>How Farm WAPs are prepared</u>

TI facilitates the preparation of Farm WAPs for new schemes. There are four stages as follows:



Farm WAPs can only be completed by a prequalified consultant who has been approved by the Minister and are prepared in accordance with the soil, water and biodiversity modules approved by NRE. The overall time to develop Farm WAPs can be more than six months.

<u>Farm WAP Biodiversity Module</u>

For each TI irrigation scheme, a scheme-specific Farm WAP biodiversity module is developed to provide scheme-specific management actions. The objective of the biodiversity module is to identify biodiversity assets within the Farm WAP area and ensure that the application of Tasmanian Irrigation water will not have a direct or indirect impact on these assets, including but not limited to:

- Threatened native vegetation communities (e.g. EPBC Act and Tasmanian *Nature Conservation Act 2002* [NC Act] communities).
- Non-threatened native vegetation.
- Threatened fauna and flora species listed under the Tasmanian *Threatened Species Protection Act 1995 Act* (TSP Act) or the EPBC Act.
- Wetlands, waterways, floodplains, and dams.
- Weeds listed as declared under the Tasmanian *Biosecurity Regulations 2022* (in effect under the *Tasmanian Biosecurity Act 2019*).

The biodiversity module must achieve the following aims:

1. Avoid impacts to MNES.
2. Avoid impacts to potential habitat for MNES.
3. No significant impacts on MNES resulting from the operation of the SWISA and the associated irrigation district.
4. Identification of the biodiversity values that occur within the Farm WAP area and an understanding of how to sustainably manage these.
5. Understand the legislation and planning instruments relevant to biodiversity and their compliance obligations under these.
6. Development of specific management actions that address any identified risks to biodiversity values within the Farm WAP area.

7. An understanding of their role in monitoring the actions within the Farm WAP.
8. An increased understanding of the interaction between biodiversity management and other natural resources such as soils and water.
9. Highlight any potential clearing and the process to gain approval.

The content of the completed biodiversity module is owned by the individual property owner. Farm WAPs are attached to land, not individual irrigators, or property owners. Farm WAPs can be transferred to new owners or irrigators if the land is sold or leased.

Landholders must be aware that Tasmanian Irrigation will keep a copy of their Farm WAP on file with their water contract. This copy can be viewed at any time by the State and Australian Governments at the request of the relevant Minister.

The biodiversity module is a living document and must be reviewed at a minimum every two years to account for changes in technology, market developments, species listings and relevant legislation.

Who is responsible for, and complying with, a Farm WAP?

The person irrigating the land (the irrigator) is responsible for:

- Having a Farm WAP in place;
- Ensuring TI water is only applied to land where a current Farm WAP is in place;
- Informing TI of any changes to practices, so TI can assist with the updating and approval of a revised Farm WAP prior to those changed practices being implemented;
- Applying the water in accordance with the Farm WAP requirements including ensuring that the volume of water applied matches the land capability and crop water usage volumes;
- Complying with the management actions and monitoring schedules prescribed in the Farm WAP; and
- Keeping records of irrigation, chemical and fertiliser use in compliance with Tasmanian regulations.

Ordinarily the landowner is the irrigator and therefore the person responsible for obtaining a Farm WAP. In situations where water is transferred or land is leased, a business arrangement between the irrigator and the landowner and/or lessee may be required to facilitate obtaining the Farm WAP. Farm WAPs must be reviewed and checked upon transfer, and prior to each irrigation season, to ensure the Farm WAP area covers the proposed irrigation area and that the land capability is appropriate.

What compliance monitoring relates to Farm WAPs?

In accordance with conditions of approval of the irrigation schemes under the Tasmanian *Water Management Act 1999*, TI has implemented a Farm WAP auditing program. The program includes annual audits of randomly selected Farm WAPs, and triggered audits where non-compliance is identified or monitoring results indicating a decline in scheme water quality or other environmental factors.

Audits focus on compliance with the management prescriptions set out in each Farm WAP. Criteria to be addressed includes whether water has been applied in accordance with the Farm WAP, whether land capability limitations and biodiversity have been managed, monitoring has been undertaken, and required records are being kept in accordance with the Farm WAP.

Non-compliance penalties range from offering further information on best practices, through to corrective action notices being issued, and in extreme situations water delivery services being withdrawn.

1.3.3 Anticipated Timeframes

Anticipated project timeframes are detailed in Table 2 below.

Table 2: Proposed construction and commissioning schedule

Phase	Activity	Planned Start	Planned Duration	Planned End
Construction	Great Bend pump station refurbishment	24-Apr-25	307 d	26-Jun-26
	Install Sassafras booster pump station	10-Jul-25	60 d	1-Oct-25
	Install Saggers Hill balance tank	24-Apr-25	50 d	2-Jul-25
	Install Pipework	24-Apr-25	253 d	13-Apr-26
	Install Outlets	28-Oct-25	120 d	13-Apr-26
	SWIS Cutovers	1-Apr-26	150 d	31-Oct-26
	Install Valves	16-Sep-25	150 d	13-Apr-26
Commissioning	Filling	13-Apr-26	2 d	15-Apr-26
	Flushing	15-Apr-26	14 d	29-Apr-26
	Pump Station	26-Jun-26	14 d	15-Jul-26
	Tank	2-Jul-25	5 d	9-Jul-25
	Outlets	29-Apr-26	130 d	31-Oct-26

1.4 Project Area

The Project Area is located in the central north of Tasmania, extending between Devonport and Port Sorell in the northern extent, and southward to Sassafras (Figure 2), covering an area of just over 41,000 ha. The proposed SWISA pipeline is located within this broad area, with the pipeline distributing water from the Great Bend pump station on the Mersey River to a balance tank and pump boost pump station at Saggers Hill, and then further distributing northward through a network of pipeline alignments. The proposed pipeline route occurs almost entirely within the Latrobe Council (100.69 km, or 96.77 % of the pipeline), with a small section within the Devonport Council (3.36 km, or 3.23 % of the pipeline).

The Construction Corridor, which is the extent of potential impacts, is a nominal 15 m buffer of the proposed pipeline alignment, with additional buffer areas applied around permanent infrastructure, as well as areas of temporary impact for the lay down of materials. The construction corridor is larger in areas where larger pipe is required, and it is narrowed to the extent possible where threatened natural values are present.

The SWISA Irrigation District is the land area to which SWISA water is available and covers 18, 000 ha. The SWISA Operational Area includes land properties that have purchased SWISA water within the Irrigation District.

Surrounding land cover along the pipeline route is predominantly non-forest agricultural land with small patches of remnant native vegetation. Native forest areas are more widespread to the south of the Project Area, and the only significant area of native forest through which the pipeline route passes is within the Warrawee Conservation Area near the Great Bend Pump Station on the Mersey River.

1.4.1 Climate

The SWISA region has an oceanic, bordering on mild-summer mediterranean climate, with mild summers and cool winters. Mean annual rainfall for the area is approximately 905 mm per annum[3] , with limited seasonality, albeit with precipitation greatest in the winter months of July and August. Annual mean maximum temperatures[4] are around 17.1 °C, with mean maximum temperatures during summer around 21 °C, and mean minimum temperature in winter of 5.0 °C.

1.4.2 Topography

Elevation along the pipeline route ranges from 10 m to 170 m above sea level (ASL), with Saggers Hill and the Sassafras township being the highest points of the proposed alignment.

1.4.3 Geology

The geology of the proposal area (derived from Mineral Resources Tasmania Geological Polygons 250K data[5]) is largely comprised of quaternary gravels and tertiary basalt with a mixture of mudstone, sandstone, and limestone. Soils in the Project Area are derived from the following base materials displayed in Table 3 and Figure 3.

[3] Station details: East Sassafras (Elphin Grove), 41.27°S, 146.55°E, 81 m asl, commenced 1966
[4] Station details: Devonport Airport, 41.17°S, 146.43°E, 8 m asl, commenced 1992
[5] Available as thematic layers on LISTmap (https://www.thelist.tas.gov.au/app/content/home/)

Table 3: Geology (1:250,000 scale) within the Project Area (all areas are in hectares)

Symbol (Code)	Description	Extent in Construction Corridor	Extent in Project Area
Lt (1496)	Undifferentiated pelitic rocks and quartzite sequences, with greenschist facies metamorphism.	2.52	1,151.58
Ldp (1500)	Strongly faulted sequence of pyritic, carbonaceous and cherty siltstone, chert, greywacke, laminated siltstone, dolomite and basalt (Port Sorell Formation, possible correlate of Success Creek Group).	-	561.17
CO (2996)	Undifferentiated or poorly constrained conglomerate-sandstone sequences of Late Cambrian to Ordovician age.	-	114.29
Os (2999)	Shallow marine sandstone- mudstone +/- conglomerate +/- limestone sequences, typically grey, trace fossils and tubicular burrows in places. Ordovician fossils in places. Includes Moina Sandstone, Pioneer beds, Butler Island Formation.	-	238.42
Ol (3496)	Shallow marine limestone sequence with minor siltstone and sandstone (Gordon Group).	-	20.36
Pl (5988)	Lower glaciomarine sequences of mudstone, pebbly mudstone, pebbly sandstone, minor limestone and tasmanite oil shale.	11.02	4,670.50
Pf (5989)	Freshwater and paralic sandstone and mudstone with some coal measures.	4.45	1,662.27
Pu (5991)	Upper glaciomarine sequences of pebbly mudstone, pebbly sandstone and limestone.	0.87	2,141.51
P (5993)	Undifferentiated Upper Carboniferous-Permian glacial, glaciomarine and non-marine sedimentary rocks.	-	161.84
Jd (6499)	Dolerite (tholeiitic) with locally developed granophyre.	15.93	5,220.24
Tc (7495)	Conglomerate, gravel and grit.	-	403.13
Ts (7497)	Dominantly non-marine sequences of gravel, sand, silt, clay and regolith.	133.34	8,183.50
Tb (7499)	Basalt (tholeiitic to alkalic) and related pyroclastic rocks.	135.55	6,679.09
TQ (8494)	Undifferentiated Cenozoic sediments.	-	940.88
Qps (8496)	Coastal sand and gravel.	0.13	706.98
Qpt (8497)	Talus, vegetated and active.	-	419.13
Qp (8498)	Glacial, periglacial and fluvioglacial sediments including till and interglacial deposits.	-	468.82
Qh (8499)	Sand gravel and mud of alluvial, lacustrine and littoral origin.	19.69	5,278.90

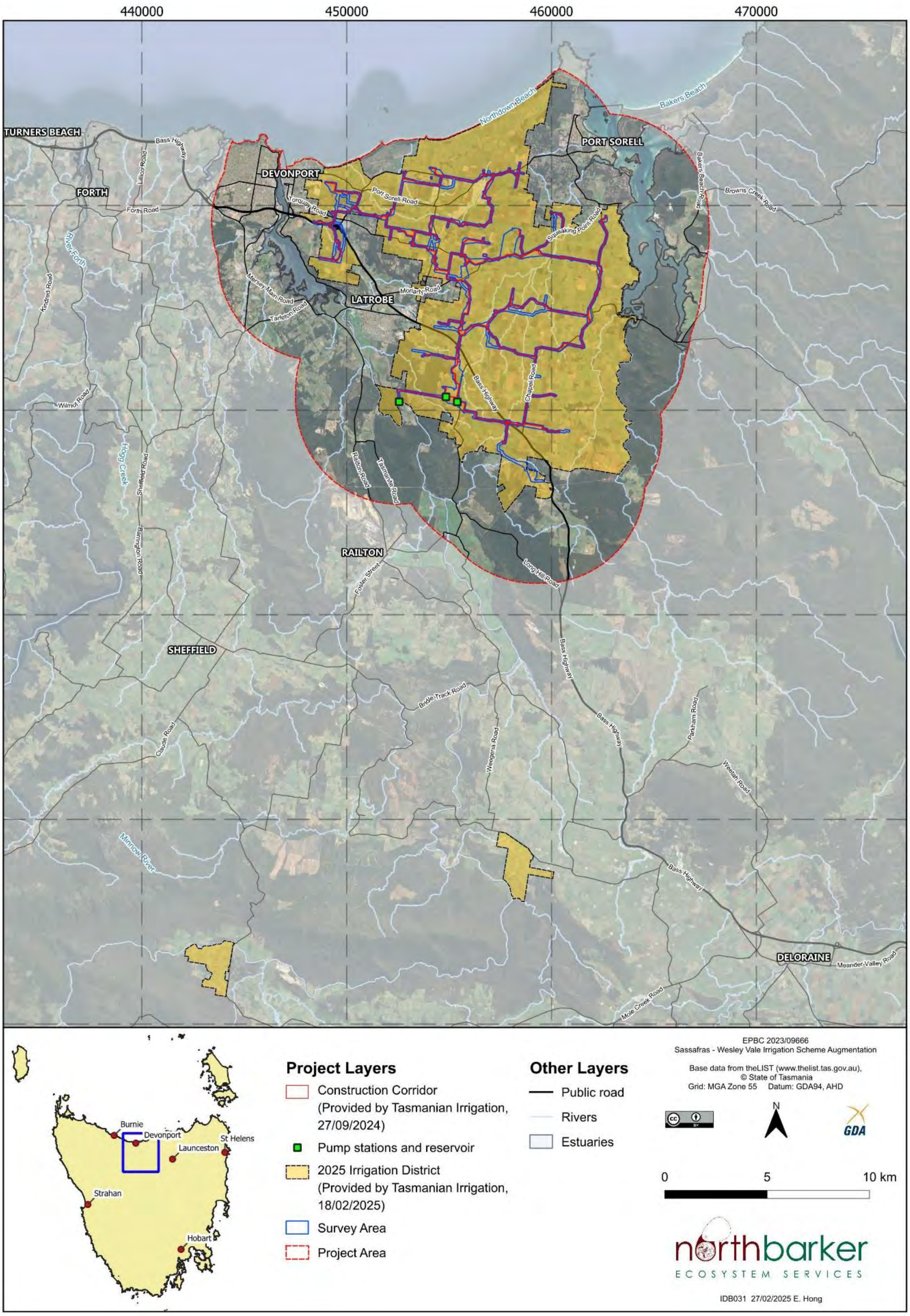


Figure 2: Location of the proposed pipeline and associated infrastructure

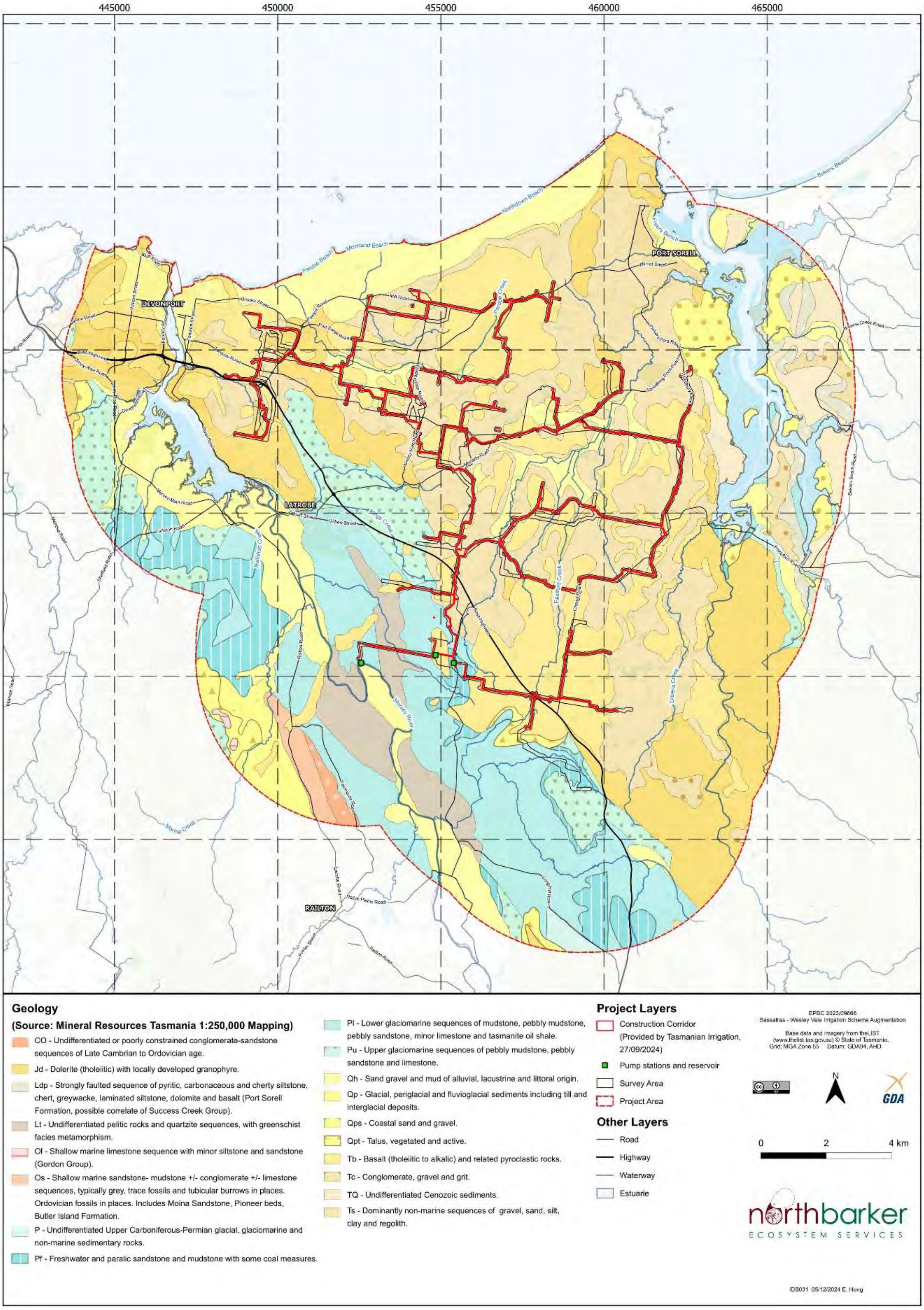


Figure 3: Geology across the Project Area

1.4.4 Hydrology and aquatic values

The Project Area is located within the broad valley of the Mersey and Rubicon Rivers on the central north coast of Tasmania.

The source of the Mersey River is Lake Meston with Lees Creek the other major tributary flowing into it. The Mersey River flows through two large hydro-electric impoundments, Lake Rowallan. and Lake Parangana. Downstream from here several other major tributaries such as Lobster Rivulet, Dasher River, and Coilers Creek join until the Mersey flows through the port city of Devonport before feeding into the Bass Strait.

The Rubicon River source is at Red Hills, west of Deloraine. The river flows through agricultural land with numerous farm dams established along its course until it passes through areas of native forest, flanked by the Wurra Wurra and Rubicon Hills. The river then empties into Port Sorell.

Both river catchments support extensive agricultural activities including grazing, piggeries, dairying, and commercial cropping. There are 386 water licenses currently allocated for water extraction for irrigation or commercial use across both catchments[6].

Rainfall in the catchment is nominally 250 mm during the irrigation season[7]. This would manifest as 45,000 ML of uncontrolled water across the proposed SWISA irrigation district of 18,014 ha. The system augmentation of an additional 9,200 ML is all highly controlled, high-cost water targeted at plant water use. The practices utilised generally result in a well less than 10 % of un-utilised (uncontrolled) water (i.e. water that is not evaporated or transpired through the plant water use process). This water, at 920 ML, is a 2 % change in the uncontrolled water within the scheme area. It should be noted that this taking place in a drying climate where traditional water resources availability to the agricultural community are under likely reductions in surety, thus the outcome is much more likely to be a status quo scenario.

Water is proposed to be extracted from the Mersey River at the existing pump station at Great Bend, which is proposed to be upgraded to meet the requirements of SWISA.

The proposed SWISA will not increase on the existing summer season water licence of 12,410 ML, with an application for a winter licence of an additional 7,800 ML underway. This additional licence is to allow the utilisation of the proposed infrastructure to those with land suitable for on-farm storage to take water in the winter period to store for use during summer. This is expected to occur in a controlled and incremental manner

The operation of SWISA is covered by the NRE water licence and is supported by the allocation of 9,200 ML of stored water at Lake Parangana (managed by Hydro Tasmania). This water does not form part of the normal release program for the Mersey-Forth Power Scheme. As this water allocation is not part of the normal release into the Mersey River, the process for obtaining water is as follows:

a) When the NRE system flow triggers require augmentation of the river to meet current stakeholder uses inclusive of environmental flows, fully controlled releases into the river based on a defined ordering system between TI and Hydro Tasmania, metered in and metered out through a water transfer agreement.
b) Marginally more base flow in the river during the irrigation season, approved by NRE under a water course authority. One element that is addressed through this process is ensuring there will not be impacts to existing water users or the environment.
c) Releases will not occur during periods of flood within the Mersey system and thus will have negligible effects to flood flow hydrology and geomorphology.

[6] Land Information System Tasmania (2024)
[7] Estimated from monthly mean rainfall data from various stations across the catchment area – www.bom.gov.au/climate/data/

Tasmanian Irrigation's established Farm WAP system and ongoing compliance framework manages irrigation application and risks to natural values, including the risk of runoff to waterways and deep percolation to groundwater by:

a) Presenting a maximum irrigation rate;
b) Requiring the use of irrigation scheduling to avoid irrigation runoff and infiltration;
c) Enforcing buffers to waterways where habitat exists for threatened species;
d) Mapping and management of soil types in accordance with the land capability system;
e) An annual audit program approved by the State Minister to ensure compliance is maintained during the life of the irrigation scheme, and to encourage opportunities for improvement. To date no major non-compliance (impact on environment) has been identified in the SWIS audits, while extension opportunities have been implemented.

Existing water quality monitoring has not shown any adverse changes in water quality due to the operation of the SWIS[8]. Baseline data that precedes SWISA exists, which provides sound background for management and proactive identification of issues through ongoing water quality monitoring. The development of SWISA will continue the existing monitoring and provide opportunities to review and improve monitoring, which may include the addition of new monitoring sites.

SWISA utilises existing water storage infrastructure within the Project Area, thus the localised effects from developing on and off stream dams will not be experienced. Land clearance for construction and operations are not likely to impact local or regional hydrology[9].

The proposed Construction Corridor intersects with 82 water courses. All works in, and around watercourses will be conducted in accordance with strict protocols to ensure the impacts to hydrological flow and environmental values are minimal.

Aquatic flora surveyed as part of the natural values assessment was limited due to physical access constraints, with flora surveyed only capturing what could be safely collected from the margins. In terms of vegetation, the general condition of waterways within the Project Area is poor, with many smaller streams highly modified in agricultural land, and weed species present in place of native riparian vegetation in others. Additionally, there are no Ramsar wetlands present within the Project Area.

Aquatic fauna surveys were not conducted as part of the natural values assessment beyond visual inspection of waterways and the potential for noting calls from aquatic habitats during the general survey efforts. The Australian grayling (*Prototroctes maraena*) has been recorded in the Mersey and Rubicon Rivers, with occurrences in the Mersey as far upstream as Liena (near Mole Creek).

Aquatic values have been surveyed by Elgin Associates, with results provided in a standalone document.

1.4.5 Land use

The majority of the Project Area is private freehold (30,902 ha or 79.10 % of the Project Area), with minor components occurring within the Warrawee Conservation Area (227.80 ha or 0.58 % of the Project Area) in the south, Narawntapu National Park (302.06 ha or 0.77 % of the Project Area) in the northeast, as well as a number of other smaller conservation areas and reserves (6 reserves totalling 339.95 ha or 0.87 % of the Project Area) and private timber plantations to the south, smaller areas of Crown Land occur adjacent to the Bass Highway, south of Sassafras.

The Great Bend pump station and 850 m of the pipeline alignment are located within the Warrawee Conservation Area, managed by the Tasmanian Parks and Wildlife Service (PWS). This land is reserved under the Tasmanian *National Parks and Reserve Management Act 2002*. A natural values assessment

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[8] Pinion Advisory (2023)
[9] Pinion Advisory (2023)

for the proposed works within the Warrawee Conservation Area has been produced separately for the purposes of meeting the PWS requirements for this area.

The Project Area is predominantly used for agricultural activities including meat production, vegetable and cereal cropping, stone fruits, and fodder, as well as dry-land grazing. Private production timber plantations occur within the irrigation district.

There are several townships and localities located within the irrigation district, including Wesley Vale, Sassafras, Harford, Northdown, Thirlstane, and Pardoe. The Sassafras - Wesley Vale district is one of the most diverse irrigation areas in the State with high value land and proximity to transportation links, with the district being adjacent to the port of Devonport and air and road freight hubs at Bellfield, and East Devonport. The Bass Highway, a major transport link, intersects the irrigation district.

The central north region is also a popular tourist destination, with local produce, historic towns, beaches and coastlines, limestone caves being popular destinations in the region, and activities mountain biking, horse riding, hiking water sports and fishing popular among locals and tourists.

1.5 Background Research

The following sources were used for biological records from the region to supplement field data collected by NBES and to ensure efforts were targeted to detect presence and/or habitat for threatened values:

- EPBC Act Protected Matters Report (PMSR) [10] – all Matters of National Environmental Significance (MNES) that may occur in the area or relate to the area in some way (**Attachment A**);
- Tasmanian Natural Values Atlas[11] – this NRE database includes biological records (**Attachment B**);
- TASVEG 4.0 (and TASVEG Live) digital data[12] – this layer was field-truthed during ground surveys
- Previous assessments on natural values within and near the Project Area (by NBES); and
- Previous natural values records from the SWIS scheme.

The following survey guidelines, conservation advice, recovery plans, and web resources were consulted throughout the assessment process:

- Survey guidelines for Australia's threatened mammals: Guidelines for detecting mammals listed as threatened under the *Environment Protection and Biodiversity Conservation Act 1999*[13];
- Survey guidelines for Australia's threatened frogs: Guidelines for detecting frogs listed as threatened under the *Environment Protection and Biodiversity Conservation Act 1999*[14];
- Guidelines for Natural Values Surveys - Terrestrial Development Proposals[15];
- Various Species Profile and Threats Database (SPRAT) profiles[16], including recovery plans, policy statements, conservation advice, listing advice, species specific significant impact guidelines, and threat abatement plans.

[10] Department of Climate Change, Energy, the Environment & Water (2024a)
[11] Department of Natural Resources & Environment (2024a)
[12] Land Information System Tasmania (2024)
[13] Department of Sustainability, Environment, Water, Population & Communities (2011a)
[14] Department of the Environment, Water, Heritage & the Arts (2010a)
[15] Department of Primary Industries, Parks, Water & Environment (2019)
[16] Available at https://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

1.6 LIMITATIONS

Due to the size of the assessment area, and the numerous matters that are required to be considered, there are invariably limitations associated with this natural values assessment, with those limitations listed below:

- Due to seasonal variations in detectability and accurate discrimination (*i.e.* identification of closely related species), there may be some herb, orchid and/or graminoid species present on the route that have been overlooked. Flora surveys were strategically timed to maximize the opportunity to detect seasonal threatened flora, though may not have been ideal for detection of all species.
- Due to lack of visibility, and access limitations, submerged species may also be under-surveyed to some degree. To compensate for this, field data from the present study were supplemented with data from the Tasmanian Natural Values Atlas[17] and the EPBC Act Significant Matters Database[18]. All threatened plant species known to occur in the local area (500 m) were considered in terms of habitat suitability on site. A wider radius of 5 km was considered in our background assessment.
- Threatened fauna habitat, including the presence of tree hollows, was assessed from ground level only, other than for the aerial assessment of eagle nesting habitat.
- Burrowing crayfish surveys were limited in some areas by high biomass load. In some potential roadside and farm ditch habitat, the likelihood of finding chimneys was limited by high grass and herb biomass, *i.e.*, if burrows were present, they would not be seen under the dense vegetation.
- Spatial data was collected with a handheld non-differential Global Positioning System (GPS) with an average accuracy of between 3 and 10 m.
- Operational impacts and mitigation strategies are developed on the known values recorded during targeted field assessments, acknowledging that the extent of these surveys does not cover the entirety of the Operational Area. Where MNES are predicted to occur based on either site knowledge, or expert advice, mitigation measures have been developed in anticipation of these values being present in the Operational Area. Any values not captured in this assessment will be captured through individual property assessments within the Farm WAP process.

[17] Department of Natural Resources & Environment (2024a)
[18] Department of Climate Change, Energy, the Environment & Water (2024a)

2 SIGNIFICANT IMPACT ASSESSMENT OF RESIDUAL IMPACTS TO MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE[19]

All EPBC Act listed values that have the potential to occur in the Project Area are considered in this report[20]. The potential for these values to occur, and likelihood/extent of residual impact and recommended mitigation have been considered. In this report, the residual impacts for MNES listed under the EPBC Act that have a reasonable chance of occurring and/or of being notably impacted by the project are considered under significant impact criteria. All MNES that are listed in the RFAI have been addressed in this report, with the exception of the Australian grayling which has been assessed in a separate report concerning aquatic values. Where an MNES has a specific set of significant impact guidelines, these are also considered in our assessment of significant residual impacts.

The potential impacts to MNES as a result of both the construction and the operation of the SWISA are considered in assessing the significance of residual impacts of this Project. The Construction Corridor alignment and extent has been designed by an iterative process of adjustment and redesign to minimise the impact of construction of the SWISA on natural values. Although the Project is seeking approval for the Project Area, assessment of direct impacts to MNES due to construction are based on the Construction Corridor presented in this report. Any deviation from the approved Construction Corridor impact area within the Survey Area will not require additional survey but will require assessment of potential to impact MNES. Deviation outside the referred Construction Corridor can only occur if there is no change or a reduction in the quantum of impact to MNES, or approval from the regulator is sought.

Species that either have a low likelihood of occurrence or abundance and/or low potential for impact are not considered in this assessment, discussion regarding these values is found in **Attachment C**.

2.1 SIGNIFICANT IMPACT CRITERIA

The EPBC Act is structured for self-assessment so the proponent must determine whether or not the project is considered a 'controlled action', which, if confirmed, would require approval from the Commonwealth Minister. An action will require approval from the Minister if the action has, will have, or is likely to have, a significant impact on a MNES, which encompasses all species and habitats listed under the Act. A 'significant impact' is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends on the sensitivity, value, and quality of the environment, which is impacted, and upon the intensity, duration, magnitude, and geographic extent of the impacts. A proponent must consider all of these factors when determining whether an action is 'likely' to have a significant impact on MNES. To be likely, it is not necessary for a significant impact to have a greater than 50 % chance of happening; it is sufficient if a significant impact on the environment is a real or not remote chance or possibility. If there is scientific uncertainty about the impacts of an action and potential impacts are serious or irreversible, the precautionary principle is applicable. Accordingly, a lack of scientific certainty about the potential impacts of an action will not itself justify a decision that the action is not likely to have a significant impact on the environment. Substantial penalties apply for taking an action that has, will have, or is likely to have a significant impact on a MNES without approval.

Significant impact criteria are identical for critically endangered and endangered species. The criteria for vulnerable species only apply to 'important populations'. Ecological communities are assessed against slightly different criteria to flora and fauna MNES.

[19] Statements in this section referring to self-assessment guidelines and impact criteria have been taken verbatim or paraphrased from the Matters of National Environmental Significance: Significant Impact Guidelines 1.1. Commonwealth of Australia (2013a)
[20] Department of Climate Change, Energy, the Environment & Water (2024a)

2.2 TERMS AND DEFINITIONS

2.2.1 What is a significant impact?

A significant impact is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment, which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts. You should consider all of these factors when determining whether an action is likely to have a significant impact on matters of national environmental significance.

To be 'likely', it is not necessary for a significant impact to have a greater than 50 % chance of happening; it is sufficient if a significant impact on the environment is a real or not remote chance or possibility.

If there is scientific uncertainty about the impacts of the action and potential impacts are serious or irreversible, the precautionary principle is applicable. Accordingly, a lack of scientific certainty about the potential impacts of an action will not itself justify a decision that the action is not likely to have a significant impact on the environment.

2.2.2 Significant impact criteria[21]

2.2.2.1 Critically endangered and endangered species

What is a population of a species?

A 'population of a species' is defined under the EPBC Act as an occurrence of the species in a particular area. In relation to critically endangered, endangered, or vulnerable threatened species, occurrences include but are not limited to:

- a geographically distinct regional population, or collection of local populations, or
- a population, or collection of local populations, that occurs within a particular bioregion.

Invasive species

An invasive species is an introduced species, including an introduced (translocated) native species, which out-competes native species for space and resources, or which is a predator of native species. Introducing an invasive species into an area may result in that species becoming established. An invasive species may harm listed threatened species or ecological communities by direct competition, modification of habitat or predation.

Habitat critical to the survival of a species or ecological community

Habitat critical to the survival of a species or ecological community refers to areas that are necessary:

- For activities such as foraging, breeding, roosting, or dispersal
- For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- To maintain genetic diversity and long term evolutionary development, or
- For the reintroduction of populations or recovery of the species or ecological community.

Such habitat may be but is not limited to:

- Habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or
- Habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act.

[21] Commonwealth of Australia (2013a)

Significant impact criteria – critically endangered & endangered species

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

1. Lead to a long-term decrease in the size of a population;
2. Reduce the area of occupancy of the species;
3. Fragment an existing population into two or more populations;
4. Adversely affect habitat critical to the survival of a species;
5. Disrupt the breeding cycle of a population;
6. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
7. Result in invasive species that are harmful to the species becoming established in the species' habitat;
8. Introduce disease that may cause the species to decline; or
9. Interfere with the recovery of the species.

Significant impact criteria – critically endangered & endangered ecological communities

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

1. Reduce the extent of an ecological community
2. Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines
3. Adversely affect habitat critical to the survival of an ecological community
4. Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns
5. Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting
6. Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:
   i. Assisting invasive species, that are harmful to the listed ecological community, to become established, or
   ii. Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or
7. Interfere with the recovery of an ecological community.

2.2.2.2 Vulnerable species

Important population

An important population is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

Significant impact criteria – vulnerable species

An action is considered likely to have a significant impact if there is a real chance or possibility that it will:

1. Lead to a long-term decrease in the size of an important population;
2. Reduce the area of occupancy of an important population;
3. Fragment an existing important population into two or more populations;
4. Adversely affect habitat critical to the survival of a species;
5. Disrupt the breeding cycle of an important population;
6. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
7. Result in invasive species that are harmful to the species becoming established in the species' habitat;
8. Introduce disease that may cause the species to decline; or
9. Interfere substantially with the recovery of the species.

2.2.2.3 Migratory species

What is important habitat for a migratory species?

An area of 'important habitat' for a migratory species is:

1. Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or
2. Habitat that is of critical importance to the species at particular life-cycle stages, and/or
3. Habitat utilised by a migratory species which is at the limit of the species range, and/or
4. Habitat within an area where the species is declining.

What is an ecologically significant proportion?

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an 'ecologically significant proportion' of the population varies with the species (each circumstance will need to be evaluated). Some factors that should be considered include the species' population status, genetic distinctiveness and species specific behavioural patterns (for example, site fidelity and dispersal rates).

What is the population of a migratory species?

Population, in relation to migratory species, means the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries including Australia.

Significant impact criteria for migratory species

The criteria for migratory species are relevant to species that are not also listed as threatened. An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

1. Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles, or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species
2. Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or
3. Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

2.2.3 Other key terminology

2.2.3.1 Extent of occurrence

Extent of occurrence is a key factor in determining the risk factors to MNES, particularly in regard to geographic distribution, and whether the action will impact this. It is not defined within the *Significant Impact Guidelines 1.1*[22]. In lieu of this, the Internation Union for Conservation of Nature (IUCN) definition has been adopted within this report. It is defined as follows:

> Extent of occurrence is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy. This measure may exclude discontinuities or disjunctions within the overall distributions of taxa (e.g. large areas of obviously unsuitable habitat). Extent of occurrence can often be measured by a minimum convex polygon (the smallest polygon in which no internal angle exceeds 180 degrees, and which contains all the sites of occurrence)[23].

2.2.3.2 Area of occupancy

One of the criteria relates to the area of occupancy and whether the action will impact this. It is not defined within the *Significant Impact Guidelines 1.1*[24]. In lieu of this, the IUCN definition has been adopted within this report. It is defined as follows:

> Area of occupancy is defined as the area within its 'extent of occurrence' which is occupied by a taxon, excluding cases of vagrancy. The measure reflects the fact that a taxon will not usually occur throughout the area of its extent of occurrence, which may contain unsuitable or unoccupied habitats. In some cases (e.g. irreplaceable colonial nesting sites, crucial feeding sites for migratory taxa) the area of occupancy is the smallest area essential at any stage to the survival of existing populations of a taxon. The size of the area of occupancy will be a function of the scale at which it is measured[25].

[22] Commonwealth of Australia (2013a)
[23] International Union for Conservation of Nature (2012)
[24] Commonwealth of Australia (2013a)
[25] International Union for Conservation of Nature (2012)

3 SURVEY SUMMARY

Table 4 summarises the surveys conducted for this assessment, noting the relevant parties and relevant guidelines used to inform the survey timing, effort, and design.

Table 4: Summary of surveys conducted for the SWISA project

Date(s)	Survey Purpose	Description of Survey	Personnel	Relevant Guidelines
29/08/2022	Alignment reconnaissance and fatal flaws	A drive-through survey to provide a broad overview and identify fatal flaws.	Mark Wapstra (ECOtas) Jesse Lewis (TI)	N/A
01/11/2022	Targeted orchid survey	Targeted surveys for *Caladenia tonellii* in the Devil Rd vicinity.	Brian French (ECOtas) Jesse Lewis (TI)	Commonwealth of Australia (2013b). Survey guideline for Australia's threatened orchids: guidelines for detecting orchids listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999, Commonwealth Government, Canberra.
16/11/2022	Targeted orchid survey	Targeted surveys for *Caladenia tonellii* in the Devil Rd vicinity.	Mark Wapstra (ECOtas)	Commonwealth of Australia (2013b). Survey guideline for Australia's threatened orchids: guidelines for detecting orchids listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999, Commonwealth Government, Canberra.
09/02/2023 – 10/02/2023	Aerial eagle nest search	Aerial search of a 1.5 km buffer of the proposed alignment for eagle nests.	Erin Harris (NBES) Aleida Williams (NBES) Adam Hardy (Raptor Care North West)	Forest Practices Authority (2014a). *Wedge-tailed eagle nesting habitat model*, Fauna Technical Note No. 6, Forest Practices Authority, Hobart, Tasmania. Forest Practices Authority (2023). *Eagle nest searching, activity checking and nest management*, Fauna Technical Note No. 1, Forest Practices Authority, Hobart, Tasmania.
14/02/2023 – 17/02/2023	Full alignment survey	Full walkthrough of the proposed alignment, documenting vegetation, weeds,	Aleida Williams (NBES) Hayley Kingsley (NBES) Jesse Lewis (TI)	Department of Primary Industries, Parks, Water & Environment (2019). *Guidelines for Natural Values Surveys - Terrestrial Development Proposals*. Department of Primary Industries,

Date(s)	Survey Purpose	Description of Survey	Personnel	Relevant Guidelines
		threatened flora, and threatened fauna habitat.		Parks, Water and Environment (Natural & Cultural Heritage Division), Hobart, Tasmania.
17/05/2023 – 19/05/2023	Realignment survey	Additional survey to capture areas of realigned pipeline based on results of the full alignment survey, and to assess the patch quality of *Eucalyptus ovata* forests for listing under the EPBC Act.	Aleida Williams (NBES) Danah Leary (NBES) Jesse Lewis (TI)	Department of Primary Industries, Parks, Water & Environment (2019). *Guidelines for Natural Values Surveys - Terrestrial Development Proposals*. Department of Primary Industries, Parks, Water and Environment (Natural & Cultural Heritage Division), Hobart, Tasmania. Department of the Environment & Energy (2019). *Approved Conservation Advice (incorporating listing advice) - Tasmanian Forests and Woodlands dominated by black gum or Brookers gum (Eucalyptus ovata / E. brookeriana)*. Department of the Environment and Energy, Canberra, Australian Capital Territory.
06/11/2023 – 08/11/2023	Targeted orchid survey	Targeted surveys for *Caladenia tonellii* in the Devil Rd vicinity.	Aleida Williams (NBES) Mark Wapstra (ECOtas)	Commonwealth of Australia (2013b).. Survey guideline for Australia's threatened orchids: guidelines for detecting orchids listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999, Commonwealth Government, Canberra.
04/12/2023 – 08/12/2023	Habitat tree assessment	Targeted assessment of identified potential habitat trees to determine their habitat potential.	Aleida Williams (NBES)	Forest Practices Authority (2014b). *Identifying masked owl habitat*, Fauna Technical Note No. 17, Forest Practices Authority, Hobart, Tasmania. Forest Practices Authority (2014c). *Identifying swift parrot breeding habitat*, Fauna Technical Note No. 3, Forest Practices Authority, Hobart, Tasmania. Department of the Environment, Water, Heritage & the Arts (2010b). *Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*. Department of Sustainability, Environment, Water,

Date(s)	Survey Purpose	Description of Survey	Personnel	Relevant Guidelines
				Population & Communities, Canberra, Australian Capital Territory.
04/12/2023 – 08/12/2023	Targeted green and gold frog survey	Systematic survey of potential green and gold frog habitat to determine the range extent of this species.	Aleida Williams (NBES) Morgan Humphrey (NBES) John Gooderham (The Waterbug Company)	Department of the Environment, Water, Heritage & the Arts (2010b). *Survey guidelines for Australia's threatened frogs: Guidelines for detecting frogs listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*. Department of the Environment, Water, Heritage & the Arts, Canberra, Australian Capital Territory. Department of State Growth (2015). *Green and Golden Frog (Litoria raniformis) Management Guidelines*, report prepared by GHD.
04/12/2023 – 05/03/2024	Eastern quoll camera trapping survey	Setup, survey period, and collection of camera trapping survey.	Morgan Humphrey (NBES) Amy Madsen (TI) Jesse Lewis (TI)	Department of Sustainability, Environment, Water, Population & Communities (2011a). *Survey guidelines for Australia's threatened mammals - Guidelines for detecting mammals listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*. Department of Sustainability, Environment, Water, Population & Communities, Canberra, Australian Capital Territory. Environment Strategic Business Unit (2023). *Survey Guidelines and Management Advice for Development Proposals that may impact the Tasmanian Devil (Sarcophilus harrisii)*. Department of Natural Resources & Environment, Tasmania.
17/12/2023 – 19/12/2023	Masked owl call back surveys	Targeted call back surveys to determine presence in potential habitat.	Aleida Williams (NBES) Ramit Singal (NBES) Jesse Lewis (TI)	Department of Environment, Water, Heritage & the Arts (2010b). *Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*. Department of Environment, Water, Heritage & the Arts, Canberra, Australian Capital Territory.

Date(s)	Survey Purpose	Description of Survey	Personnel	Relevant Guidelines
17/12/2023 – 21/12/2023	Targeted green and gold frog survey	Systematic survey of potential green and gold frog habitat to determine the range extent of this species.	Aleida Williams (NBES) Ramit Singal (NBES) Jesse Lewis (TI)	Department of the Environment, Water, Heritage & the Arts (2010a). *Survey guidelines for Australia's threatened frogs: Guidelines for detecting frogs listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*. Department of the Environment, Water, Heritage & the Arts, Canberra, Australian Capital Territory. Department of State Growth (2015). *Green and Golden Frog (Litoria raniformis) Management Guidelines*, report prepared by GHD.
08/01/2024 – 12/01/2024	Targeted green and gold frog survey	Systematic survey of potential green and gold frog habitat to determine the range extent of this species.	Ramit Singal (NBES) John Gooderham (The Waterbug Company)	Department of the Environment, Water, Heritage & the Arts (2010a). *Survey guidelines for Australia's threatened frogs: Guidelines for detecting frogs listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*. Department of the Environment, Water, Heritage & the Arts, Canberra, Australian Capital Territory. Department of State Growth (2015). *Green and Golden Frog (Litoria raniformis) Management Guidelines*, report prepared by GHD.
04/12/2023-18/01/2024	Targeted green and gold frog survey-song meter audio survey	Setup, survey period, collection, and redeployment of song meter to green and gold frog habitats.	Amy Madsen (TI) Jesse Lewis (TI) Harsha Naraj (NBES)-Acoustics analysis	Department of the Environment, Water, Heritage & the Arts (2010a). *Survey guidelines for Australia's threatened frogs: Guidelines for detecting frogs listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*. Department of the Environment, Water, Heritage & the Arts, Canberra, Australian Capital Territory. Department of State Growth (2015). *Green and Golden Frog (Litoria raniformis) Management Guidelines*, report prepared by GHD.
15/04/2024 – 16/04/2024	Realignment survey	Additional survey to capture areas of realigned pipeline	Aleida Williams (NBES) Scott O'Halloran (TI)	Department of Primary Industries, Parks, Water & Environment (2019). *Guidelines for Natural Values Surveys - Terrestrial*

Date(s)	Survey Purpose	Description of Survey	Personnel	Relevant Guidelines
		based on results of an impact mitigation workshop.		*Development Proposals*. Department of Primary Industries, Parks, Water and Environment (Natural & Cultural Heritage Division), Hobart, Tasmania.
20/05/2024 – 24/04/2024	Targeted burrowing crayfish survey	Systematic survey of potential central north burrowing crayfish habitat with the Survey Area to determine the extent of habitat this species.	Aleida Williams (NBES) Ramit Singal (NBES) Scott O'Halloran (TI) Jesse Lewis (TI)	Department of State Growth (2014) *A guide to managing threatened burrowing crayfish in the Department of State Growth road reserves*, Tasmanian Government, Hobart. Department of Sustainability, Environment, Water, Population & Communities (2011b). *Draft referral guidelines for four Tasmanian burrowing crayfish.* Australian Government, Canberra, Australian Capital Territory.
28/08/2024	Realignment survey	Additional survey to capture areas of realigned pipeline.	Ramit Singal (NBES)	Department of Primary Industries, Parks, Water & Environment (2019). *Guidelines for Natural Values Surveys - Terrestrial Development Proposals*. Department of Primary Industries, Parks, Water and Environment (Natural & Cultural Heritage Division), Hobart, Tasmania.

4 BIOLOGICAL VALUES

4.1 VEGETATION

The following subsection of this document provides further detailed information requested to assist the assessment of potential impacts to the ecological communities protected by the EPBC Act and additional vegetation communities listed as threatened under the Tasmanian *Nature Conservation Act 2002* (NC Act) for the development of the Sassafras – Wesley Vale Irrigation Scheme Augmentation.

A particular emphasis is on the listed MNES listed in RFAI 4 a) which pertain to the Tasmanian forests and woodlands dominated by black gum ecological community, and RFAI 5 which requests an assessment of all potential impacts on MNES, including direct, indirect, facilitated, and cumulative, and must be assessed in accordance with the *Significant Impact Guidelines 1.1*[26].

Vegetation types were mapped throughout the Survey Area as a key component of this assessment. Vegetation mapping informs statements on the distribution of vegetation types throughout this section, noting that in some cases the characteristics of the vegetation reflect types of land use, which are highlighted where relevant. Statements on the composition of communities, including the presence of weeds, threatened flora, habitat values, etc., are referring to observations made during field investigations.

4.1.1 TASVEG 4.0 Vegetation Communities

Context

The SWISA region has a long agricultural history, with much of the broader area dominated by modified pasture and cropping land (Plate 1, Plate 2), as well as forestry activities (Plate 3). Forest remnants are scattered throughout the SWISA region. This is reflected by the distribution of vegetation communities present within the Project Area.

Plate 1: Agricultural landscape typical of the SWISA region

[26] Commonwealth of Australia (2013a)

Plate 2: Agricultural landscape typical of the SWISA region

Plate 3: Large-scale forestry activity conducted within the SWISA region

Survey Methods

In Tasmania, the primary source on the distribution of vegetation is the state-wide TASVEG[27] mapping database (with TASVEG 4.0 being the latest published version, and current distribution data available in the TASVEG-Live database version). The compilation of TASVEG has been an iterative process of improvement and refinement upon an original base layer that was collated from several sources[28]. As a result, data within TASVEG do not completely represent vegetation extent and distribution at a single date, and some areas of vegetation are still mapped at a coarser scale than the general 1:25,000 or are based on interpretation of imagery over ten years old[29]. Furthermore, vegetation mapping at any scale can be an exercise in judgement, with an inherent potential for errors in interpretation. Subsequently, it is standard practice to truth TASVEG data using recent imagery and ground sampling[30].

The image interpretation process for the current proposal involved several satellite images accessed via Google Earth Pro[31], LIST basemap imagery[32], and Nearmap imagery[33]. The images had a resolution of no more than 2.5 m, with capture dates ranging from 09/01/2016 to 14/04/2024. Imagery was examined for patterns of tone, texture, colour, and contrast to identify homogeneous patches of vegetation (aerial signatures). This was also informed by the interpretation of environmental traits such as slope, aspect, and elevation, due to their consistent associations with vegetation units[34]. Patches were then manually assigned to TASVEG units based on correlation with existing polygons within the TASVEG database and evident aerial signatures.

Ground sampling was undertaken over the course of all field visits. Ground sampling involved one or two ecologists traversing the survey area (mostly on foot) in a stratified fashion that ensured ground sampling of the complete range of image signatures. When a patch was ground sampled, the observer assessed the requisite traits of vegetation structure, floristics, geology, and environment to discriminate the patch from any other possible TASVEG units using the descriptions and stepwise keys within the online versions of the current TASVEG companion manual[35]. Boundary discrimination was based on image interpretation and aided by point data collected on a hand-held GPS unit. All ground sampling was undertaken during the daytime, mostly in fine weather due to the potential sampling constraints associated with reduced visibility from rain and/or low light.

This combination of image interpretation followed by stratified ground sampling and interpolation is consistent with the NRE guidelines for natural values assessments[36] as well as the methods applied within vegetation mapping elsewhere[37] and described in ecological manuals[38].

TASVEG units observed on site were cross-referenced against all vegetation communities listed as threatened under the NC Act and/or the EPBC Act, as well as conservation priorities for the Woolnorth bioregion[39] area under the Tasmanian *Regional Forest Agreement* (RFA)[40].

[27] Department of Primary Industries, Parks, Water & Environment (2020)
[28] Harris & Kitchener (2005)
[29] Kitchener & Harris (2013)
[30] Tasmanian Vegetation Monitoring & Mapping Program (2013)
[31] Google Earth Pro (2024)
[32] Land Information System Tasmania (2024)
[33] Nearmap (2024)
[34] Kirkpatrick & Nunez (1980)
[35] Kitchener & Harris (2013)
[36] Department of Primary Industries, Parks, Water & Environment (2019)
[37] The Nature Conservancy (1994)
[38] Kuchler & Zonneveld (2012)
[39] Noting that the Forest Practices system operates under IBRA 4.0, which has since been superseded by IBRA 7.0
[40] Forest Practices Authority (2024)

Following TASVEG[41] guidelines, minimum mappable vegetation patch size was set at 0.25 ha except where patches as small as 0.10 ha of forest and woodland communities of high conservation significance were assessed as viable and therefore mapped.

To support the determination of TASVEG units (as per NRE guidelines[42]) and provide general floristic data, within each native community at least one full vascular plant species list was taken in representative ¼ ha plots using a Timed Meander Search Procedure[43]; this method requires the observer to continue survey effort until survey yields (*i.e.*, new species observations) diminish towards zero. Outside the ¼ ha plots, threatened species observations, and observations of additional non-threatened plant species were noted as encountered while traversing the site and while conducting all other observations – where nodes of additional plants were present, additional plots were undertaken.

Areas of agricultural land were surveyed in a stratified fashion, prioritising known locations and areas containing habitat of threatened species (e.g. drainage channels and damp areas). Timber plantations, urban areas, paddocks, roadsides, and large-scale weed infestations were surveyed less intensively based on the lower suitability of habitat for conservation significant values. Areas subject to cropping and/or pivot irrigation were not surveyed other than where suitable localised niches for conservation significant values were evident.

Declared[44] and environmental weeds, as well as symptomatic evidence of plant pathogens, were recorded where evident within or close to (such as on an adjacent road) the project area.

Botanical nomenclature follows the 2023 census of Tasmanian plants[45].

Assessment of Conservation Significance

The state and federal governments are committed to achieving a Comprehensive, Adequate and Representative (CAR) reserve system based on TASVEG mapping. The reservation target of a vegetation type relates to its current extent compared with the modelled extent prior to European settlement. This comparison provides an estimate of the proportion lost due to land clearing. Those vegetation types that are rare (generally less than 1,000 ha) or have suffered considerable loss (approaching 70% for vulnerable and 90% for endangered types) qualify for listing as "threatened" under the NC Act[46].

For forests, reservation targets were set using the nationally agreed Joint Australian New Zealand National Forest Policy Statement Implementation Sub-committee (JANIS) criteria[47] as part of the Tasmanian RFA. These aim to achieve a 15% reservation level of the area of extent prior to European settlement (often referred to as pre-1750). The reservation targets reflect the extent of loss, with "threatened" vegetation types having higher targets. The JANIS principles also include the consideration of the bioregional representation of each vegetation type within the CAR reserve system.

The most recent bioregional and state analysis reservation against JANIS criteria was completed for the Independent Verification Group for the Tasmanian Forests Intergovernmental Agreement[48]. This analysis calculates areas required to achieve a CAR reserve system based on the RFA modelling. No similar modelling has been undertaken for the current TASVEG non-forest communities, although native grassland communities have been assessed at the state level[49].

[41] Kitchener & Harris (2013)
[42] Department of Primary Industries, Parks, Water & Environment (2019)
[43] Goff *et al.* (1982)
[44] Tasmanian *Biosecurity Regulations 2022*
[45] de Salas & Baker (2023)
[46] Schedule 3A Tasmanian *Nature Conservation Act 2002*
[47] Commonwealth of Australia (1997)
[48] Knight (2012)
[49] Lowland Grassland Review Expert Group (2008)

The conservation significance of flora and fauna species is determined at a State and Federal level by the Tasmanian *Threatened Species Protection Act 1995* (TSP Act) and Commonwealth EPBC Act (**Appendix A**), the implications of which are considered according to relevant legislation (**Appendix B**).

Survey findings

Twenty-one TASVEG mapping units were identified across the various field surveys, eleven of which are native communities and ten are non-native (or substantially modified) communities. The status of the ten native vegetation communities in both a state and local context is presented in Table 5. In total, 172 flora species were recorded during field surveys, with 46 being introduced species (7 of which are listed as declared under the Tasmanian *Biosecurity Act 2019*). One species listed as vulnerable under the TSP Act was recorded, as well as one TSP Act endangered / EPBC Act critically endangered species.

Native vegetation communities observed during field surveys include:

- Freshwater aquatic sedgeland and rushland (ASF)
- *Eucalyptus amygdalina* coastal forest and woodland (DAC)
- *Eucalyptus amygdalina* forest on mudstone (DAM)
- *Eucalyptus obliqua* dry forest (DOB)
- *Eucalyptus ovata* forest and woodland (DOV)
- *Eucalyptus amygdalina* - *Eucalyptus obliqua* damp sclerophyll forest (DSC)
- *Acacia dealbata* forest (NAD)
- *Acacia melanoxylon* swamp forest (NAF)
- *Melaleuca ericifolia* swamp forest (NME)
- *Eucalyptus obliqua* forest with broad-leaf shrubs (WOB)
- *Eucalyptus obliqua* forest over *Leptospermum* (WOL)

The vast majority of the Construction Corridor (92.55 %) traverses extensive areas of agricultural land predominantly used for vegetable crops, dairy and cattle farming, and a further 6.28 % is other modified land classes (e.g. non-native vegetation units). Small remnants of native vegetation exist within, and some larger native forest areas surround, this modified landscape.

The non-native vegetation communities recorded in the Survey Area include:

- Improved pasture with native tree canopy (FAC)
- Agricultural land (FAG)
- Permanent easements (FPE)
- Plantation forest for silviculture - hardwood (FPH)
- Plantation forest for silviculture - softwood (FPS)
- Regenerating cleared land (FRG)
- Extra-urban miscellaneous (FUM)
- Urban areas (FUR)
- Weed infestation (FWU)
- Water, sea (OAQ)

A total of 75.44 ha (4.53 %) of native vegetation is present within the 1,664.64 ha Survey Area, as well as 1,589.20 ha (95.47 %) on non-native, modified land, and water. An overview of the native vegetation recorded during field surveys is present in the following subsections.

Maps displaying the distribution of the native vegetation communities is provided in **Attachment D**. A list of all species recorded in during field surveys is presented in **Appendix C**, and plant species recorded within each vegetation survey plot is presented in **Appendix D**.

ASF - Freshwater aquatic sedgeland and rushland

This community occurs across the Project Area largely as isolated patches within larger waterbodies, typically as a component of man-made farm dams (See examples in **Maps 1, 15, 26, 29, 37, and 46 of Attachment D**). This community also occurs in small watercourses throughout the Project Area; however, these occur at a scale that is too small to constitute a mappable unit as per TASVEG 4.0[50].

In most cases, the dominant species within these wetland patches is *Eleocharis sphacelata*, which can form dense mats covering almost 100 % of the vegetated area (Plate 4, Plate 5). Other species recorded in this community include *Cycnogeton procerum*, *Centipeda elatinoides*, *Eleocharis acuta*, *Ornduffia reniformis*, and *Persicaria decipiens*, as well as the introduced *Typha latifolia*, *Alisma* spp., and *Glyceria maxima*. Patch condition varies depending on whether the dominant species is native or non-native. Weeds such as blackberry are present in some areas (Plate 4), particularly where wetlands interact with adjacent farm land.

The ASF vegetation community is listed as threatened under the NC Act; however, it does not correspond to any threatened ecological community under the EPBC Act. Non-forest communities are not listed as a priority under the RFA.

Plate 4: ASF wetland with blackberry on the margins

Plate 5: ASF wetland with a high proportion of native species cover

[50] Kitchener & Harris (2013)

DAC - *Eucalyptus amygdalina* coastal forest and woodland

The DAC vegetation community is typical of relatively infertile soils in coastal areas in the north and east of Tasmania. This vegetation type is often highly diverse floristically and structurally, with a diversity of legumes, heaths, and shrubs[51].

This community occurs within the Project Area only as remnant patches adjacent to Woodbury Lane and Frankford Roads (**See Maps 35 and 45 of Attachment D**). The patches have limited viability as small remnants within an agricultural matrix. As a result, floristic diversity is poor, particularly in the shrub and ground levels, and weeds are prevalent. The patches recorded do not represent typical occurrences of this vegetation type.

The canopy is dominated by *Eucalyptus amygdalina* (Plate 6), with occasional localised patches of *E. ovata* in low-lying areas. The understorey largely consists of a tall shrub / small tree layer, with *Acacia dealbata*, *Bedfordia salicina* and *Exocarpos cupressiformis* the most frequent species. Where low shrubs are present, *Cassinia aculeata* is dominant. The understorey is dominated by *Pteridium esculentum* and *Juncus* species, or *Lepidosperma longitudinale* and *Lomandra longifolia*; along the margins pasture grasses and weeds are prevalent on account of edge effects. Woody weeds are common throughout, including patches of gorse, blackberry, Spanish heath. Non-declared weeds such as arum lily and agapanthus were also recorded within the forest area.

This vegetation community is not listed as threatened under the NC Act nor does it correspond to any threatened ecological community under the EPBC Act. The DAC vegetation unit does not correspond to a listed conservation priority under the RFA[52].

Plate 6: Disturbed DAC on Woodbury Lane

[51] Kitchener & Harris (2013)
[52] Forest Practices Authority (2005)

DAM - *Eucalyptus amygdalina* forest on mudstone

The DAM vegetation community occurs predominantly in the lower Derwent Valley and northeast uplands of Tasmania; however isolated patches occur elsewhere in the northern slopes and midlands regions[53].

This vegetation community occurs at one location within the Project Area, perpendicular to Abey's Road (Plate 7). This patch is contiguous with a much larger forest block. The alignment avoids the need for clearance of this forest through the utilisation of an existing cleared easement through the forest block (**See Map 52 of Attachment D**).

This community occurs on dry slopes and is relatively open and floristically species poor. The canopy is almost purely *Eucalyptus amygdalina* with occasional *E. obliqua* present in areas of poor drainage. The understorey tall shrub layer is dominated by *Allocasuarina littoralis* and *Exocarpos cupressiformis*, while the ground layer is open with a sparse covering of *Lepidosperma longitudinale, Lomandra longifolia* and patches of *Pteridium esculentum*, interspersed with almost complete ground cover of leaf litter.

This community is not listed as threatened under the NC Act nor does it correspond to any threatened ecological community under the EPBC Act. The DAM vegetation unit does not correspond to a listed conservation priority under the RFA unless it occurs as an old growth forest[54].

Plate 7: DAM and cleared easement perpendicular to Abey's Road

[53] Kitchener & Harris (2013)
[54] Forest Practices Authority (2005)

DOB - *Eucalyptus obliqua* dry forest

Dry *Eucalyptus obliqua* forest is one of the most widespread forest types in Tasmania, with distribution occurring across the northwest and northeast, as well as extensive forests in the southeast. It is generally associated with dolerite and argillaceous substrates[55].

This community is the most extensive native forest community throughout the Project Area. The largest area of DOB is on forestry land between the Great Bend pump station and the proposed Saggers Hill balance tank site (Plate 8, Plate 9), where the forest continues outside the Survey Area (**See Maps 56-57 of Attachment D**). It also occurs within the Warrawee Conservation Area, with this patch extending northward towards Abeys Road (Plate 10). Smaller patches occur along the Creeley's Road extension (which has since been omitted from the pipeline design) and west of Port Sorell Road, along the Pardoe extension (**See Maps 67-68 of Attachment D**).

The canopy is dominated by medium height (20-30 m) *Eucalyptus obliqua*, occurring in a mosaic with smaller, subdominant patches of *E. amygdalina*. The understorey is shrubby and dominated by *Acacia* species. The tall shrub layer also includes *Allocasuarina littoralis, Bursaria spinosa, Exocarpos cupressiformis* and *Pomaderris apetala*. The ground layer varies with aspect, hydrology, and disturbance history but generally includes *Pteridium esculentum*, graminoids such as *Gahnia grandis, Lepidosperma longitudinale* and *Patersonia fragilis*, and herb species such as *Chiloglottis reflexa, Dipodium roseum* and *Gonocarpus teucrioides.* The TSP Act endangered and EPBC Act critically endangered orchid *Caladenia tonellii* was recorded within the DOB forest on the slopes between the proposed alignment and the current reservoir tank near Great Bend.

This community is not listed as threatened under the NC Act nor does it correspond to any threatened ecological community under the EPBC Act. The DOB vegetation unit does not correspond to a listed conservation priority under the RFA[56].

Plate 8: DOB near Native Plains Road. Timber has been selectively harvested from this area

[55] Kitchener & Harris (2013)
[56] Forest Practices Authority (2005)

Plate 9: DOB near Native Plains Road

Plate 10: DOB near Abeys Road with disturbed understorey but floristic elements present

DOV - *Eucalyptus ovata* forest and woodland

Eucalyptus ovata forest is typically associated with drainage flats and moderately to poorly drained fertile soils. Due to large-scale land conversion across the state, patches are often small (<10 ha) with only a small number of larger patches remaining in private land. This vegetation community is distributed across all regions of Tasmania; however, it is most prevalent in the northern slopes, midlands, and southeast regions[57].

Eight remnant patches of DOV were recorded during field surveys. All patches are surrounded by modified vegetation units, either cleared land for paddock or crops (Plate 11), or paddock trees over pasture grasses (**See Maps 4, 6, 7, 14, 18, 19, 35, 43, and 68 of Attachment D**).

The dominant canopy tree is *Eucalyptus ovata,* with subdominant *Eucalyptus obliqua* and *Eucalyptus viminalis* in some patches. The understorey typically consists of a tall shrub/small tree layer with *Acacia melanoxylon, Acacia verticillata, Bedfordia salicina,* and *Melaleuca ericifolia* the most frequent species. The ground layer consists of sedges and rushes such as *Carex appressa, Juncus sarophorus* and *Lepidosperma elatior*, as well as *Lomandra longifolia* (Plate 12). Ferns such as *Blechnum nudum, B. wattsii, Polystichum proliferum* and *Pteridium esculentum* vary in prevalence with hydrology. Patches that are within the farm paddocks and have stock grazing pressure have a modified understorey structure and/or diversity of characteristic species and have a greater proportion of pasture grass ground cover and weed presence (such as blackberry, briar rose and gorse) as is shown in Plate 13.

The DOV community is listed as threatened under the NC Act and can qualify for listing under the EPBC Act (For more detail, see **Section 4.1.1.1**). The DOV vegetation community (both grassy and shrubby facies) is also listed as a priority A for floristic communities within the Woolnorth bioregion due to the community being poorly reserved[58] (Table 5), as well as being a high conservation priority for old growth and non-old growth forests under the RFA[59].

Plate 11: High quality DOV remnant adjacent to agricultural land

[57] Kitchener & Harris (2013)
[58] Knight (2012); Department of Primary Industries, Parks, Water & Environment (2020)
[59] Forest Practices Authority (2005)

Plate 12: Good quality DOV with sedge and sagg dominant understorey near Winspears Road

Plate 13: Poor quality DOV remnant surrounded by agricultural land at Woodbury Lane. This patch would once have been more extensive but has largely been reduced to *E. ovata* trees over pasture grass

DSC - *Eucalyptus amygdalina* - *Eucalyptus obliqua* damp sclerophyll forest

The DSC community can have a damp sclerophyll understorey and *Eucalyptus amygdalina* and/or *E. obliqua* can both be prominent in the overstorey. *E. viminalis* and *E. ovata* may be present as subdominant or minor species or may dominate very small patches within a mosaic of forest dominated by *E. amygdalina* or *E. obliqua*. On most sites mapped as DSC, the vegetation can be better allocated to other RFA communities[60], however this forest type is a feature of the central north, particularly in the Frankford region, which is immediately east of the Project Area. This vegetation unit is characterised by the lack of a clear dominant eucalypt species and typically a variety of species grow in a mixed stand or mosaic that changes over short distances[61].

This community was recorded at five locations within the Project Area (**See Maps 1, 2, 5, 6, 10, 54, 67, and 68 of Attachment D**) - three remnants in the western extent of Project Area (Native Plains Road, Loanes Lane, and west of Port Sorell Road), a gully which intergrade with the drier DOB forest community along the Creeley's Road extension (which has since been omitted from the pipeline design) (Plate 14), and a small remnant at the Wesley Vale mill site.

Four codominant eucalypt species (*E. amygdalina, E. obliqua, E. ovata,* and *E. viminalis*) were recorded either as mixed stands or a mosaic of patches. *Acacia melanoxylon* frequently occurs alongside these canopy eucalypts. The understorey consists of a tall shrub/tree layer with *Acacia verticillata, Bursaria spinosa, Melaleuca ericifolia, Pomaderris apetala,* and *Exocarpos cupressiformis* the most common species. Low shrubs such as *Coprosma quadrifida* and *Cassinia aculeata* also occur often over a ground layer consisting of sedges such as *Carex appressa, Gahnia grandis, Lepidosperma laterale* and *Lomandra longifolia,* and ferns such as *Blechnum wattsii, Polystichum proliferum,* and *Pteridium esculentum.* The remnant DSC patches within the Survey Area are situated within the agricultural landscape and are weed infested to varying degrees with blackberry and gorse, as well as pasture grasses accounting for a considerable proportion of the ground layer.

This community is not listed as threatened under the NC Act nor does it correspond to any threatened ecological community under the EPBC Act. The DSC vegetation community is also listed as a priority A for floristic communities within the Woolnorth bioregion, as well as being a high conservation priority for old growth forests under the RFA[62].

Plate 14: Remnant DSC; mixed canopy *E. amygdalina*, *E. obliqua*, *E. ovata* and *E. viminalis* on Creeleys Road extension

[60] Forest Practices Authority (2005)
[61] Kitchener & Harris (2013)
[62] Forest Practices Authority (2005)

NAD - *Acacia dealbata* forest

Acacia dealbata forest occurs throughout Tasmania as a successional community, commonly succeeding wet forest and damp sclerophyll forest after disturbance. It can also occur on stream banks subject to flood disturbance[63].

This vegetation community was recorded at three locations across the Project Area, all of which are on the margins of larger forest patches (**Maps 31 and 54 of Attachment D**). A patch on Appleby Road appears to be a result of relatively recent land modification. The other patches on Creeleys Road (which has since been omitted from the pipeline design) and Native Plains Road (Plate 15) appear to be more established and may be a result of clearing for agriculture in the past.

The remnants are dominated by a canopy of *Acacia dealbata*, with understorey components typically representing a subset of the understorey species of the adjacent forest communities.

This vegetation community is not listed as threatened under the NC Act nor does it correspond to any threatened ecological community under the EPBC Act. The NAD vegetation unit does not correspond to a listed conservation priority under the RFA[64].

Plate 15: Remnant NAD at Native Plains Road appear to be more established and may be a result of clearing for agriculture in the past

NAF - *Acacia melanoxylon* swamp forest

Acacia melanoxylon swamp forests are typically a tall, open forest dominated by blackwoods, with a variable understorey occurring on alluvial flats prone to inundation and/or poor drainage[65]. This vegetation type is most commonly observed in the far northwest of Tasmania, however localised occurrences have been recorded elsewhere[66]

Three highly localised and isolated patches of this vegetation community were recorded within the Project Area, all three patches <1 ha in size. All three patches occur on the headwaters of minor waterways (**See Maps 22, 27, and 29 of Attachment D**).

This community is dominated by a canopy of *Acacia melanoxylon*, with *Melaleuca squarrosa* forming the tallest understorey tree. Tall sedges such as *Carex appressa* and *Machaerina tetragona* are present, as well as numerous fern species. Due to the patches occurring as small remnants within a highly modified agricultural environment, this community is generally in poor condition across the Project Area, with weeds such as blackberry prevalent.

This vegetation community is not listed as threatened under the NC Act nor does it correspond to any threatened ecological community under the EPBC Act. The NAF vegetation unit does not correspond to a listed conservation priority under the RFA[67].

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[63] Kitchener & Harris (2013)
[64] Forest Practices Authority (2005)
[65] Kitchener & Harris (2013)
[66] Department of Primary Industries, Parks, Water & Environment (2020)
[67] Forest Practices Authority (2005)

NME - *Melaleuca ericifolia* swamp forest

This vegetation type occurs across the northern coast of Tasmania as almost pure stands of even-aged *Melaleuca ericifolia*. It is generally restricted to coastal and near coastal areas as narrow strips on lagoons, saltmarshes and other waterways. Old growth NME forests that demonstrate a long history of regeneration in the absence of disturbance are uncommon[68].

Melaleuca ericifolia swamp forest vegetation is likely to have been more widespread in the broader region in the past where the land has been modified for agricultural purposes particularly in the northern reaches of the Project Area. All that currently remains are small remnants and regrowth patches of the key species along ditches and areas of poor drainage, which are too small and depauperate to be considered a viable example of a vegetation community. Where the patches were >0.1 ha they were considered to meet the TASVEG definitions[69] of NME and have been mapped accordingly (**See maps in Attachment D**).

The patches of NME are dominated by a canopy of dense, even-aged *Melaleuca ericifolia* (Plate 16). *Acacia melanoxylon* is a subdominant canopy species within the largest patch within the Survey Area. The understorey is generally simple and devoid of shrubs other than sparse *Coprosma quadrifida*; it is dominated by *Carex appressa* and/or *Gahnia grandis*, with occasional *Blechnum wattsii* and *Histiopteris incisa*. Weeds are present and abundant, varying with the apparent level of disturbance.

The NME vegetation community is listed as threatened under the NC Act; however, it does not correspond to any threatened ecological community under the EPBC Act. The NME vegetation community is also listed as a priority A for floristic communities within the Woolnorth bioregion due to the community being poorly reserved[70] (Table 5), as well as being a high conservation priority under the RFA[71].

Plate 16: NME adjacent to agricultural land

[68] Kitchener & Harris (2013)
[69] Kitchener & Harris (2013)
[70] Knight (2012); Department of Primary Industries, Parks, Water & Environment (2020)
[71] Forest Practices Authority (2005)

WOB - *Eucalyptus obliqua* forest with broad-leaf shrubs

Eucalyptus obliqua forest with broad-leaf shrubs occurs throughout Tasmania, with concentrations in the northwest, northeast, and southeast, typically in areas of high rainfall. This community is a characteristic of most sites of moderate to high fertility. Forest patches usually form as even-aged stands that have regenerated after significant disturbance[72].

This vegetation community occurs in the damp gullies and lower slopes within the forested area between the Great Bend pump station (Plate 17) and the proposed Saggers Hill balance tank site (**See Maps 56-57 of Attachment D**). This community grades into DOB vegetation upslope with decreasing soil moisture.

The closed canopy is comprised *E. obliqua* trees (>25 m) and occasional *Acacia melanoxylon*, with an understorey of predominantly *Pomaderris apetala* interspersed with areas of a more diverse shrub layer including *Coprosma quadrifida, Acacia dealbata* and *A. verticillata*. In gullies where the canopy and tall shrub layer is dense, the ground layer is a sparse layer of *Gahnia grandis*, *Lepidosperma laterale,* mosses and localised *Dicksonia antarctica*. On the lower slopes within the Warrawee Conservation Area the ground layer is denser, predominantly with *Pteridium esculentum, Gahnia grandis, Lepidosperma longitudinale, Lomandra longifolia* and *Polystichum proliferum.* This area has been selectively logged in the past, with occasional remnant older growth trees (Diameter at Breast Height [DBH] >1.2 m) remaining.

This community is not listed as threatened under the NC Act nor does it correspond to any threatened ecological community under the EPBC Act. The WOB vegetation unit does not correspond to a listed conservation priority under the RFA[73].

Plate 17: WOB in near Great Bend pump station

[72] Kitchener & Harris (2013)
[73] Forest Practices Authority (2005)

WOL - *Eucalyptus obliqua* forest over *Leptospermum*

Eucalyptus obliqua forest over *Leptospermum* is described as tall *E. obliqua* forest over a secondary tree or tall shrub layer of *Melaleuca squarrosa* or *Leptospermum spp*. This community is typically found on moderately fertile substrates in wet, flat, and low-lying areas with impeded drainage[74]. The WOL vegetation community is distributed throughout Tasmania; however, it is most widespread in the high rainfall areas of the northwest, northeast, and the south[75].

This community occurs in a poorly drained area between Great Bend and the proposed Saggers Hill balance tank site (Plate 18). The area has a land use history of forest production, and the hydrology has been altered by historical earth works (possibly for a borrow pit or water source creation) resulting in a disturbed wet area that has now been recolonised. The patch is surrounded by DOB and FPH (**See Maps 56-57 of Attachment D**).

The sparse canopy is regrowth *Eucalyptus obliqua* over a tall shrub layer of *Melaleuca squarrosa* and occasional *Acacia verticillata*. The ground layer is dense and dominated by *Gahnia grandis* and *Gleichenia microphylla*.

This community is not listed as threatened under the NC Act nor does it correspond to any threatened ecological community under the EPBC Act. The WOL vegetation unit does not correspond to a listed conservation priority under the RFA[76].

Plate 18: WOL along a logging road, west of Saggers Hill

[74] Kitchener & Harris (2013)
[75] Department of Primary Industries, Parks, Water & Environment (2020)
[76] Forest Practices Authority (2005)

Table 5: Reservation status of the native vegetation communities against present[77] extent and pre-1750 extent[78]. JANIS criterion: E = endangered, R = rare, p(C) = not threatened

TASVEG Community	Extent in Survey Area (ha)	Extent Within Construction Corridor (ha)	Tasmania			Furneaux Bioregion			Northern Slopes Bioregion			Permanent Native Forest Estate[79] (Extant 2024)	Status (JANIS)
			Current Extent	Reserved [% of Current Extent in Reserves]	Pre-1750 Extent [% of Pre-1750 Extent in Reserves**]	Current Extent	Reserved [% of Current Extent in Reserves]	Pre-1750 Extent [% of Pre-1750 Extent in Reserves**]	Current Extent	Reserved [% of Current Extent in Reserves]	Pre-1750 Extent [% of Pre-1750 Extent in Reserves**]		
ASF Freshwater aquatic sedgeland and rushland	6.41	0.00	7,100	4,300 [60.56 %]	-	1,900	1,600 [84.21 %]	-	300	3 [0.90 %]	-	-	-
DAC *Eucalyptus amygdalina* coastal forest and woodland	2.52	0.39	149,800	79,800 [53.27 %]	258,238 [30.90 %]	77,300	38,900 [50.32 %]	149,898 [25.95 %]	8,200	5,000 [60.98 %]	9,148 [54.66 %]	23,612	P (C)
DAM *Eucalyptus amygdalina* forest on mudstone	3.73	0.18	40,700	15,700 [38.57 %]	69,140 [22.71 %]	2,100	1,200 [57.14 %]	3,719 [32.27 %]	3000	600 [20.00 %]	4,949 [12.12 %]	&	P (C)
DOB *Eucalyptus obliqua* dry forest	23.69	1.31	182,700	82,300 [45.05 %]	262,331 [31.37 %]	6,500	3,800 [58.46 %]	7,889 [48.17 %]	29,100	14,700 [50.52 %]	47,687 [30.83 %]	24,429	P (C)
DOV *Eucalyptus ovata* forest and woodland	4.41	0.03	14,600	4,400 [30.14 %]	186,618 [2.36 %]	900	500 [55.56 %]	21,590 [2.32 %]	3,400	900 [26.47 %]	28,746 [3.13 %]	2,093	E
DSC *Eucalyptus amygdalina - Eucalyptus obliqua* damp sclerophyll forest	22.64	1.11	49,300	18,000 [37.51 %]	85,576 [21.03 %]	900	200 [22.22 %]	3,252 [6.15 %]	34,100	12,800 [37.54 %]	65,630 [19.50 %]	27,943	R
NAD *Acacia dealbata* forest	1.91	0.23	41,500	15,000 [36.14 %]	48,278 [31.07 %]	300	100 [33.33 %]	1,887 [5.30 %]	18,800	6,300 [33.51 %]	21,309 [29.56 %]	15,708	P (C)
NAF *Acacia melanoxylon* swamp forest	1.04	0.00	9,400	3,400 [36.17 %]	19,200 [17.71 %]	400	300 [75.00 %]	790 [37.97 %]	70	20 [28.57 %]	2,364 [0.85 %]	7,153	P (C)
NME *Melaleuca ericifolia* swamp forest	3.07	0.13	10,100	4,200 [41.58 %]	30,934 [13.58 %]	3,800	1,400 [36.84 %]	8,322 [16.82 %]	100	40 [40.00 %]	1,129 [3.54 %]	158	E
WOB*^ *Eucalyptus obliqua* forest with broad-leaf shrubs	5.10	0.25	120,200	53,200 [44.26 %]	578,926* [35.00 %]	500	500 [100.00 %]	2,608* [17.64 %]	19,500	9,000 [46.15 %]	178,638* [20.49 %]	104,648	P (C)
WOL*^ *Eucalyptus obliqua* forest over *Leptospermum*	0.92	0.11	24,100	11,200 [46.47 %]	578,926* [35.00 %]	20	0 [0.00 %]	2,608* [17.64 %]	400	200 [50.00 %]	178,638* [20.49 %]	104,648	P (C)

*** For WOB and WOL extent and reservation data shown are for its undifferentiated parent class WOU – this is because data is currently not available for the more precise divisions based on understorey composition – nonetheless, the reservation and conservation status of the undifferentiated parent classes is considered indicative of the more precise classes.**

**** The percentage of the pre-1750 extent within reserves is calculated using the most recent TASVEG 4.0 reservation figures rather than those provided in the Knight (2012) report.**
& Anomalies in mapping (shown with an ampersand [&])) are subject to further field verification. Area data may be modified by the Forest Practices Authority (FPA) as mapping is refined.
^ Captured within the same RFA Forest Community.

[77] Department of Primary Industries, Parks, Water & Environment (2021a)
[78] Knight (2012)
[79] Forest Practices Authority (2024)

Modified land

Much of the Project Area is covered by modified land units. This is dominated by agricultural land (FAG - Plate 19), and industrial land, permanent road easements, and shelter belts (FUM - Plate 20, Plate 21). Smaller areas contain plantation timbers (FPH [hardwood – i.e. eucalypts] and FPS [softwood – i.e. pines]). Table 6 details the extent of modified and other environments recorded within the Survey Area.

Agricultural land across the Project Area contains small native remnants throughout, typically occurring as isolated stands of *Melaleuca ericifolia* forest, eucalyptus woodland, or eucalyptus over an understorey of pasture (FAC - Plate 22). Where size and condition thresholds are met, native remnants are classified according to their relevant TAVEG mapping unit. Due to the intensity of agricultural activities, native remnants are often confined to riparian margins and headwaters of streams, or as isolated forest blocks. Many of the isolated remnants are in poor condition due to the surrounding activities.

In some instances, farm dams contain native elements sufficient to map portions of waterbodies as the freshwater aquatic sedgeland and rushland (ASF - Plate 23) vegetation community. This includes waterbodies that are dominated by the weedy rush, *Typha latifolia*. In other instances, farm dams can be largely free of aquatic vegetation, with only occasional native species present on the margins (Plate 24).

Table 6: Summary of the extent of modified land units

TASVEG Community	Extent Within Survey Area (ha)	Extent Within Construction Corridor (ha)
FAC Improved pasture with native tree canopy	22.77	1.55
FAG Agricultural land	1,382.93	295.40
FPE Permanent easements	0.46	0.41
FPH Plantations for silviculture - hardwood	12.68	4.11
FPS Plantations for silviculture - softwood	9.12	0.62
FRG Regenerating cleared land	1.16	0.06
FUM Extra-urban miscellaneous	108.83	14.41
FUR Urban areas	22.66	0.43
OAQ Water, sea	28.08	0.12
Total	**1,588.69**	**317.11**

Plate 19: Recently cultivated agricultural land (FAG)

Plate 20: Extra-urban miscellaneous (FUM) at Great Bend pump station

Plate 21: Planted shelter belt (FUM)

Plate 22: Eucalyptus trees over a modified FAC

Plate 23: Farm dam with dominant *Typha latifolia* (ASF) present

Plate 24: Farm dam (OAQ) with a narrow band of native vegetation on the margins

Extent and Reservation Status of Vegetation Communities

The most appropriate measure of reservation status (using JANIS criteria) relies on a 15 % reserved target of extent prior to European settlement (pre-1750). A reserved area greater than 15 % is considered to meet the minimum reservation target. The reservation status for each forest community is assessed against pre-European (pre-1750) extent of vegetation[80]. Reservation status for non-forest communities is assessed against the current extent of vegetation[81], as pre-European levels have not been calculated. Refer to Table 5 for the current status. The reservation status at state and bioregional levels is calculated for all TASVEG 4.0 communities. This does not include any modelling of pre-1750 levels but is based on a tenure analysis of what is currently mapped.

Of the communities being impacted by the SWISA project, all vegetation types except DOV and NME are adequately reserved. DOV is inadequately reserved with just 2.36 % of the pre-1750 extent reserved statewide and 2.32 % and 3.13 % within the bioregions. The NME community is inadequately reserved with 13.58 % of the pre-1750 extent reserved at the state level, and between 3.54 % and 16.82 % at the bioregional level.

Avoidance

Attempts to avoid impacts to native vegetation have been achieved across several design phases to the point where only 4.95 % of the native vegetation recorded in the Survey Area will be impacted due to the construction of the SWISA (an Avoidance Area of 71.20 ha of native vegetation [Table 7]). Of this impact area, 99.68 % will be rehabilitated post-works.

Table 7: Summary of impacts in relation to vegetation type, location, and permanency of impact. All areas are in hectares

	Survey Area	Construction Corridor	Temporary Impact	% of Extent in Survey Area	Permanent Impact	% of Extent in Survey Area	Avoidance Area	% of Extent in Survey Area
Native Non-forest Vegetation	6.41	0.00	0.00	0.00 %	0.00	0.00 %	6.41	100 %
Native Forested Vegetation	69.03	3.74	3.67	5.32 %	0.06	0.09 %	65.29	94.59 %
Agricultural	1,405.70	296.96	296.29	21.08 %	0.67	0.05 %	1,108.74	78.87 %
Other Modified	155.41	20.04	19.74	12.70 %	0.29	0.19 %	135.38	87.11 %
Water	28.08	0.12	0.12	0.44 %	0.00	0.00 %	27.96	99.56 %
Total	**1,664.64**	**320.86**	**319.83**	**19.21 %**	**1.02**	**0.06 %**	**1,343.78**	**80.73 %**

Impacts

Table 7 summarises the impact in relation to the vegetation class, location, and permanency of impact. Impacts to vegetation for 99.68 % of the Construction Corridor are temporary only, as areas of pipeline will be installed underground and will be covered over and revegetated post-construction, or are temporary lay-down areas, that will not be subject to any excavation or native vegetation removal. Permanent impacts (0.32 % of the Construction Corridor) are only applicable to pump station and balance tank sites (noting that the Great Bend pump station site is an upgrade of existing facilities, and the footprint is contained entirely within modified land), property outlets, and scour valves. The overall impact to native vegetation under the proposal is expected to be minor due to the relatively narrow

[80] Knight (2012)
[81] Department of Primary Industries, Parks, Water & Environment (2021a)

impact area and the prevalence of modified land units, particularly farm land. A total of only 3.74 ha of native vegetation will be impacted within the Construction Corridor, with the corridor modified substantially from its initial design to reduce the impact on native vegetation as much as possible.

A total of 3.74 ha of native vegetation will be impacted within the Construction Corridor (as well as 317.12 ha of modified/water/non-native vegetation). The remaining avoidance area within the Survey Area is 1,343.78 ha (71.70 ha of native vegetation). A total of 1.02 ha (of which only 0.06 ha is native vegetation) will be lost due to permanent infrastructure. The balance will have scope for natural and assisted revegetation after the pipeline is installed.

The vast majority (296.96 ha, 92.55 %) of the proposed construction impact area is agricultural land, and a further 20.16 ha (6.28 %) is other modified land classes (i.e. non-native vegetation and water units under the TASVEG classification system) or water. Native vegetation remnants are generally in a poor condition due to the fragmented landscapes, with moderate condition remnants occurring in areas located within larger contiguous forest blocks, with condition improving away from the fringes, where weeds are often prevalent.

Mitigation measures

The impacts of vegetation clearance are difficult to mitigate; however, the risk of unnecessary and indirect impacts on vegetation within buffer zones and outside of the Construction Corridor can be minimised. The CEMP must include the following measures:

<u>Exclusion zones</u>

- Clearly define the extent of clearance required for the project and ensure that any additional impacts are avoided.
- Mark the works area on operation plans and on site, and confine all works, vehicles and materials to the works area.

<u>Revegetation</u>

- In addition to exclusion zones and in order to compensate for the temporary disturbance to vegetation, a revegetation strategy must be included within the CEMP prior to the commencement of the action and be implemented throughout the duration of the construction phase. The environmental outcome of the revegetation strategy is to restore 3.74 ha of temporarily impacted native vegetation. The revegetation plan must be consistent with the DCCEEW *Environmental Management Plan Guidelines*[82], and must include:
  a) Details of the habitat requirements of any relevant MNES.
  b) A table of commitments made in the plan to achieve environmental outcomes, with reference to where these commitments are made in the plan.
  c) Compliance with any commitments made in the Commonwealth referral and preliminary documentation, as well as this Natural Values Assessment.
  d) Commitments capable of ensuring that the environmental outcomes are achieved, which include:
     1. Commencing revegetation immediately post disturbance.
     2. Methods of revegetation (and corrective actions should the primary method not be successful).
     3. Measures, including for hygiene, ground preparation, and weed and herbivore control, and the approximate timing of the measures to be undertaken prior to, during, and following planting/seeding to ensure the success of the revegetation.
  e) Reporting and review mechanisms to ensure compliance with the revegetation plan.

[82] Department of Climate Change, Energy, the Environment & Water (2024b)

f) A monitoring program which includes measurable performance indicators, trigger values for corrective actions, timing, and frequency of monitoring, and proposed corrective actions, and the timing and methods of submitting monitoring data to the relevant authorities.

- The revegetation requirements are as follows:
  - Revegetation must only be of plants listed in the Vegetation Condition Benchmarks[83] of the impacted vegetation community (e.g. DOB, WOB, WOL, NME), or identified in surveys of intact examples of the target vegetation type in the local area;
  - Seedlings, seeds or fertile material of plants must be of local provenance – collected from within the Survey Area. This is important to maintain genetic integrity of local populations and will also give the highest likelihood of plant survival;
  - Revegetation methods which involve the least amount of soil disturbance must be considered to reduce risk of PC infection as well as introduction of non-native species. This may include brush-matting of fertile material of locally sourced trees and shrubs. This method is also effective as the plant material surrounding emerging seedlings provides some protection from herbivores;
  - Herbivore protection will be required for any planting of tube stock. Whole planting areas can be fenced with floppy topped fencing to exclude herbivores from the area. will also allow natural regeneration of shrub and tree species within the fenced area. Alternatively, seedlings can be individually protected with cardboard guards. Tree guards may also have the effect of providing some protection from frosts. Plastic tree guards are not to be used unless they can be maintained frequently and removed when necessary to avoid littering the environment with plastic;
  - Timing of planting must consider local climatic effects such as frost and cold air drainage. Rehabilitation must commence within 30 days of the closure of a works area, noting that in colder months, the uptake of plants may be inhibited due to climatic conditions. This is to limit the potential impact to MNES through the introduction of and increased carrying capacity of pest species such as feral cats, which may prey on native ground mammals, including quolls and bandicoots, as well as to restore foraging habitat for species such as the blue-winged parrot; and
  - Density of tree planting can be derived from the Vegetation Condition Benchmarks[84] of the target vegetation community. Where natural regeneration of understorey plants is not observed (or whole patch fencing not undertaken), these must be included in plantings, at densities that can also be derived from these benchmarks. The Department of Sustainability and Environment Victoria report *Native Vegetation Revegetation planting standards – Guidelines for establishing native vegetation for net gain accounting*[85] provides guidance on deriving target planting densities from vegetation condition benchmarks.

[83] Michaels *et al.* (2020)
[84] Michaels *et al.* (2020)
[85] Department of Sustainability & Environment (2006)

4.1.2 EPBC Act Listed Ecological Communities

The Protected Matters Search Report[86] indicates that the critically endangered communities of Tasmanian forests and woodlands dominated by black gum or Brookers gum (*Eucalyptus ovata / E. brookeriana*), and Tasmanian white gum (*Eucalyptus viminalis*) wet forest, as well as the endangered giant kelp marine forests of southeast Australia and vulnerable subtropical and temperate coastal saltmarsh, may occur in the Project Area. As the latter two ecological communities have no chance of occurring within the Project Area and are not at risk of any direct or indirect impact, they are not addressed within this report.

To determine if any of the vegetation in the Survey Area had the potential to quality as these ecological community and thus to be protected as a Matter of National Environmental Significance, vegetation was assessed against the key diagnostic characteristics and condition requirements of the relevant community.

4.1.2.1 Tasmanian forests and woodlands dominated by black gum or Brookers gum

Context

Conservation status

This ecological community was listed as critically endangered in 2019[87] after meeting a number of listing criteria. The key reasons for listing are provided below. There is currently no adopted or made recovery plan for this ecological community as the "*Conservation Advice provides sufficient guidance on the recovery of the ecological community and that a decision to have a Recovery Plan is unlikely to lead to substantial additional conservation benefits given the resources required to develop a plan*"[88].

> On the 19th of June, 2019, the Minister accepted reasons for listing this ecological community as critically endangered on the basis of available scientific information. This conclusion was reached from the following assessment criteria:
>
> **Criterion 1** – Decline in geographic distribution
>
> The black gum – Brookers gum forest/woodland ecological community has undergone a decline in extent of about 90 % based on available estimates of extent. This is consistent with a very severe decline in geographic distribution. Therefore, the ecological community has met the relevant elements of Criterion 1 to make it eligible for listing as **critically endangered**.
>
> **Criterion 2** – Restricted geographic distribution coupled with demonstrable threat
>
> The black gum – Brookers gum forest/woodland ecological community was likely to have been naturally fragmented and currently has a geographic distribution that can be considered limited, based on an area of occupancy between 10,000 to 100,000 ha and most patches being under 10 ha in size but retaining connectivity with larger areas of native forests. There are ongoing threats to the ecological community and the timeframe for potential loss is likely to be within the near future. Therefore, the ecological community has been demonstrated to have met the relevant elements of Criterion 2 to make it eligible for listing as **Endangered**.
>
> **Criterion 3** – Loss or decline of functionally important species
>
> The key tree canopy species are well known and not considered threatened in their own right, at this time. However, little is known about the functional roles of most other species

[86] Department of Climate Change, Energy, the Environment & Water (2024a)
[87] Department of Climate Change, Energy, the Environment & Water (2024c)
[88] Department of the Environment & Energy (2019)

present in the ecological community. Therefore, at the time of assessment, there was **insufficient evidence** to determine the eligibility of the ecological community against this criterion.

Criterion 4 – Reduction in community integrity

The change in integrity experienced by the ecological community, for instance through fragmentation and the influence of modified landscapes on smaller patches, a decline in old growth with hollows that take a long time to replenish, the degree of weed invasion and impacts from recent fires, is severe. Regeneration across much of the extent of the ecological community is unlikely over the near future. Therefore, the ecological community is **eligible** for listing as **Endangered** under this criterion.

Criterion 5 – Rate of continuing detrimental change

The available data indicates there has been ongoing loss of the ecological community since 1996, with increased rates of loss since 2014; however, the rates of loss are below the minimum threshold value for this criterion. No data are available to predict rates of future change, or to estimate the extent of past losses due to degradation and threats other than clearing over the immediate past, whether measured by years or generations of key species. Therefore, the available information indicates that there is **insufficient information** to determine the eligibility of the ecological community against this criterion.

Criterion 6 – Quantitative analysis showing the probability of extinction

At the time of assessment, there were no quantitative data to assess this ecological community under this criterion. Therefore, it was **not able to be assessed** for listing under this criterion.

Department of the Environment & Energy (2019)

Ecology

This national ecological community has several variants, notably a major component with a canopy dominated by *Eucalyptus ovata* (black gum) and another dominated by *E. brookeriana* (Brookers gum)[89]. The community is generally associated with sites that are typically damp and/or poorly drained, including riverine habitats naturally occurs in mosaics with within forest types.

Black gum forest occurs mostly at elevations below 400 m ASL, however there are some occurrences associated with impeded drainage up to 700 m ASL[90]. Typical sites are drainage flats and valley bottoms[91]. *Eucalyptus ovata* forests are strongly associated with fertile soils in depositional landforms, though sometimes overlying infertile base rocks beneath the soil profile. The soils are not tied to a particular geology[92].

Brookers gum forest typically occur from below 100 m ASL to 200 m ASL, with isolated occurrences at higher elevations[93]. This community is usually located on moist, rocky soils of dolerite slopes and ridges, alluvial deposits near waterways, and on the margins of blackwood swamp forests.

The general structure of this ecological community ranges from forest to open woodland dominated by black gum or Brookers gum. The canopy typically has a height of 10 m to 25 m and a tree canopy cover of 20 % to 40%. Other eucalypt species may be present in the tree canopy though are less abundant and not dominant across a patch. The other eucalypt species that are most likely to co-occur with black

[89] Department of the Environment & Energy (2019)
[90] Williams & Potts (1996)
[91] Kitchener & Harris (2013)
[92] North Barker & Associates (2002)
[93] Williams & Potts (1996)

gum or Brookers gum include: *E. viminalis*, *E. amygdalina*, *E. pauciflora*, *E. pulchella*, *E. rodwayi*, *E. tasmaniensis*, *E. obliqua*, *E. regnans*, and *E. globulus* [89].

The understorey is often dominated by shrubs and/or sedges, with the mix of species present depending on several factors, notably the moisture regime and soil fertility at the site. Variants that have a heathy or a mostly grassy understorey also occur, generally in response to changes in soil fertility, the type of substrate and/or past disturbance at a site. Trees/shrubs present include various medium to tall species of *Acacia*, *Leptospermum*, *Melaleuca*, and *Bursaria spinosa*. The tall shrubs *Bedfordia salicina*, *Pomaderris apetala*, and *Olearia argophylla* are associated with more sheltered sites and/or higher rainfall areas, particularly in the northwest of the distribution. Some higher rainfall sites in the northwest may include *Phyllocladus aspleniifolius* and *Dicksonia antarctica*, that represent intrusions of rainforest elements or a wet sclerophyll forest component of the ecological community. Sedges and related graminoids that might be present in the ground layer include *Carex* species, *Gahnia* species, *Juncus* species, *Lepidosperma* species, and *Lomandra longifolia*. Ferns become a more common component in sites that are more moist and wet.

The ecological community is essential habitat for a diverse range of fauna ranging from larger mammalian herbivores to small invertebrates. Threatened fauna of note known to utilise this community include quolls, Tasmanian devils, swift parrots, and various crayfish species.

<u>Identification and condition thresholds</u>

Identification of the *Eucalyptus ovata / E. brookeriana* forest community follows the diagnostic features guidelines, detailed in Section 2.2 of the approved conservation advice for the black gum – Brookers gum forest/woodland ecological community[94]. A summary of the key diagnostic traits is as follows:

- Typical sites include flats with impeded drainage, lower slopes, undulating plains, headwaters, and gullies or seepage slopes.
- Vegetation structure varies between dry and wet sclerophyll forest. A tree canopy must have a minimum solid crow cover of 5 % and the dominant trees must be ≥ 5 m tall.
- The tree canopy is dominated or co-dominated by *Eucalyptus ovata* and / or *Eucalyptus brookeriana*. Other tree species may be present but are never dominant.
- The understorey retains a significant component of native plant species but can be variable in structure and composition. The understorey of *E. ovata* forest typically comprises of shrubs and/or sedges but includes variants where the understorey includes or may be dominated by heathy shrubs and grasses. The understorey of *E. brookeriana* forest typically consists of broad-leafed shrubs, ferns, and may contain rainforest elements.

The *Eucalyptus ovata* facies of this ecological community is primarily comprised three TASVEG 4.0 communities:

- DOV – *Eucalyptus ovata* forest and woodland;
- DOW – *Eucalyptus ovata* heathy woodland; and
- WBR – *Eucalyptus brookeriana* wet forest

Other TASVEG units may have a component that is consistent with the description of the listed ecological community while the remainder of the unit is dominated by another eucalypt species. DSC - *Eucalyptus amygdalina – Eucalyptus obliqua* damp sclerophyll forest for example, may include internal patches that match the description of the listed community.

Mapped TASVEG communities affiliated with the black gum – Brookers gum forest / woodland do not automatically equate to this community but must meet condition thresholds and size requirements[95] (Table 8). National listing focuses legal protection on patches of the ecological community that are the most functional, relatively natural and in comparatively good condition. Condition classes and

[94] Department of the Environment & Energy (2019)
[95] Department of the Environment & Energy (2019)

categories are used to distinguish between patches of the ecological community of different qualities, to aid environmental management decisions.

Because the ecological community has been heavily cleared and fragmented, many remnants are small, isolated, and in a modified condition. Any remnants that remain largely intact (in terms of structure and/or diversity of characteristic species), retain mature/old growth trees, or are connected to other native vegetation and form a large patch, are a high priority for protection and management. Patches that retain some degree of intact vegetation structure and are connected to a larger native vegetation remnant have the best chance for longer-term survival.

Class A describes patches of the ecological community in the best condition, and Class B represents the minimum for a patch of the ecological community (Table 8). Class C patches are excluded from protection under the EPBC Act, as in many cases, the loss and degradation are irreversible due to the permanent removal of natural characteristics[96].

In addition to the patch itself, a minimum buffer zone that extends 30 m beyond the canopy of the outermost trees in the patch is essential to assist in the conservation of the patch. The buffer zone is not part of the patch of the ecological community but will ideally consist of other native vegetation that is retained wherever possible. Because black gum and Brookers gum forests naturally occurred as a mosaic within larger forest remnants, patches of the ecological community that remain connected with other native forests have a better chance of future survival. The purpose of the buffer zone, whether made up of native or non-native vegetation, is to protect the community from likely negative external and edge effects, such as fertiliser, pesticide or herbicide applied or sprayed in adjacent land (e.g. spray drift), weed invasion, water runoff, soil erosion and other damage and edge effects. The buffer is also protected under national environmental law[97].

The area considered critical to the survival of the ecological community includes all patches that meet the key diagnostic characteristics and at least the minimum condition thresholds (Class B) for the ecological community plus the buffer zone (particularly where this includes native vegetation)[98]. The area's most critical to the survival of the ecological community are those patches in best condition and connected to a larger native vegetation remnant (e.g. Class A of Table 8). Patches in best condition represent those parts of the ecological community closest to the benchmark state of the ecological community. However, this does not mean that areas that otherwise meet the minimum condition thresholds (i.e. Class B in Table 8) are unimportant for the future survival of the ecological community. Many of these sites may contain features that are unique or important in a regional or local context. Some of these elements can still be critical for maintaining diversity and the longer-term survival of the ecological community.

[96] Department of the Environment & Energy (2019)
[97] Department of the Environment & Energy (2019)
[98] Department of the Environment & Energy (2019)

Table 8: Condition thresholds for the black gum - Brookers gum forest/woodland ecological community

Class A – Highest Quality		
Patches with the best chance for longer-term survival that retain a high degree of intact vegetation, habitat value, or connectivity. Such remnants are more able to provide buffers from disturbance, sources of natural regeneration, and natural wildlife corridors and habitats.		
Category and Rationale	**Native Cover and Habitat Thresholds**	**Minimum Patch Size Thresholds**
Category A1 Large patch with few weeds and habitat trees	≥ 70% of perennial vegetation* cover in the understorey is made up of native species. **AND** The patch has at least 4 locally indigenous trees per 1 ha that either: have hollows OR are large (> 60 cm DBH**) OR are in either of these categories.	≥ 2 ha
Category A2 Patches with mostly native understorey and connected to a larger native vegetation remnant.	≥ 70% of perennial vegetation cover in the understorey is made up of native species. **AND** The patch is contiguous^ with a native vegetation remnant.	≥ 0.5 ha for a patch of the ecological community **AND** ≥ 2.0 ha for the entire native vegetation remnant.
Class B – Good Quality		
Patches that retain conservation value(s) and may or may not be isolated from other native vegetation remnants.		
Category and Rationale	**Native Cover and Habitat Thresholds**	**Minimum Patch Size Thresholds**
Category B1 Isolated patch that remains largely intact and has few weeds.	≥ 70% of perennial vegetation cover in the understorey is made up of native species.	≥ 0.5 ha
Category B2 A larger isolated patch with a mostly native understorey remaining.	≥ 50% of perennial vegetation cover in the understorey is made up of native species.	≥ 2 ha
Category B3 A patch with mostly native understorey and high plant species diversity. May or may not be isolated.	≥ 50% of perennial vegetation cover in the understorey is made up of native species. **AND** ≥ 15 native understorey species per 0.5 ha **OR** ≥ 8 native understorey species per 0.5 ha for patches dominated by *E. brookeriana*[2].	≥ 0.5 ha

* Perennial understorey vegetation cover includes vascular plant species of the ground and mid layers with a lifecycle of more than two growing seasons. The ground layer includes herbs (i.e., graminoids, forbs, and low shrubs [woody plants <0.5 m high]). Measurements of perennial understorey vegetation cover exclude annuals, leaf litter or exposed soil. The mid layer is typically comprised of shrubs and small trees and may include juvenile canopy trees.

** The DBH is used as a surrogate measure to determine whether mature trees are present. The requirement for locally indigenous trees refers to any large eucalypt trees naturally present in the patch of the ecological community (i.e., the area dominated by *E. ovata* and/or *E. brookeriana*). The patch may or may not be part of a larger native vegetation remnant that may contain additional mature trees.

^ Contiguous means a patch of the ecological community is continuous with or close to (periphery within 50 m) another area of native vegetation. The native vegetation remnant that is contiguous includes any native vegetation where the cover in each layer present is dominated by native plant species. It includes forest and non-forest native vegetation structures. The minimum total area of native vegetation (i.e., patch of the ecological community plus contiguous remnant) is 2 ha.

Distribution and site significance

The black gum – Brookers gum forest / woodland ecological community is limited to Tasmania. The range of this ecological community mirrors the distribution of the dominant canopy tree species and usually associated with locally moist sites in low to moderate rainfall areas of Tasmania. The corresponding TASVEG units for the *E. ovata* facies are DOV – *Eucalyptus ovata* forest and woodland, DOW – *Eucalyptus ovata* heathy woodland, and DMW – Midlands woodland complex. The corresponding TASVEG unit for the *E. brookeriana* facies is WBR – *Eucalyptus brookeriana* wet forest. These vegetation units do not automatically equate to the black gum – Brookers gum forest / woodland ecological community as they must meet certain condition thresholds (identification and condition thresholds below).

The black gum – Brookers gum forest / woodland ecological community mostly occurs in the northern and eastern parts of Tasmania, but small remnants are scattered through the southern and western parts the State (Figure 4). The extent of occurrence therefore approximates the area of Tasmania, about 6,840,000 ha[99].

The estimated total area of occupancy of this ecological community (based on TASVEG and associated TASVEG equivalent vegetation units) is 20,000-26,000 ha (200-260 km^2) and the median patch size is 2.45 ha (0.025 km^2)[100]. The mapped extent of DOV, DOW and DMW in TASVEG 4.0[101] is 16,475 ha, with a median patch size of 1.56 ha.

The community is generally associated with sites that are typically damp and / or poorly drained, including riverine habitats. The *E. ovata* dominant facies of this community typically occurs east of direct line between Burnie and Dover, with almost half of the mapped extent of the *E. ovata* component occurring in the Tasmanian South East and Tasmanian Northern Slopes IBRA[102] bioregions with a moderate extent (about 29 %) in the Ben Lomond and Tasmanian Southern Ranges bioregions. There are only very minor occurrences in the Tasmanian West and Tasmanian Central Highlands bioregions. The majority, about 80 %, of the *E. brookeriana* component occurs in the King bioregion, that is: in the far northwest and King Island, with scattered occurrences elsewhere[103].

The Project Area falls mostly within the Furneaux-Flinders bioregion which contains 5.3 % (1,170 ha) of the remaining distribution area of the black gum – Brookers gum forest / woodland ecological community (up to 2016)[104]. The remainder of the Project Area is within the Tasmanian northern slopes bioregion which contains 16.3 % (3,620 ha) of this community[105]. The highly modified landscape and lack of native vegetation within the Project Area means that good quality patches of this community contiguous with native vegetation are unlikely to occur.

SWIS management actions

The black gum – Brookers gum forest / woodland threatened ecological community was not identified during the referral / preliminary documentation process for the SWIS project[106]. As such, no management actions were required as conditions of approval of the SWIS as a controlled action.

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[99] Department of the Environment and Energy (2019)
[100] Appendix D in Department of the Environment & Energy (2019)
[101] Department of Primary Industries, Parks, Water & Environment (2020)
[102] Department of the Environment & Energy (2012)
[103] Department of the Environment & Energy (2019)
[104] Department of the Environment & Energy (2019)
[105] Department of the Environment & Energy (2019); Department of Primary Industries, Parks, Water & Environment (2020)
[106] Referral EPBC: 2010 / 5327; Tasmanian Irrigation Development Board (2010)

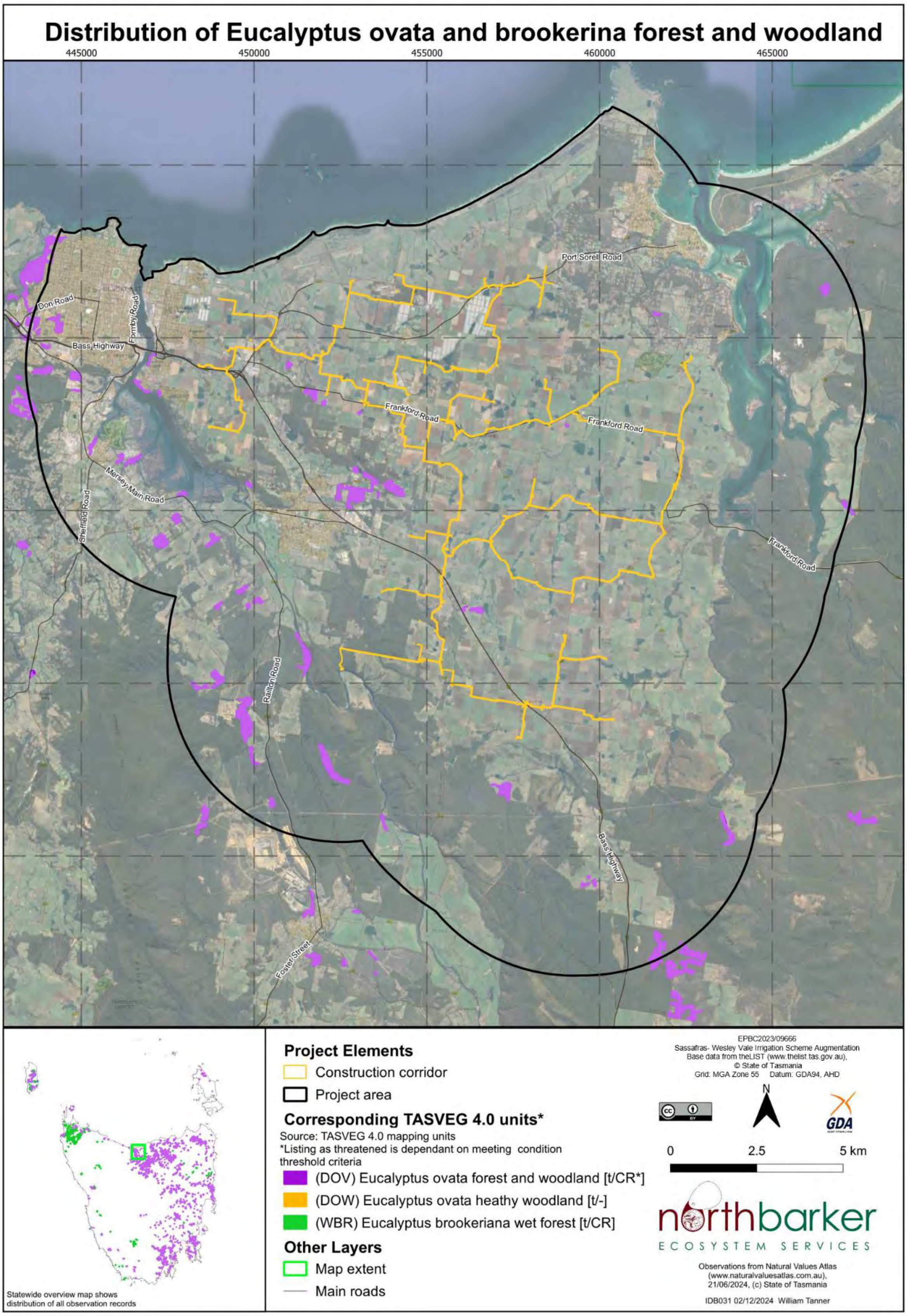

Figure 4: Distribution of potential qualifying patches of the Tasmanian forests and woodland dominated by black gum / Brookers gum ecological community

Threats

The black gum – Brookers gum forest/woodland ecological community has been primarily impacted by historic clearing for agriculture and forestry, and the remnants that remain continue to be under threat from ongoing degradation. Listed threats and impact pathways to this ecological community include[107]:

- Clearance of native vegetation. Increasingly this is due to urban and infrastructure projects. This threat involves clearing of entire remnants as well as incremental damage from tree removal or lopping, or removal of native understorey vegetation. The consequences of clearing in already modified environments include fragmentation into smaller, more isolated patches susceptible to further degradation.
- Impacts from invasive species including weed invasion, notably from perennial weeds such as blackberry, gorse and Spanish heath, and damage from pest animals such as deer.
- Altered hydrology and water quality including modifications to the landscape that disrupts natural water flows, increased dryland salinity, and excessive groundwater extraction and eutrophication from urban runoff, intensive agriculture, irrigation and irrigated cropping, or other sources.
- Grazing pressure including by domestic stock and browsing of regrowth by native fauna.
- Nutrient enrichment and chemical drift from application of inorganic fertilisers, and pesticide / herbicide spray drift may occur from crops and pastures adjacent to a patch. Nutrient enrichment can also occur from manure from livestock and runoff from roads, urban and industrial infrastructure.
- Altered fire regimes of both wildfires and prescribed or hazard reduction burning resulting in altered fire frequency and changes to fire intensity and season. It is noted that the *E. brookeriana* component of the ecological community is particularly sensitive to fire.
- Hybridisation with non-Tasmanian plantation eucalypts particularly hybridisation with the introduced plantation species, *Eucalyptus nitens*.
- Disease and dieback (e.g. plant diseases such as *Phytophthora cinnamomi*) may impact on species diversity and structure.
- Climate change including altered fire and flooding regimes, decline in tree health due to prolonged drought and heat stress, exacerbating proliferation of invasive species and poor regeneration and recruitment of native species.

Survey methods

Vegetation was mapped during field surveys following the methods set out in **Section 4.1.1** All areas with a dominant canopy of *E. ovata* were considered as potential black gum – Brookers gum forest/woodland ecological community. The Project Area is outside the range *E. brookeriana* communities.

All *E. ovata* dominant vegetation patches ≥ 0.5 ha were assessed for the following as required to inform the condition thresholds and criteria set out in Table 8.

- Percent of perennial undercover vegetation that is native (categories >70 %, 50-70 %, <50 %)
- Adjacent contiguous vegetation type
- Number of native understory species if ≥50 % of perennial undercover vegetation within the patch is native
- If the patch is ≥2 ha: trees per 1 ha that have either hollows or are large (>60 cm DBH)

[107] Department of the Environment & Energy (2019)

Survey findings

Within the Survey Area, eight patches of DOV totalling 11.33 ha were confirmed. Within the Project Area 280.84 ha of DOV has been mapped by TASVEG 4.0; however, verification of these patches would be required to confirm this extent of occurrence.

While *E. ovata* patches were recorded within other vegetation communities within the Survey Area, namely DSC, it was not the dominant canopy tree species in any patch other than those mapped as DOV and therefore non-DOV patches do not meet the key diagnostics for the EPBC Act listed community.

Patches of DOV were assessed against the condition thresholds set out by the conservation advice for this community[108] to determine if they qualify as the listed community, and the class and category based on condition and quality. Cover of non-native species, patch size, and connectivity with contiguous native vegetation were the main constraints to qualifying patches (Table 9). This is to be expected in this highly modified landscape.

Of the eight confirmed patches DOV patches, two did not meet minimum size requirements (>0.5 ha). Of the six patches that meet the minimum size requirement, four patches meet the condition thresholds to qualify as black gum – Brookers gum forest / woodland (Table 9). The two patches that did not qualify did not meet the non-native understory vegetation cover threshold.

The [redacted] patch is the only Class A patch. Class A describes patches of the ecological community in the best condition, in terms of native understorey vegetation cover and connectivity. This is despite the patch being within the highly modified agricultural environment. The DOV patch itself is of high quality with few weeds, large trees, and provides habitat for burrowing crayfish. It is also as part of a larger patch and linear corridor along [redacted] The entire vegetation patch has been fenced, and therefore while the patch is surrounded by modified land, disturbance to the native vegetation is limited.

The remaining three qualifying patches are Class B patches. Class B represents the minimum for a patch of the ecological community to be subject to the referral, environment assessment and compliance provisions of the EPBC Act.

While all remnants are within the modified agricultural landscape, the landscape surrounding the [redacted] patch is less modified than the other areas as it is on the edge but contiguous with a large, forested area at the very southern part of the Survey Area. However, the adjacent forest blocks undergo regular selective timber harvesting which reduces the intrinsic quality of the larger patch which by definition the Class A captures. That is, selective logging reduces the intactness and habitat value of the vegetation and increases the potential for weed and pest impacts. Thus, this patch has been classed as Class B1 not Class A. This alignment has been omitted from the final design, as such, this patch is not at risk of any impacts.

The [redacted] patch is highly disturbed due to ongoing access by cattle. In this area, different quality patches were mapped following the conservation advice (Section 2.4)[109]. While 60 % (1.45 ha) of the DOV patch qualifies as the EPBC Act listed community, the remaining 30 % (0.95 ha) does not qualify but forms part of the required 30 m buffer zone for this community patch. In addition, the areas surrounding the mapped DOV within the 30 m buffer area would likely have been DOV in the past, however these have been modified to the extent that they cannot be mapped as native vegetation units and have been mapped as FAC, FRG, and where there are no native elements, FAG. The FAC and non-qualifying DOV in particular have a high cover of non-native vegetation cover.

[108] Department of the Environment & Energy (2019)
[109] Department of the Environment & Energy (2019)

Table 9: DOV patches mapped within the Survey Area with reference to listing criteria detailed in Table 8

Patch Location	Patch Size (ha)	Percentage of Perennial* Native Vegetation Cover	Number of Trees >60 cm DBH or Hollow Bearing Per Hectare	Contiguous^ With a Native Vegetation Remnant ≥2 ha	EPBC Act Category	Justification
[redacted]	1.82	≥70 %	≥4	Contiguous	**A2**	This patch has not been degraded by stock access. The patch is floristically and structurally intact. Weed cover is <5 %. While not directly contiguous with native vegetation, a dam on a natural water course separates this patch from ~10 ha patch of native vegetation, which when taken as a whole natural system with only modified water body, this patch qualifies as a Class A patch. The larger remnant is a linear patch surrounding within the drainage line. The DOV and the larger patch is surrounded by dairy paddocks and glass houses for berry farming. The Construction Corridor is **40 m** from the patch and is not at risk of impacts.
[redacted]	0.78	≥70 %	0	Not contiguous	**B1**	This is a good quality patch with <5 % weed cover. It is within a larger patch (10 ha in total) of modified vegetation, i.e. native eucalypt tree (including but not *E. ovata* dominant) canopy over pasture grass, and an area of pine plantation. It is likely that stock have access to the area but not at a high impact level. This larger area is surrounded by agricultural farm paddocks. This patch does not qualify as Class A as contiguous vegetation, though native canopy, is not intact, and it is devoid of large trees. The Construction Corridor is **40 m** from the patch and is not at risk of impacts.
[redacted]	2.14	≥70 %	<4	Contiguous but disturbed native vegetation block	**B1**	This patch is dominated by *E. ovata* and is located in a damp gully near to larger area of DSC with patchy codominant *E. viminalis*, *E. obliqua*, and *E. ovata* to the north (downslope). It is good quality with very little (<5 %) non-native cover and little evidence livestock access, though floristic diversity is low with a predominantly *Melaleuca ericifolia* and *Lepidosperma elatior* understorey. It is likely that the area has been logged in the past as there are few large trees present.

Patch Location	Patch Size (ha)	Percentage of Perennial* Native Vegetation Cover	Number of Trees >60 cm DBH or Hollow Bearing Per Hectare	Contiguous^ With a Native Vegetation Remnant ≥2 ha	EPBC Act Category	Justification
						The lack of mature trees prevents this patch from qualifying as a Category A patch. While the DOV patch is contiguous with native forest vegetation (within 50 m to the north), this forest is regularly selectively logged, reducing its value, and the patch is otherwise within farm paddocks. Therefore, although it is a good quality patch it does not quite meet the value of a Class A patch. This alignment has been omitted from the final design and this DOV patch is 2 km from the nearest Construction Corridor location. Therefore, this patch is not at risk of any impacts.
[redacted]	Total area = 1.45 Qualifying area = 0.95	Between 50 % and 70 % and ≥15 native understorey species per 0.5 ha	0	Not contiguous	**B3**	This remnant patch is highly modified, is a surrounded by crop and livestock paddocks, and is regularly accessed by stock. A central area of 0.95 ha meets EPBC Act criteria, however 0.50 ha does not qualify as the EPBC Act community based on <50 % of the understorey vegetation cover being native. The areas surrounding the mapped black gum forest would have been DOV in the past, however these have been modified to the extent that they cannot be mapped as native vegetation units and have been mapped as FAC, FRG, and where there are no native elements, FAG. The Construction Corridor is **15 m** from the patch within already modified land.
East of Beer Street 451593E, 5439567N	2.79	<50 %	<4	Not contiguous	**Fails to qualify**	This is a remnant patch within farm paddocks and regularly accessed by stock. It has a modified understorey structure and reduced diversity of characteristic species. Pasture grass is prevalent and woody weeds are present (such as blackberry, briar rose and gorse). This patch is not contiguous with native vegetation units.
Oppenheim's Road 460561E, 5435853N	0.56	<50 %	-	Contiguous	**Fails to qualify**	This patch is fenced off to protect from stock access but infested with blackberry and blue periwinkle (*Vinca major*) with >50 % cover. This patch was likely part of a larger DOV patch which has been cleared of

Patch Location	Patch Size (ha)	Percentage of Perennial* Native Vegetation Cover	Number of Trees >60 cm DBH or Hollow Bearing Per Hectare	Contiguous^ With a Native Vegetation Remnant ≥2 ha	EPBC Act Category	Justification
						understorey vegetation and as such has been mapped as FAC. This patch is contiguous with remnant native vegetation to the east, though this has also been modified.
East of Woodbury Lane 462753E, 5438639N	0.41	<50 %	-	Contiguous	**Fails to qualify**	Less than 0.5 ha within farm paddocks and regularly accessed by stock. This patch has a modified understorey structure and reduced diversity of characteristic species. Pasture grass are prevalent and woody weeds present (such as blackberry and briar rose) are present. This patch is contiguous with native vegetation units (though heavily impacted by stock access), and with FAC vegetation units *(E. ovata* trees over pasture).
West of Appleby Road 458692E, 5441583N	0.43	<50 %	-	Contiguous but less than 2 ha	**Fails to qualify**	Less than 0.5 ha within peri urban landscape. This patch has a modified understorey structure and reduced diversity of characteristic species. Pasture grass are prevalent and woody weeds (such as blackberry and hawthorn) are dominant. This patch is part of a larger native remnant (<2 ha), though the entire patch is degraded and weedy.

*** Perennial understorey vegetation cover includes vascular plant species of the ground and mid layers with a lifecycle of more than two growing seasons. The ground layer includes herbs (i.e., graminoids, forbs, and low shrubs [woody plants <0.5 m high]). Measurements of perennial understorey vegetation cover exclude annuals, leaf litter or exposed soil. The mid layer is typically comprised of shrubs and small trees and may include juvenile canopy trees.**

^ Contiguous means a patch of the ecological community is continuous with or close to (periphery within 50 m) another area of native vegetation. The native vegetation remnant that is contiguous includes any native vegetation where the cover in each layer present is dominated by native plant species. It includes forest and non-forest native vegetation structures. The minimum total area of native vegetation (i.e., patch of the ecological community plus contiguous remnant) is 2 ha.

Impact pathways

Potential impact pathways relevant to the construction of the SWISA include:

- Clearance of vegetation associated with the community and its buffer zone resulting in fragmentation into smaller, more isolated patches susceptible to further degradation.
- Impacts from invasive species introduced or exacerbated by construction processes including weed invasion, notably from perennial weeds such as blackberry, gorse and Spanish heath.

Potential impact pathways relevant to the operation of the SWISA include:

- Clearance of native vegetation including prescribed or hazard reduction burning.
- Impacts from invasive species including weed invasion, notably from perennial weeds such as blackberry, gorse and Spanish heath, and damage from pest animals such as deer.
- Altered hydrology and water quality including modifications to the landscape that disrupts natural water flows, increased dryland salinity, and excessive groundwater extraction and eutrophication from intensive agriculture, irrigation and irrigated cropping.
- Grazing pressure including by domestic stock and browsing of regrowth by native fauna.
- Nutrient enrichment and chemical drift from crops and pastures adjacent to a patch.
- Hybridisation with non-Tasmanian plantation eucalypts particularly hybridisation with the plantation species, *Eucalyptus nitens*.

Avoidance

All areas of vegetation qualifying as this threatened ecological community have been avoided during the rigorous realignment design process undertaken to avoid conservation significant values. No patches of this community are within the Construction Corridor nor will be directly impacted (cleared) during construction of the SWISA. This eliminates the potential impact pathway of direct clearance of vegetation due to construction of the SWISA.

The Creeleys Road extension has been omitted from the final design, further avoiding a large qualifying patch. This patch will not be at risk of any impacts due to the construction and operation of the SWISA.

Impacts

<u>Construction</u>

Although direct impacts to this community have been avoided through design, the Construction Corridor is within the requisite 30 m buffer zone for this community at one patch, [redacted] At this site, the Construction Corridor is 15 m from the canopy of this patch within already modified land. The Construction Corridor impact area has been reduced to the minimum (6 m) width within the buffer zone (but 15 m form the canopy). In addition, the Construction Corridor is within existing modified land and will not alter the land use or the environment within the buffer zone. The conservation advice for this community allows for activities and continued land use (such as cropping and grazing) within the buffer if there is no impact on the ecological community[110].

The Construction Corridor is within the buffer zone for 65 m at a minimum distance is 15 m from the nearest edge of the qualifying community patch at [redacted] (Plate 25). The buffer through which the Construction Corridor passes is FAC vegetation (native trees over pasture) and FAG (agricultural land (Plate 26). These are existing modified vegetation units and construction of the pipeline will not alter the quality of vegetation within or land use of the 30 m buffer area.

A large patch of winged thistle (*Carduus tenuiflorus*) was recorded in the buffer zone of this patch, including within the Construction Corridor. In addition, blackberry and hawthorn were recorded within the buffer zone, including in areas of DOV that failed to qualify as the threatened ecological community. Measures to avoid spread of existing weed species and introduction of other invasive species to the

[110] Department of the Environment & Energy (2019)

area during construction are required, as well as strict controls around the proposed works area to ensure that there are no unanticipated impacts to the forest patch.

Plate 25: [redacted] Construction Corridor adjacent and parallel to fence (right hand side). Winged thistle shown in the foreground

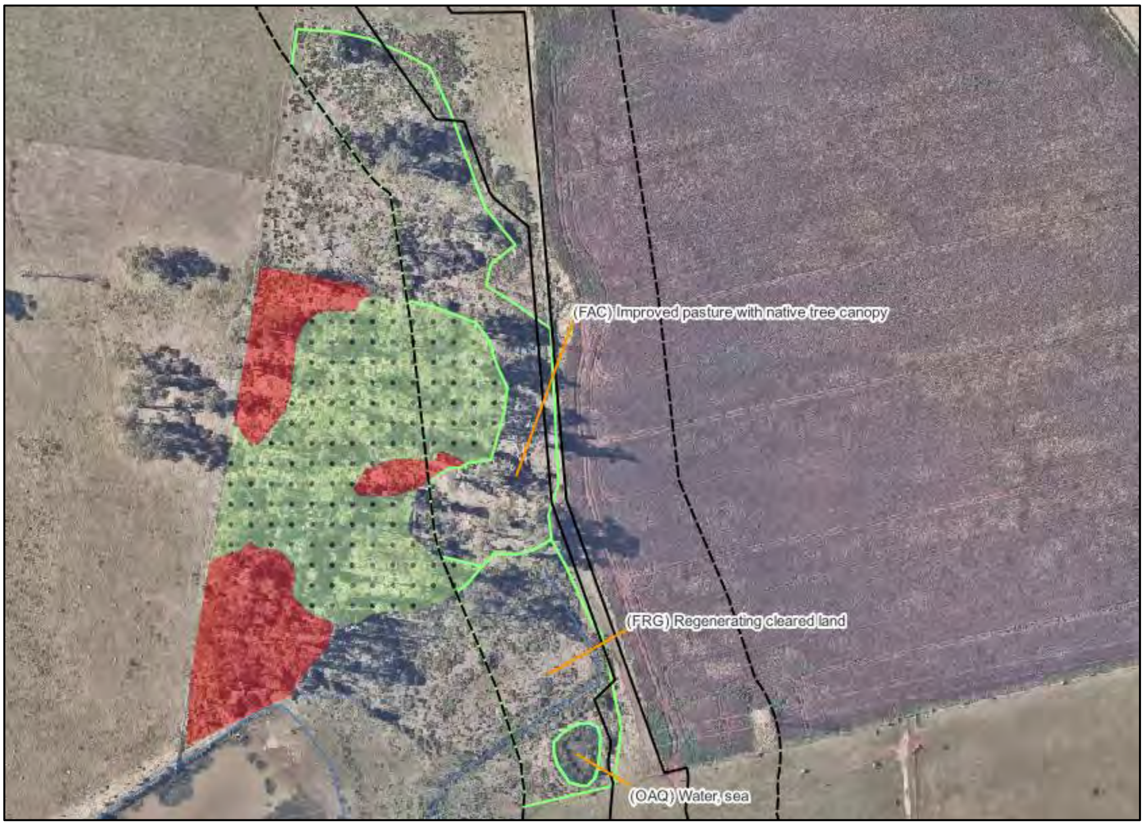

Plate 26: [redacted] EPBC Act qualifying (green) and non-qualifying (red) black gum forest patch and Construction Corridor (solid black line)

Operation

The greatest risk of impact to this ecological community due to the operation of the SWISA is from the potential for changes in land use resulting in the following potential impacts.

- Clearance of native vegetation including prescribed or hazard reduction burning.
- Impacts from invasive species including weed invasion, notably from perennial weeds such as blackberry, gorse and Spanish heath, and damage from pest animals such as deer.
- Altered hydrology and water quality including modifications to the landscape that disrupts natural water flows, increased dryland salinity, and excessive groundwater extraction and eutrophication from intensive agriculture, irrigation and irrigated cropping.
- Grazing pressure including by domestic stock and browsing of regrowth by native fauna.
- Nutrient enrichment and chemical drift from crops and pastures adjacent to a patch.
- Hybridisation with non-Tasmanian plantation eucalypts particularly hybridisation with the plantation species, *Eucalyptus nitens* (shining gum).

Within the broader Project Area, isolated remnants of DOV (totalling 280.84 ha) have been mapped[111], particularly around Latrobe. Much of this vegetation has not been field verified and the DOV community does not directly correlate to the critically endangered black gum – Brookers gum forest / woodland community. However, there is a moderate likelihood that this ecological community may occur on a SWISA irrigators land.

Given that the SWIS has been operating within the majority of the SWISA Project Area since 2012, there is unlikely to any further significant change in land use on land that is already taking water from the SWIS. The greatest potential for land use change, and associated impacts to the community, are those properties that are not currently part of the SWIS and therefore the current land use is dryland agriculture or non-agricultural. Of the properties likely to use water from the SWISA, 80 % are already on the SWIS[112]. These properties are already under operating under approved Farm WAPs, and land use is unlikely to change significantly. Thus only 20 % of properties will be newly receiving scheme water likely to result in change in land use to irrigated agriculture.

Mitigation measures

Construction

All areas of vegetation qualifying as this threatened ecological community have been avoided during the rigorous realignment process to avoid conservation significant values. No patches of this community are within the Construction Corridor nor will be directly impacted (cleared) during construction of the SWISA. The Construction Corridor is however within the 30 m buffer zone requisite for this community at one patch, [redacted] At this site, the Construction Corridor impact area has been reduced to the minimum (6 m) width within the buffer zone and is 15 m from the canopy of this patch at its outer extent.

The purpose of the buffer zone is to protect the community from likely negative impacts such as fertiliser, pesticide or herbicide applied or sprayed in adjacent land (e.g. spray drift), weed invasion, water runoff, soil erosion and some other damage and edge effects. The land use of the buffer areas in which the SWISA pipeline is aligned will be the same post-construction as pre-construction, therefore the purpose of the buffer will be sustained.

Construction of the SWISA within the buffer zone may increase risk to the ecological community of:

- Impacts from invasive species introduced or exacerbated by construction processes including weed invasion, notably from perennial weeds such as blackberry, gorse and Spanish heath.

[111] Department of Primary Industries, Parks, Water & Environment (2020)
[112] John Wright pers. comm. (2024)

In order to mitigate the risk of impact to the community during construction the following actions as part of the SWISA CEMP are required:

- Exclusion zone fencing of Construction Corridor to preclude unregulated direct impact to the community/buffer.
- A scheme-wide weed and hygiene management plan must be implemented across throughout all construction activities. See Section 4.4 for further information. This must include:
    - Pre-treating of woody and herbaceous weeds within the Construction Corridor and buffer areas.
    - Strict construction weed, pathogen, and pest hygiene protocols. This will ensure that any weed control measures will not adversely affect the environmental values within the ecological community or the buffer areas.
    - Follow up weed control post construction with Construction Corridor and buffer areas.

These actions will ensure risk of direct impact and spread of weed species due to construction works will be mitigated to negligible.

<u>Operation</u>

A full survey of the entire Project Area has not been undertaken and it is likely that additional remnant patches of this community exist within the broader Project Area.

The greatest risk to this ecological community due to the operation of the scheme is the potential for changes in land use and resulting clearance and conversion of native vegetation to agricultural land. Altered hydrology and water quality, and nutrient enrichment and chemical drift are potential threats resulting from altered land use surrounding the ecological community. Grazing pressure may also increase with changing land use of an area of the ecological community.

Operational impacts to this community will be mitigated through the application of an OEMP. All land irrigated with Tasmanian Irrigation water within the SWISA will be subject to rigorous assessment through the Farm WAP process. The OEMP and Farm WAP process will ensure measures are in place to safeguard that remnants that qualify as this ecological community are adequately protected.

The Farm WAP process for each SWISA irrigator property will require the following:

- Land managers will be familiar with *Tasmanian Black Gum and Brookers Gum Forests and Woodlands: A Nationally Significant Ecological Community. A guide for farmers and other land managers* [113].
- Mapping of the extent of this community (this will include areas that qualify for protection under the EPBC Act and those that do not qualify, ie poor quality DOV vegetation, as DOV is protected under the NC Act).
- Prohibition of clearance or modification of a threatened community. The provision of Tasmanian Irrigation water does not allow for landowners to conduct unregulated land clearance. Modification includes decline or loss of functionally important species, timber harvesting, decrease in quality of the community as set out by the condition thresholds for this community.
- Application of exclusion areas and buffers from particular agricultural activities (chemical and nutrient spray, and activity changing the land use or environment within 30 m of the community). Any future irrigation use must occur outside of a 50 m buffer of known occurrences of this ecological community (20 m outside requisite community buffer zone). The buffer zone begins from the edge of known forest remnants, or new remnants if discovered.
- Annual monitoring of quality of the ecological community if present within a SWISA Operational Area. Monitoring will use a repeatable method that is comparable between monitoring events,

[113] Department of Agriculture, Water and the Environment (2020).

such as permanent Vegetation Condition Assessment[114] or Community Condition Threshold[115] monitoring plots. Any determinable reduction in quality or condition of the patch will require site specific corrective actions to be applied.
- Restriction on plantation of *Eucalyptus nitens* within pollinator range (minimum distance of 200 m)[116].

By identifying areas of this community prior to the commencement of SWISA water application, prescription of buffer and exclusion zones, and through regulation by the Farm WAP process, impacts to this threatened ecological community due to clearance of native vegetation, impacts from invasive species, altered hydrology and water quality, altered grazing pressure, nutrient enrichment and chemical drift, and hybridisation with non-Tasmanian plantation eucalypts will be mitigated to negligible risk.

If it is determined by the Farm WAP that impacts due to the operation of the SWISA on individual properties are likely to trigger the MNES *Significant Impact Criteria*[117], individual irrigators may need to refer their action independently.

Opportunities to aid recovery and conservation of the ecological community

The SWISA can potentially improve the protection and conservation of this critically endangered community within a highly modified environment by:

- Identifying and mapping areas of this ecological community on private land;
- Providing protection to patches under the Farm WAPs; and
- Potential increase quality of patches already degraded by livestock and weeds.

While not directly related to the SWISA Project, general farming practices have had an impact on this ecological community within the Project Area. A number of potentially qualifying patches do not qualify due to the impacts of livestock access resulting in degraded vegetation, increased non-native cover (particularly blackberry), and clearing of edges reducing patch size and increasing edge effects. Removal and exclusion of livestock, and active weed removal and revegetation may will assist in retaining conservation value and long-term viability of community patches. Conservation efforts may also elevate patches to higher quality ranking and non-qualifying patches to qualify. Inclusion of buffer zones and contiguous native vegetation units are important to include in conservation efforts.

Residual significant impacts

With the above context, survey results, avoidance, impacts, and mitigation, an assessment of the residual impacts as a result of the construction and operation of the SWISA against the significant impact criteria[118] is provided below.

1) Reduce the extent of an ecological community.

The estimated total area of occupancy of black gum – Brookers gum forest / woodland (based on TASVEG and associated TASVEG equivalent vegetation units) is 20,000-26,000 ha (200-260 km^2) and the median patch size is 2.45 ha (0.025 km^2)[119]. The mapped extent of DOV, DOW and DMW (which may qualify at this community) in TASVEG 4.0[120] is 16,475 ha, with a median patch size of 1.56 ha.

All known occurrences of this ecological community have been avoided through design such that there will be no direct to this ecological community due to construction. The Construction Corridor is within the 30 m buffer zone of one patch, but the vegetation / land use of this buffer is such that the

[114] Michaels *et al.* (2020)
[115] Department of the Environment & Energy (2019)
[116] Barbour *et al.* (2010)
[117] Commonwealth of Australia (2013a)
[118] Commonwealth of Australia (2013a)
[119] Appendix D in Department of the Environment & Energy (2019)
[120] Department of Primary Industries, Parks, Water & Environment (2020)

construction of the SWISA will not alter their land use or the environment. By reducing the Construction Corridor to a minimum width, exclusion fencing, and weed and disease hygiene management measures during construction will ensure that there will be no direct or indirect impacts to this ecological community due to construction.

During the operational phase, all SWISA irrigators' land is subject to the TI Farm WAP process which prohibits the of clearance of a threatened community should it be found on a SWISA irrigators' land and must operate within the prescriptions of the OEMP.

With the prescribed mitigation measures in place, the construction and operation of SWISA **will not** reduce the extent of an ecological community.

2) Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines.

All known occurrences of this ecological community have been avoided through design such that there will be no direct to this ecological community due to construction. The Construction Corridor is within the 30 m buffer zone of one patch, but the vegetation / land use of this buffer is such that the construction of the SWISA will not alter their land use or the environment. Mitigation by reducing the Construction Corridor to a minimum width within already cleared land / roadway, and exclusion fencing to prevent accidental clearing during construction will ensure that there will be no direct or indirect impacts to this ecological community due to construction.

During the operational phase, all SWISA irrigators' land is subject to the TI Farm WAP process which prohibits the of clearance of a threatened community should it be found on a SWISA irrigators' land and must operate within the prescriptions of the OEMP.

With the prescribed mitigation measures in place, the construction and operation of SWISA **will not** fragment or increase fragmentation of this ecological community.

3) Adversely affect habitat critical to the survival of an ecological community.

The habitat or areas most critical to the survival of the ecological community are those patches that are in the best condition (i.e. Class A). These represent those parts of the ecological community closest to the benchmark state of the ecological community; they are the patches that retain the highest diversity and most intact structure and ecological function and have the highest chance of persisting in the long-term[121].

All known occurrences of black gum – Brookers gum forest / woodland have been avoided through design such that there will be no direct impacts to this ecological community due to construction. In the one area where the construction corridor is within the 30 m community buffer, the buffer is made up of modified vegetation units (agriculture) and the construction of the pipeline will not change or intensify the land use within the buffer. Therefore, there will be no significant impact to the buffer vegetation or to the ecological community.

During the operational phase, all SWISA irrigators' land is subject to the TI Farm WAP process which prohibits the of clearance of a threatened community should it be found on a SWISA irrigators' land and must operate within the prescriptions of the OEMP.

With the prescribed mitigation measures in place, the construction and operation of SWISA **will** not adversely affect habitat critical to the survival of this ecological community.

[121] Department of the Environment and Energy (2019)

4) Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns.

All known occurrences of black gum – Brookers gum forest / woodland have been avoided through design such that there will be no direct or indirect impacts to this ecological community due to construction.

During the operational phase, all SWISA irrigators' land is subject to the TI Farm WAP process and must operate within the prescriptions of the OEMP. Application of a 50 m buffer and exclusion of farming practices with potential to impact the abiotic factors around any identified patch of this community avoid potential impacts due to altered hydrology and water quality, and nutrient enrichment and chemical drift to this ecological community within the SWISA operational area.

Operation of the SWISA will not lead to a decrease in ground water levels or decrease in surface water drainage to the ecological community. Any new dam construction is subject to a dam works permit under the Tasmania *Water Management Act 1999* and must maintain environmental flow within the catchment area.

With the prescribed mitigation measures in place, the construction and operation of SWISA **will not** modify or destroy abiotic factors necessary for the survival of this ecological community.

5) Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting.

There are no direct impacts to this ecological community anticipated due to construction or operation of the SWISA.

During the operational phase, all SWISA irrigators' land is subject to the TI Farm WAP process and must operate within the prescriptions of the OEMP. Application of a 50 m buffer and exclusion of particular farming practices, prohibition of clearing, timber harvest or altering land use within the patch, and monitoring of quality of the community with corrective action to be taken if change in quality is determined will preclude substantial change in the species composition of an occurrence of an ecological community.

With the prescribed mitigation measures in place, the construction and operation of SWISA **will not** cause a substantial change in the species composition of an occurrence of this ecological community.

6) Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including but not limited to:
   - ***a. assisting invasive species, that are harmful to the listed ecological community, to become established, or***
   - ***b. causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community.***

There are no direct or indirect impacts to this ecological community anticipated due to construction of the SWISA. All construction activities will be subject to a project specific weed and hygiene management plan, including follow up weed control. This measure will minimise the risk of spreading invasive species and pathogens to the community and throughout the broader area.

During the operational phase, all SWISA irrigators' land is subject to the TI Farm WAP process. Application of a 50 m buffer and exclusion of farming practices with potential to impact the community (chemical and nutrient spray) will avoid potential impacts due to water quality, nutrient enrichment and chemical drift to this ecological community within the SWISA operational area. Prohibition of clearing, timber harvest or altering land use within the patch, and monitoring of quality of the community with corrective action to be taken if change in quality is determined will preclude reduction in the quality or integrity of an occurrence of this ecological community. Any increase in any weedy or invasive species will be assessed and addressed during the monitoring process

With the prescribed mitigation measures in place, the construction and operation of SWISA **will not** cause a substantial reduction in the quality or integrity of an occurrence of this ecological community.

7) Interfere with the recovery of an ecological community.

There is currently no adopted or made recovery plan for this ecological community as the main threats and the priority actions required to address these threats are largely understood. The conservation advice[122] sufficiently outlines the priority actions needed for this ecological community.

The proposed construction and operation of the SWISA will not interfere with any of the priority actions listed in the conservation advice, therefore **will not** interfere with the recovery of this ecological community.

Summary

The construction and operation of the SWISA **will not** have a significant residual impact on Tasmanian black gum – Brookers gum forest / woodland.

[122] Department of the Environment and Energy (2019)

4.1.2.2 Tasmanian white gum wet forest

Context

The Tasmanian white gum wet forest ecological community (which corresponds to the TASVEG 4.0 *Eucalyptus viminalis* wet forest – WVI unit) has been predicted as likely to occur within the Project Area[123].

Conservation status

This ecological community was listed as critically endangered in 2021[124] after meeting a number of listing criteria[125]. The key reasons for listing are provided below.

> On the 23rd of September, 2021, the Minister accepted reasons for listing this ecological community as critically endangered on the basis of available scientific information. This conclusion was reached from the following assessment criteria:
>
> **Criterion 1** – Decline is geographic distribution
>
> The white gum wet forest ecological community has undergone a decline in extent of about 90-95 % since 1750 based on available estimates of extent. This represents a severe decline in geographic distribution. Therefore, the ecological community has met the relevant elements of Criterion 1 to make it eligible for listing as **critically endangered**.
>
> **Criterion 2** – Restricted geographic distribution coupled with demonstrable threat
>
> The white gum wet forest ecological community is severely fragmented, with 81 % of remnants less than 10 ha in size, and only 3 % above 50 ha at the time of assessment. The fragmented distribution of this ecological community leaves it susceptible to edge effects, with particular threats including invasive species, climate change, and cumulative loss of remnants. The collective action of these threatening process have the potential to cause loss in the immediate future. Therefore, the ecological community has met the relevant elements of Criterion 2 to make it eligible for listing as **critically endangered**.
>
> **Criterion 3** – Loss or decline of functionally important species
>
> *Eucalyptus viminalis*, has undergone a decline in abundance along with losses of the ecological community. Although as a species it is not considered to be threatened at this time, it is subject to significant losses to 'rural tree decline' throughout Tasmania and on the mainland, and white gum trees are subject to significant decline within and without the ecological community due to 'ginger tree syndrome'. *Eucalyptus viminalis* is known to be highly susceptible to stress due to climatic factors.
>
> The loss of live white gum trees, the dominant species in the canopy, is likely to substantially alter the character and function of the ecological community. This represents a very severe decline in a species that plays a major role in community structure and processes, such that restoration is unlikely to be possible in the immediate future (3 generations of *E. viminalis*).
>
> Therefore, the ecological community has met the relevant elements of Criterion 3 to make it eligible for listing as **critically endangered**.
>
> **Criterion 4** – Reduction in community integrity
>
> The ecological community occurs mainly as scattered remnants, with very few old-growth stands or large stands remaining. Regrowth trees lack hollows that are found in older trees

[123] Department of Climate Change, Energy, the Environment & Water (2024d)
[124] Department of Climate Change, Energy, the Environment & Water (2024d)
[125] Department of Agriculture, Water & the Environment (2021)

and therefore reduce the ecological complexity and functionality of the ecological community, particularly for hollow-dependant species. Due to the fragmented nature of the community, patches often contain infestation of weeds, to the point where few patches can be considered viable in the long term without active management. This represents a severe reduction in integrity across much of the ecological communities distribution, thus making it eligible for listing as **endangered**.

Criterion 5 – Rate of continuing detrimental change

The five-yearly Tasmanian State of the Forests[126] reports show the rate of continuing losses (from all causes) of this ecological community. These changes represent a continuing loss of around 1.5 % a year since 1996. Since 2011 this loss has been around 2.5 % per annum. This represents a loss of 15 % to 25 % over ten years.

This equates to a very severe rate of detrimental change over the immediate past (3 generations of *E. viminalis*), therefore considers that the ecological community has met the relevant elements of Criterion 5 to make it eligible for listing as **critically endangered**.

Criterion 6 – Quantitative analysis showing the probability of extinction

At the time of assessment, there were no quantitative data to assess this ecological community under this criterion. Therefore, it was **not able to be assessed** for listing under this criterion.

Department of Agriculture, Water & the Environment (2021)

Ecology

This ecological community is a wet eucalypt forest, with a wet sclerophyll or mixed forest understorey. It typically a tall, open forest, with a canopy dominated by *Eucalyptus viminalis* over a secondary tree layer, broad leaf shrubs, ferns, and graminoids.

The canopy generally consists of an even-aged stand of tall trees that can exceed 60 m in height on fertile sites. The understorey often consists of a dense layer of shrubs and thick layer of leaf litter, which can prevent continuous regeneration of shade-intolerant species, including eucalypts. Regeneration in wet eucalypt forest is typically through disturbance, notably wildfire. This in part explains why forest patches are even-aged, as the cohort of regeneration has arisen from the same disturbance event. The canopy is dominated by *Eucalyptus viminalis*, however other species can also be present, including *E. obliqua*, *E. tasmaniensis*, *E. regnans*, and *E. ovata* (in poorly drained areas)[127].

The understorey often contains *Acacia melanoxylon* and *A. dealbata* and are successively replaced by rainforest trees such as *Nothofagus cunninghamii* and *Atherosperma moschatum*. Most sites also contain a range of common wet sclerophyll shrubs and small trees, as well as tree ferns and ground ferns. Species such as *Leptospermum* and *Melaleuca* are often present in poorly drained sites.

Identification and condition thresholds

This ecological community intergrades with other vegetation types. Key diagnostic characteristics[128] are used to identify forest patches that may qualify as the Tasmanian white gum wet forest ecological community and define features that distinguish it from other ecological communities.

To potentially qualify as this ecological community, patches must:

- Occur within Tasmania, including the Furneaux group;
- Have a tree canopy crown cover of ≥5 %;

[126] Forest Practices Authority (2017)
[127] Department of Agriculture, Water & the Environment (2021)
[128] Department of Agriculture, Water & the Environment (2021)

- Have a tree canopy dominated by *Eucalyptus viminalis*;
- Have a wet forest understorey, which is typically dominated by:
  - o Ferns or broad-leaf shrubs; or
  - o Tall (>2 m) *Leptospermum* or *Melaleuca* spp.; or
  - o Rainforest species; and
  - o Is not dominated by grasses, heath, or narrow-leaf shrubs.

National listing focuses legal protection on patches of the ecological community that are the most functional, relatively natural and in comparatively good condition. These patches are identified through condition and size requirements.

Condition classes and categories are used to distinguish between patches of the ecological community of different qualities, to aid environmental management decisions.

In order to be protected as a matter of national environmental significance areas of the ecological community must meet both:

- the key diagnostic characteristics; and
- the condition and size requirements (Table 10).

Class C patches are excluded from protection under the EPBC Act, as in many cases, the loss and degradation is irreversible due to the permanent removal of natural characteristics[129]; however, these patches may still qualify as the WVI community listed as threatened under Schedule 3A of the Tasmanian NC Act, and therefore are still afforded protection at the State level.

Distribution and site significance

This ecological community can occur in all Tasmanian bioregions; however, it is predominantly recorded in the Northern Slopes and Ben Lomond bioregions[130] (Figure 5). It typically occurs on flats and lower slopes of major river valleys.

The estimated total area of occupancy (including the areas on Flinders Island that are not included in the Tasmanian state listed '*Eucalyptus viminalis* wet forest') is around 7,600 ha (76 km^2) and the median patch size is 2.5 ha (0.025 km^2). The mapped extent of WVI in TASVEG[131] 4.0 is 7,975 ha, with a median patch size of 1.86 ha.

SWIS management actions

The Tasmanian white gum wet forest threatened ecological community was not listed under the EPBC Act at the time of the SWIS referral assessment[132]. As such, no management actions were required as conditions of approval of the SWIS as a controlled action.

[129] Department of Agriculture, Water & the Environment (2021)
[130] Department of Agriculture, Water & the Environment (2021)
[131] Department of Primary Industries, Parks, Water & Environment (2020)
[132] Referral EPBC: 2010 / 5327

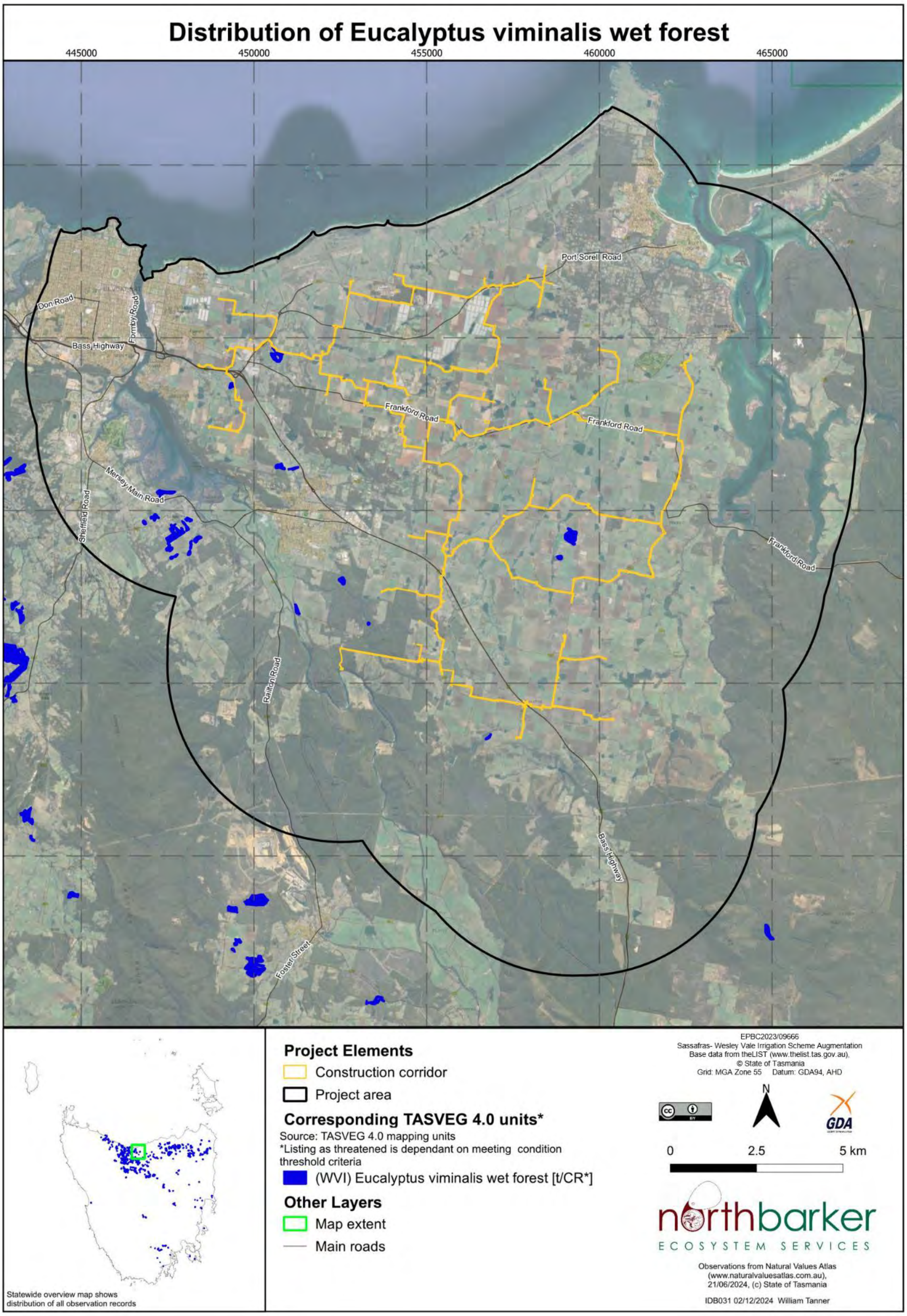

Figure 5: Distribution of potential qualifying patches of the Tasmanian white gum wet forest ecological community

Table 10: Condition thresholds for the white gum wet forest ecological community*

Condition Class	Site Components	Minimum Patch Size
Class A – High Quality Patches with close to or above the benchmark level for most measures	Sites with 3 or more site components rated as Category 3	0.5 ha
Class B – Moderate Quality Larger patches approaching the benchmark level for most measures	Sites not meeting Class A, and with 3 or more site components rated as Category 2	2 ha
Class C – Poor Quality Patches with somewhat less than the benchmark level for most measures	Sites with less than 3 site components rated as Category 2 or 3	Not included

Site Components and Condition Categories

Site Components	Category 1	Category 2	Category 3
Understorey[A] Number of major lifeforms present	Largely absent <4 lifeforms present	Limited structural diversity 4-5 lifeforms present	Obvious structural diversity ≥6 lifeforms present
Recruitment[B] Proportion of species present with immature specimens	Absent <30 % of species showing adequate recruitment	Uncommon 30-70 % of species showing adequate recruitment	Common >70 % of species showing adequate recruitment
Lack of weeds[C] Percentage of exotic cover	Visually dominated by exotics >25 % cover	Easily observed exotics 5-25 % cover	Very rarely observed <5 % cover
Large trees[D] Number / ha	Largely absent <5 / ha	Few 5-17 / ha	Many ≥18 / ha
Tree canopy cover[E] Percentage cover	Absent <3 % canopy cover	Scattered and sparse 3-15 % canopy cover	Complete ≥15 % canopy cover
Organic litter[F] Percentage cover	Absent <7 % cover	Low cover 7-35 % cover	High cover >35 % cover
Logs[G] Metres / ha	Absent <4 m / 0.1 ha	Uncommon (Occasional logs and/or stumps) 4-20 m / 0.1 ha	Common (Many large logs) >20 m / 0.1 ha

* All site component measurements must be assessed as per the TASVEG Vegetation Condition Manual (Michaels, 2006).

[A] Lifeforms are considered present when the following are met: sub-canopy trees and large shrubs (T) ≥4 % cover; medium and small shrubs (S) ≥1 % cover; herbs and orchids (H) ≥1 specimen; large sedge/rush/sagg/lily (LSR) ≥1 specimen; ground fern and fern allies (GF) ≥2 % cover; scrambler/climber and epiphytes (SCE) ≥1 specimen; mosses and lichens (ML) ≥ 1 specimen.

[B] Recruitment is assessed for medium and small shrubs (S), subcanopy trees and large shrubs (T), and canopy trees only. Adequate recruitment for a species is indicated by a number of recruits ≥10 % the number of mature specimens. A recruit is defined as an immature plant that contains no evidence of flowering or fruiting material.

[C] Exotics are measured as projective foliage cover of all non-indigenous species.

[D] Large trees are trees with a DBH of ≥80 cm.

[E] The canopy includes all trees >32 m in height. Canopy cover is measured as projective foliage cover.

[F] Litter is defined as dead organic material detached from the parent plant, including both coarse and fine plant debris, and material such as fallen leaves, twigs and small branches less than 10 cm diameter present at ground level.

[G] Logs are defined as any dead timber fallen to the with a diameter ≥10 cm. Stumps ≥10 cm in diameter at the base and less than 1.3 m tall are also included. The total length includes all logs and stumps measured individually and added together.

Threats

Tasmanian white gum wet forests have been primarily impacted by historic clearing for agriculture and forestry, and the remnants that remain continue to be under threat from ongoing degradation. Listed threats to this ecological community include:

- Land clearing, particularly due to urban development and infrastructure projects.
- Fragmentation. Historic clearance of the ecological community as well as other surrounding vegetation has resulted in severe fragmentation and invasion by exotic species, which leads to ongoing loss of species diversity and ecological function in remaining patches; and greater vulnerability and reduced resilience of smaller patches to stochastic events.
- Inappropriate fire regime. Frequent fires in wet forest communities may result in the simplification of the understorey and promote invasion of weeds.
- Weed invasion, which may lead to increased competition and habitat quality reduction;
- Browsing by native marsupials, which may prevent seedling recruitment, particularly where adjacent to agricultural land;
- Hybridisation, with particular reference to the hybridisation of *Eucalyptus viminalis* with the plantation timber, *Eucalyptus nitens*[133];
- Climate change. *Eucalyptus viminalis* is known to be highly susceptible to stress due to climatic factors and climate change projections indicate an increasing frequency and intensity of heat waves. 'Ginger tree syndrome' is the term given to a condition affecting eucalypts, often following extreme heat events. Elevated ambient air temperatures can cause water stress and hence shrinkage of the bark and trunk leading to the production of kino[134]. The syndrome is typified by the seeping of kino through the bark, turning the trees 'ginger' and providing a visual means of identifying affected trees. Tree mortality is often rapid and can occur within 12 months. The loss of canopy trees has the potential to substantially alter the character, composition, and function of the ecological community; and
- Altered hydrology, including dam building, stream diversion, increasing irrigated land, or climate change can induce significant stressors for canopy trees, particularly *Eucalyptus viminalis*, compounding other threats and making them more susceptible to disease and dieback[135].

Survey methods

Vegetation was mapped during field surveys following the methods set out in **Section 4.1.1** All areas with a dominant canopy of *E. viminalis* were considered as potential white gum wet forest ecological community, and the requisite level of detail was collected to determine patch quality against the condition thresholds (Table 10) if the ecological community was recorded as present.

Survey findings

Localised stands of *Eucalyptus viminalis* are present in patches of DSC and DOV vegetation; however, no *Eucalyptus viminalis* wet forest (WVI) was recorded during any of the surveys across the Project Area. Two patches of mapped WVI were visited during field surveys, however these patches were both determined to be DOV with localised dominance of *Eucalyptus viminalis*.

Numerous patches of this ecological community are mapped within the Project Area; however, verification of these patches would be required to confirm the extent of occurrence. Assessment of aerial imagery[136] suggests that the mapped WVI in the region is unlikely to be accurate, and if it is, patches are likely to be highly modified.

[133] Forest Practices Authority (2011)
[134] Mitchell (2015)
[135] Mitchell (2015)
[136] ECOtas (2022) – **Attachment E**

Impact pathways

There are no potential impact pathways due to the construction of the SWISA. Potential impact pathways relevant to the operation of the SWISA include:

- Clearance of native vegetation including prescribed or hazard reduction burning.
- Impacts from invasive species including weed invasion, notably from perennial weeds such as blackberry, gorse and Spanish heath, and damage from pest animals such as deer.
- Altered hydrology and water quality including modifications to the landscape that disrupts natural water flows, increased dryland salinity, and excessive groundwater extraction and eutrophication from intensive agriculture, irrigation and irrigated cropping.
- Grazing pressure including by domestic stock and browsing of regrowth by native fauna.
- Nutrient enrichment and chemical drift from crops and pastures adjacent to a patch.
- Hybridisation with non-Tasmanian plantation eucalypts particularly hybridisation with the plantation species, *Eucalyptus nitens*.

Avoidance

All previously mapped occurrences of this ecological community have been avoided through design, and no occurrences were recorded during field surveys. There may be remnants of this community present within the Project Area within the Operation Area, which will require further avoidance and impact mitigation measures.

Impacts

Construction

This ecological community is not at risk of construction impacts as it is not present within the Survey Area or the Construction Corridor.

Operation

The greatest risk of impact to this ecological community due to the operation of the SWISA is from the potential for changes in land use resulting in the following potential impacts.

- Clearance of native vegetation including prescribed or hazard reduction burning.
- Impacts from invasive species including weed invasion, notably from perennial weeds such as blackberry, gorse and Spanish heath, and damage from pest animals such as deer.
- Altered hydrology and water quality including modifications to the landscape that disrupts natural water flows, increased dryland salinity, and excessive groundwater extraction and eutrophication from intensive agriculture, irrigation and irrigated cropping.
- Grazing pressure including by domestic stock and browsing of regrowth by native fauna.
- Nutrient enrichment and chemical drift from crops and pastures adjacent to a patch.
- Hybridisation with non-Tasmanian plantation eucalypts particularly hybridisation with the plantation species, *Eucalyptus nitens* (shining gum).

Although no white gum forest was identified during field surveys, potential habitat occurs outside of the Survey Area, and isolated remnants are mapped[137] within the broader Project Area. There is a moderate likelihood that this ecological community may occur in a SWISA irrigators land and thus be at risk of operational impacts.

[137] Department of Primary Industries, Parks, Water & Environment (2020)

Mitigation measures

Construction

As this ecological community is not present within the Construction Corridor, specific mitigation measures for construction are not required for this MNES.

Operation

The greatest risk to this ecological community due to the operation of the scheme is the potential for changes in land use and resulting clearance and conversion of native vegetation to agricultural land. Altered hydrology and water quality, and nutrient enrichment and chemical drift are potential threats resulting from altered land use surrounding the ecological community. Grazing pressure may also increase with changing land use of an area of the ecological community.

Operational impacts to this community will be mitigated through the Farm WAP process and the application of an OEMP. All land irrigated with Tasmanian Irrigation water within the SWISA will be subject to rigorous assessment through the Farm WAP process. The OEMP and Farm WAP process will ensure measures are in place to safeguard that remnants that qualify as this ecological community are adequately protected.

In order to mitigate the risk of impact to this ecological community during the operation of the scheme, the following actions as part of the SWISA OEMP for each SWISA irrigator property are required:

- Mapping of the extent of this community (this will include areas that qualify for protection under the EPBC Act and those that do not qualify, ie poor quality WVI vegetation, as WVI is also protected under the NC Act).
- Prohibition of clearance or modification of a threatened community. The provision of Tasmanian Irrigation water does not allow for landowners to conduct unregulated land clearance. Modification includes decline or loss of functionally important species, timber harvesting, decrease in quality of the community as set out by the condition thresholds for this community.
- Application of exclusion areas and buffers from particular agricultural activities (chemical and nutrient spray, and activity changing the land use or environment within 30 m of the community). Any future irrigation use must occur outside of a 50 m buffer of known occurrences of this ecological community (20 m outside requisite community buffer zone). The buffer zone begins from the edge of known forest remnants, or new remnants if discovered.
- Annual monitoring of quality of the ecological community if present within a SWISA Operational Area. Monitoring will use a repeatable method that is comparable between monitoring events, such as permanent Vegetation Condition Assessment[138] monitoring plots. Any determinable reduction in quality or condition of the patch will require site specific corrective actions to be applied.
- Restriction on plantation of *Eucalyptus nitens* within pollinator range.

By identifying areas of this community prior to the commencement of SWISA water application, prescription of buffer and exclusion zones, and through regulation by the Farm WAP process, impacts to this threatened ecological community due to clearance of native vegetation, impacts from invasive species, altered hydrology and water quality, altered grazing pressure, nutrient enrichment and chemical drift, and hybridisation with non-Tasmanian plantation eucalypts will be mitigated to negligible risk.

If it is determined by the Farm WAP that impacts due to the operation of the SWISA on individual properties are likely to trigger the MNES *Significant Impact Criteria*[139], individual irrigators may need to refer their action independently.

[138] Michaels *et al.* (2020)
[139] Commonwealth of Australia (2013a)

Residual significant impacts

With the above context, survey results, avoidance, impacts, and mitigation, an assessment of the residual impacts as a result of the construction and operation of the SWISA against the significant impact criteria[140] is provided below.

1) Reduce the extent of an ecological community.

The estimated total area of occupancy (including the areas on Flinders Island that are not included in the Tasmanian state listed '*Eucalyptus viminalis* wet forest') is around 7,600 ha (76 km^2) and the median patch size is 2.5 ha (0.025 km^2). The mapped extent of WVI in TASVEG[141] 4.0 is 7,975 ha, with a median patch size of 1.86 ha.

All known occurrences of white gum wet forest have been avoided through design such that there will be no direct or indirect impacts to this ecological community due to construction.

During the operational phase, all SWISA irrigators' land is subject to the TI Farm WAP process which prohibits the of clearance of a threatened community should it be found on a SWISA irrigators' land and must operate within the prescriptions of the OEMP.

With the prescribed mitigation measures in place, the construction and operation of SWISA **will not** lead to a long-term decrease in the size of this ecological community.

2) Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines.

All known occurrences of white gum wet forest have been avoided through design such that there will be no direct or indirect impacts to this ecological community due to construction.

During the operational phase, all SWISA irrigators' land is subject to the TI Farm WAP process which prohibits the of clearance of a threatened community should it be found on a SWISA irrigators' land and must operate within the prescriptions of the OEMP.

With the prescribed mitigation measures in place, the construction and operation of SWISA **will not** fragment or increase fragmentation of this ecological community.

3) Adversely affect habitat critical to the survival of an ecological community.

The habitat or areas most critical to the survival of the ecological community are those patches that are in the best condition (i.e. Class A), or those patches with no sign of ginger tree syndrome or other significant canopy dieback. These represent those parts of the ecological community closest to the benchmark state of the ecological community; they are the patches that retain the highest diversity and most intact structure and ecological function and have the highest chance of persisting in the long-term.

All known occurrences of white gum wet forest have been avoided through design such that there will be no direct or indirect impacts to this ecological community due to construction.

During the operational phase, all SWISA irrigators' land is subject to the TI Farm WAP process which prohibits the of clearance of a threatened community should it be found on a SWISA irrigators' land and must operate within the prescriptions of the OEMP.

With the prescribed mitigation measures in place, the construction and operation of SWISA **will not** adversely affect habitat critical to the survival of this ecological community.

140 Commonwealth of Australia (2013a)
141 Department of Primary Industries, Parks, Water & Environment (2020)

4) ***Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns.***

All known occurrences of white gum wet forest have been avoided through design such that there will be no direct or indirect impacts to this ecological community due to construction.

During the operational phase, all SWISA irrigators' land is subject to the TI Farm WAP process which prohibits the of clearance of a threatened community should it be found on a SWISA irrigators' land and must operate within the prescriptions of the OEMP.

With the prescribed mitigation measures in place, the construction and operation of SWISA **will not** modify or destroy abiotic factors necessary for the survival of this ecological community.

5) ***Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting.***

There are no direct or indirect impacts to this ecological community anticipated due to construction of the SWISA. All construction activities will be subject to a project specific weed and hygiene management plan, as is recommended in this report. This measure will minimise the risk of spreading invasive species and pathogens that may threaten functionally important species within this ecological community.

The application of a Farm WAP and OEMP to all properties that wish to purchase and use water from the SWISA will implement measures to ensure that no future actions will cause a substantial change in the species composition of this ecological community should one be identified through this process.

With the prescribed mitigation measures in place, the construction and operation of SWISA **will not** cause a substantial change in the species composition of an occurrence of this ecological community.

6) ***Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including but not limited to:***
    a. ***assisting invasive species, that are harmful to the listed ecological community, to become established, or***
    b. ***causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or***

There are no direct or indirect impacts to this ecological community anticipated due to construction of the SWISA. All construction activities will be subject to a project specific weed and hygiene management plan, as is recommended in this report. This measure will minimise the risk of spreading invasive species and pathogens throughout the broader area.

During the operational phase, all SWISA irrigators' land is subject to the TI Farm WAP process. Application of a 50 m buffer and exclusion of farming practices with potential to impact the community (chemical and nutrient spray) will avoid potential impacts due to water quality, nutrient enrichment and chemical drift to this ecological community within the SWISA operational area. Prohibition of clearing, timber harvest or altering land use within the patch, and monitoring of quality of the community with corrective action to be taken if change in quality is determined will preclude reduction in the quality or integrity of an occurrence of this ecological community. Any increase in any weedy or invasive species will be assessed and addressed during the monitoring process

With the prescribed mitigation measures in place, the construction and operation of SWISA **will not** cause a substantial reduction in the quality or integrity of an occurrence of this ecological community.

7) Interfere with the recovery of an ecological community.

There is currently no adopted or made recovery plan for this ecological community as the main threats and the priority actions required to address these threats are largely understood. The conservation advice[142] sufficiently outlines the priority actions needed for this ecological community.

The proposed construction and operation of the SWISA will not interfere with any of the priority actions listed in the conservation advice, therefore **will not** interfere with the recovery of this ecological community.

Summary

The construction and operation of the SWISA **will not** have a significant residual impact on Tasmanian white gum wet forest.

[142] Department of Agriculture, Water & the Environment (2021)

4.2 Conservation Significant Flora

The following subsection of this document provides further detailed information requested to assist the assessment of potential impacts to threatened flora MNES protected by the EPBC Act and the TSP Act for the development of the Sassafras – Wesley Vale Irrigation Scheme Augmentation.

A particular emphasis is on the listed MNES listed in RFAI 4 k), l), and m) which pertain to threatened flora species, and RFAI 5 which requests an assessment of all potential impacts on MNES, including direct, indirect, facilitated, and cumulative, and must be assessed in accordance with the *Significant Impact Guidelines 1.1*[143].

4.2.1 Survey Methods

Flora surveys were strategically timed to maximize the opportunity to detect seasonal threatened flora. Nonetheless, due to seasonal variations in detectability and accurate discrimination (*i.e.* identification of closely related species), there may be some herb, orchid and/or graminoid species present on the route that were overlooked due to flowering at times of the year other than when the survey was undertaken; due to lack of visibility, submerged species could also be under-surveyed to some degree. Targeted surveys were however undertaken when this was considered a potentially significant limitation, e.g. the targeted spring flowering flora survey. To further compensate for the potential for values to be overlooked, field data from the present study were supplemented with data and range predictions from the Tasmanian Natural Values Atlas[144] (**Attachment B**) and the EPBC Act Significant Matters Database[145] (**Attachment A**). All threatened plant species known to occur in the local area (5,000 m) are considered in terms of habitat suitability on site

Flora survey effort was concentrated within locations considered as likely threatened species habitat (based on NBES knowledge and NRE habitat descriptions[146]). These included but were not limited to *Caladenia caudata, Caladenia tonellii, Cassinia rugata*, and *Persicaria decipiens*. In addition, locations of previous threatened flora observations within the Project Area (based on NVA observation data) were visited for verification of identification and to establish if the species were still present.

In total, 172 vascular plant species were recorded within the Survey Area (**Appendix C, Appendix D**). Two threatened flora species were recorded during field surveys:

- *Persicaria decipiens* (slender waterpepper) listed as vulnerable under the TSP Act; and
- *Caladenia tonellii* (robust fingers) listed as endangered under the TSP Act and critically endangered under the EPBC Act.

Threatened species previously recorded within the Project Area[147] have been considered for the potential to occur within the Survey Area (**Appendix E**).

4.2.1.1 Threatened Orchid Targeted Survey Methods

Targeted orchid surveys were undertaken for species determined to be likely to occur within the survey area[148]; *Caladenia caudata* and *C. tonellii*. Surveys followed specific guidelines for threatened orchid species[149]. *Caladenia tonellii* is known to occur within 500 m of the Construction Corridor, however there are only 2 unreliable records of *C. caudata* within 500 m of the Construction Corridor[150].

[143] Commonwealth of Australia (2013a)
[144] Department of Natural Resources & Environment (2024a)
[145] Department of Climate Change, Energy, the Environment & Water (2024a)
[146] Threatened Species Section (2024a)
[147] Department of Natural Resources & Environment (2024a)
[148] Department of Climate Change, Energy, the Environment & Water (2024a)
[149] Commonwealth of Australia (2013b)
[150] Department of Natural Resources & Environment (2024a)

Initial desktop and high-level habitat assessment for threatened orchids were undertaken before detailed design work for this project was commenced[151]. As a result, a **superficially suitable potential habitat area** was identified. The **superficially suitable potential habitat area** is potential habitat for a species based on geographical range, proximity to known records, and broad vegetation mapping but without ground-truthing of actual habitat availability or presence of the target species. Consequently, it was recommended that all areas of dry forest within and adjacent to the proposed pipeline corridor between the Mersey River and the Bass Highway be surveyed during the spring flowering season[152]. Targeted surveys were undertaken by a suitably qualified orchid expert (M. Wapstra, ECOtas) during the flowering period of *Caladenia caudata* and *C. tonellii* (flowering known from local type locations) in November 2022. Given the search area and species were known to the botanist (the area had been searched in previous years[153]), known locations and habitat within the superficially suitable potential habitat area were strategically searched and individuals recorded. All areas outside the known location and habitat (particularly the areas recommended as a pipeline realignment adjacent to Devil Road) were searched in a random 'meander' survey method to confirm lack of potential habitat and absence of threatened species. Based on results of the two peak flowering surveys, habitat mapping was undertaken (see below).

A second targeted search for *C. caudata* and *C. tonellii* was undertaken at peak flowering in November 2023 (Table 4) once the pipeline alignment had been designed to avoid the known locations of threatened orchids in the area. Survey effort was concentrated within:

- optimal habitat (outside the natural values assessment pipeline Survey Area) to confirm and refine the population distribution and optimal habitat mapping, and
- the Construction Corridor Survey Area within 200 m of likely optimal habitat (along Devil Road and northern boundary of the Warrawee Conservation Area).

All known threatened orchid microhabitat patches were visited and searched. Where no suitable microhabitat patches were present, random 'meander' survey by 2 people confirmed unsuitability of habitat and absence of these species.

All occurrences of the visibly similar species *Caladenia carnea* were checked to determine the presence of *C. tonellii.*

Surveys in 2021 and 2022 were undertaken by a suitably qualified orchid expert (M. Wapstra, ECOtas). The 2023 survey was undertaken by a suitably qualified orchid expert and suitably qualified botanist (M. Wapstra (ECOtas) and A Williams (NBES) respectively). All surveys were undertaken during peak flowering event for these species (*C. tonellii* flowering checked from local type locations), though it should be noted that *C. caudata* was not known to flower locally at a nearby reference sites during 2023.

Threatened Orchid Habitat Mapping

C. tonellii **optimal habitat** was mapped post ground truthing to encompass known recent records of the species and observed microhabitat preferences. Once the optimal habitat was mapped and confirmed, **potential habitat** area was mapped as a 100 m buffer of the optimal habitat. This is a conservative extension of the optimal habitat in order to capture any potential outliers or stochastic recruitment. The mapping of potential habitat is an acknowledgement that orchid presence may vary year to year, that individual plants may not be recorded at the same location ever year, and that distribution may vary season to season. The potential habitat area is outside the area encompassing optimal habitat requirements for this species but there is potential for an outlying individual to occur.

[151] ECOtas (2022) – **Attachment E**
[152] ECOtas (2022) – **Attachment E**
[153] ECOtas (2022) – **Attachment E,** Department of Natural Resources & Environment (2024a)

After three ground surveys to confirm microhabitat preferences of the species from the known population, superficially suitable potential habitat areas outside the optimal habitat and potential habitat were deemed not potential habitat for this species.

Superficially suitable potential habitat area: potential habitat determined based on geographical range, proximity to known records, and broad vegetation mapping but without ground-truthing the actual habitat availability or presence of the target species within the area. Forms the basis for initial targeted species search effort.

Optimal Habitat: the area encompassing known records and known microhabitat features of the target species. The optimal habitat is the area that it is expected to find plants if they indeed occur, and the search is in a good flowering season occurs.

Potential habitat: a 100 m buffer of the optimal habitat. This is outside the range of the known microhabitat preference and is a conservative habitat extension to capture any potential outliers or stochastic recruitment. **Potential habitat:** a 100 m buffer of the optimal habitat. It is a conservative habitat extension to capture any potential outliers or stochastic recruitment.

4.2.2 EPBC Act listed flora

4.2.2.1 *Caladenia caudata* (tailed spider orchid)

Context

Conservation status

Listed as vulnerable under both the EPBC Act and TSP Act, *Caladenia caudata* is a terrestrial orchid, found mainly in dry heathland as well as grassy and heathy woodland habitats (often with sheoaks)[154]. This species was uplisted to vulnerable under the TSP Act in 2007 as it meets Criterion C of the TSP Act, where the total population is estimated to be fewer than 10,000 mature individuals and and a continuing decline, observed, projected or inferred in numbers of mature individuals, with no subpopulation estimated to contain more than 1,000 mature individuals[155]. This species is also listed as vulnerable under the EPBC Act, however justification for listing is not provided in the SPRAT profile for this species[156].

Ecology

This species belongs to the large-flowered section of the *Caladenia* genus. *Caladenia caudata* reproduces from seed in association with mycorrhizal fungi. The basal leaf appears above the ground in later autumn/early winter following rain[157]. These above-ground parts are susceptible to grazing, drought stress, and fire, however plants can survive beyond an impact event due to the presence of tubers below ground[158].

Plate 27: *Caladenia caudata* recorded near the Hobart Airport (NBES Photo Archive)

Caladenia caudata plants are 8-15 cm tall, with a densely hairy scape, which bears 1 to 4 flowers. The basal leaf is broadly linear, 10-16 cm long and 7-10 mm wide. The flowers are 40-50 mm across, and are usually pinkish to reddish, but can sometimes be paler and fawn[159] (Plate 27) *Caladenia caudata* flowering is enhanced by summer fires, with detectability highest in the years immediately post-fire[160]. Flowering can occur as early as mid-August and be complete by the end of September, however flowering periods is variable across Tasmania, with observed flowering observed commencing in late September in southern Tasmania, and as late as mid to late October and November at northern sites. Detection of this species is most successful when flowers are fully open, which has a duration of 1-2 weeks depending on seasonal and local conditions[161].

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[154] Threatened Species & Marine Section (2014)
[155] Threatened Species & Marine Section (2014)
[156] Department of Climate Change, Energy, the Environment & Water (2024e)
[157] Threatened Species & Marine Section (2014)
[158] Jones *et al.* (1999)
[159] Threatened Species & Marine Section (2014)
[160] Jones (2006)
[161] Threatened Species & Marine Section (2014); Wapstra (2018)

Habitat

Caladenia caudata is often found on sunny, north-facing, highly insolated sites. The species is endemic to Tasmania, where it is widespread but localised in lowland coastal and near-coastal areas of northern, eastern and southeastern Tasmania (Figure 6).

The *Threatened Tasmanian Orchids Flora Recovery Plan*[162] defines habitat critical to the survival of species as specific areas within and beyond a species' current distribution range containing biological and ecological characteristics essential to the continued existence of the species. Therefore, habitat critical to the survival of a particular species includes all areas deemed important to that species' survival or recovery, whether the species currently resides in those areas, historically resided in those areas, or may successfully recruit there in the future. By identifying and providing protection for habitat considered critical to the species' survival, the extinction risk of a species may be significantly reduced.

Population parameters

Caladenia caudata is represented by over 40 subpopulations, but there is very little information available on the size of most subpopulations, and many have not been recorded for several decades[163]. It is thought that the total population of this species in less than 10,000.

According to the listing statement for *Caladenia caudata*[164], the extent of occurrence is estimated to be about 34,800 km^2 with a linear extent of about 363 km. The total area occupied by this species is unlikely to be greater than 6 km^2, which is likely to be an overestimate due to the figure being heavily weighted by the two largest subpopulations of this species. Most sub-populations occupy less than 0.05 km^2.

The SPRAT profile[165] for *Caladenia caudata* does not define what an important population for this species is; however, the *Threatened Tasmanian Orchids Flora Recovery Plan*[166] highlights five priority subpopulations considered critical to the survival of the species (Table 11) and are therefore considered to be important populations. The nearest important population is located at the Henry Somerset Reserve (~1.4 km west of the Great Bend pump station), which is not at risk of any construction or operational impacts.

Distribution and site significance

Caladenia caudata occurs in coastal and near coastal across the central north, northeast, east, and southeast of Tasmania, as well as the Furneaux Group of islands (Figure 6).

According to the NVA[167], there are 2 observation records attributed to within 500 m of the pipeline alignment (one recorded within the Warrawee Conservation Area in 1975 with an accuracy of 500 m, and the other recorded in 1932 with an accuracy of 2000 m) and a further 37 within 5 km, the most recent being in 2022[168]. Within the broader area this species is known primarily from the Henry Somerset Reserve on Railton Road but there are also older sightings from the Warrawee Conservation Area[169], Harford, Latrobe, and Hawley Beach[170].

The Survey Area contains only marginal habitat for this species, with the primary habitat in the Devil Road area a forest on a damp, south facing slope that is unlikely to be suitable for this species. Pockets of dry forest are present within the Survey Area; however, they are largely isolated remnants and are disjunct from known habitat areas.

162 Threatened Species Section (2017)
163 Threatened Species & Marine Section (2014)
164 Threatened Species & Marine Section (2014)
165 Department of Climate Change, Energy, the Environment & Water (2024e)
166 Threatened Species Section (2017)
167 Natural Values Atlas data – as at 11 of September 2024
168 Natural Values Atlas data – as at 11 of September 2024
169 ECOtas (2022) – **Attachment E**
170 Natural Values Atlas data – as at 11 of September 2024

SWIS management actions

This species was briefly discussed in the referral / preliminary documentation process for the SWIS project[171], however it was deemed to not be at risk of any impacts due to the construction or operation of the SWIS. As such, no management actions were required as conditions of approval of the SWIS as a controlled action.

Threats

General threats[172] to *Caladenia caudata* include:

- Land clearing, largely from urban development and agriculture;
- Inappropriate disturbance, including absence / inappropriate fire regimes;
- Road maintenance works which may remove topsoils, eliminating roadside occurrences;
- Weed invasion leading to increase competition and habitat quality reduction;
- Climate change and stochastic risk;
- *Phytophthora cinnamomi*. No subpopulations are currently known to be affected by this pathogen, however increased activity in areas containing a subpopulation has the potential to spread the pathogen, and thus lead to a decrease in habitat quality; and
- Forestry activities. Threatened flora sites are consider during the planning and implementation of forestry operations between the proponent and the Forest Practices Authority.

Specific recovery actions for this species are outlined in the *Threatened Tasmanian Orchids Flora Recovery Plan*[173] and include additional surveys to determine extent and subpopulation size, weed control, provision of suitable fire regime, fencing, management planning and collection of seed and mycorrhizal fungi.

Table 11: Important (priority) population sites for *Caladenia caudata* as defined in the *Threatened Tasmanian Orchids Flora Recovery Plan*[174], with additional data collated from the Natural Values Atlas[175] and listing statement[176]

Priority Population	Last Seen	Estimated Abundance	Estimated Area of Occupancy	Threats	Tenure
Bellingham / Lulworth	2023	50+	Unknown	Subdivision, inappropriate fire regime	Crown land
Waverly Flora Park	2022	145	3 ha	Inappropriate fire regime, weeds	Council
Beechford	2016	200+	400-500 ha	Clearance, grazing	Private
Austins Ferry	2011	80-100	Unknown	Inappropriate fire regime, weeds	Private
Henry Somerset Reserve	2022	1000	75-80 ha	Inappropriate fire regime, weeds	Private Sanctuary

[171] Referral EPBC: 2010 / 5327; Tasmanian Irrigation Development Board (2010)
[172] Threatened Species & Marine Section (2014)
[173] Threatened Species Section (2017)
[174] Threatened Species Section (2017)
[175] Natural Values Atlas data – as at 11 of September 2024
[176] Threatened Species & Marine Section (2014)

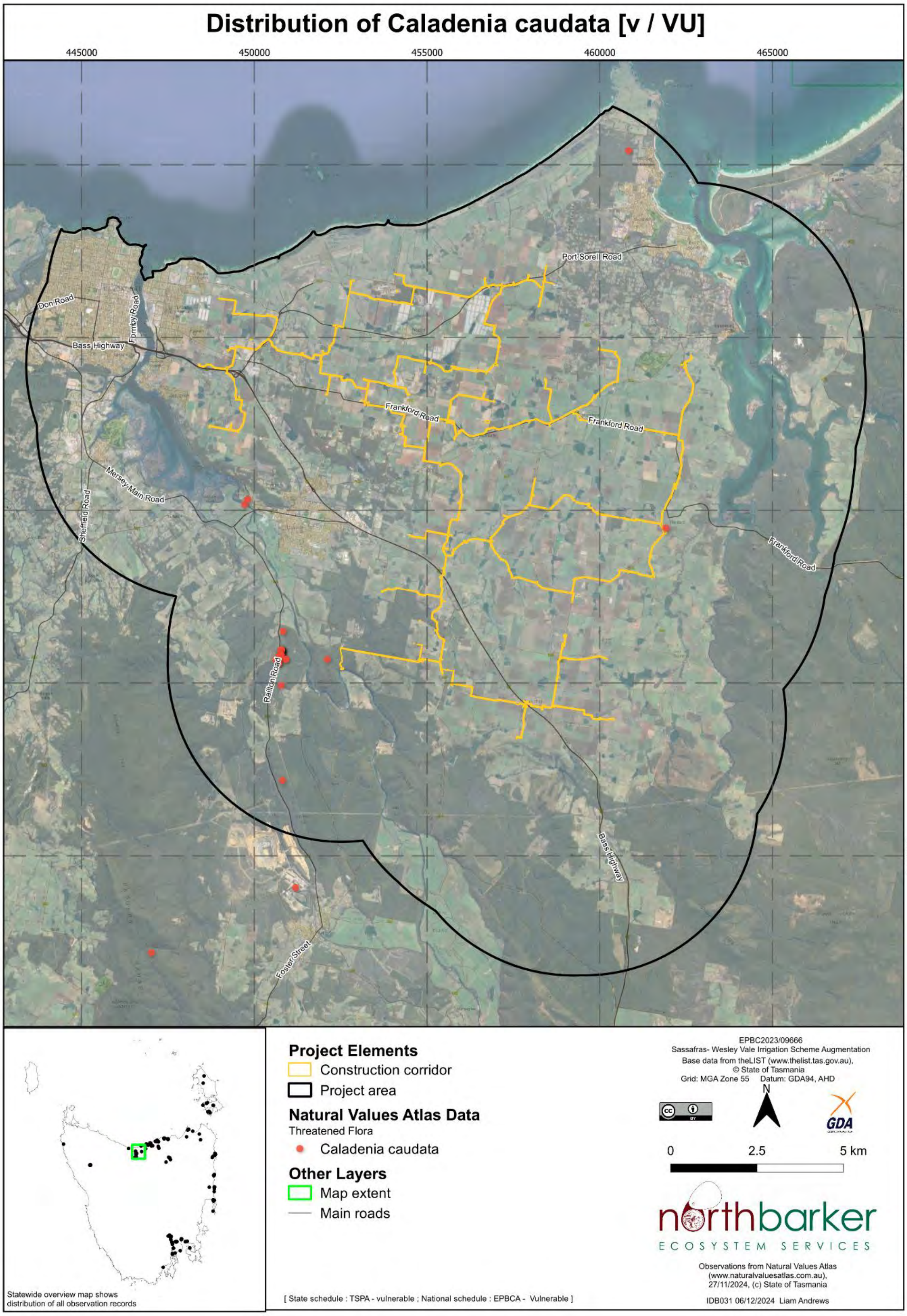

Figure 6: Distribution of *Caladenia caudata* in relation to the Project Area

Survey findings

The initial targeted search for *Caladenia caudata* and *Caladenia tonellii* undertaken in November 2022[177] (Table 4). The survey covered all superficially suitable potential habitat (dry forest) within and adjacent to the proposed pipeline corridor between the Mersey River and the Bass Highway.

No evidence of *C. caudata* was detected from habitat areas known to support *C. tonellii*, nor the in the vicinity of Devil Road (targeted during this survey as a potential alignment alternative to avoid known *C. tonellii* records).

The second targeted search for *C. caudata* and *C. tonellii* undertaken in November also provided no evidence of in the area. Despite related *Caladenia* species *C. carnea* (non-threatened) and *C. tonellii* (threatened), along with several other orchid species, being recorded during these surveys (Figure 8), no *C. caudata* plants were recorded.

As no evidence of *C. caudata* was recorded during any survey during local peak flowering time, optimal and potential habitat cannot be mapped for this species in its own right. However, in this environment it is likely that *C. caudata* shares habitat preferences with *C. tonellii*[178] and as such the combined optimal habitat and potential habitat for *C. tonellii* (Figure 8) can be taken conservatively to represent potential *C. caudata* habitat.

No *C. caudata* plants nor optimal habitat were recorded within the construction corridor, however, the potential habitat area within the Construction Corridor and a 20 m buffer represents the area that should be searched in during the peak flowering season prior to construction to confirm absence.

Impact pathways

Potential impact pathways relevant to the construction of the SWISA include:

- Weed invasion leading to increase competition and habitat quality reduction; and
- *Phytophthora cinnamomi*. Increased activity in areas containing the subpopulation has the potential to spread the pathogen, and thus lead to a decrease in habitat quality;

Potential impact pathways relevant to the operation of the SWISA include:

- Land clearing, largely from urban development and agriculture; and
- Inappropriate disturbance, including absence / inappropriate fire regimes.

Avoidance

All known locations of this species were avoided early in the design phase of the project due to the significant constraints associated with impacting this species. Potential habitat was surveyed twice during the assessment phase (Table 4) to establish presence / absence within the Construction Corridor.

Impacts

Construction

There are no occurrences of this species within the Construction Corridor. Nevertheless pre-clearance mitigation measures, including additional preclearance searches will ensure that the construction phase of the SWISA project will not directly or indirectly impact any unknown occurrence of this species.

Operation

The greatest risk to this species due to the operation of the scheme is from the potential for changes in land use, as well as clearance and conversion of native vegetation to agricultural land. Although no observations of this species were made during field surveys, potential habitat occurs outside of the

[177] ECOtas (2022) – **Attachment E**
[178] M. Wapstra pers comm (2024)

Survey Area and within the broader Project Area. There is a moderate likelihood that this species may occur in a SWISA irrigators land and thus be at risk of operational impacts. With an OEMP and Farm WAPs in place, there will be no impacts to this species due to the operation of the SWISA.

Mitigation measures

Construction

In order to mitigate the risk of impact to this species during construction, the following actions as part of the SWISA CEMP are required in any area where the Construction Corridor is within or immediately adjacent to potential habitat for threatened orchids:

- A pre-clearance search for *C. caudata* and *C. tonellii* will be undertaken:
    - During the peak flowering period (late August to November, noting that flowering times can be variable across the state[179] and may vary between species). Peak flowering should be verified locally before undertaking pre-clearance search and surveys should be undertaken 5 days either side of peak flowering dates.
    - The pre-clearance search area is defined as all potential habitat within the construction corridor plus a 20 m buffer of the construction corridor (Figure 9). The total area of the pre-clearance survey area is 2.68 ha.
    - The whole pre-clearance search area is to be surveyed by a minimum two people walking parallel adjacent transects 5 m apart. Transects are to be walked in both directions and if an occurrence is found, the immediate surrounds will be thoroughly searched.
    - Personnel will include a minimum of one suitable qualified orchid expert and the remainder will be suitably qualified ecologists.
- In the event that this species is recorded during pre-clearance surveys, alternative avenues to avoid impacts must be explored. If it is deemed that impacts cannot be avoided, reconsideration of the potential for significant residual impacts is required, and an application for a permit to take under the TSP Act must be submitted to NRE for consideration.
- Exclusion zone fencing of Construction Corridor to preclude unregulated direct impact to this species. This must be sufficient to prevent vehicle access to areas outside the Construction Corridor but not to limit wildlife movement.
- Exclusion buffer (a minimum 10 m buffer) of any known occurrences of this species within 50 m of the Construction Corridor demarcated with bunting or fencing.
- A scheme-wide weed and hygiene management plan to be embedded within the CEMP. This must include:
    - Pre-treating of woody and herbaceous weeds within the Construction Corridor and buffer area.
    - Strict construction weed, pathogen, and pest hygiene protocols. This will ensure that any weed control measures will not adversely affect the environmental values within e community of the buffer zone.
    - Follow up weed control post construction with Construction Corridor and buffer area.
- Rehabilitation must commence within 30 days of the completion of works (i.e. a staged rehabilitation program throughout the construction phase) to allow for the fastest possible recovery and to minimise disruption to habitat values.

Operation

The provision of Tasmanian Irrigation water does not allow for landowners to conduct unregulated land clearance. All land irrigated with Tasmanian Irrigation water within the SWISA are subject to rigorous assessment through the Farm WAP process and the provisions of an OEMP. The risk of *Caladenia*

[179] Threatened Species & Marine Section (2014); Wapstra (2018)

caudata direct impact and habitat clearance due to Tasmanian Irrigation water will be managed through the Farm WAP process, with measures in place to ensure that this species is adequately protected by applying exclusion areas and applying buffers from particular agricultural activities.

In order to mitigate the risk of impact to this species during operation of the scheme, the following actions as part of the SWISA OEMP for each SWISA irrigator property are required:

- Application of a Farm WAP for each property within the Operational Area
- Property-wide survey of potential habitat and mapping of this species.
- Prohibition of clearance of a MNES threatened species. The provision of Tasmanian Irrigation water does not allow for landowners to conduct unregulated land clearance. Any removal of other threatened flora species must be conducted under a TSP Act permit to take.
- Application of exclusion areas and buffers from particular agricultural activities (chemical and nutrient spray, and activity changing the land use or environment within 50 m of known occurrences of this species). Any future irrigation use must occur outside of a 50 m buffer of known occurrences of this species.
- Targeted weed management within 50 m of a known population and / or occurrence of this species within an Operational Area.

By identifying distribution of this species prior to the commencement of SWISA water application, prescription of buffer and exclusion zones, and through regulation by the Farm WAP process, impacts to this species due to clearance of native vegetation, impacts from invasive species will be mitigated to negligible risk.

If it is determined by the Farm WAP that impacts due to the operation of the SWISA on individual properties are likely to trigger the MNES *Significant Impact Criteria*[180], individual irrigators may need to refer their action independently.

Residual significant impacts

With the above context, survey results, avoidance, impacts, and mitigation, an assessment of the residual impacts as a result of the construction and operation of the SWISA against the significant impact criteria[181] is provided below.

1) Lead to a long-term decrease in the size of an important population.

The SPRAT profile[182] for *Caladenia caudata* does not define what an important population for this species is; however, the *Threatened Tasmanian Orchids Flora Recovery Plan*[183] highlights five priority subpopulations considered critical to the survival of the species and are therefore considered to be important populations. The nearest important population is located at the Henry Somerset Reserve (~1.4 km west of the Great Bend pump station), which is not at risk of any construction or operational impacts.

As all known occurrences of *Caladenia caudata* have been avoided through design, and the known subpopulation occurs within a NC Act managed reserve which will not be impacted by the operation of SWISA. Prior to construction, a targeted survey of the impact area will be conducted during the optimal flowering period (mid-August to November[184]) to further confirm that no impacts to this species will occur, and if present, to guide localised micro-siting to avoid impacts.

[180] Commonwealth of Australia (2013a)
[181] Commonwealth of Australia (2013a)
[182] Department of Climate Change, Energy, the Environment and Water (2024e)
[183] Threatened Species Section (2017)
[184] Threatened Species and Marine Section (2014); Wapstra (2018)

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that this species is located within the SWISA Operational Area.

With the prescribed mitigation measures in place, the construction and operation of SWISA **will not** lead to a long-term decrease in the size of an important population.

2) Reduce the area of occupancy of an important population.

The SPRAT profile[185] for *Caladenia caudata* does not define what an important population for this species is; however, the *Threatened Tasmanian Orchids Flora Recovery Plan*[186] highlights five priority subpopulations considered critical to the survival of the species and are therefore considered to be important populations. The nearest important population is located at the Henry Somerset Reserve (~1.4 km west of the Great Bend pump station), which is not at risk of any construction or operational impacts.

According to the listing statement for *Caladenia caudata*[187], the extent of occurrence is estimated to be about 34,800 km^2 with a linear extent of about 363 km. The total area occupied by this species is unlikely to be greater than 6 km^2, which is likely to be an overestimate due to the figure being heavily weighted by the two largest subpopulations of this species. Most subpopulations occupy less than 0.05 km^2.

As all known occurrences of *Caladenia caudata* have been avoided through design, and the known subpopulation occurs within a NC Act managed reserve which will not be impacted by the operation of SWISA. Prior to construction, a targeted survey of the impact area will be conducted during the optimal flowering period (mid-August to November[188]) to further confirm that no impacts to this species will occur, and if present, to guide localised micro-siting to avoid impacts.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that this species is located within the SWISA Operational Area.

With the prescribed mitigation measures in place, the construction and operation of the SWISA **will not** reduce the area of occupancy of an important population.

3) Fragment an existing important population into two or more populations.

As the construction of the SWISA will not impact upon any population of this species, and any known subpopulations in the vicinity of the works area will be clearly marked as exclusion zones, there will be no direct or indirect impacts to an existing population due to the construction of the SWISA.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that this species is located within the SWISA Operational Area.

With prescribed mitigation measures in place, the proposed construction and operation of the SWISA **will not** fragment an existing important population into two or more populations.

4) Adversely affect habitat critical to the survival of a species.

Habitat critical to the survival of a particular species includes all areas deemed important to that species' survival or recovery, whether the species currently resides in those areas, historically resided in those areas, or may successfully recruit there in the future[189].

[185] Department of Climate Change, Energy, the Environment and Water (2024e)
[186] Threatened Species Section (2017)
[187] Threatened Species and Marine Section (2014)
[188] Threatened Species and Marine Section (2014); Wapstra (2018)
[189] Threatened Species Section (2017)

Habitat for *Caladenia caudata* includes dry heathland as well as grassy and heathy woodland habitats (often with sheoaks)[190]. The species is often found on sunny, north-facing, highly insolated sites. The species is endemic to Tasmania, where it is widespread but localised in lowland coastal and near-coastal areas of northern, eastern and southeastern Tasmania.

The highest quality habitat available in the Survey Area correlates to the *C. tonellii* optimal habitat at Devil Road, however, no records of *C. caudata* were recorded here over three years. Nevertheless, there will be no permanent or temporary impact to this habitat for this species. Furthermore, impacts to suboptimal habitat within the Construction Corridor will be temporary in nature.

The construction and operation of the SWISA **will not** adversely affect habitat critical to the survival of this species.

5) Disrupt the breeding cycle of an important population.

The SPRAT profile[191] for *Caladenia caudata* does not define what an important population for this species is; however, the *Threatened Tasmanian Orchids Flora Recovery Plan*[192] highlights five priority subpopulations considered critical to the survival of the species and are therefore considered to be important populations. The nearest important population is located at the Henry Somerset Reserve (~1.4 km west of the Great Bend pump station), which is not at risk of any construction or operational impacts.

As the proposed action will not impact upon any populations of this species, the proposed construction and operation of the SWISA **will not** disrupt the breeding cycle of an important population of this species.

6) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

The highest quality habitat available in the Survey Area correlates to the *C. tonellii* optimal habitat at Devil Road, however, no records of *C. caudata* were recorded here over three years. Nevertheless, there will be no permanent or temporary impact to this habitat for this species. Furthermore, impacts to suboptimal habitat within the Construction Corridor will be temporary in nature.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that this species is located within the SWISA Operational Area.

Based on this assessment, the construction and operation of the SWISA **will not** modify, destroy, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline.

7) Result in invasive species that are harmful to the species becoming established in the species' habitat.

The introduction of weed species poses a risk to this species. With this potential risk in mind, TI are committed to implementing a project specific weed and hygiene management plan within a CEMP to prevent the introduction of weeds to the landscape and to contain existing infestations. Ongoing monitoring and audits will be a component of this management plan.

With this measure in place, the construction and operation of the SWISA **will not** result in invasive species that are harmful to this species becoming established in the species' habitat.

[190] Threatened Species and Marine Section (2014)
[191] Department of Climate Change, Energy, the Environment and Water (2024e)
[192] Threatened Species Section (2017)

8) Introduce disease that may cause the species to decline.

The construction and operation of the SWISA **will not** introduce disease that may cause the species to decline, noting no diseases are known to be a risk to the species. The implementation of a project specific weed and hygiene management plan is nonetheless a commitment made by TI.

9) Interfere substantially with the recovery of the species.

The recovery plan for this species is part of a recovery plan for all Tasmanian orchids[193]. While the proposed action **will not** interfere with the recovery plan, it has contributed to Strategy 1a and 1b of the plan through conducting extension surveys in habitat assessed as suitable in the vicinity of a previously recorded site (Warrawee Conservation Area).

Summary

With the prescribed mitigation measures in place, our assessment is that the proposed construction and operation of the SWISA **will not** have significant residual impacts on this species.

[193] Threatened Species Section (2017)

4.2.2.2 *Caladenia tonellii* (robust fingers)

Context

Conservation status

Caladenia tonellii (Plate 28) is endemic to Tasmania and is known from a limited number of sites in lowland near-coastal parts of the north coast, extending inland by a few kilometres in the Railton-Latrobe area[194]. *Caladenia tonellii* is listed as endangered under the TSP Act. This is due to meeting criterion B for endangered under the TSP Act as the extent of occurrence is less than 500 km^2 and the area of occupancy is estimated to be less than 10 ha[195]. This species is also listed as critically endangered under the EPBC Act due to:

> The species exists in extremely low numbers (35-45) in three populations, none exceeding 20 mature individuals. The geographic distribution, area of occupancy being 0.25 ha and extent of occurrence, 42 km^2, is precarious for the survival of the species in the face of projected declines due to plantation development, mechanical disturbance, fire regimes, and the vulnerability of small populations to stochastic disturbance events. The species is eligible for listing as critically endangered under Criteria 3 and 4.
>
> **Threatened Species Scientific Committee (2001)**

Ecology

Plants grow singly, or in loose groups. Flowering plants have a single, narrow hairy dark green basal leaf and a thin, wiry stem. *Caladenia tonellii* basal leaves appear above the ground in later autumn/early winter following rain. Flowers are usually white or pink, and a single plant can produce between 1 and 5 flowers. *Caladenia tonellii* is one of the larger-flowered *Caladenia* species (within the small-flowering group of *Caladenia*) and is almost certainly pollinated by insects[196]. *Caladenia tonellii* flowering response to fire is unknown, but its habitat is generally considered to be fire prone, suggesting that it is likely to be tolerant of fire[197].

Plate 28: *Caladenia tonellii* recorded near the existing Great Bend reservoir during the 2023 surveys

The flowering period is late October to early December. Detection of this species is possible prior to anthesis due to its distinctive long leaves and can also be identified after anthesis due to the stature of fertilised plants and the structure of the inflorescence[198].

[194] Threatened Species Section (2010)
[195] Threatened Species Section (2010)
[196] Threatened Species & Marine Section (2014)
[197] Threatened Species Section (2010)
[198] Threatened Species Section (2010); Wapstra (2018)

Habitat

Habitat includes *Eucalyptus amygdalina* dominated forest with a shrubby understorey on shallow clay loam and shallow gravelly loam over clay; topography varies from flats to slopes up to about 80 m elevation[199].

The *Threatened Tasmanian Orchids Flora Recovery Plan*[200] defines habitat critical to the survival of species as specific areas within and beyond a species' current distribution range containing biological and ecological characteristics essential to the continued existence of the species. Therefore, habitat critical to the survival of a particular species includes all areas deemed important to that species' survival or recovery, whether the species currently resides in those areas, historically resided in those areas, or may successfully recruit there in the future. By identifying and providing protection for habitat considered critical to the species' survival, the extinction risk of a species may be significantly reduced.

As this species is listed as critically endangered, all subpopulations are considered critical to the survival of the species (Table 12). The nearest important population is located at the Warrawee Conservation Area (~140 m east of the Devil Road alignment near the Great Bend pump station).

Population parameters

The total population of *Caladenia tonellii* is probably less than 250 mature individuals with most sites represented by very low numbers, although the subpopulation in the Henry Somerset Reserve may support around 100 plants[201] (Table 12).

Distribution and site significance

Caladenia tonellii is endemic to Tasmania and is known from a small number of sites, primarily between Sheffield and Port Sorell, with very small outlying subpopulations along the north coast.

There are 22 observation records on the NVA attributed to within 500 m of the pipeline alignment (last recorded in 2022) and a further 42 within 5 km, the most recent being in 2023[202].

This species is known primarily from the Henry Somerset Reserve on Railton Road but has also recently been confirmed from the Devil Road-Old Deloraine Road area, including from within the existing SWIS pipeline corridor[203]. Distribution of *Caladenia tonellii* records in relation to the Project Area is shown in Figure 7. Pipeline alignments were moved to avoid known locations of this species.

SWIS management actions

This species was briefly discussed in the referral / preliminary documentation process for the SWIS project[204], however it was deemed to not be at risk of any impacts due to the construction or operation of the SWIS. At the time of assessment, the species was only known from the Henry Somerset Reserve, and records near Railton and Port Sorell thought to be spurious records. No management actions were required as conditions of approval of the SWIS as a controlled action.

Threats

Caladenia tonellii occurs in highly localised sites. Because of its localised distribution, stochastic events can lead to extinction. In addition, the small population sizes may lead to inbreeding problems possibly in combination with insufficient maintenance of populations of pollinating insects and associated mycorrhizal fungi[205].

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[199] Threatened Species Section (2017)
[200] Threatened Species Section (2017)
[201] Threatened Species Section (2017)
[202] Natural Values Atlas data – as at 11 of September 2024
[203] ECOtas (2022) – **Attachment E**
[204] Referral EPBC: 2010 / 5327; Tasmanian Irrigation Development Board (2010)
[205] Threatened Species Section (2010)

Other general threats[206] to the species include:

- Land clearing and habitat fragmentation, with particular regard to forestry activity in the vicinity of known subpopulations;
- Forestry activities. Threatened flora sites are consider during the planning and implementation of forestry operations between the proponent and the Forest Practices Authority;
- Inappropriate fire regime, particularly in relation to the frequency, timing, and intensity of fires in potential habitat at known sites;
- Weed invasion leading to increase competition and habitat quality reduction;
- Stochastic events; and
- Climate change.

Specific recovery actions for this species are outlined in the Threatened Tasmanian Orchids Flora Recovery Plan 2017 [207] and include additional surveys to determine subpopulation size and demographic monitoring, weed control, provision of suitable fire regime and management planning.

Table 12: Population summary for *Caladenia tonellii*[208], with additional data collated from the Natural Values Atlas[209]

Priority Population	Last Seen	Estimated Abundance	Estimated Area of Occupancy	Threats	Tenure
Henry Somerset Reserve	2022	100	1-2 ha	Inappropriate fire regime, weeds	Private Sanctuary
Warrawee Conservation Area	2018	50	Unknown	Inappropriate fire regime, weeds	Conservation Area
Great Bend Reservoir	2023	40-50	1-2 ha	Inappropriate fire regime, weeds	Private / Tasmanian Irrigation
Old Deloraine Road	1996	3	Unknown	Inappropriate fire regime, weeds, forestry activity	State Forest
Rubicon Sanctuary	2004	Unknown	Unknown	Inappropriate fire regime, weeds	Conservation Covenant
Appleby Creek	2007	Unknown	Unknown	Inappropriate fire regime, weeds	Private
Badgers Range	2023	>1	Unknown	Inappropriate fire regime, weeds, forestry activity	State Forest
Kate Reed Nature Recreation Area	2017	Unknown	Unknown	Inappropriate fire regime, weeds	Nature Recreation Area
Lake Llewellyn	2000	Unknown	Unknown	Inappropriate fire regime, stochastic risk	National Park
Shanty Road	1998	5	Unknown	Forestry activity	Crown Land

[206] Threatened Species Section (2010)
[207] Threatened Species Section (2017)
[208] Threatened Species & Marine Section (2014)
[209] Natural Values Atlas data – as at 11 of September 2024

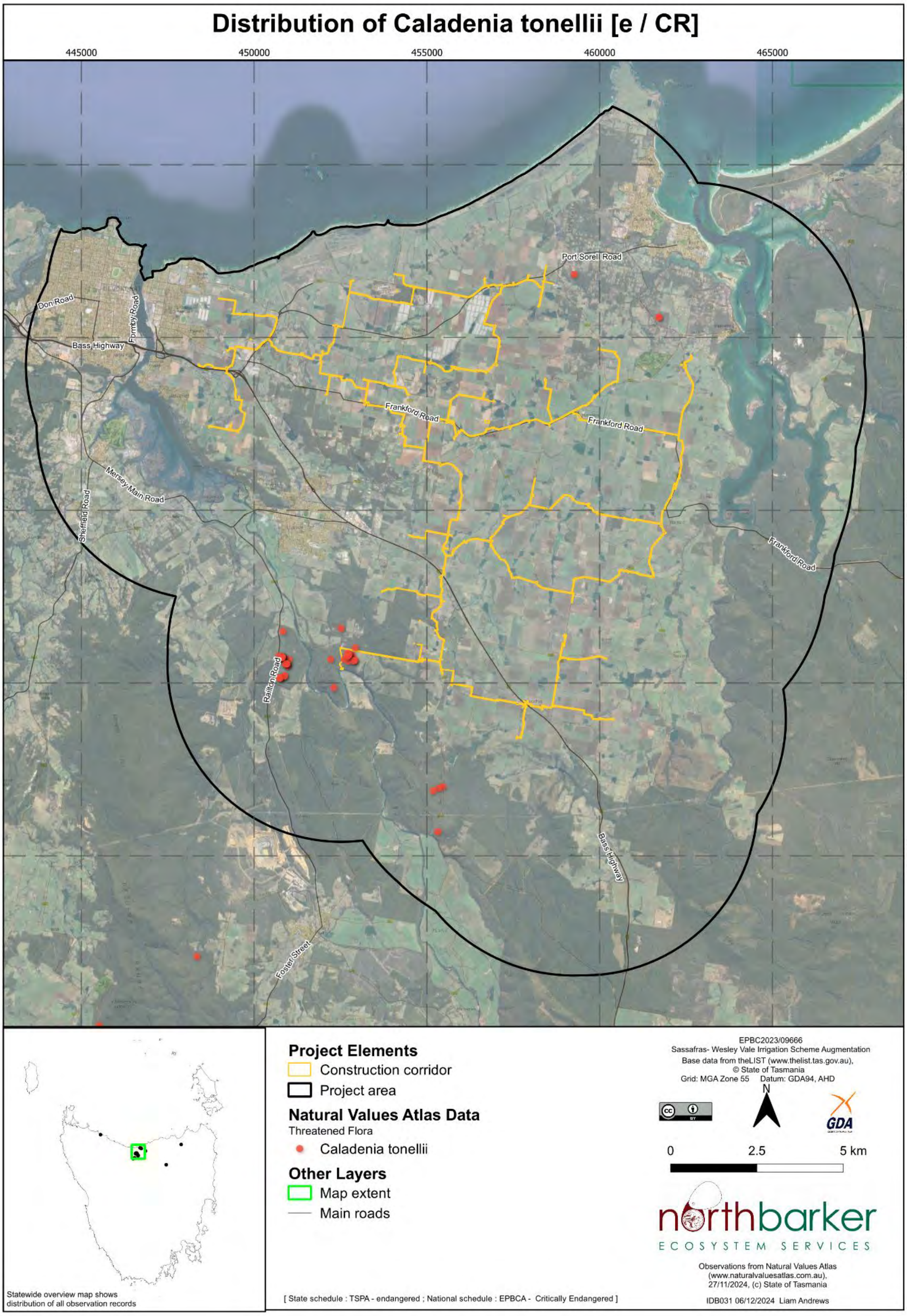


Figure 7: Distribution of *Caladenia tonellii* in relation to the Project Area

Survey findings

A targeted search for *Caladenia tonellii* and *Caladenia caudata* was undertaken during the peak flowering time in November 2022[210] and November 2023 (Table 4). The former covered all superficially suitable potential habitat (dry forest) within and adjacent to the proposed pipeline corridor between the Mersey River and the Bass Highway while the second concentrated on known habitat of *C. tonellii* and the area surrounding the Construction Corridor.

Caladenia tonellii plants were recorded around the existing SWIS pipeline in 2022 and 2023 (Figure 8) in the same area as plants had been recorded in 2021[211]. No plants of this species were recorded within the Construction Corridor nor within 50 m of the Construction Corridor.

During the 2022 surveys, microhabitat preferences of this species were assessed based on observation of individual plant locations, and optimal habitat broadly mapped. The 2023 survey confirmed and refined the population distribution and optimal habitat mapping. Optimal *C. tonellii* habitat has been mapped on the drier upper slope/ top of the hill above the Mersey River (Figure 8). Optimal habitat for this species is described as dry open habitat at the top/high regions of the slope, characterised by an open understory and a high percentage cover of bare ground or leaf litter. Two patches of *Caladenia tonellii* optimal habitat totalling 6.37 ha (5.96 ha + 0.41 ha) were mapped in the vicinity of the Construction Corridor. While 0.45 ha of optimal *C. tonellii* habitat exists within the Construction Project Area (ie, within 50 m of the Construction Corridor), no optimal habitat is within the Construction Corridor.

An extensive area of superficially suitable potential habitat surrounds the mapped *C. tonellii* optimal habitat, and indeed is the same vegetation type: Dry *E. obliqua* forest (DOB) with patches of *E. amygdalina*. However, as the elevation decreases, the understory shrubs and ground cover (particularly *Gahnia grandis* and *Pteridium esculentum*) become increasingly dense and bare ground/ leaf litter cover decreases. This is particularly evident within the Construction Corridor adjacent to Devil Road. These areas have been excluded from *C. tonellii* habitat mapping despite the presence of closely related common species *C. carnea* (Figure 8) in these areas. Habitat partitioning between these two species has been observed within the nearby with Henry Somerset Reserve where *C. carnea* is found throughout the area, including damper and more densely vegetated microhabitats, while *C. tonellii* is found in drier, sparsely vegetated microhabitats higher in the landscape.

A potential habitat area for this species has been mapped as a conservative extension of the optimal habitat in order to capture any potential outliers or stochastic recruitment. It is outside the area encompassing optimal habitat requirements for this species. Moreover, where the Construction Corridor overlaps with this area to the north of the larger patch of optimal habitat (Figure 8), the microhabitat is not suitable for *C. tonellii* as the construction corridor alignment is within a gully with impeded drainage areas and a prevalence of *Gahnia grandis* and a variety of fern species. This gully microhabitat has resulted in the two separate patches of optimal habitat being mapped. Nevertheless, this area has been included in the pre-clearance search area (Mitigation Measures) as a precaution.

Impact pathways

Potential impact pathways relevant to both the construction and operation of the SWISA include:

- Land clearing and habitat fragmentation; and
- Weed invasion leading to increase competition and habitat quality reduction.

[210] ECOtas (2022) – **Attachment E**
[211] Natural Values Atlas data – as at 11 of September 2024

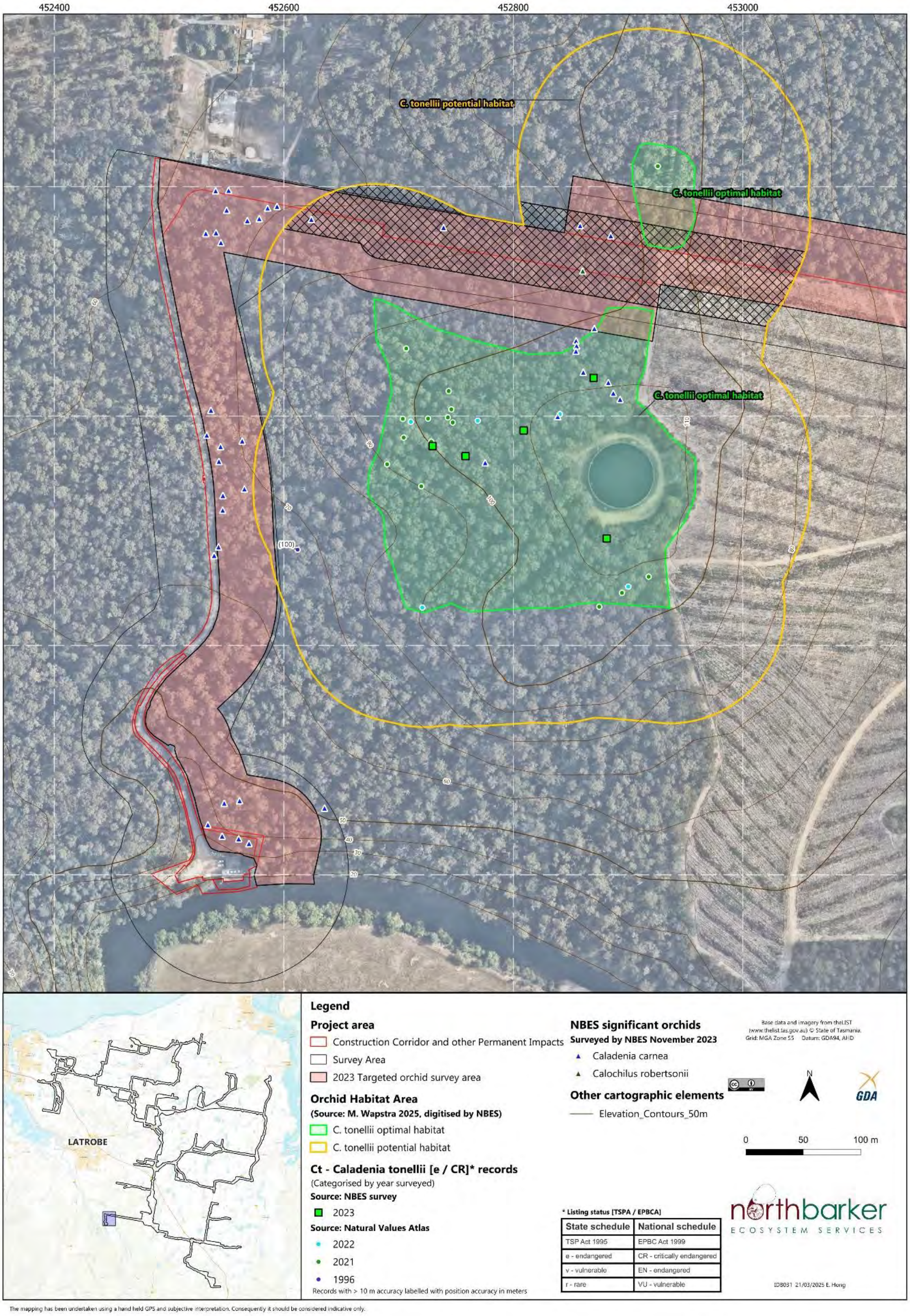


Figure 8: Known records and habitat of *Caladenia tonellii*

Avoidance

All known locations of this species recorded around the existing SWIS pipeline were avoided early in the design phase by realignment of the pipeline adjacent to Devil Road. Potential habitat was surveyed twice during the assessment phase (Table 4) to establish presence/absence within the Construction Corridor. All optimal *C. tonellii* habitat has been avoided through alignment design.

Impacts

Construction

There are no occurrences of this species within Construction Corridor. However, as optimal habitat exists within 50 m of Construction Corridor pre-clearance mitigation measures (including preclearance spring surveys) and adequate buffer zones will ensure that the construction phase of the SWISA project will not directly or indirectly impact this species.

No optimal habitat for *C. tonellii* occurs within the Construction Corridor and therefore there will be no direct impact to habitat for this species. Indirect impact to habitat outside the Construction Corridor will be mitigated by preconstruction requirements.

Any impact to marginal habitat surrounding the optimal *C. tonellii* habitat will be temporary in nature, and in fact disturbance increase habitat value for *C. tonellii* by providing an increase in bare ground and reduction in understorey competition[212]. Disturbance is likely to facilitate orchid germination and may lead to population recruitment as long as the soil mycorrhizal load is retained[212]. Indeed, it should be noted that this species was not known from the Great Bend area at the time of the SWIS assessment[213], and further surveys have since demonstrated that this species colonised disturbed ground that resulted from the construction of the SWIS, thus indicating that the temporary disturbance may provide a similar opportunity for this species.

Operation

The known population of this species within the Project Area is within the Warrawee Conservation Area and is not at risk of any operational impacts. The greatest risk to this species due to the operation of the scheme is from the potential for changes in land use, as well as clearance and conversion of native vegetation to agricultural land. Although no observations of this species were made during field surveys, potential habitat occurs outside of the Survey Area, and within the broader Project Area. There is a low likelihood that this species may occur in a SWISA irrigators land and thus be at risk of operational impacts. With an OEMP and Farm WAPs in place, there will be no impacts to this species due to the operation of the SWISA.

Mitigation measures

Construction

In order to mitigate the risk of impact to this species during construction the following actions as part of the SWISA CEMP are required within the any area where the Construction Corridor is within or immediately adjacent to potential habitat for threatened orchids:

- A pre-clearance search for *C. caudata* and *C. tonellii* will be undertaken:
  - o During the peak flowering period (late October to early December[214], noting that flowering times can be variable across the state and may vary between species). Peak flowering should be verified locally before undertaking pre-clearance search and surveys should be undertaken 5 days either side of peak flowering dates.

[212] M. Wapstra Pers Comm (2024)
[213] Referral EPBC: 2010 / 5327; Tasmanian Irrigation Development Board (2010)
[214] Threatened Species Section (2010); Wapstra (2018)

- The pre-clearance search area is defined as all potential habitat within the construction corridor plus a 20 m buffer of the construction corridor (Figure 9). The total area of the pre-clearance survey area is 2.68 ha.
- The whole pre-clearance search area is to be surveyed by a minimum two people walking parallel adjacent transects 5 m apart. Transects are to be walked in both directions and if an occurrence is found, the immediate surrounds will be thoroughly searched.
- Personnel will include a minimum of one suitable qualified orchid expert and the remainder will be suitably qualified ecologists.

- In the event that this species is recorded during pre-clearance surveys, alternative avenues to avoid impacts must be explored. If it is deemed that impacts cannot be avoided, reconsideration of the potential for significant residual impacts is required.
- Exclusion zone fencing of the Construction Corridor to preclude unregulated direct impact to this species. This must be sufficient to prevent vehicle access to areas outside the Construction Corridor but not to limit wildlife movement.
- The area containing the known population must be buffered by a minimum of 50 m and be clearly demarcated on construction plans and on the ground to avoid any impacts to this population. This must be conducted at the same time as pre-clearance surveys to have confidence of the extent of the population.
- A scheme-wide weed and hygiene management plan to be embedded within the CEMP. This must include:
  - Pre-treating of woody and herbaceous weeds within the Construction Corridor and buffer area.
  - Strict construction weed, pathogen, and pest hygiene protocols. This will ensure that any weed control measures will not adversely affect the environmental values within e community of the buffer zone.
  - Follow up weed control post construction with Construction Corridor and buffer area.
- Additional threats such as fire are to be managed on a case-by-case basis. No works are to be undertaken in the area containing the known population during periods of heightened fire risk.
- Rehabilitation must commence within 30 days of the completion of works (i.e. a staged rehabilitation program throughout the construction phase) to allow for the fastest possible recovery and to minimise disruption to habitat values. Facilitated natural regeneration of any disturbed area within 50 m of optimal *C. tonellii* habitat is recommended to allow threatened orchid species every opportunity to utilise the disturbed open ground. If natural regeneration is at odds with rehabilitation plans required for other purposes, then it is recommended that planting density of shrubs, rushes, and sedges is minimal within areas immediately adjacent to optimal habitat (the area equivalent to the pre-clearance search area).

<u>Operation</u>

The provision of Tasmanian Irrigation water does not allow for landowners to conduct unregulated land clearance. All land irrigated with Tasmanian Irrigation water within the SWISA are subject to rigorous assessment through the Farm WAP process and the provisions of an OEMP. The risk of *Caladenia tonellii* direct impact and habitat clearance due to Tasmanian Irrigation water will be managed through the Farm WAP process, with measures in place to ensure that this species is adequately protected by applying exclusion areas and applying buffers from particular agricultural activities.

In order to mitigate the risk of impact to this species during operation of the scheme, the following actions as part of the SWISA OEMP for each SWISA irrigator property are required:

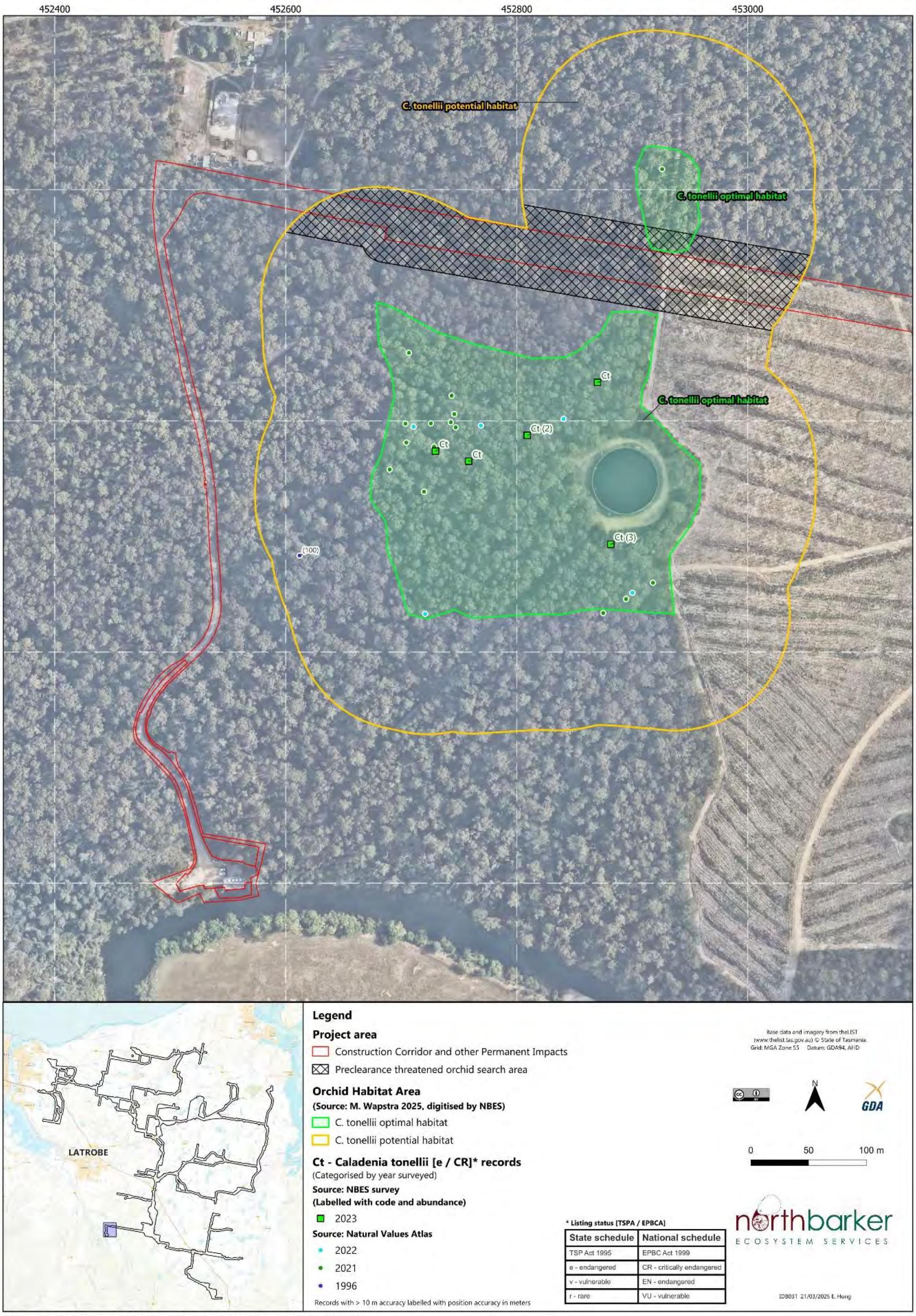
- Application of a Farm WAP for each property within the Operational Area
- Property-wide survey of potential habitat and mapping of this species.

- Prohibition of clearance of a MNES threatened species. The provision of Tasmanian Irrigation water does not allow for landowners to conduct unregulated land clearance. Any removal of other threatened flora species must be conducted under a TSP Act permit to take.
- Application of exclusion areas and buffers from particular agricultural activities (chemical and nutrient spray, and activity changing the land use or environment within 50 m of known occurrences of this species). Any future irrigation use must occur outside of a 50 m buffer of known occurrences of this species.
- Targeted weed management within 50 m of a known populations and / or occurrences of this species within an Operational Area.

By identifying distribution of this species prior to the commencement of SWISA water application, prescription of buffer and exclusion zones, and through regulation by the Farm WAP process, impacts to this species due to clearance of native vegetation, impacts from invasive species will be mitigated to negligible risk.

If it is determined by the Farm WAP that impacts due to the operation of the SWISA on individual properties are likely to trigger the MNES *Significant Impact Criteria*[215], individual irrigators may need to refer their action independently.

[215] Commonwealth of Australia (2013a)



The mapping has been undertaken using a hand held GPS and subjective interpretation. Consequently it should be considered indicative only.

Figure 9: Pre-clearance search area for threatened orchids

Residual significant impacts

With the above context, survey results, avoidance, impacts, and mitigation, an assessment of the residual impacts as a result of the construction and operation of the SWISA against the significant impact criteria[216] is provided below.

1) Lead to a long-term decrease in the size of a population

All known occurrences of *Caladenia tonellii* have been avoided through design, and the known sub-population occurs within a NCA managed reserve which will not be impacted by the operation of SWISA. Prior to construction, a targeted survey of the impact area will be conducted during the optimal flowering period (late October to early December) to eliminate further risk of impacts to unknown occurrences of this species.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that this species is located within the SWISA Operational Area.

With the prescribed mitigation measures in place, the construction and operation of SWISA **will not** lead to a long-term decrease in the size of a population.

2) Reduce the area of occupancy of the species

According to the listing advice for *Caladenia tonellii*[217], the extent of occurrence is estimated to be about 42 km^2. The total area occupied by this species is ~0.25 ha. At the time of listing, this species was known from only 30 locations; however, further surveys have established additional, small subpopulations, with the total population likely to be fewer than 250 individuals[218] .

There will be no permanent or temporary impact to any known individuals or optimal habitat for this species. Impacts to suboptimal habitat within the Construction Corridor that is adjacent to optimal habitat will be temporary in nature and there is potential for vegetation clearance and ground disturbance followed by strategic revegetation to elevate suboptimal habitat to optimal habitat for this species, at least in the short term. It should also be noted that this species was not known from the Great Bend area at the time of the SWIS assessment[219], and further surveys have since demonstrated that this species colonised disturbed ground that resulted from the construction of the SWIS, thus indicating that the temporary disturbance may provide a similar opportunity for this species.

With pre-clearance surveys in place, the risk of reducing a known area of occupancy will be eliminated through either confirming that a subpopulation will not be impacted, or through implementing further controls to ensure a population is not impacted.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that this species is located within the SWISA Operational Area.

With the prescribed mitigation measures in place, the construction and operation of the SWISA **will not** reduce the area of occupancy of a population.

3) Fragment an existing population into two or more populations

As the construction of the SWISA will not impact upon any population of this species, and any known subpopulations in the vicinity of the works area will be clearly marked as exclusion zones, there will be

[216] Commonwealth of Australia (2013a)
[217] Threatened Species Scientific Committee (2001)
[218] Threatened Species Section (2010)
[219] Referral EPBC: 2010 / 5327; Tasmanian Irrigation Development Board (2010)

no direct or indirect impacts to an existing population due to the construction of the SWISA, thus there is no chance of fragmenting an existing population.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that this species is located within the SWISA Operational Area.

With the prescribed mitigation measures in place, the proposed construction and operation of the SWISA **will not** fragment an existing population into two or more populations.

4) Adversely affect habitat critical to the survival of a species

There is no published definition of critical habitat for this species, however the Tasmanian threatened species listing statement defines habitat as *Eucalyptus amygdalina* dominated forest with a shrubby understorey on shallow clay loam and shallow gravelly loam over clay; topography varying from flats to slopes up to about 80 m elevation[220]. It should be noted that this definition of suitable habitat is widespread throughout northern and eastern Tasmania (with *E. amygdalina* dominated forest covering ~64,000 ha in the northern slopes bioregion alone[221]), and habitat critical to survival of *Caladenia tonellii* is likely to be only a very small subset of this broader extent of habitat, with niche habitat requirements poorly understood. Based on the extent of potential habitat and an apparent wide distribution in northern Tasmania, the discovery of additional subpopulations seems likely[222].

Optimal habitat for this species was mapped based specifically on observed microhabitat preferences of *C. tonellii* recorded during spring surveys. Microhabitat preference assessment and habitat mapping was refined over the course of three seasons for the subpopulation within the vicinity of the SWISA Construction Project Area. This is the habitat that is deemed critical to the survival of the species.

The total impact area to vegetation that could conceivably provide suitable habitat for this species is a maximum of 4.71 ha, of which 4.65 ha will be rehabilitated post-construction. Further to this, 93.18 % of the forested vegetation that has been verified within the Survey Area that could support this species will be avoided during construction. It should also be noted that this species was not known from the Great Bend area at the time of the SWIS assessment[223], and further surveys have since demonstrated that this species colonised disturbed ground that resulted from the construction of the SWIS, thus indicating that the temporary disturbance may provide a similar opportunity for this species.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that this species is located within the SWISA Operational Area.

With the prescribed mitigation measures in place, the proposed construction and operation of the SWISA **will not** affect habitat critical to the survival of this species.

5) Disrupt the breeding cycle of a population

As the construction of the SWISA will not impact upon any population of this species, and any known subpopulations in the vicinity of the works area will be clearly marked as exclusion zones, there will be no direct or indirect impacts to an existing population due to the construction of the SWISA.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that this species is located within the SWISA Operational Area.

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[220] Threatened Species Section (2017)
[221] Department of Primary Industries, Parks, Water & Environment (2021a)
[222] Threatened Species Section (2010)
[223] Referral EPBC: 2010 / 5327; Tasmanian Irrigation Development Board (2010)

Thus, with the prescribed mitigation measure in place, the proposed construction and operation of the SWISA **will not** disrupt the breeding cycle of a population.

6) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

There will be no permanent or temporary impact to any known individuals or optimal habitat for this species. Impacts to suboptimal habitat within the Construction Corridor that is adjacent to optimal habitat will be temporary in nature and there is potential for vegetation clearance and ground disturbance followed by strategic revegetation to elevate suboptimal habitat to optimal habitat for this species, at least in the short term. It should also be noted that this species was not known from the Great Bend area at the time of the SWIS assessment[224], and further surveys have since demonstrated that this species colonised disturbed ground that resulted from the construction of the SWIS, thus indicating that the temporary disturbance may provide a similar opportunity for this species.

With pre-clearance surveys and protocols in place, the risk of unanticipated impact to habitat will be eliminated through either confirming that a subpopulation (and thus habitat) will not be impacted, or through implementing further controls to ensure a population is not impacted.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that this species is located within the SWISA Operational Area.

Based on this assessment, the construction and operation of the SWISA **will not** modify, destroy, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline.

7) Result in invasive species that are harmful to the species becoming established in the species' habitat

The introduction of weed species poses a risk to this species. With this potential risk in mind, TI are committed to implementing a project specific weed and hygiene management plan within the CEMP to prevent the introduction of weeds to the landscape and to contain existing infestations. Ongoing monitoring and audits will be a component of this management plan.

With this measure in place, the construction and operation of the SWISA **will not** result in invasive species that are harmful to this species becoming established in the species' habitat.

8) Introduce disease that may cause the species to decline

The construction and operation of the SWISA **will not** conceivably introduce disease that may cause the species to decline, noting no diseases are known to be a risk to the species. The implementation of a project specific weed and hygiene management plan is nonetheless a commitment made by TI.

9) Interfere with the recovery of the species

The recovery plan for this species is part of a recovery plan for all Tasmanian orchids[225]. While the proposed action **will not** interfere with the recovery plan, it has contributed to Strategy 1a and 1b of the plan through conducting extension surveys in habitat assessed as suitable in the vicinity of a previously recorded site.

Summary

The construction and operation of the SWISA **will not** have a significant residual impact on *Caladenia tonellii* – robust fingers.

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[224] Referral EPBC: 2010 / 5327; Tasmanian Irrigation Development Board (2010)
[225] Threatened Species Section (2017)

4.2.2.3 *Cassinia rugata* (wrinkled dollybush)

Context

Conservation status

Cassinia rugata is listed as endangered under the TSP Act. This is due to meeting criterion B for endangered under the TSP Act as the extent of occurrence is less than 500 km^2 and the area of occupancy is estimated to be less than 10 ha[226]. It is also listed as vulnerable under the EPBC Act due to the limited extent of occurrence and area of occupancy, small population size, and the high level of fragmentation of subpopulations[227].

Ecology

Cassinia rugata is a perennial spreading to erect shrub growing to about 3 m tall. It is densely multi-branched from the base. Young twigs are weakly sticky and have a dense covering of both cottony and bristly hairs. The leaves are 6-25 mm long and 2-4 mm wide, however they are sometimes narrower due to the rolled leaf margins. The inflorescence is 3-12 cm in diameter and supports 20-200 (300) flowerheads (Plate 29) which are 4.2-5 mm long[228].

Plate 29: *Cassinia rugata* (not recorded in Survey Area). Source: Ben Zeeman 27/02/2022, Atlas of Living Australia

The main flowering period for this species is between February and April[229]. Identification to species level is maximised during this period as the florets required for identification are present during this time. *Cassinia rugata* could be confused with *Cassinia aculeata*[230]; however, the habitat requirements and flowering times differ between the two species[231].

Habitat

In mainland subpopulations, *Cassinia rugata* is found in damp, low open forest or dense heathy scrub and is restricted to near coastal areas[232]. The Tasmanian subpopulation is found in open sedgy and/or shrubby wetlands associated with *Themeda triandra*, rarely with over-topping shrubs or trees[233]. However, ECOtas[234] notes that the species can also occur in disturbed road verges (**Attachment E**).

Population parameters

The Tasmanian subpopulation was discovered in 2010 on a remnant wetland that was purchased in 2003 to conserve its natural values. Approximately 300 plants were recorded on this property. Informal searches in the broader area identified a further six patches, supporting very small numbers. The linear extent of the subpopulation is approximately 1.3 km, and the extent of occurrence is estimated at less

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226 Threatened Species Section (2011)
227 Threatened Species Scientific Committee (2016a)
228 Threatened Species Section (2011)
229 Carter & Walsh (2006)
230 Collier (2010)
231 Threatened Species Section (2011)
232 Carter & Walsh (2006)
233 Threatened Species Section (2011)
234 ECOtas (2022)

than 10 ha. The area of occupancy therefore is nested within this extent of occurrence, covering an area of approximately 0.35 ha[235].

Distribution and site significance

This species is known from two key regions on the mainland, near Portland in Victoria, and near Mount Gambier in South Australia[236]. A population of this species was only recognised as occurring in Tasmania in 2010 and is only known from the Parkers Ford Road / Squeaking Point Road area near Port Sorell[237]; however, an extant subpopulation of unknown size was recorded by renowned botanist Leonard Rodway near Cape Portland in the late 1800's / early 1900's[238]. This subpopulation has not been seen since; however, suitable habitat remains in the area[239].

The species has 22 observation records on the NVA attributed to within 500 m of the pipeline alignment (last recorded 2014) and a further 715 records within 5 km, the most recent being in 2020[240], at the Rubicon Sanctuary. No records are associated with the currently proposed pipeline route. Distribution of *Cassinia rugata* records in relation to the project area is shown in Figure 10.

SWIS management actions

This species was not discussed in the referral / preliminary documentation process for the SWIS project[241]. As such, no management actions were required as conditions of approval of the SWIS as a controlled action.

Threats

Cassinia rugata is threatened by numerous factors[242] such as:

- Habitat loss, largely due to conversion of low-lying land for agriculture and urban development;
- Fragmentation and degradation;
- Weed invasion, which may lead to increased competition and habitat quality reduction;
- Inappropriate fire regime, noting that the known subpopulation has been regularly burnt and lack of fire can lead to the emergence of larger shrubs or trees which may cause decline in the species;
- Roadworks such as grading, slashing and weed control activities may further threaten subpopulations through a combination of the above threatening process.
- Altered landscape hydrology, particularly through drying out of sites through drainage, damming, or irrigation;
- Stochastic risk; and
- Climate change.

The recovery plan for this species was prepared in 2006 prior to the species being discovered in Tasmania and thus only relates to the Victorian range of the species[243]. The main objective for the management of *Cassinia rugata* in Tasmania is to increase the number of known subpopulations through increased survey and to ensure that all subpopulations do not decline by protecting and managing habitat. An improved understanding of factors needed to promote recruitment may be required[244].

[235] Threatened Species Section (2011)
[236] Threatened Species Scientific Committee (2016a)
[237] Threatened Species Section (2011)
[238] Threatened Species Scientific Committee (2016a)
[239] Threatened Species Section (2011)
[240] Natural Values Atlas data – as at 11 of September 2024
[241] Referral EPBC: 2010 / 5327; Tasmanian Irrigation Development Board (2010)
[242] Threatened Species Scientific Committee (2016a)
[243] Carter & Walsh (2006)
[244] Threatened Species Section (2011)

A recent translocation program by the Tasmanian Land Conservancy[245] at the Rubicon Sanctuary (Parkers Ford Road subpopulation) commenced with the aim of translocating germinated seedlings to other areas of the property and providing protective mechanisms to prevent browsing to increase the population size and distribution across this property. This is in addition to a translocation of 26 seedlings at the same location in 2014. The success of this program will be monitored to determine its effectiveness and whether it can be implemented elsewhere.

Survey findings

High level constraints surveys within the Project Area by ECOtas in 2022 (**Attachment E**) failed to record this species from targeted roadside sites within its known range. Examination of topographic maps and aerial imagery, combined with the drive-through assessment, suggests limited potential habitat for the species will be present within the Project Area. This was confirmed within the Survey Area by NBES during surveys in February 2023 which noted limited potential habitat and failed to locate any individuals within areas of remnant native vegetation in the Survey Area.

Impact pathways

Potential impact pathways relevant to the construction of the SWISA include:

- Habitat loss, largely due to conversion of low-lying land for agriculture; and
- Weed invasion leading to increase competition and habitat quality reduction.

Potential impact pathways relevant to the operation of the SWISA include:

- Habitat loss, largely due to conversion of low-lying land for agriculture;
- Weed invasion leading to increase competition and habitat quality reduction; and
- Altered landscape hydrology, particularly through drying out of sites through drainage, damming, or irrigation.

Avoidance

All known locations of this species were avoided early in the design phase of the project due to the significant constraints associated with impacting this species. Potential habitat was surveyed twice during the assessment phase (Table 4) to establish presence/absence within the Construction Corridor.

Impacts

<u>Construction</u>

No occurrences of this species have been recorded within the Construction Corridor, and it is considered highly unlikely to have been overlooked during field surveys. The construction of the SWISA will not have a direct or indirect impact on this species.

<u>Operation</u>

The greatest risk to this species due to the operation of the scheme is from the potential for changes in land use, as well as clearance and conversion of native vegetation to agricultural land. Although no observations of this species were made during field surveys, potential habitat occurs outside of the Survey Area, and within the broader Project Area. There is a low likelihood that this species may occur in a SWISA irrigators land and thus be at risk of operational impacts. With an OEMP and Farm WAPs in place, there will be no impacts to this species due to the operation of the SWISA.

[245] Tasmanian Land Conservancy (2024)

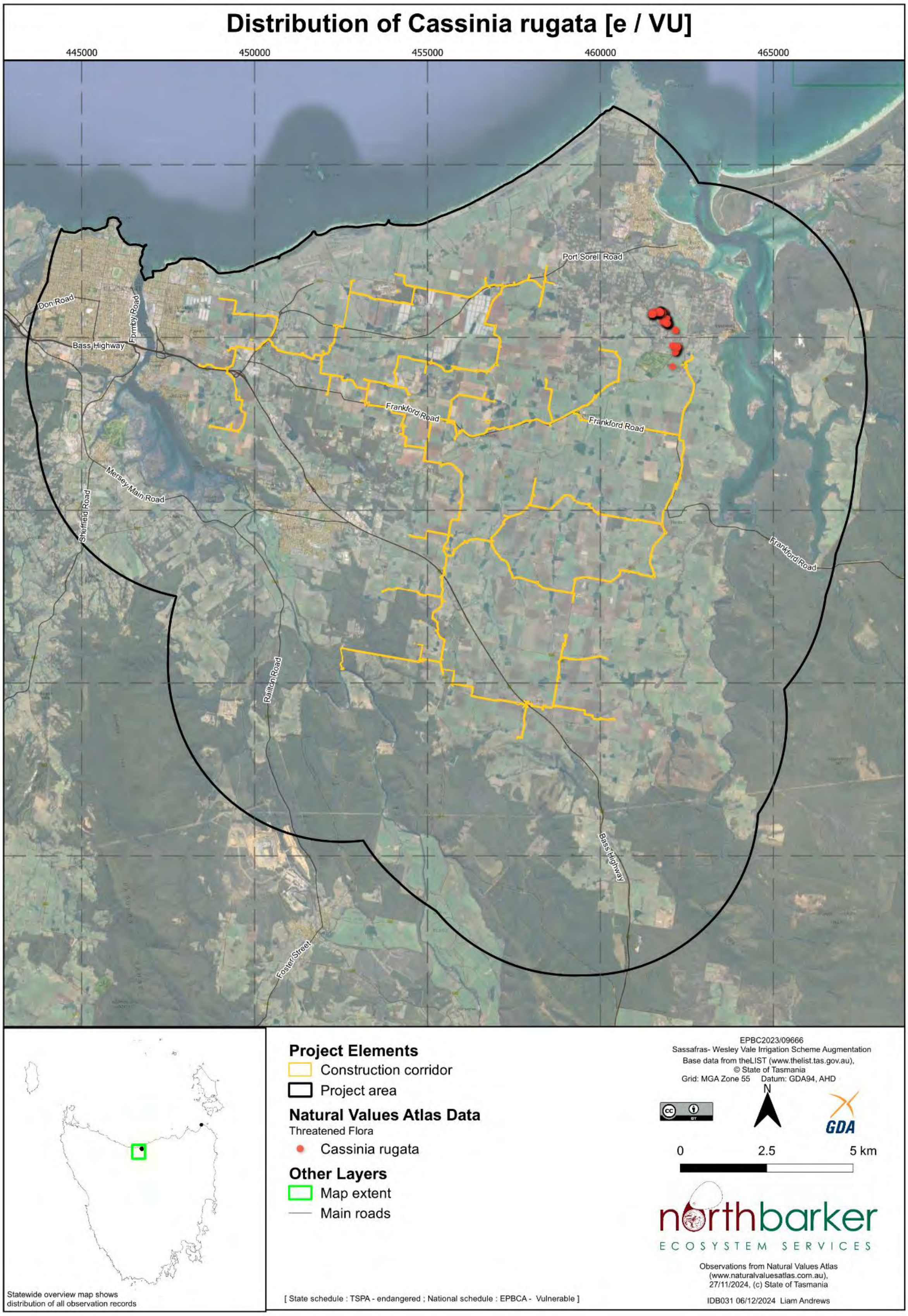

Figure 10: Distribution of *Cassinia rugata* in relation to the Project Area

Mitigation measures

Construction

In order to mitigate the risk of impact to this species during construction the following actions as part of the SWISA CEMP are required:

- A scheme-wide weed and hygiene management plan to be embedded within the CEMP. This must include:
    - Pre-treating of woody and herbaceous weeds within the Construction Corridor and buffer area.
    - Strict construction weed, pathogen, and pest hygiene protocols. This will ensure that any weed control measures will not adversely affect the environmental values within e community of the buffer zone.
    - Follow up weed control post construction with Construction Corridor and buffer area.

Operation

The provision of Tasmanian Irrigation water does not allow for landowners to conduct unregulated land clearance. All land irrigated with Tasmanian Irrigation water within the SWISA are subject to rigorous assessment through the Farm WAP process and the provisions of an OEMP. The risk of *Caladenia tonellii* direct impact and habitat clearance due to Tasmanian Irrigation water will be managed through the Farm WAP process, with measures in place to ensure that this species is adequately protected by applying exclusion areas and applying buffers from particular agricultural activities.

In order to mitigate the risk of impact to this species during operation of the scheme, the following actions as part of the SWISA OEMP for each SWISA irrigator property are required:

- Application of a Farm WAP for each property within the Operational Area
- Property-wide survey of potential habitat and mapping of this species.
- Prohibition of clearance of a MNES threatened species. The provision of Tasmanian Irrigation water does not allow for landowners to conduct unregulated land clearance. Any removal of other threatened flora species must be conducted under a TSP Act permit to take.
- Application of exclusion areas and buffers from particular agricultural activities (chemical and nutrient spray, and activity changing the land use or environment within 50 m of known occurrences of this species). Any future irrigation use must occur outside of a 50 m buffer of known occurrences of this species.
- Targeted weed management within 50 m of a known populations and / or occurrences of this species within an Operational Area.

By identifying distribution of this species prior to the commencement of SWISA water application, prescription of buffer and exclusion zones, and through regulation by the Farm WAP process, impacts to this species due to clearance of native vegetation, impacts from invasive species will be mitigated to negligible risk.

If it is determined by the Farm WAP that impacts due to the operation of the SWISA on individual properties are likely to trigger the MNES *Significant Impact Criteria*[246], individual irrigators may need to refer their action independently.

[246] Commonwealth of Australia (2013a)

Residual significant impacts

With the above context, survey results, avoidance, impacts, and mitigation, an assessment of the residual impacts as a result of the construction and operation of the SWISA against the significant impact criteria[247] is provided below.

1) Lead to a long-term decrease in the size of an important population

The relevant regulatory documentation for *Cassina rugata* does not define what an important population for this species is; however, given the highly fragmented and low number of subpopulations, we are a treating each subpopulation as an important population.

All known occurrences of *Cassinia rugata* have been avoided through design, and the largest known sub-population occurs within a conservation covenant which will not be impacted by the operation of the SWISA. Pre-construction surveys are not required for this species as there are no occurrences, nor potential habitat present within the Construction Corridor. Weed and hygiene management measures must be implemented across the entire Construction Corridor to prevent competition for available habitat.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that this species is located within the SWISA Operational Area.

With the prescribed mitigation measures in place, the construction and operation of SWISA **will not** lead to a long-term decrease in the size of an important population.

2) Reduce the area of occupancy of an important population

The relevant regulatory documentation for *Cassina rugata* does not define what an important population for this species is; however, given the highly fragmented and low number of subpopulations, we are a treating each subpopulation as an important population.

The linear extent of the subpopulation is approximately 1.3 km, and the extent of occurrence is estimated at less than 10 ha. The area of occupancy therefore is nested within this extent of occurrence, covering an area of approximately 0.35 ha[248].

As the construction of the SWISA will not impact upon any population of this species, and any known subpopulations in the vicinity of the works area will be clearly marked as exclusion zones, there will be no direct or indirect impacts to an existing population due to the construction of the SWISA.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that this species is located within the SWISA Operational Area.

With the prescribed mitigation measures in place, the construction and operation of the SWISA **will not** reduce the area of occupancy of an important population.

3) Fragment an existing important population into two or more populations

As the construction of the SWISA will not impact upon any population of this species, and any known subpopulations in the vicinity of the works area will be clearly marked as exclusion zones, there will be no direct or indirect impacts to an existing population due to the construction of the SWISA.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that this species is located within the SWISA Operational Area.

[247] Commonwealth of Australia (2013a)
[248] Threatened Species Section (2011)

With the prescribed mitigation measures in place, the proposed construction and operation of the SWISA **will not** fragment an existing population into two or more populations.

4) Adversely affect habitat critical to the survival of a species

There are no published definitions of critical habitat for this species; however, the Tasmanian subpopulation is found in open sedgy and/or shrubby wetlands associated with *Themeda triandra*, rarely with over-topping shrubs or trees, as well as a small number of road verges containing these habitat elements[249].

There will be no impact to any known subpopulations, nor potential habitat for the species.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that this species is located within the SWISA Operational Area.

With the prescribed mitigation measures in place, the proposed construction and operation of the SWISA **will not** affect habitat critical to the survival of this species.

5) Disrupt the breeding cycle of an important population

As the construction of the SWISA will not impact upon any population of this species, and any known subpopulations in the vicinity of the works area will be clearly marked as exclusion zones, there will be no direct or indirect impacts to an existing population due to the construction of the SWISA.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that this species is located within the SWISA Operational Area.

Thus, with the prescribed mitigation measure in place, the proposed construction and operation of the SWISA **will not** disrupt the breeding cycle of a population.

6) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

All impacts to viable habitat for this species will be remediated post-construction, as per the recommendations in **Section 4.1.1**.

With this measure in place, the proposed construction and operation of the SWISA **will not** modify, destroy, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline.

7) Result in invasive species that are harmful to the species becoming established in the species' habitat

The introduction of weed species poses a risk to this species. With this potential risk in mind, TI are committed to implementing a project specific weed and hygiene management plan within a CEMP to prevent the introduction of weeds to the landscape and to contain existing infestations. Ongoing monitoring and audits will be a component of this management plan.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for targeted weed treatment in the event that this species is located within the SWISA Operational Area in order to protect any newly discovered subpopulations.

With these measures in place, the construction and operation of the SWISA **will not** result in invasive species that are harmful to this species becoming established in the species' habitat.

[249] Threatened Species Section (2011); ECOtas (2022)

8) Introduce disease that may cause the species to decline

The construction and operation of the SWISA **will not** conceivably introduce disease that may cause the species to decline, noting no diseases are known to be a risk to the species. The implementation of a project specific weed and hygiene management plan is nonetheless a commitment made by TI.

9) Interfere substantially with the recovery of the species

The overall objective of the recovery plan[250] for *Cassinia rugata* is to minimise the probability of extinction and increase the probability of important populations becoming self-sustaining. The construction and operation of the SWISA **will not** interfere with any specific objectives of this recovery plan.

Summary

The construction and operation of the SWISA **will not** have a significant residual impact on *Cassinia rugata* – wrinkled dollybush.

4.2.2.4 Other listed flora MNES

An additional 17 MNES flora species are either known to occur within 500 m or 5 km of the Project Area or are predicted to occur based on potential habitat availability[251]. These species are discussed in further detail, with justification of the significance of impacts addressed, in **Attachment C**.

- *Barbarea australis* - native wintercress
- *Caladenia pallida* – rosy spider orchid
- *Epacris virgata* – pretty heath
- *Glycine latrobeana* – clover glycine
- *Lepidium hyssopifolium* – basalt peppercress
- *Leucochrysum albicans* subsp. *tricolor* – hoary sunray
- *Paraprasophyllum apoxychilum* – tapered leek orchid
- *Paraprasophyllum limnetes* – marsh leek orchid
- *Paraprasophyllum pulchellum* – pretty leek orchid
- *Paraprasophyllum robustum* – robust leek orchid
- *Pterostylis ziegeleri* – grassland greenhood
- *Senecio psilocarpus* – swamp fireweed
- *Spyridium obcordatum* – creeping dusty miller
- *Thelymitra jonesii* – sky blue sun orchid
- *Xanthorrhoea arenaria* – sand grasstree
- *Xanthorrhoea bracteata* – shiny grasstree
- *Xerochrysum palustre* – swamp everlasting

[250] Carter & Walsh (2006)
[251] Department of Climate Change, Energy, the Environment & Water (2024a)

4.2.3 TSP Act listed flora

4.2.3.1 *Persicaria decipiens*

Context

Persicaria decipiens (slender waterpepper) is an annual or perennial herb with sparingly branched slender stems that grow up to 60 cm long. The species is listed as vulnerable under the TSP Act and is not listed under the EPBC Act. This species is found all throughout the Australian mainland and New Zealand. In Tasmania, *Persicaria decipiens* is most frequent in the north of the State, where it occurs on the banks of rivers and streams, as well as colonising farm dams[252]. Flowers are required to confirm the identity and aid detection of this species which may die back in winter. Flowering is predominantly from December to April with most herbarium specimens collected from November to May.

The species has 40 observation records on the NVA attributed to within 500 m of the pipeline alignment and a further 43 within 5 km, the most recent being in 2019[253]. This species was recorded at a number of locations in the Survey Area (refer to survey findings below).

Survey findings

This species was recorded at numerous locations throughout the Survey Area through agricultural land (**Maps 1-2, 4-9, 16-18, 22, 26-27, 29-30, 32, 36-37, 39, 42, 49, and 54 of Attachment D**). It was found in wet to damp sites including margins of dams and creeks, drainage ditches, damp paddocks, and ephemeral soaks. The number of plants recorded at each location ranged from a single plant to forming carpets of interminable number of plants (Plate 30). Therefore, this species was recorded by area. A total of 4,642 m^2 was recorded during surveys, with 2.993 m^2 within the Survey Area.

Abundance and the number of occurrences were significantly greater than for the same general area in 2009[254] consistent with a statewide increase in the number of reported occurrences since the threatened flora note sheet for this species was published in 2003. There is widespread recognition that the status of the species warrants review (downlist to rare or even delist)[255]. EcoTAS (2022) notes that the species should be treated as a widespread and locally abundant species that thrives in disturbed habitats such as roadside and paddock ditches, as well as more naturally poorly-drained sites (**Attachment E**).

Plate 30: Abundant *Persicaria decipiens* in a slow moving stream within agricultural land

[252] Threatened Species Section (2024b)
[253] Natural Values Atlas data – as at 11 of September 2024
[254] ECOtas (2022)
[255] ECOtas (2022)

Avoidance

Due to the widespread distribution across the Project Area, complete avoidance of this species was not possible, however pipeline alignments have been moved to reduce the level of impact to this species. A total of 4,227 m^2 of this species has been avoided.

Mitigation measures

Construction

In order to mitigate the risk of impact to this species during construction the following actions as part of the SWISA CEMP are required:

- The Construction Corridor must be narrowed to the smallest extent possible to minimise the area of impact to this species. All areas outside of the impact area must be clearly demarcated on construction plans and on the ground to avoid additional impacts.
- All impacted occurrences of this species are rehabilitated with tube stock of *Persicaria decipiens* from locally sourced seed to offset the impact to this species.
- All impacts to *Persicaria decipiens* must be removed under a Tasmanian TSP Act permit to take. The definition of 'take' encompasses actions that kill, injure, catch, damage, destroy and/or collect threatened species or vegetation elements that support threatened species.

Operation

The provision of Tasmanian Irrigation water does not allow for landowners to conduct unregulated land clearance. All land irrigated with Tasmanian Irrigation water within the SWISA are subject to rigorous assessment through the Farm WAP process and the provisions of an OEMP. The risk of *Caladenia tonellii* direct impact and habitat clearance due to Tasmanian Irrigation water will be managed through the Farm WAP process, with measures in place to ensure that this species is adequately protected by applying exclusion areas and applying buffers from particular agricultural activities. As this species is known to colonise farm dams and agricultural waterways, the application of buffers to known occurrences is not a practical solution for the operation of the SWISA.

In order to mitigate the risk of impact to this species during operation of the scheme, the following actions as part of the SWISA OEMP for each SWISA irrigator property are required:

- Application of a Farm WAP for each property within the Operational Area
- Property-wide survey of potential habitat and mapping of this species.
- All known occurrences must be protected from further clearance though the application of direct impact exclusion zones, unless conducted under the relevant TSP Act permits.
- Application of exclusion areas and buffers from particular agricultural activities (chemical and nutrient spray, and activity changing the land use or environment within 10 m of known occurrences of this species).

Impacts

Construction

The proposed Construction Corridor will impact on 415 m^2 of *Persicaria decipiens*, with an avoidance area of 4,227 m^2. Given the distribution and extent of recorded occurrences within the Project Area, it is possible that this species is much more widespread across the region.

Operation

The greatest risk to this species due to the operation of the scheme is from the potential for changes in land use, as well as clearance and conversion of native vegetation to agricultural land. Although no observation of this species were made during field surveys, potential habitat occurs outside of the Survey Area, and within the broader Project Area. There is a low likelihood that this species may occur in a SWISA irrigators land and thus be at risk of operational impacts. With an OEMP and Farm WAPs in place, there will be no impacts to this species due to the operation of the SWISA.

4.2.3.2 Other TSP Act listed flora

This section details other threatened flora species that are known to occur within 500 m of the pipeline alignment[256]. Note that none of these species were recorded during field assessments for this project. Specific habitat requirements, local context, and assessment of the likelihood of occurrence for these species is given in the subsections below. An additional 43 species are known to occur within the Project Area[257]. These species have been considered, however given the highly modified landscape, are considered highly unlikely to occur. These species are listed and discussed in **Appendix E**.

Brunonia australis

Brunonia australis (blue pincushion) is listed as rare under the TSP Act. In Tasmania, the species typically occurs in grassy woodlands and dry sclerophyll forests dominated by *Eucalyptus amygdalina* or less commonly *E. viminalis* or *E. obliqua*. Some smaller populations are found in heathy and shrubby dry forests. The species occurs on well-drained flats and gentle slopes with elevations of between 10 m and 350 m. It is most commonly found on sandy and gravelly alluvial soils with a particular preference for ironstone gravels. Populations found on dolerite are usually small[258].

The species has 5 observation records on the NVA attributed to within 500 m of the pipeline alignment and a further 18 within 5 km, the most recent being in 2021[259].

Suitable habitat for this species occurs within forest patches throughout the Survey Area, and to a lesser extent the Construction Corridor; however, this is a highly distinctive species when in flower and is unlikely to be overlooked unless restricted in extent, very low in abundance, and/or suppressed by grazing/mowing during our assessments.

Specific mitigation measures are not warranted for this species.

Caladenia congesta

Caladenia congesta (blacktongue finger-orchid) is listed as endangered under the TSP Act. It is a small herb, found mainly in dry heathland and heathy woodland habitats in lowland areas of the northern half of Tasmania[260].

The species has 2 observation records on the NVA attributed to within 500 m of the pipeline alignment and a further 35 within 5 km, the most recent being in 2014[261].

There is a very low likelihood of this species occurring in the Construction Corridor due to the limited presence of undisturbed heathy or open forest vegetation.

Specific mitigation measures are not warranted for this species.

Corunastylis nuda

Corunastylis nuda (tiny midge-orchid) is listed as rare under the TSP Act. The species occurs in a wide range of habitats including scrub, subalpine grassland, heathy open forest, open rock plates among forest, shrubby dry sclerophyll forest and open wet sclerophyll forest, from near sea level to 1,000 m elevation on a range of different soil types and parent geologies[262].

[256] Natural Values Atlas data – as at 11 of September 2024
[257] Natural Values Atlas data – as at 11 of September 2024
[258] Threatened Species Section (2024c)
[259] Natural Values Atlas data – as at 11 of September 2024
[260] Threatened Species Section (2024d)
[261] Natural Values Atlas data – as at 11 of September 2024
[262] Threatened Species Section (2024e)

The species has 3 observation records on the NVA attributed to within 500 m of the pipeline alignment and a further 5 records within 5 km, the most recent being in 2023[263].

The most recent record of this species within 500 m of the Survey Area is from 1986. Although this species has a wide range of suitable habitat, surveys were undertaken at peak flowering time. If plants were not flowering at the time of survey, they could have been overlooked. There remains a very low likelihood of this species occurring within the Survey Area.

Specific mitigation measures are not warranted for this species.

Gratiola pubescens

Gratiola pubescens (hairy brooklime) is listed as rare under the TSP Act. In Tasmania the species is most commonly located in permanently or seasonally damp or swampy ground, including the margins of farm dams[264].

The species has 1 observation record on the NVA attributed to within 500 m of the pipeline alignment and a further 99 records attributed to within 5 km, the most recent being in 2016[265] at the Rubicon Sanctuary. This species has been recorded from three locations within 5 km of the pipeline alignment since 2000. Suitable habitat for this species is present throughout the Construction Corridor. The survey was undertaken at peak flowering time however no plants were recorded during surveys. There remains a low likelihood of this species occurring within the survey area.

Specific mitigation measures are not warranted for this species.

Gynatrix pulchella

Gynatrix pulchella (fragrant hempbush) is listed as rare under the TSP Act. In Tasmania, the species occurs as a riparian shrub, found along rivers and drainage channels predominantly in the north of the State[266]. Recruitment occurs after gap-forming disturbance. Flood events have proven to aid seed dispersal through disturbance and a subsequent increase in openness[267].

The species has 3 observation records on the NVA attributed to within 500 m of the pipeline alignment and a further 50 records within 5 km, the most recent being in 2018[268].

This species is known from the larger creeks and Mersey River within the Project Area. There is limited habitat within the Construction Corridor. This is a tall shrub/ tree 2-5 m tall and is unlikely to have been overlooked during the surveys. Thus, there is a no chance of this species occurring within the Construction Corridor.

Lythrum salicaria

Lythrum salicaria (purple loosestrife) is listed as vulnerable under the TSP Act. In Tasmania, the species inhabits swamps, stream banks and rivers mainly in the north and north-east of the State. It can also occur between gaps in *Melaleuca ericifolia* forest. This species can act as a weed, proliferating along roadsides and other disturbed areas, and, as horticultural strains are in cultivation and birds can disperse seed, some occurrences may not be native[269].

The species has 2 observation records on the NVA attributed to within 500 m of the pipeline alignment and a further 76 records within 5 km, the most recent being in 2023[270].

[263] Natural Values Atlas data – as at 11 of September 2024
[264] Threatened Species Section (2024f)
[265] Natural Values Atlas data – as at 11 of September 2024
[266] Threatened Species Section (2024g)
[267] Threatened Species Section (2016)
[268] Natural Values Atlas data – as at 11 of September 2024
[269] Threatened Species Section (2024h)
[270] Natural Values Atlas data – as at 11 of September 2024

The closest records of this species are 300 m from the Construction Corridor on the Panatana Rivulet, recorded in 2007/2008. While there is suitable within the Construction Corridor, this species is conspicuous when flowering and is unlikely to have been missed during the February 2023 field survey. Thus, there is a no chance of this species occurring within the Construction Corridor.

Pimelea curviflora var. *gracilis*

Pimelea curviflora var. *gracilis* (slender curved riceflower) is listed as rare under the TSP Act. In Tasmania, the species now predominantly occurs in the north of the State in wet sclerophyll forest, especially in disturbed areas[271].

The species has 2 observation records on the NVA attributed to within 500 m of the project area and a further 9 records attributed to within 5 km, the most recent being in 2020[272] by NBES near the Valley Road soccer complex in Devonport.

This species occurs in a variety of habitats, including modified lands. There is limited habitat for this species within the Construction Corridor. This is a distinctive species and is unlikely to have been overlooked. Thus, there is a no chance of this species occurring within the Construction Corridor.

Solanum opacum

Solanum opacum (greenberry nightshade) is listed as endangered under the TSP Act. It is a sprawling annual or short-lived herb, predominantly associated with poorly-drained swamp forests and riparian areas. The species is known from 9 sites across northern Tasmania and the Bass Strait islands with historical land clearing likely contributing to its very disjunct distribution[273].

The species has 2 observation records on the NVA attributed to within 500 m of the pipeline alignment, the most recent being in 1932[274]. No other occurrences of this species are known from within 5 km of the pipeline alignment

Of the 7 records of this species within 50 km of the Project Area, only one of these was recorded in the past 50 years (recorded in 1980). All other records are >90 years old. While this species is short lived, there is limited habitat availability within the Survey Area. There is a very low likelihood of this species occurring within the Construction Corridor.

Specific mitigation measures are not warranted for this species.

[271] Threatened Species Section (2024i)
[272] Natural Values Atlas data – as at 11 of September 2024
[273] Threatened Species Section (2012a)
[274] Natural Values Atlas data – as at 11 of September 2024

4.3 Conservation Significant Fauna

The following subsection of this document provides further detailed information requested to assist the assessment of potential impacts to threatened fauna MNES protected by the EPBC Act and the TSP Act for the development of the Sassafras – Wesley Vale Irrigation Scheme Augmentation.

A particular emphasis is on the listed MNES listed in RFAI 4 b) to j) which pertain to threatened fauna species, and RFAI 5 which requests an assessment of all potential impacts on MNES, including direct, indirect, facilitated, and cumulative, and must be assessed in accordance with the *Significant Impact Guidelines 1.1*[275]. Additional information specific to the Tasmanian wedge-tailed eagle, spotted-tail quoll, eastern quoll, and the Tasmanian devil is provided to satisfy RFAI j) to m).

4.3.1 EPBC Act listed fauna

4.3.1.1 Threatened dasyurids

Context

Eastern quoll (*Dasyurus viverrinus*)

Conservation status

The eastern quoll is listed under the EPBC Act as nationally endangered, and not listed under the TSP Act. No recovery plan has been developed for the species. The species EPBC Act listing relates to inferred decline of the surviving Tasmanian population, exceeding 50 % since 1990[276].

> The species has undergone a severe reduction in numbers over the past 10 years, equivalent to at least 50 % and the reduction has not ceased, the cause has not ceased and is not fully understood. Numbers are also projected to decline by more than 50 % in the future due to declining habitat suitability and ongoing threats. Therefore, the species has been demonstrated to have met the relevant elements of Criterion 1 to make it eligible for listing as Endangered.
>
> **Threatened Species Scientific Committee (2015)**

Ecology

Eastern quolls are nocturnal, carnivorous marsupials weighing between 850-1,250 g (females and males respectively). They are opportunistic carnivores, consuming both live and scavenged prey, with invertebrates comprising a large part of the species diet. Eastern quolls are relatively solitary, although they are not territorial. Home ranges for this species are upwards of 35 to 44 ha (females and males respectively), with an extensive amount of overlap between individuals[277]. Dens are made in underground burrows, under rocks or within fallen logs.

Breeding is highly synchronised, occurring in May-June with litters up to six joeys. Young emerge from dens in November-December, resulting in a large increase in population abundance and dispersal activity over summer. Juvenile mortality is high, and typical adult longevity is around 2 – 3 years in the wild[278].

[275] Commonwealth of Australia (2013a)
[276] Fancourt *et al.* (2013)
[277] Threatened Species Scientific Committee (2015)
[278] Godsell (1983)

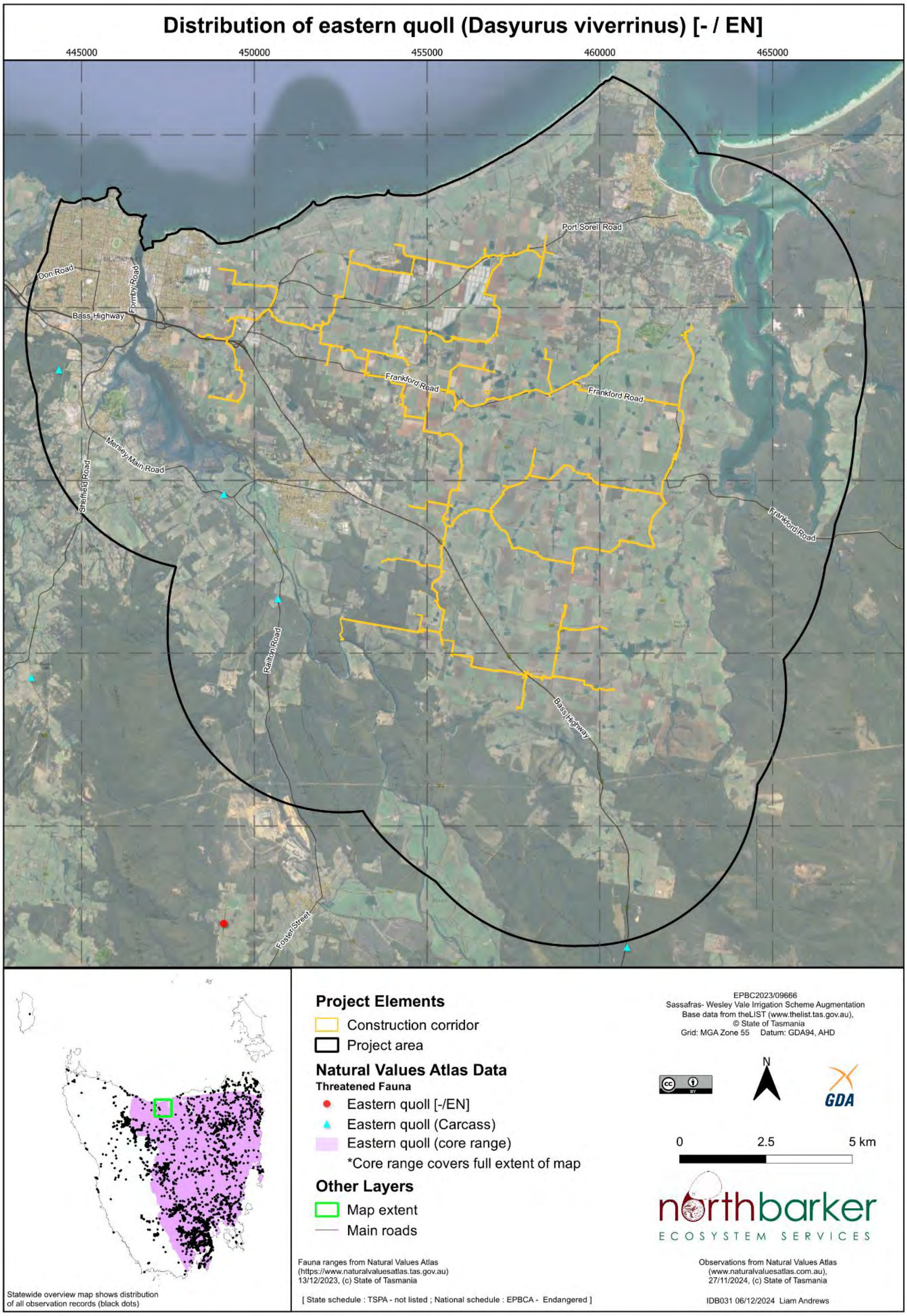

Figure 11: Distribution of the eastern quoll in relation to the Project Area

Habitat

The species is found in a range of vegetation types including open grassland (including farmland), tussock grassland, grassy woodland, dry eucalypt forest, coastal scrub, and alpine heathland, but is typically absent from large tracts of wet eucalypt forest and rainforest[279]. The species' distribution is associated with areas of low rainfall and cold winter minimum temperatures.

Population parameters

The current population size is unknown, though the species has continued to decline since listing in 2015[280]. The cause for the decline is not fully understood; however, the EPBC Act Scientific Advisory Committee refers to a correlation of the decline with successive mild wet winters between 2001 and 2003, followed by very limited recovery in the population since[281]. As an endangered species, all populations are seen as important, although some areas might be considered as the primary strongholds for the species (e.g., Cradoc and North Bruny Island)[282].

The conservation advice for this species[283] estimates the extent of occurrence is between 41,629 km^2 and 47,000 km^2, and the area of occupancy is estimated to be between 2,300 km^2 and 2,556 km^2.

Distribution and site significance

Eastern quolls are widespread in Tasmania but recorded less frequently in the wettest third of the state. Currently, eastern quolls are most abundant in the south-east and north-east of the state, and they are present throughout the north and central regions. They are occasionally observed in low densities in open habitat in the west[284].

The species has no observation records on the NVA attributed to within 500 m of the pipeline alignment and only 3 records within the Project Area, the most recent being two roadkill records in 2022[285]. Distribution of eastern quoll records in relation to the Project Area is shown in Figure 11. Records of the species are sparse in the central-north, although eastern quolls do occupy mosaic woodland and farmland throughout their range[286]. Given the size and span of the corridor there is a chance this species may occur on occasion, therefore presence and activity were assessed through fauna surveys.

SWIS management actions

This species was not discussed in the referral / preliminary documentation process for the SWIS project[287]. As such, no management actions were required as conditions of approval of the SWIS as a controlled action.

Threats

The eastern quoll is an MNES species, however, it is not currently listed on the Tasmanian TSP Act, and no recovery plan has been developed for this species. Conservation advice specific to eastern quolls has been prepared by the Threatened Species Scientific Committee and lists the following as threats to the species[288]:

- Predation by introduced predators (cats, foxes and dogs). Juveniles are particularly vulnerable;

[279] Godsell (1983)
[280] Cunningham *et al.* (2022)
[281] Threatened Species Scientific Committee (2015); Fancourt (2016)
[282] Threatened Species Scientific Committee (2015)
[283] Threatened Species Scientific Committee (2015); Woinarski *et al.* (2014); Fancourt *et al.* (2015)
[284] Fancourt *et al.* (2015)
[285] Natural Values Atlas data – as at 11 of September 2024
[286] Fancourt *et al.* (2015)
[287] Referral EPBC: 2010 / 5327; Tasmanian Irrigation Development Board (2010)
[288] Fancourt (2016); Cunningham *et al.* (2022); Commonwealth of Australia (2013a)

- Disease was likely a major factor in eastern quolls extinction on the mainland[289], and continues to pose a major threat to quoll populations in Tasmania;
- Climate change. Increased frequency and severity of extreme weather events may increase the rate of population decline, and changes in temperature and frequency and severity of extreme rainfall events may reduce the amount of available habitat[290];
- Non-target poisoning (rodent poison and 1080). Eastern quolls are a low risk of mortality due to 1080 baiting[291], however secondary poisoning through rodenticides present a larger threat to eastern quolls[292]; and
- Vehicle collision mortality.

Changes in predator population biology, resulting from decline in Tasmanian devil populations, and subsequent behavioural change in feral cat behaviour (increased nocturnal activity plus likely increase in population size) has been proposed as being a likely factor affecting the eastern quolls population recovery[293]. Furthermore, as an EPBC Act listed endangered species, reductions in habitat quality and availability, long-term decreases in population size or disruptions to breeding in important populations are considered significant impacts to the species[294].

Spotted-tail quoll (*Dasyurus maculatus maculatus*)

Conservation status

The Tasmanian subspecies *Dasyurus maculatus maculatus*, is listed as vulnerable under the EPBC Act and as rare under the TSP Act. There is no approved conservation advice for the subspecies, however there is a national recovery plan[295]. This species is listed under the EPBC Act due to the low population size and ecological limitations for population recovery after decline.

> Population size estimates[296] have been estimated at <10,000, which falls under the threshold for listing as vulnerable for criterion 3 of the listing assessment, the spotted-tail quoll has intrinsic biological and ecological traits that render it particularly susceptible to threatening processes. These include large area requirements, female territoriality, low population density, short life span, and low lifetime fecundity[297]. These traits mean that the spotted-tail quoll has a limited ability to rapidly recover from population declines or to colonise, or recolonise, suitable habitat
>
> **Threatened Species Section (2023a)**

Ecology

The spotted-tail quoll is a medium-sized carnivorous marsupial found in forest habitats in south-eastern mainland Australia and Tasmania. They are generally solitary with home ranges that vary typically between 100 ha and 5,000 ha. Females tend to have smaller, exclusive ranges with male ranges overlapping several female ranges[298].

Average size is between 2.6-4.6 kg for males and 1.5-2.2 kg for females. The species is a primarily nocturnal hunter and feeds on a range of terrestrial and arboreal prey including mammals, birds, reptiles

[289] Fancourt *et al.* (2015)
[290] Fancourt *et al.* (2015)
[291] Threatened Species Scientific Committee (2015)
[292] Fancourt *et al.* (2015)
[293] Fancourt (2016)
[294] Commonwealth of Australia (2013a)
[295] Department of Environment, Land, Water & Planning (2016)
[296] Jones & Rose (1996); Troy (2014)
[297] Jones *et al.* (2003)
[298] Long & Nelson (2010)

and invertebrates. Carrion comprises a larger part of the diet in areas when Tasmanian devils have declined[299].

Habitat

Spotted-tail quolls are predominantly a forest dependent species, though they are also known to persist within fragmented and agricultural areas. Presence is correlated with availability of suitable denning habitat, prey availability and structural connectivity of matrix habitat[300]. Quolls utilise multiple dens within their home ranges, denning in rock crevices, hollow logs and trees, underground burrows and dense vegetation such as sedges. Habitat critical to the survival of the species includes large patches of forest with adequate denning resources and relatively high densities of medium-sized mammalian prey, however thresholds have not been defined[301].

Population parameters

The subspecies *Dasyurus maculatus maculatus*, is restricted to Tasmania. The species has an estimated population size of ~5,700 individuals in Tasmania as of 2016[302].

The listing statement for this species[303] estimates the extent of occurrence is 75,696 km^2, and the area of occupancy is estimated to be 4,536 km^2.

The National Recovery Plan[304] identifies important populations for the spotted-tail quoll in Tasmania (Figure 12, Table 13). Key sites for the spotted-tail quoll in Tasmania according to the Tasmanian Threatened Fauna Handbook[305] include:

- Northern forested areas bounded by Wynyard, Gladstone, and the central and north-eastern highlands;
- The north-western wet forests; including the catchments of the Arthur and Montagu Rivers;
- The dry eucalypt forests in the central north coastal regions bounded by the Tamar, Devonport, and Western Tiers;
- Patches between the King River and Strahan, the Gordon River and Huon River Catchments as well as the coastal strip from Strahan to Temma.

The Project Area falls within the central north Tasmanian population, designated in the *National Recovery Plan for Spotted-tail Quolls*[306] as an important stronghold and research population[307].

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[299] Cunningham *et al.* (2018)
[300] Troy (2014): Henderson *et al.* (2023)
[301] Department of Environment, Land, Water & Planning (2016)
[302] Threatened Species Section (2023a)
[303] Threatened Species Section (2023a)
[304] Threatened Species Section (2023a)
[305] Bryant & Jackson (1999)
[306] Department of Environment, Land, Water & Planning (2016)
[307] Threatened Species Section (2023a)

Table 13: Important populations of spotted-tail quolls identified in the National Recovery Plan

Population	Basis for 'importance' classification
Freycinet National Park	Research Population
Central-north Tasmania (including Great Western Tiers to Narawntapu)	Stronghold and Research Population
Cradle Mountain National Park	Stronghold and Research Population
Far north-western Tasmania (including the Smithton and Marrawah regions)	Stronghold and Research Population
Eastern Tiers/northern Midlands (including Nugent and Ross regions)	Stronghold Population
Southern forests/South Coast (including the Hastings region)	Stronghold Population
Gordon River system	Stronghold Population
South-west Cape	Stronghold Population

Distribution and site significance

Spotted-tail quolls are widely, but sparsely distributed across the state[308], with predictable rainfall, prey densities and denning availability predicting their range[309]. The north and north-west regions report a relatively high abundance of spotted-tail quolls, though they are found in suitable habitat across the state.

Figure 12 presents a composite map of the likely areas occupied by the above definitions of key sites and important populations, used here to indicate the core range of this species, in relation to the location of the Project Area. The species has 2 observation records on the NVA attributed to within 500 m of the pipeline and a further 160 records within the Project Area, the most recent being in 2023 [310]. Seventeen of these occurrences are attributed to roadkill. Figure 13 displays the distribution of spotted-tail quoll records listed on the NVA in relation to the Project Area.

SWIS management actions

This species was discussed in the referral / preliminary documentation process for the SWIS project[311], however it was deemed to not be at risk of any impacts due to the construction or operation of the SWIS with mitigation measures in place. The development of Farm WAPs was the only management action that was required as a condition of approval of the SWIS as a controlled action.

Threats

The *National Recovery Plan for Spotted-tail Quolls*[312] list the major threatening processes as follows:

- Habitat loss and modification due to urban and agricultural development, conversion of forest to pasture or plantation, and road construction, and activities that remove or prey or habitat features;
- Population fragmentation;
- Human persecution, largely due to quolls preying upon free ranging domestic poultry, ducks, and small pets;

[308] Threatened Species Section (2023a)
[309] Troy (2014)
[310] Natural Values Atlas data – as at 11 of September 2024
[311] Referral EPBC: 2010 / 5327; Tasmanian Irrigation Development Board (2010)
[312] Department of Environment, Land, Water & Planning (2016)

- Non-target poisoning (rodent poison and 1080). Spotted-tail quolls are a low risk of mortality due to 1080 baiting[313], however secondary poisoning through rodenticides present a larger threat[314].
- Competition and predation from other predators (devils, foxes and cats). Spotted-tail quolls live sympatrically with Tasmanian devils[315], and the presence of feral cats throughout the landscape do not appear to have contributed to declines at the population scale; however juvenile quolls may be susceptible to predation[316]; and
- Vehicle collision mortality due to collision with vehicles while scavenging carcasses of other roadkill fauna.

Habitat loss and modification is a major threatening process for the spotted-tail quoll in Tasmania[317]. Large home ranges, generally solitary behaviour and low population densities predispose the species to be affected by loss and fragmentation of habitat through land conversion. Poisoning and fox predation are not likely to be relevant for the Tasmanian subpopulation.

Presence of spotted-tail quolls within agricultural mosaics and some selectively logged forests indicate the species is tolerant of some habitat disturbance and fragmentation[318], although suitability is associated with presence of prey and denning habitat. Changes that remove habitat features or reduce vertebrate prey abundances such as removal of hollow bearing logs, hollow trees, burrows, or vegetation structural complexity may make habitat less suitable for spotted-tail quolls[319].

313 Department of Environment, Land, Water & Planning (2016)
314 Threatened Species Section (2023a)
315 Troy (2014)
316 Glen & Dickman (2013)
317 Threatened Species Section (2023a)
318 Henderson *et al.* (2023); Glen & Dickman (2006); Troy (2014)
319 Henderson *et al.* (2023)

Figure 12: Spotted-tail quoll important populations and key sites

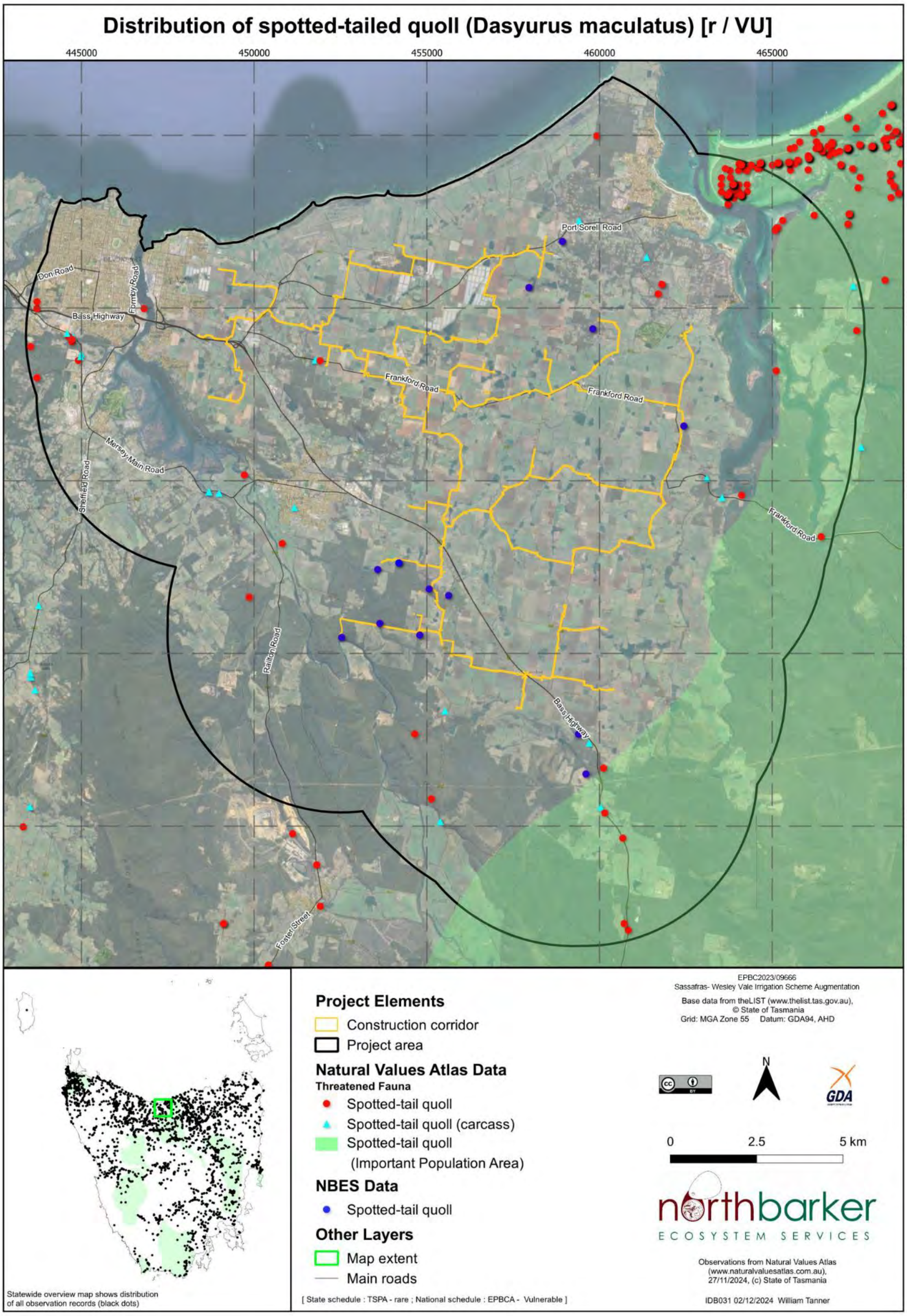

Figure 13: Distribution of the spotted-tail quoll in relation to the Project Area

Tasmanian devil (*Sarcophilus harrisii*)

Conservation status

The Tasmanian devil is listed as endangered under both the EPBC Act and the TSP Act.

The Tasmanian devil was previously listed as vulnerable under EPBC Act. On the 29th of May 2009, this species was uplisted to endangered on the basis of available scientific information. This conclusion was reached from the following assessment criteria:

Criterion 1 – Population size reduction (reduction in total numbers)

> With the emergence of DFTD in the mid-1990's, the Tasmanian devil population suffered an estimated decline in numbers of 64 % from the mid-1990's to 2008, with predictions of a further 70 % decline over the following decade. Modelling of the extent and spread of DFTD indicates that there is a strong possibility of extinction within 25-35 years if trends and rate of decline continues. The reduction in population numbers and the predicted severe decline in the future makes the Tasmanian devil eligible for listing as **endangered** under this criterion.

Criterion 2 – Geographic distribution as indicators for either extent of occurrence and/or area of occupancy

> The Tasmanian devil is found throughout Tasmania, with the exception of offshore islands, as such, the extent of occurrence is equivalent to the area of mainland Tasmania (~64,000 km^2). With devil occurrences continuous across this area, the estimated area of occupancy is also ~64,000 km^2. The species' geographic distribution is not considered precarious for the survival of the species and is not limited, restricted, or very restricted, thus Tasmanian devils are **not eligible** for listing under this criterion.

Criterion 3 – Population size and decline

> At the time of assessment, the total population estimated to be between 10,000 and 25,000 mature individuals which is not considered to be limited. While the number of individuals is likely to continue to decline, as the number of mature individuals is not limited, this species is **not eligible** for listing under this criterion.

Criterion 4 – Number of mature individuals

> At the time of assessment, the total population estimated to be between 10,000 and 25,000 mature individuals. This species was deemed as **not eligible** for listing under this criterion as the number of mature individuals is not thought to be low, very low, or extremely low.

Criterion 5 – Quantitative analysis

> Extrapolation of local extinction modelling to the entire Tasmanian Devil population indicates that there is a strong possibility that the Tasmanian devil will be extinct within a timeframe of approximately 25-35 years, if trends in DFTD spread and population decline continues[320]. This equates to a >10 % probability of extinction in the wild in the medium-term future, which makes this species eligible for listing as **vulnerable** under this criterion.

Threatened Species Scientific Committee (2009)

[320] McCallum *et al.* (2007)

Ecology

Tasmanian devils are usually solitary animals, but they share continuously overlapping home ranges and come into contact with other Tasmanian devils around prey carcasses and during the mating season[321]. They travel up to 16 km a night, although individuals have been recorded covering more than 50 km in a single night[322]. Home ranges for adult devils range from 360-1,315 ha[323] with younger animals occupying larger home ranges. Devils are active during the day where there is no human disturbance but otherwise hunt during the night (Pemberton *pers. comm.*). In daytime devils hole up in shelter, including underground dens, wombat burrows, hollows, and caves. Communal denning, particularly natal dens, occur in clusters with suitable geomorphology above the water table.

Habitat

The Draft Tasmanian Devil Recovery Plan[324] states that critical devil habitat includes 'all disease-free areas within mainland Tasmania with suitable devil habitat', 'all areas of pre-disease core habitat', and 'areas that may be required under the recovery program for the future introduction of Tasmanian devils'.

The entire north coast is in the range of pre-disease core habitat[325]. DFTD has been present in the area since at least 2011[326].

Potential habitat for the Tasmanian devil is all terrestrial native habitats, forestry plantations and pasture. Devils require shelter (e.g. dense vegetation, hollow logs, burrows or caves) and hunting habitat (open understorey mixed with patches of dense vegetation) within their home range (4-27 km^2)[327]. Potential denning habitat for the Tasmanian devil is areas of burrowable, well-drained soil, log piles or sheltered overhangs such as cliffs, rocky outcrops, knolls, caves and earth banks, free from risk of inundation and with at least one entrance through which a devil could pass. Significant habitat for the Tasmanian devil is defined as a patch of potential denning habitat where three or more entrances (large enough for a devil to pass through) may be found within 100 m of one another, and where no other potential denning habitat with three or more entrances may be found within a 1 km radius, being the approximate area of the smallest recorded devil home range[328]. This definition of significance is relied upon because it supersedes EPBC Act conservation and listing advice and has been developed through collaboration between Tasmanian experts[329].

Devils thrive in a landscape mosaic of native habitat and agricultural land. The population uses all the habitat mosaic but typically does not forage or den in areas of cleared land more than 500 m from continuous habitat[330] (Pemberton *pers. comm.*). Dense wet eucalypt and rainforest, alpine areas, dense wet heath, and open grassland all support only low densities of devils[331]. Devils are more abundant in habitats (open eucalypt forests and woodlands, coastal scrub) that support dense populations of their prey (macropods, wombats, possums)[332].

321 Hamede *et al.* (2009)
322 Hamede *et al.* (2009)
323 Lazenby *et al.* (2018)
324 Department of Primary Industries, Parks, Water & Environment (2010)
325 Department of Primary Industries, Parks, Water & Environment (2010)
326 Lazenby *et al.* (2018); Cunningham *et al.* (2021)
327 Jones *et al.* (2004); Forest Practices Authority (2013); Threatened Species Section (2024j)
328 Forest Practices Authority (2013); Threatened Species Section (2024j); Pemberton (1990)
329 Forest Practices Authority (2013); Threatened Species Section (2024j)
330 Guiler (1970)
331 Jones *et al.* (2004)
332 Jones & Barmuta (1998)

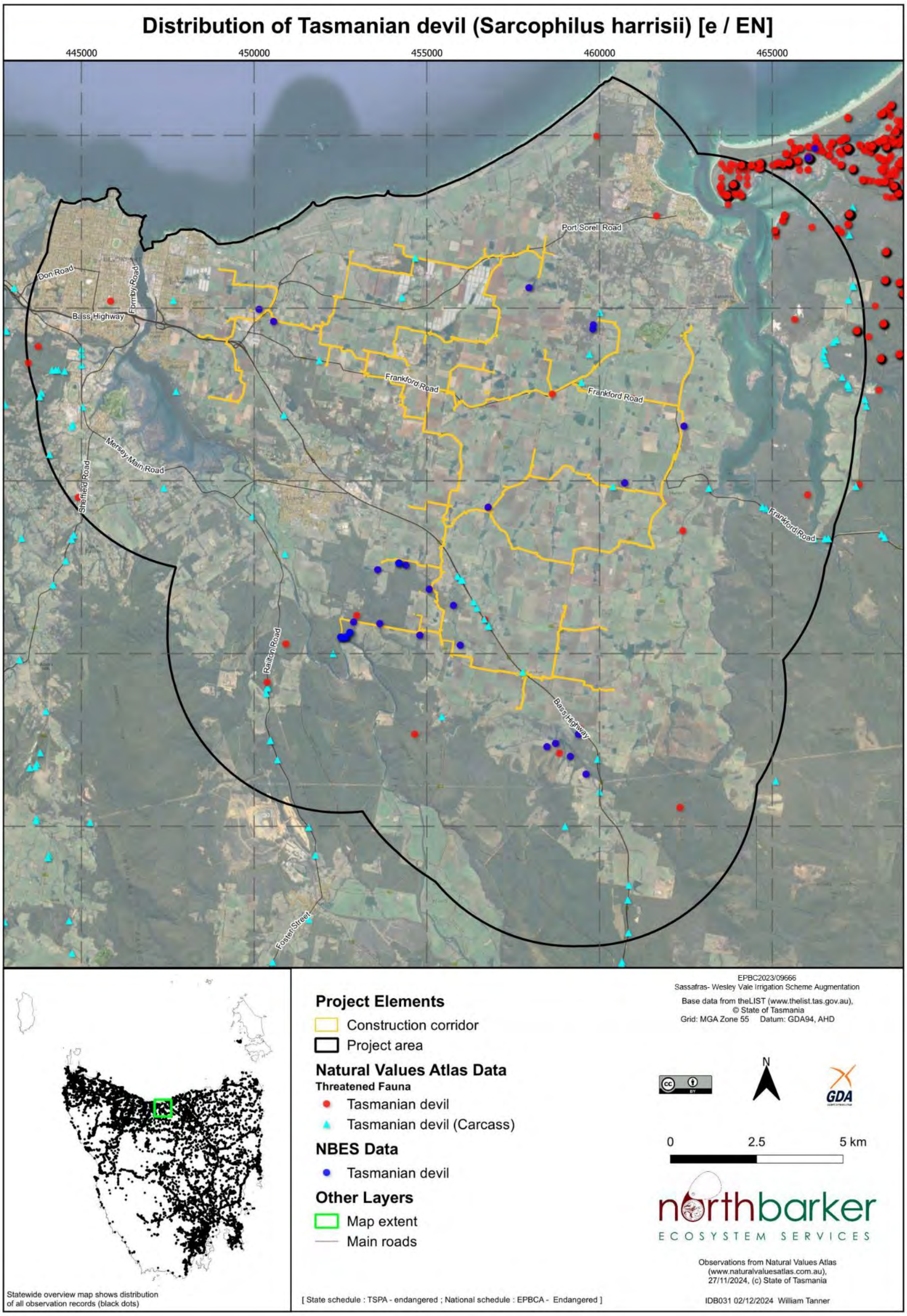

Figure 14: Distribution of the Tasmania devil in relation to the Project Area

Population parameters

Estimated population of Tasmanian devils was predicted to be ~17,000 individuals as of 2020, with species declines expected to continue due to the spread of Devil Facial Tumour Disease (DFTD) across their range[333].

The SPRAT profile for Tasmanian devils divides them into two genetically distinct populations[334]:

1) northwestern; and
2) eastern/southwestern

The Construction Corridor (322.88 ha) is within the known geographical and ecological range of the eastern/southwestern population (which in total has a range of 50,630 km^2 [335]) and overlaps with the core range of the species; defined on the Tasmanian Natural Values Atlas as the area within the known range known to support the highest densities of the species and/or thought to be of greatest importance for the maintenance of breeding populations of the species.

Distribution and site significance

Tasmanian devils are widespread throughout Tasmania, occupying all terrestrial habitats within their range. Though there is considerable variation in population density across Tasmanian since the emergence of DFTD, they are generally non-specific in their habitat requirements and are present in most areas of the state.

The species has 15 observation records on the NVA attributed to within 500 m of the pipeline alignment[336] and 664 records within the Project Area, the most recent being in February 2024 [337]. A total of 76 of these records are attributed to roadkill. Figure 14 displays the distribution of Tasmanian devil records listed on the NVA in relation to the Project Area.

SWIS management actions

This species was discussed in the referral / preliminary documentation process for the SWIS project[338], however it was deemed to not be at risk of any impacts due to the construction or operation of the SWIS with mitigation measures in place. The development of Farm WAPs was the only management action that was required as a condition of approval of the SWIS as a controlled action.

Threats

The relevant published threats to the Tasmanian devil are listed in the Draft Recovery Plan as follows:

- Devil facial tumour disease;
- Competition and predation (foxes);
- Vehicle collision mortality; and
- Habitat loss, degradation and fragmentation[339].

The Tasmanian devil was listed on the EPBC Act as endangered following the significant impact of DFTD. DFTD has spread across most of Tasmania (Figure 15, Figure 16), including the area of the action, with population declines averaging 80% since first reported[340]. DFTD is the single most significant cause of mortality and therefore threat to the conservation of the Tasmanian devil[341]. The reduced population is

[333] Cunningham *et al.* (2021)
[334] Department of Climate Change, Energy, the Environment & Water (2024f)
[335] Department of Climate Change, Energy, the Environment & Water (2024f)
[336] Natural Values Atlas data – as at 11 of September 2024
[337] Natural Values Atlas data – as at 11 of September 2024
[338] Referral EPBC: 2010 / 5327; Tasmanian Irrigation Development Board (2010)
[339] Department of Climate Change, Energy, the Environment & Water (2024f), Department of the Environment, Water, Heritage and the Arts (2009).
[340] Hawkins *et al.* (2006)
[341] Department of Primary Industries, Parks, Water & Environment (2010)

also likely to be more sensitive to additional threats such as death by roadkill, competition with cats and foxes, and loss or disturbance of areas surrounding traditional dens where young are raised[342]. The protection of breeding opportunities is particularly important for the species due to the mortalities from demographic pressures[343].

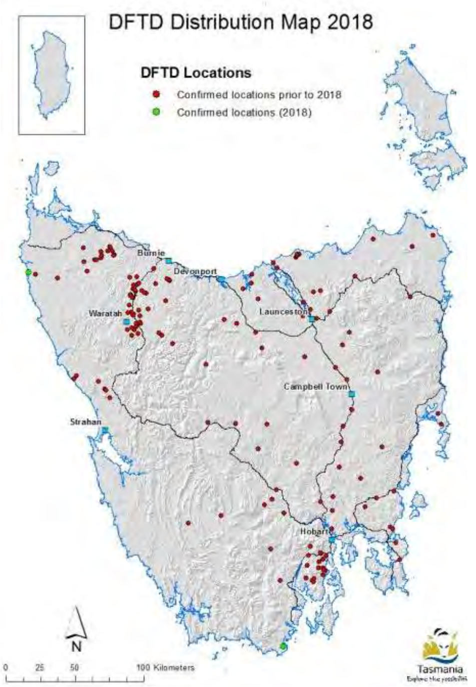

Figure 15: Devil facial tumour disease distribution in Tasmania as of 2018

Source: Department of Natural Resources & Environment (2018)

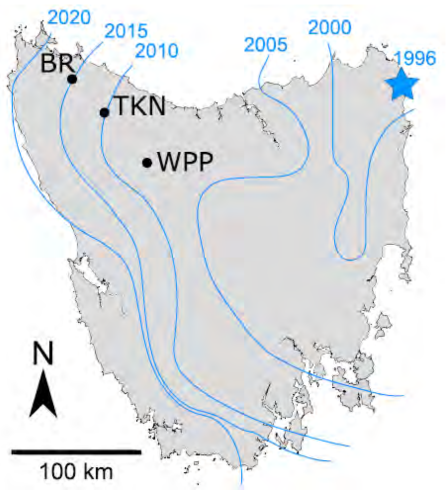

Figure 16: The east-west spread of DFTD since its origin in 1996 (blue star). Approximate location of the disease front over time is indicated by blue lines.

Source: Kozakiewicz *et al.* (2021)
BR = Black River, TKN = Takone, WPP = West Pencil Pine

Survey methods

Species presence and activity

Dasyurid presence and activity were assessed using ground surveys for habitat suitability and signs of activity, as well as remote camera surveys for validation of presence and spatial trends.

Ground surveys were conducted during baseline natural values surveys across the duration of field assessments, following the general search techniques specified in the State guidelines[344]. Broad scale habitat suitability was assessed, and presence/absence was surveyed concurrently with other survey efforts. For presence/absence[345], diurnal searching was undertaken for scats and prints, with particular attention to potential dispersal routes (e.g., tracks) and soft substrate. Scats in particular are often detectable in latrine sites such as at track junctions and creek crossings[346].

A total of 14 person days (>140 hours) targeted search effort was undertaken during the two ground surveys. A total of 81.71 ha was mapped as native vegetation and hardwood plantation. The threatened dasyurid survey effort in these areas accounted for >50 hrs, as they provide the highest suitability for denning structures and prey availability[347]. Thus, survey effort exceeded the minimum survey

[342] Department of Primary Industries, Parks, Water & Environment (2010)
[343] Environment Strategic Business Unit (2023)
[344] Environment Strategic Business Unit (2023)
[345] Department of Sustainability, Environment, Water, Population & Communities (2011a); Environment Strategic Business Unit (2023)
[346] Department of Sustainability, Environment, Water, Population & Communities (2011a)
[347] Andersen *et al.* (2017); Andersen *et al.* (2020); Jones & Rose (1996); Troy (2014)

requirement for indirect searches for diurnal mammals defined in the *Survey guidelines for Australia's threatened mammals*[348]. The guidelines recommend a minimum day-time search effort of two hours for every one-hectare survey site of a stratified sampling program in a subject site up to 5 hectares. A search survey effort of >50 hours was spent within this habitat, equating to an average of around 0.6 hours of survey searching within every hectare of native vegetation, which exceeds the recommendation of 2 hours of searching for 1 in every 5 hectares (average 0.4 hrs/ha).

An initial camera survey was conducted in areas of highly suitable dasyurid habitat within the SWISA Project Area, surrounding the Great Bend pump station in the south of the region (Figure 17). Preliminary surveys consisted of three trail cameras deployed at separate locations between the 2nd-30th March 2023, totalling 84 trap nights.

Due to the expected low density of eastern quolls within the region[349], it was determined that further survey effort was required across the broader Project Area to predict presence/absence across the region. A second remote camera survey was implemented throughout the project region, targeting both areas within the Survey Area and suitable dasyurid habitat within the greater region.

Thirty-nine cameras were deployed for an average of 63 nights (range 14-93 nights), between December 4th, 2023, and March 6th, 2024, totalling 2,462 trap nights. The survey coincided with the period of juvenile weaning and dispersal for devils and quolls[350], maximising the likelihood of detecting presence while population numbers and dispersal activity are highest.

Survey locations were primarily concentrated within 200 m of the Construction Corridor, spread throughout the Project Area (Figure 17). Deployment locations were selected based on their proximity to forest ecotones, windbreaks, riparian vegetation, or other linear features such as tracks or fence lines that may be utilised by quolls and devils for foraging and dispersal. Additional survey locations were selected further from the Construction Corridor (200-1,000 m) where areas of suitable quoll and devil habitat in continuous forest intersected the Project Area, to assess presence within the greater region.

All camera footage was assessed by a NBES ecologist with extensive experience in dasyurid ecology, with any observations of devils and quolls noted along with the date and time of occurrence, approximate age and behaviour exhibited. Observations of other threatened fauna species were noted along with the date and time of occurrence, and behaviour exhibited.

Denning habitat suitability model

In attempt to quantify areas of potential natal denning habitat for devils and quolls, vegetation communities in the site and soil drainage characteristics were used to stratify the site based upon the likelihood of it supporting denning structures. The den suitability classes are described below (Table 14). Although each species has microhabitat and climactic preferences, Tasmanian devils, spotted-tail quolls and eastern quolls have a high degree of overlap in foraging and denning habitat requirements[351], and accordingly are treated jointly in the following method. While habitat features such as vegetation cover, presence of hollow logs and soil drainage may differently affect each species in the types of dens utilised and/or population density at the site, broad scale optimal vegetation categories are likely to contain some amount of denning habitat suitable for all three species.

As the vegetation mapping underpins the model; areas of fine scale changes in the vegetation not captured in the vegetation mapping mean that areas mapped as one suitability class may contain small areas of another suitability class. As this is a model it is therefore only indicative of the spread of potentially suitable denning habitat within the Project landscape.

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[348] Department of Sustainability, Environment, Water, Population & Communities (2011)
[349] Cunningham *et al.* (2022)
[350] Godsell (1983); Troy (2014); Pemberton (1990)
[351] Glen & Dickman (2006); Forest Practices Authority (2013); Fancourt (2015)

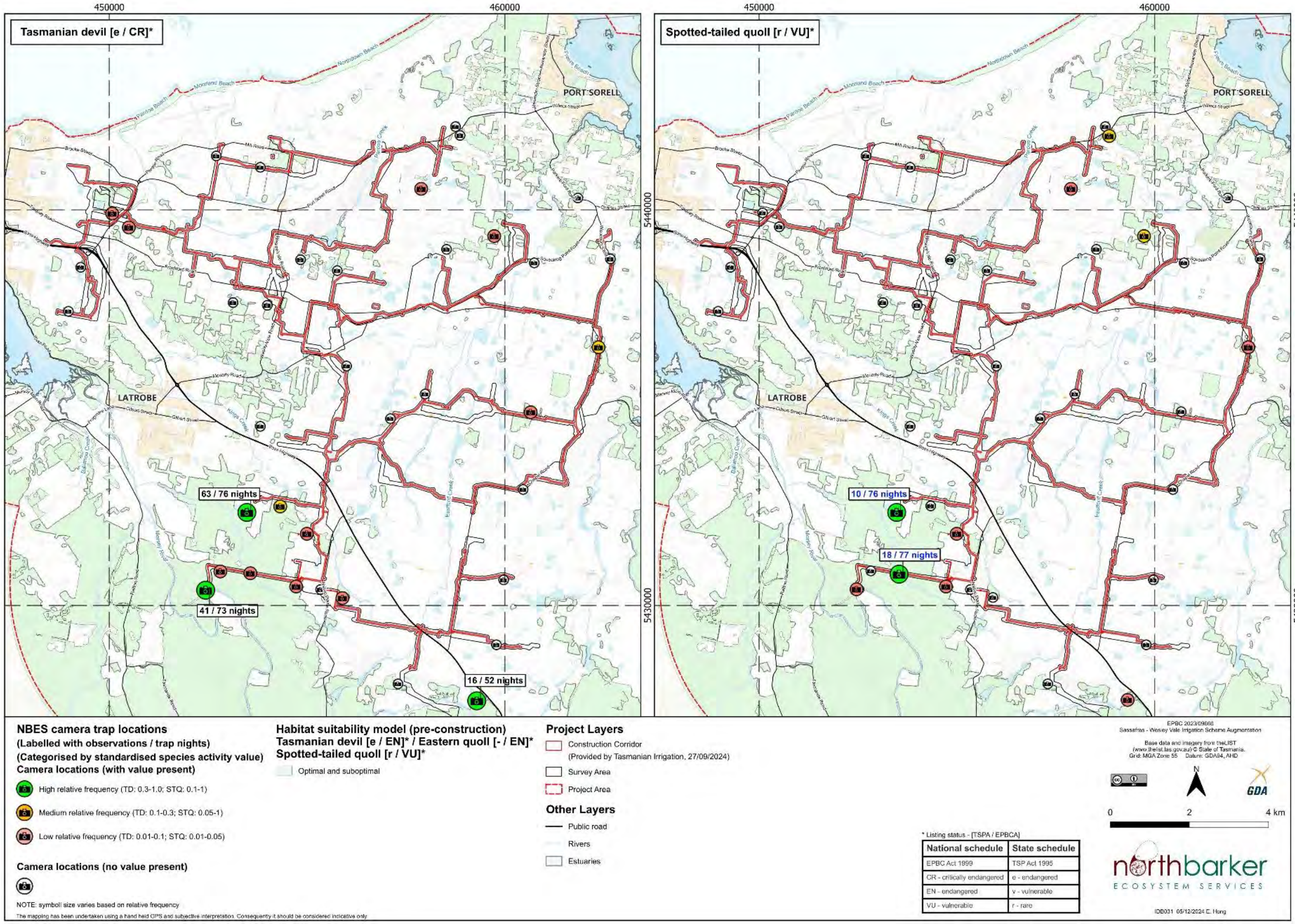

Figure 17: Dasyurid camera trapping survey locations and results

Table 14: Devil and quoll denning habitat suitability classes

Suitability class for devil and quoll maternal natal den	Rationale
Optimal (Denning)	This category contains areas deemed optimal for denning opportunities based on field observations and site attributes. Characteristics include: • All areas of dry forest TASVEG units (including non-eucalypt forests such as NBA, NAL, and NAD). This habitat likely provides optimal shelter conditions, not having an overly dense canopy (allowing sunlight to ground level) and often containing ideal soil conditions (moderate to well drained)[352]. • All wet forest communities – these are the blackwood (*Acacia melanoxylon*), *Leptospermum*, or *Melaleuca* (TASVEG units NAF, NAR, NLE, NLM, NME) and any rainforest or wet eucalypt forest and woodland TASVEG units (those beginning with R or W, respectively). Although these may be less suitable for burrowing in terms of drainage, they are likely to contain areas that are locally suitable and potentially viable ground elements like fallen hollow logs[353]. • All scrub, heathland and coastal complex communities (TASVEG units beginning with S). Some communities (e.g. wet heathland SHW) may have areas unsuitable for denning such as swamps, though broadly all scrub and heathlands have potential for occurrence of cover and ground elements suitable for denning[354]. • Native grasslands within 100 m of native forest units and/or with a dense layer of shrubs (ideal soil and sheltering conditions)[355]. • Silvicultural forest (FPH/FPS) areas (ideal soil and sheltering conditions, including the presence of windrows)[356]. • Regenerating cleared land (FRG) within a native mosaic and with optimal soil (4 - 6 classification) and sheltering characteristics (including the presence of log piles)[357].
Suboptimal (Denning)	This category includes remaining areas of intermediate habitat, including (but not limited to) those with the following traits: • Seasonally inundated lagoons and other wetland habitats not classified as unsuitable (*i.e.* those that dry out in summer)[358]. • Agricultural land within 10 m of native forest or grassland. • Exposed native grassland (lacking shrub cover) distant (>100 m) from native forest[359]. • FAC vegetation (good shelter at canopy level, but less suitable at ground level)[360].
Unsuitable (Foraging Only)	This class captures all areas that are deemed unsuitable for denning opportunities, based on field observations and site attributes. Characteristics include: • Permanently inundated areas denoted by OAQ and ASF on vegetation mapping[361]. • Areas of FAG >10 m from native vegetation. These areas are likely too far separated from high prey densities for energetically efficient maternal denning. In addition to this, exposed sites make young quolls vulnerable around their dens and are thus not selected by adults[362]. **Note -** FAG within 10 m of native forest or native grassland is considered suitable but suboptimal; and noting that micro-siting during a den management protocol must overrule the classification of unsuitable if micro-habitats suitable for denning are present within the FAG > 10 m from native forest, including the presence of rock and log piles, or thickets of suitable vegetation within the broader cleared area – these areas must be elevated to consideration as suitable in such scenarios.

[352] Jones & Barmuta (2000); Jones *et al.* (2023); Godsell (1983); Henderson *et al.* (2023); Pemberton (1990); Thalmann *et al.* (2015)
[353] Environment Strategic Business Unit (2023); Thalmann *et al.* (2015)
[354] Guiler (1970); Jones & Rose (1996)
[355] Fancourt (2016); Henderson *et al.* (2023); Jones & Barmuta (2000); Lyall (2018); Thalmann *et al.* (2015)
[356] Jones *et al.* (2023); Lyall (2018)
[357] Fancourt (2016); Jones *et al.* (2023); Lyall (2018); Pemberton (1990); Thalmann *et al.* (2015)
[358] Environment Strategic Business Unit (2023); Thalmann *et al.* (2015)
[359] Jones & Barmuta (2000); Lyall (2018); Andersen *et al.* (2017); Henderson *et al.* (2023); Thalmann *et al.* (2015); Guiler (1970)
[360] Lyall (2018); Thalmann *et al.* (2015)
[361] Environment Strategic Business Unit (2023)
[362] Jones *et al.* (2023); Andersen *et al.* (2017)

Survey findings

Eastern quoll

Remote camera surveys for eastern quolls did not detect the species at any sites across the Survey Area. This lack of detection of eastern quolls on remote cameras in the Survey Area does not conclusively indicate their absence. Eastern quolls have relatively small home ranges, typically less than 0.5 ha, therefore comprehensive coverage of the Survey Area would require camera arrays to be spaced no more than 500 m apart. Such coverage was not feasible for this survey due to the extensive Survey Area. Low population density within a widely spaced camera array may have led to undetected individuals, despite the higher activity at this time due to juvenile dispersal. Even so the lack of detection of eastern quolls, where conspecifics such as the spotted-tail quoll and Tasmanian devil were detected across multiple sites, indicates that if the species is present in the area, it likely persists at low density.

No dens or evidence of eastern quoll activity (in the form of tracks, scats, carcasses etc.) were recorded during field assessments. Potential den sites are likely widespread in the broader area and may extend into the vicinity of the of the development footprint. Denning sites for this species, especially natal dens, are located in well concealed locations to provide protection from predators. In areas with frequent occurrences and/or high densities of quolls, such indicators of presence are readily encountered (tracks, scats, etc), which is why these are an accepted survey detection technique[363]; the absence of these indicators during surveys would thus indicate the Project Area is sparsely/infrequently utilised.

Despite the lack of direct evidence of eastern quolls in the Project Area, its presence is not discounted simply due to the species occurring throughout eastern Tasmania and varying locationally by frequency of occurrence and population density associated with habitat variables (including land use), and environmental traits. Even so, efforts of both ground and remote camera surveys indicate that the area is sparsely or infrequently utilised and therefore does not constitute an important population for the species.

Spotted-tail quoll

Initial camera surveys detected spotted-tail quolls (Plate 31) on two occasions over 84 total trap nights (0.024 detections per trap night). Spotted-tail quolls were detected on one out of three cameras.

Secondary camera surveys detected spotted-tail quolls on 47 occasions over 2,462 total trap nights (0.019 detections per trap night). Spotted-tail quolls were detected at a total of 11 locations (out of 39) and were most frequently detected in dry eucalypt forest and woodland and modified land (Table 15).

Spotted-tail quolls were mostly detected within continuous forest in the south-west and mosaic woodland in the north-east of the region (Figure 17). The species was not detected in the primarily agricultural areas in the centre and north-west of the Project Area. Given the large range of individuals and the spread of the species in the greater region, lack of detection does not rule out presence in the area, particularly as mosaic woodland habitat in the north-west and south-east is likely to contain habitat suitable for denning and foraging nearby the Survey Area. This does however suggest that the species, if present, demonstrates reduced activity in these areas.

One active den was confirmed during camera surveys, [redacted] from the Construction Corridor (Figure 17). This den appeared to be located within thick sedges, although it was not investigated in the field. A further 3 potential den sites were found within the Survey Area. Ground surveys did not detect any active or potential dens within the construction corridor, although it should be noted that these surveys do not constitute comprehensive coverage of the impact area. Denning sites for this species, especially natal dens, are located in well concealed locations to provide protection from predators. Potential den sites are likely widespread in the broader area and may extend into the vicinity of the of the development footprint. Given the spread of the species across the region and the number of detections

[363] Department of Sustainability, Environment, Water, Population & Communities (2011a)

within and close to the Survey Area, it is possible that active dens may be present and pre-clearance checks of the Construction Corridor are required.

Table 15: Summary of observations of spotted-tail quolls from secondary remote camera survey

Vegetation Group	Number of Cameras	Trap Nights	Locations Detected	Total Trap Nights Observed	Total Observations	Mean Observations Per Trap Night
Dry eucalypt forest and woodland	19	1,280	6	34	37	0.029
Modified land	10	463	3	7	7	0.015
Non eucalypt forest and woodland	2	135	1	1	1	0.007
Other natural environments	1	74	0	0	0	0.000
Scrub, heathland and coastal complexes	2	109	0	0	0	0.000
Wet eucalypt forest and woodland	5	401	1	2	2	0.005
Total	**39**	**2,462**	**11**	**43**	**47**	**0.019**

Plate 31: Spotted-tail quoll recorded on a camera trap near Bonney's Creek

Tasmanian devil

Initial camera surveys detected Tasmanian devils (Plate 32-35) on 6 occasions over 84 total trap nights (0.71 detections per trap night). Tasmanian devils were detected on two out of three cameras.

Secondary camera surveys detected devils on 597 occasions over 2,462 total trap nights (0.24 detections per trap night). Tasmanian devils were detected at a total of 17 locations (out of 39) and were most frequently detected in dry eucalypt forest and woodland, modified land and non-eucalypt forest and woodland. One camera was set at the entrance of a devil den within [redacted] comprising 72 % of total detections. This has been included separately within the summary table (denoted by * in the table) to allow unbiased interpretation (Table 16).

Tasmanian devils were mostly detected within continuous forest in the south-west and mosaic woodland in the north and east of the region (Figure 17). The species was not detected in the primarily agricultural areas in the centre study area. Given the large range of individuals and the spread of the species in the greater region, lack of detection does not rule out presence in the area, particularly as mosaic woodland habitat in the north-west and south-east is likely to contain habitat suitable for denning and foraging nearby the Construction Corridor. This does however suggest that the species, if present, demonstrates reduced activity in these areas.

One active maternal den was confirmed during camera surveys, within the Survey Area, [redacted] outside of the Construction Corridor (Figure 17). [redacted] At least three young devils and their mother were detected daily throughout the entire survey period (Plate 34), and the den was visited by multiple other adult devils (as seen from unique marking patterns and size). A further 7 potential den sites were found within the Survey Area, with 3 showing signs of usage by devils (scats detected at entrances), [redacted] Ground surveys did not detect any active or potential dens within the Construction Corridor, although it should be noted that these surveys do not constitute comprehensive coverage of the impact area. Potential den sites are likely widespread in the broader area and may extend into the vicinity of the of the development footprint. Given the spread of the species across the region and the number of detections within and close to the Construction Corridor, it is possible that active dens may be present and pre-clearance checks of the Construction Corridor are required.

Table 16: Summary of observations of Tasmanian devils from secondary camera trap surveys

Vegetation Group	Number of Cameras	Trap Nights	Locations Detected	Total Trap Nights Observed	Total Observations	Mean Observations Per Trap Night
Dry eucalypt forest and woodland	18	1207	9	103	135	0.11
Dry eucalypt forest and woodland* (den entrance)	1	73	1	71	427	5.85
Modified land	10	463	3	16	24	0.052
Non eucalypt forest and woodland	2	135	2	4	4	0.030
Other natural environments	1	74	0	0	0	0.000
Scrub, heathland and coastal complexes	2	109	0	0	0	0.000
Wet eucalypt forest and woodland	5	401	2	6	7	0.018
Total	**39**	**2,462**	**17**	**191**	**597**	**0.242**

Plate 32: Adult Tasmanian devil recorded at Great Bend

Plate 33: Juvenile Tasmanian devil recorded at Great Bend

Plate 34: Mother and imps recorded at Great Bend

Plate 35: Screaming Tasmanian devil recorded at Great Bend

[redacted]

Impact pathways

Potential impact pathways to the three dasyurid species relevant to the construction of the SWISA include:

- Direct (or indirect) impact to individuals through the destruction of den and lay up sites;
- Mortality due to collision with vehicles while scavenging carcasses of other roadkill fauna, and mortality due to general vehicle collision;
- Entrapment within construction trenching;
- Disruption of breeding activities due to works conducted in the proximity of maternal dens during the maternal denning season;
- Noise disturbance. Although not a listed threat to these species, industrial noise around den sites may lead to den abandonment and disruption to breeding activities; and
- Interaction with domestic dogs.

Potential impact pathways to the three dasyurid species relevant to the operation of the SWISA include:

- Habitat loss and modification due to agricultural development, conversion of forest to pasture or plantation, and road construction, and activities that remove or prey or habitat features;
- Increase in predation from introduced fauna, cats specifically.

Avoidance

Alignment of the Construction Corridor has been adjusted to minimise the impact of construction on optimal denning habitat for devils and quolls. The proposed Construction Corridor, which is the limit of the habitat impacts, contains 11.46 ha of potential denning habitat (consisting of 8.52 ha of optimal habitat and 2.94 ha of suboptimal habitat). In contrast, a total of 309.39 ha of unsuitable denning habitat (potential foraging only) is present within the Construction Corridor (Figure 18, Table 17). The majority of impacts (96.45 %) are proposed within land determined to be unsuitable for denning.

Locations for new permanent infrastructure (balance tank, pump station, property outlets, scour valves) have been deliberately located within cleared agricultural land to minimise impact of further land clearance. Construction in the Warrawee Conservation Area surrounding the current Great Bend pump station is unable to be avoided and will impact a small area of optimal denning habitat. Further site-specific mitigation strategies are required to minimise the impact to devils and quolls in this area.

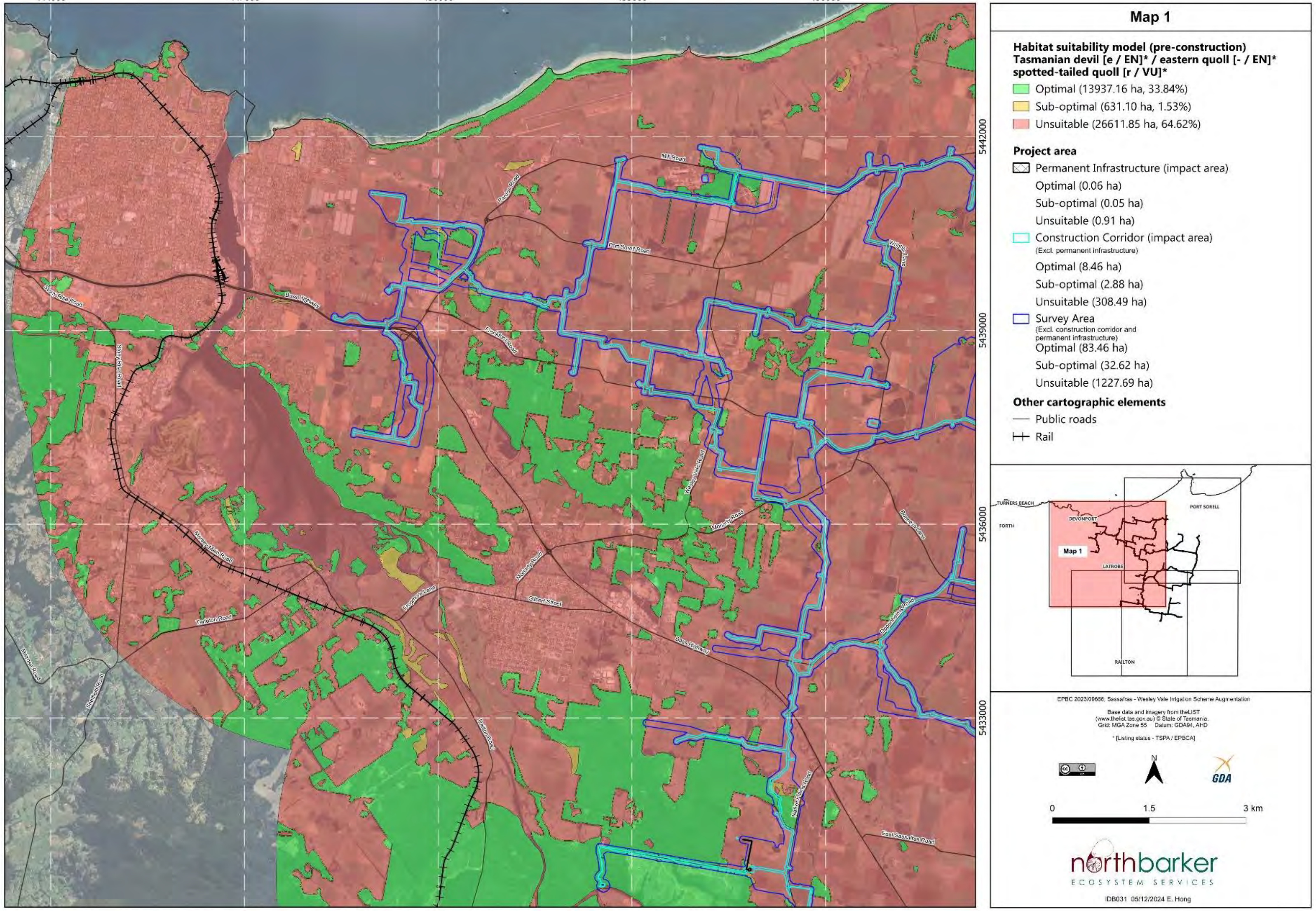

Figure 18a: Dasyurid denning habitat suitability model pre-construction

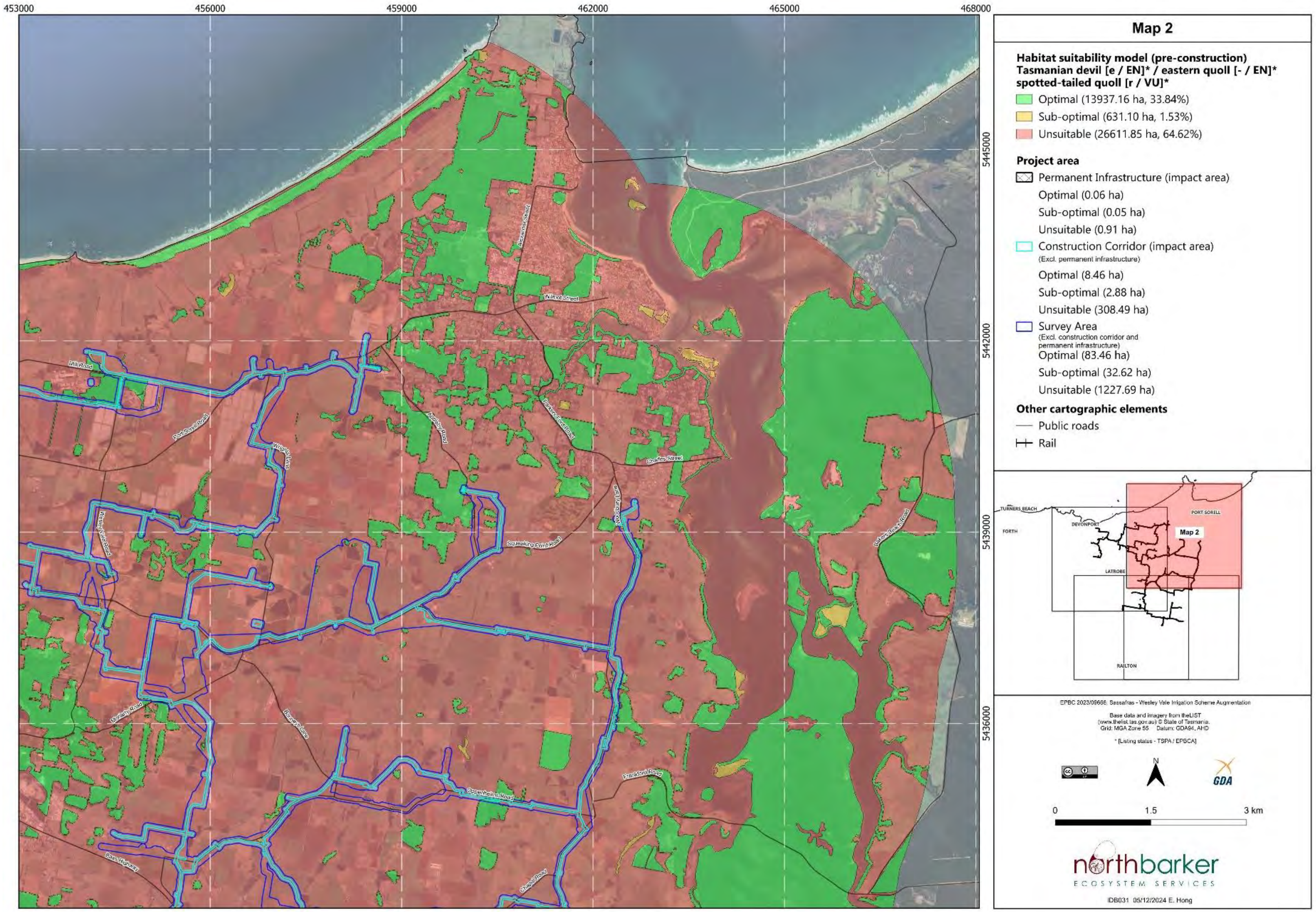

Figure 18b: Dasyurid denning habitat suitability model pre-construction

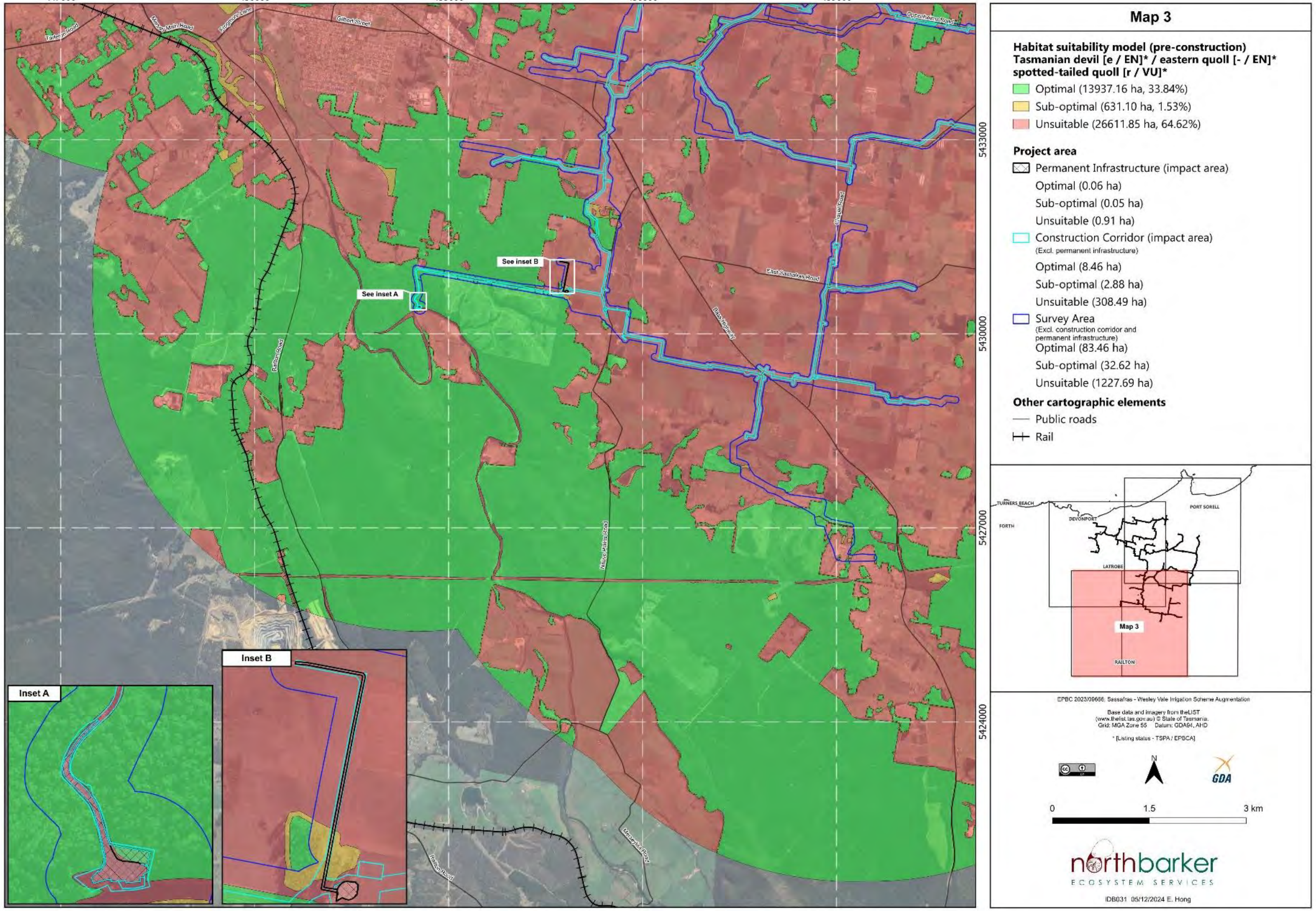

Figure 18c: Dasyurid denning habitat suitability model pre-construction

northbarker
ECOSYSTEM SERVICES

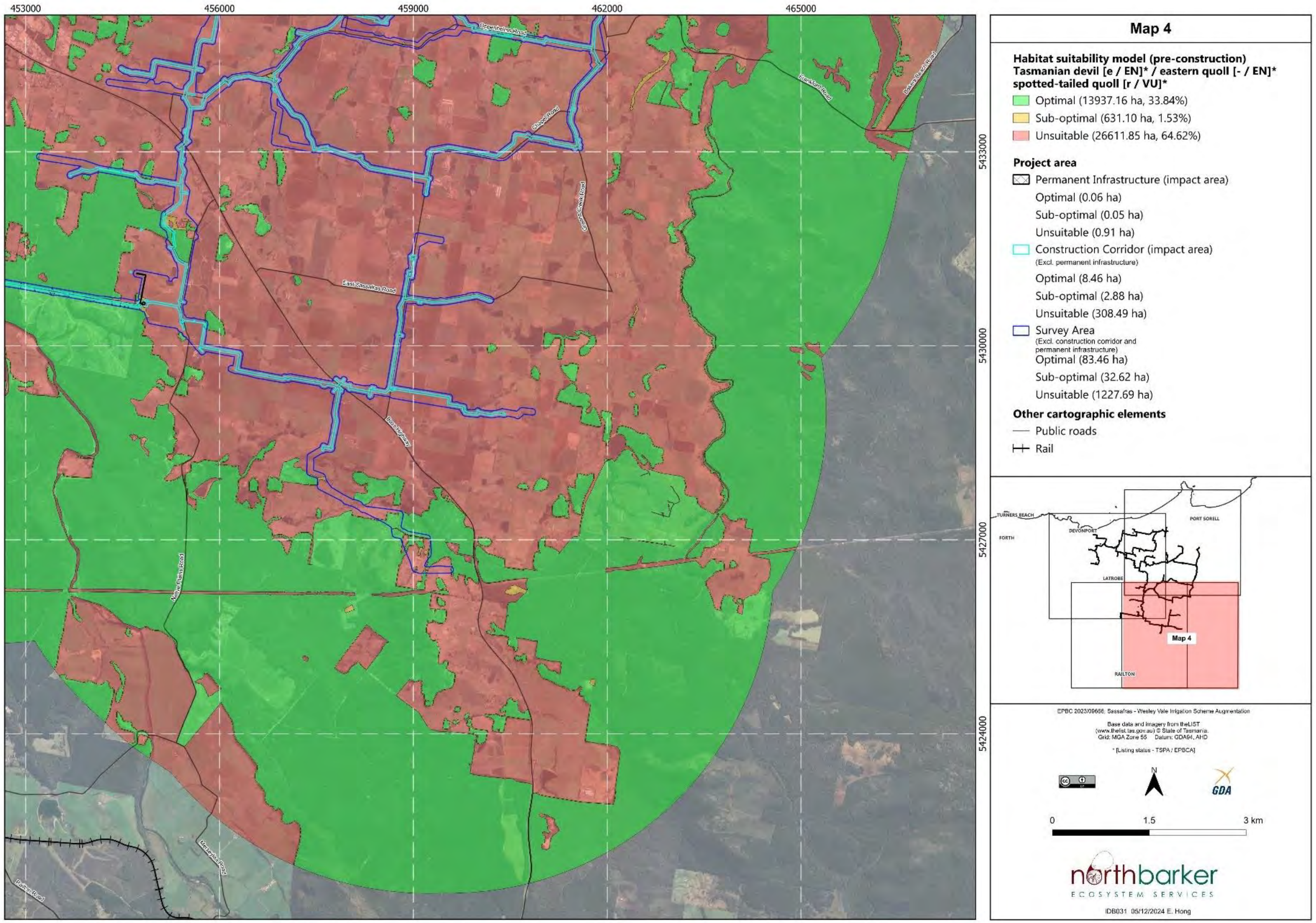

Figure 18d: Dasyurid denning habitat suitability model pre-construction

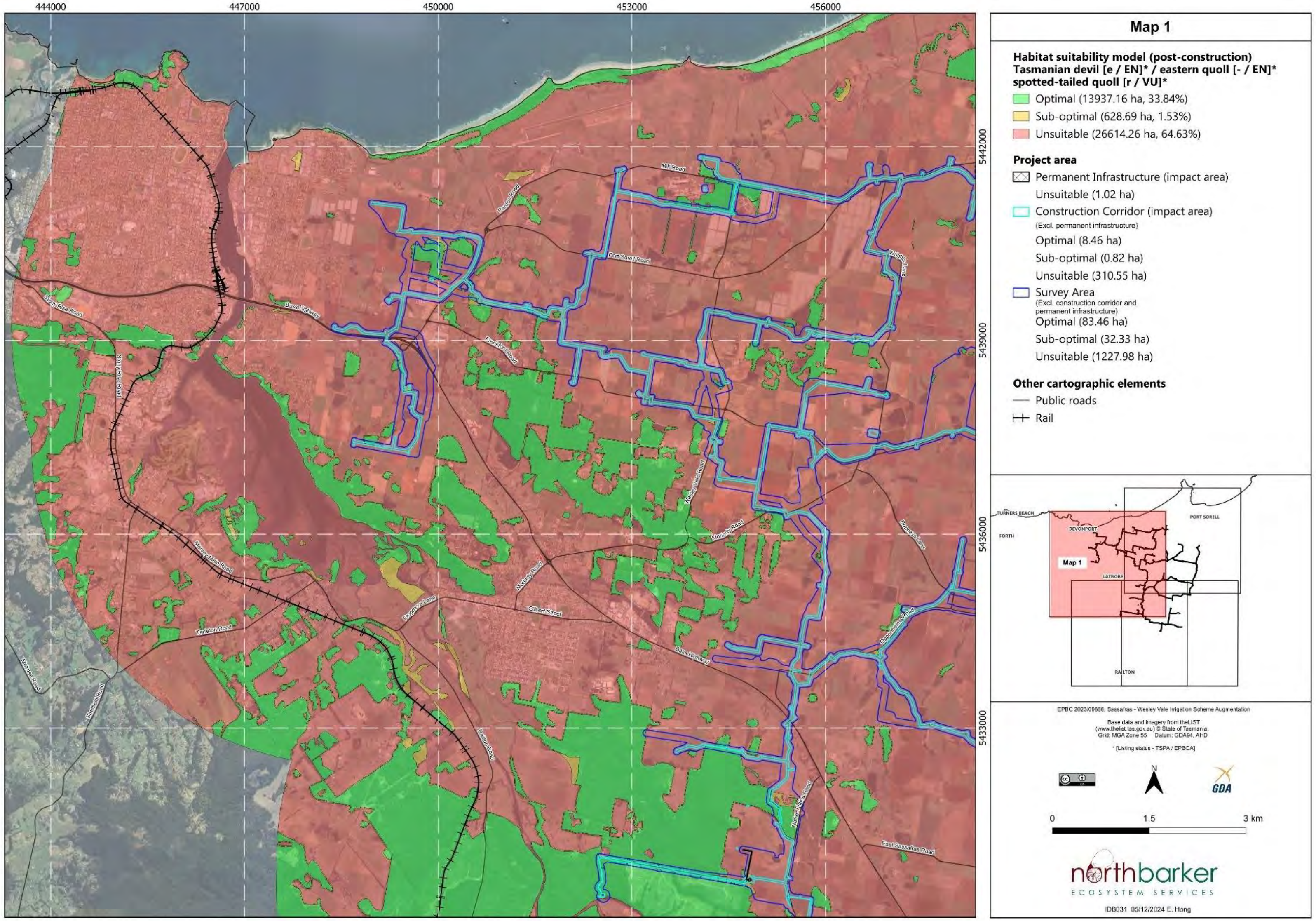

Figure 19a: Dasyurid denning habitat suitability model post-construction

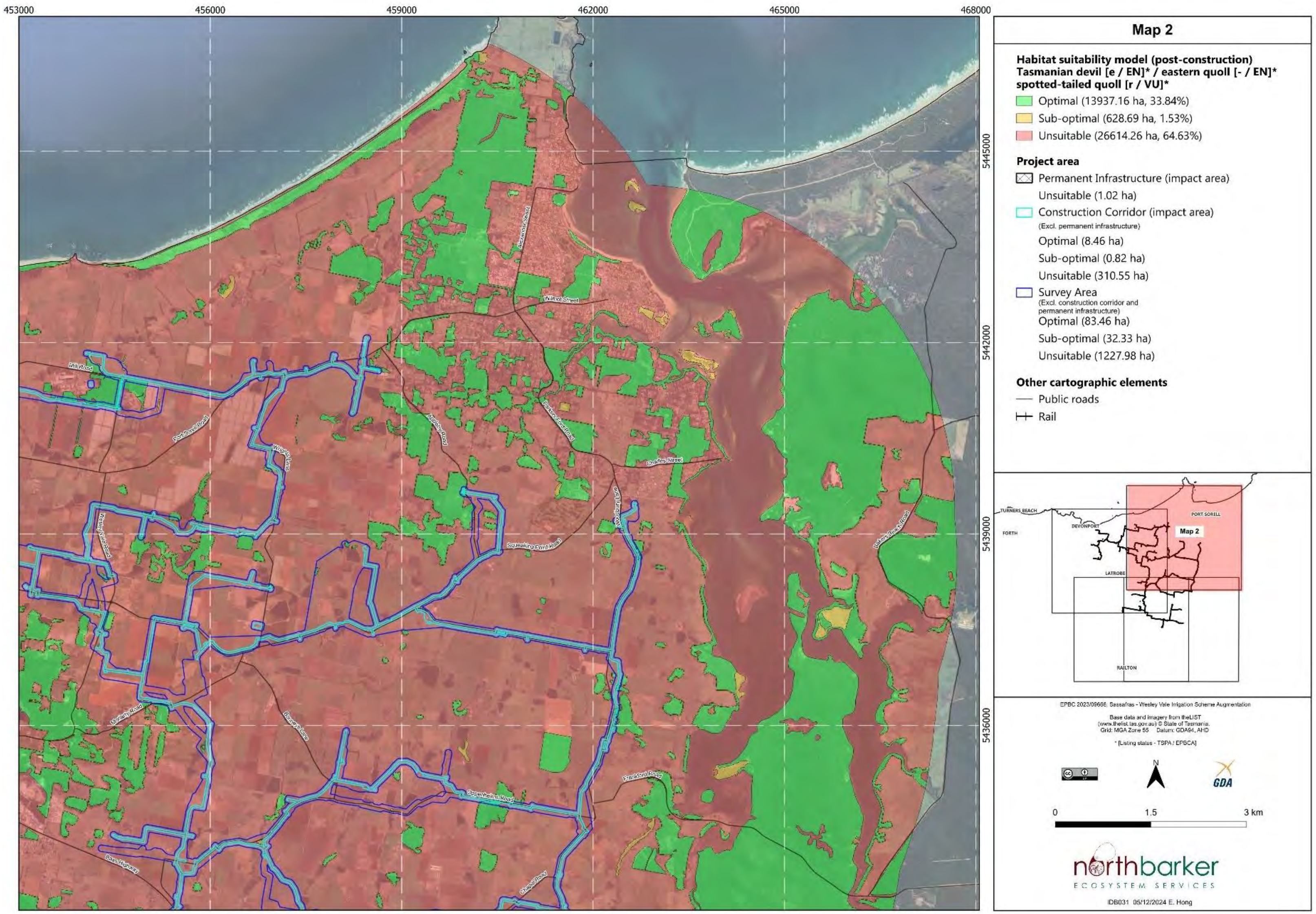

Figure 19b: Dasyurid denning habitat suitability model post-construction

northbarker
ECOSYSTEM SERVICES

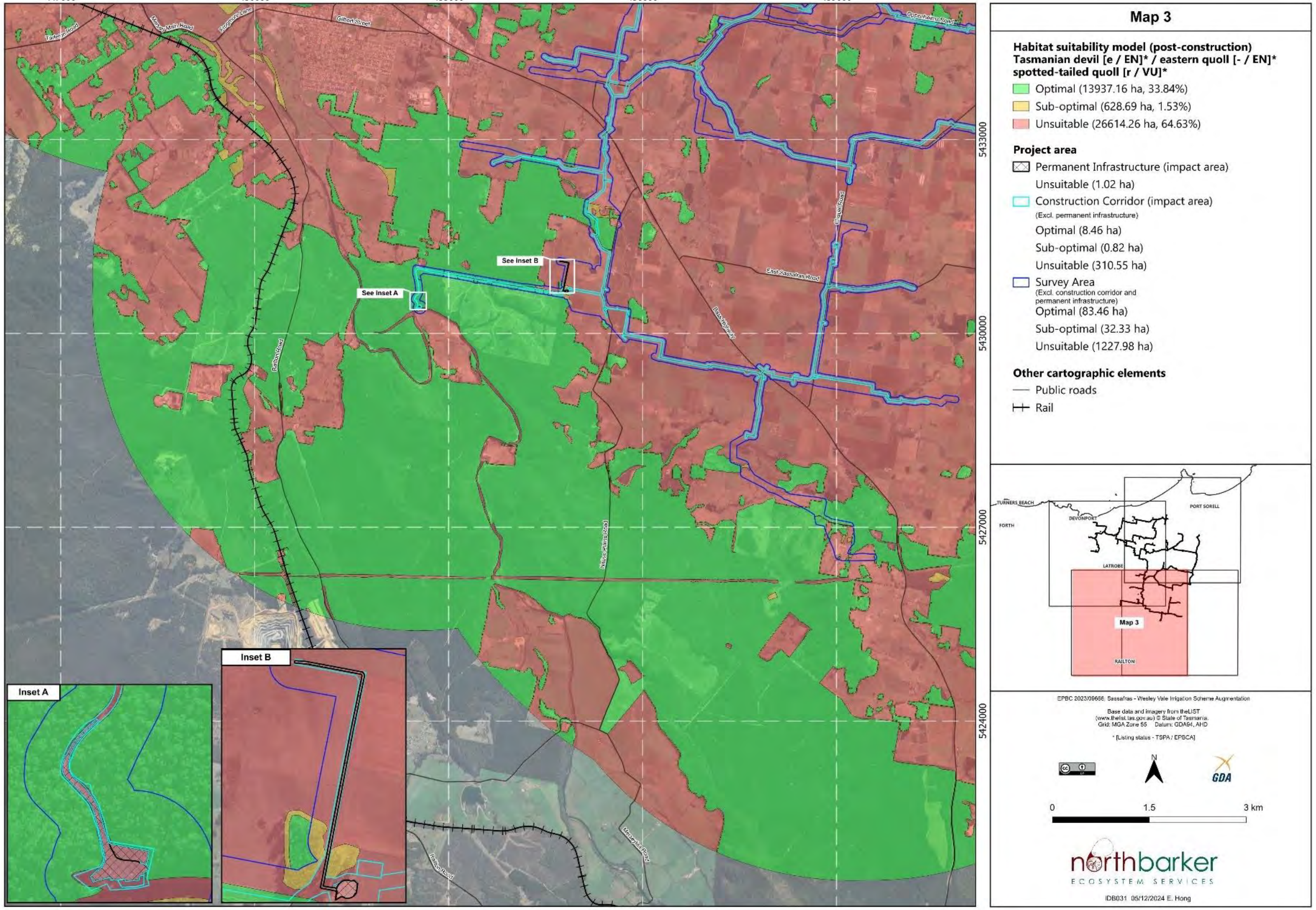

Figure 19c: Dasyurid denning habitat suitability model post-construction

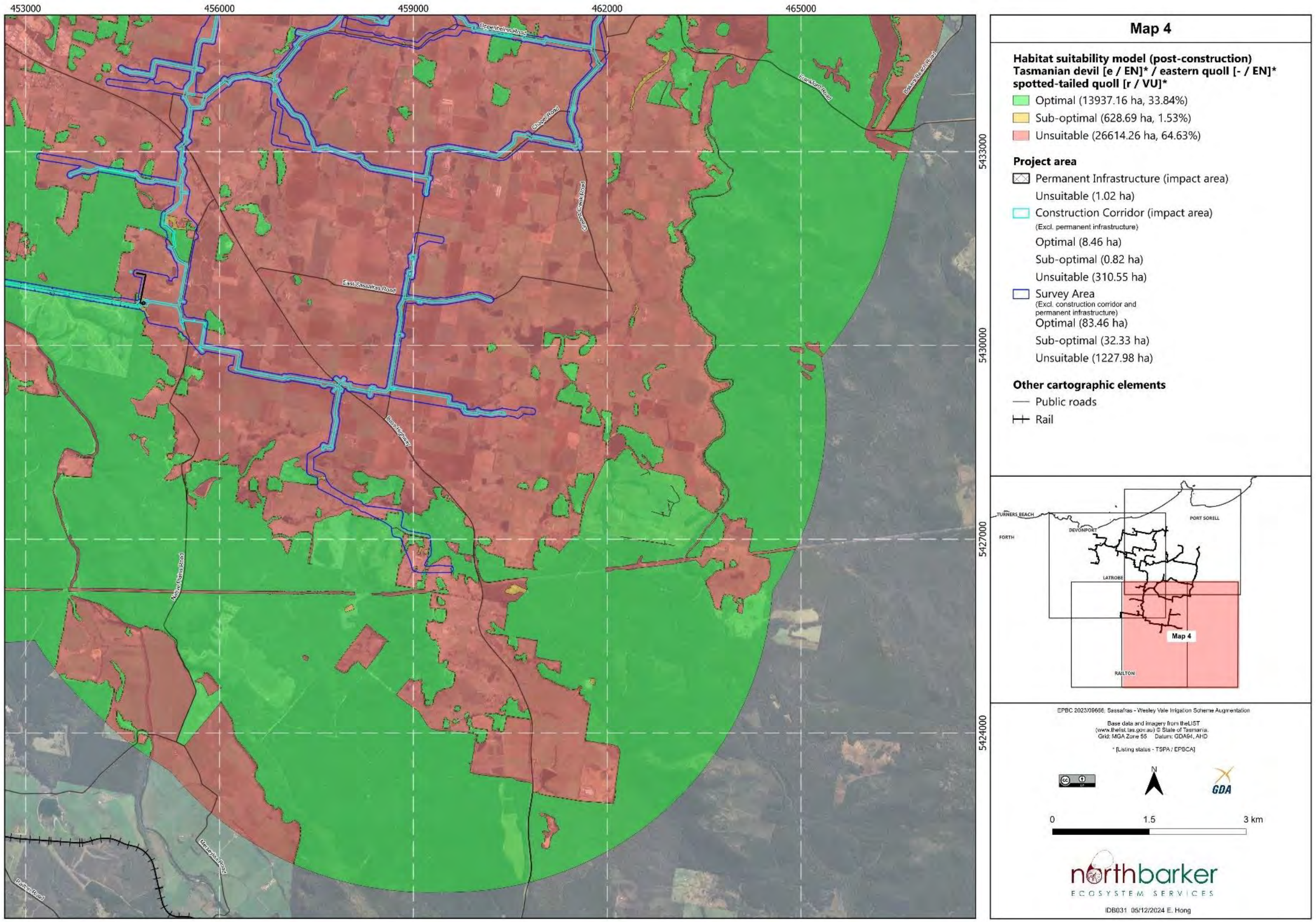

Figure 19d: Dasyurid denning habitat suitability model post-construction

Impacts

Denning habitat suitability model

Impact of proposed construction on potential devil and quoll denning habitat was assessed through a habitat suitability model. Habitat was modelled using vegetation characteristics and land use attributes to determine the suitability across the Project Area. The stratification of potential denning habitat attributes is detailed in Table 14 and is displayed in Figure 18a-d.

Surveys and analysis conducted by NBES predicted that 14,440.71 ha (36.54 %) of the Project Area represents potential denning habitat for quolls and devils (Table 17). Den habitat modelling predicts that 11.46 ha of the 320.86 ha Construction Corridor represents potential denning habitat for quolls and devils (8.52 ha of which is classed as optimal, with the remaining 2.94 ha classed as suboptimal) (Table 17). The remaining 309.39 ha of habitat is classed as unsuitable for denning and represents foraging habitat (noting areas of optimal and suboptimal denning suitability are also suitable for foraging).

Permanent infrastructure in the form of pump stations, balance tanks, and other minor infrastructure impacts a total area of 1.02 ha. This represents 0.32 % of the Construction Corridor. A total of 0.06 ha (7.89 %) of the permanent impact footprint is within areas containing optimal or suboptimal habitat (Table 18).

Changes to denning habitat suitability post-construction (Figure 19a-d) propose a total net loss of 0.06 ha of optimal denning habitat, and 0.05 ha of suboptimal habitat, with this change attributed to the construction of permanent infrastructure. A further 2.08 ha will be converted from suboptimal to unsuitable due to vegetation changes and buffer areas from native vegetation (Table 19).

Table 17: Impacts to quoll and devil denning (and foraging) habitat prior to construction in context of the availability within the Project Area (all areas in hectares)

	Potential Impact Area			Avoidance Area	
Denning Habitat Class (Note all classes are potential foraging habitat)	**Total Permanent Impacts {% of Class Within Construction Corridor} [% of Class Within Survey Area] (% of Class Within Project Area)**	**Temporary Impacts {% of Class Within Construction Corridor} [% of Class Within Survey Area] (% of Class Within Project Area)**	**Total Within Construction Corridor [% of Class Within Survey Area] (% of Class Within Project Area)**	**Total Within Survey Area (Avoidance Area)**	**Total Project Area (outside Survey Area)**
Optimal	0.06 {0.74 %} [0.07 %] (0.0005 %)	8.46 {99.26 %} [9.20 %] (0.06 %)	8.52 [9.27 %] (0.06 %)	91.99 (83.46)	13,845.17
Suboptimal	0.05 {1.81 %} [0.15 %] (0.009 %)	2.89 {99.26%} [8.11 %] (0.48 %)	2.94 [8.26 %] (0.49 %)	35.56 (32.62)	595.54
Unsuitable	0.91 {0.29 %} [0.06 %] (0.004 %)	308.49 {99.71 %} [20.07 %] (1.23 %)	309.39 [20.13 %] (1.23 %)	1,537.09 (1,227.96)	25,074.76
Total	**1.02**	**319.83**	**320.86**	**1,664.64**	**39,515.47**

Table 18: Summary of impacts to quoll and devil denning habitat suitability classes (all areas in hectares)

Habitat Class (Note all classes are potential foraging habitat)	Permanent Infrastructure Description [% of Permanent Impacts] (% of Total Impacts)				Temporary Impacts [% of Temporary Impacts] (% of Total Impacts)			Impact Summary (% of Total Impacts)		Total (% of Total)
	Great Bend Pump Station*	Saggers Hill Balance Tank & Pump Station*	Property Outlets, Scour Valves & Air Valves	Other Permanent Impacts	Laydown Areas	Temporary River Works	Construction Corridor	Total Permanent Impacts	Total Temporary Impacts	
Optimal	-	-	-	0.06 [0.59 %] (0.00 %)	0.15 [0.05 %] (0.05 %)	-	8.31 [2.60 %] (2.60 %)	0.06 (0.02 %)	8.46 (2.64 %)	**8.52 (2.66 %)**
Suboptimal	-	0.05 [4.90 %] (0.00 %)	-	-	0.04 [0.01 %] (0.01 %)	-	2.85 [0.89 %] (0.89 %)	0.05 (0.02 %)	2.88 (0.90 %)	**2.94 (0.92 %)**
Unsuitable	0.27 [26.47 %] (0.08 %)	0.52 [50.98 %] (0.16 %)	0.11 [9.80 %] (0.03 %)	0.01 [0.98 %] (0.00 %)	5.19 [1.62 %] (1.62 %)	0.03 [0.01 %] (0.01 %)	303.27 [94.82 %] (94.52 %)	0.91 (0.28 %)	308.49 (96.14 %)	**309.39 (96.43 %)**
Total	**0.27**	**0.57**	**0.11**	**0.07**	**5.38**	**0.03**	**314.43**	**1.02**	**319.83**	**320.86**

*** Includes associated infrastructure such as access roads**

Table 19: Quoll and devil denning habitat modelling results comparing pre and post construction changes (all areas in hectares)

Denning Habitat Class (Note all classes are potential foraging habitat)	**Total Within Construction Corridor (Pre-Construction)**	**Total Within Construction Corridor (Post-Construction)**	**Net Change in Area**	**Conversion Type**
Optimal	8.52	8.46	-0.06	0.06 ha lost to permanent infrastructure (unsuitable)
Suboptimal	2.94	0.82	-2.12	0.05 ha lost to permanent infrastructure (unsuitable) 2.07 ha lost from vegetation changes
Unsuitable	309.39	311.58	2.18	0.06 ha gained from permanent infrastructure (optimal) 0.05 ha gained from permanent infrastructure (suboptimal) 2.08 ha gained from vegetation changes
Total	**320.86**	**320.86**	**-**	

Eastern quoll

Potentially relevant impacts to eastern quolls in the project region include[364]:

- Predation by introduced species;
- Vehicle collision mortality;
- Construction impacts, including noise impacts;
- Modification or decrease of habitat quality and availability; and
- Disruption of breeding of an important population.

Eastern quolls persist in areas of agricultural mosaic where there is sufficient denning habitat and connectivity with continuous forest, and large areas in the south-west of the Project Area contain suitable habitat. With mitigation measures in place for den management, introduced predators and roadkill, potential impacts are predicted to be limited to conversion of optimal denning habitat and permanent removal of denning habitat from infrastructure development.

The eastern quoll is likely absent or persists at very low densities within the Project Area. Given the presence of potentially suitable quoll habitat currently unutilised by the species, a small reduction in optimal denning habitat is not likely to have population level impacts to the species.

Construction activities may result in elevated risk of impacts due to individuals becoming trapped in open trenches, as well as increased vehicle activity in areas of potential habitat.

[364] Department of Climate Change, Energy, the Environment & Water (2024g) Fancourt (2016); Cunningham *et al.* (2022);

Construction

Direct impacts

Clearance will be preceded by pre-clearance surveys; these surveys reduce the risk of direct impact to eastern quolls by systematically searching habitat to ensure to dens in use are not impacted.

Introduced predators

Competition and predation from feral cats are listed as a major threat to eastern quolls[365]. Feral cats have not been directly implicated as a causal factor in the large declines in eastern quoll populations over the last 25 years[366], although large scale population impacts such as extreme weather and climactic change have reduced population sizes to a degree where they are more susceptible to other threatening processes inhibiting population recovery, such as introduced predators[367].

Fancourt *et al.* (2015) found that while there was no direct correlation between cat abundance and quoll decline, predation by feral cats may contribute to low levels of juvenile recruitment in low density populations, preventing population recovery after weather induced declines. Presence of cats may be in part responsible for the low prevalence or absence of eastern quolls in the Project Area. When considering the low-moderate climactic suitability of the area as well as the large niche overlap of quoll and cat habitat in agricultural areas, presence of cats is likely to continue to impact eastern quoll recovery.

It may be expected that cats will at least to some extent utilise the areas of cleared land within the Construction Corridor, although construction of permanent infrastructure will also constitute habitat removal for feral cats. The linear removal of forest habitat may increase the availability of preferred habitat for cats within the Project Area[368].

Immediate post-construction revegetation to similar structural complexity will provide prey refuge and mitigate the increased predation risk from any increase in cat activity. Given the current high abundance of cats and the already highly modified landscape, it is not likely that this temporary conversion of narrow sections of habitat will result in a long-term increase in cat abundance and thus will not constitute an increase in the threat to eastern quolls in the Project Area.

Predation from foxes, and wild and domestic dogs affects quoll populations where species coexist. There are no known current occurrences of foxes or wild dogs in the Project Area, although quolls may interact with domestic dogs which can result in mortality. The project is not expected to increase interactions between quolls and dogs, provided there are restrictions prohibiting dogs on site for project-related staff and contractors.

Vehicle collision mortality

Increased traffic throughout the construction phase is not expected to result in a substantial (>10 %) increase in road mortalities, provided a roadkill mitigation plan is in place for local roads and high-risk areas. Even without mitigation, the predicted increase of 0.2 incidents per year is minimal in the context of the average 17 devil and quoll incidents per year throughout the modelled Project Area (**Attachment F**). This would have no chance of impacting eastern quolls at a population level.

Habitat modification

Threats outlined in the species conservation advice, such as predation by introduced species and climate change, have the potential to be exacerbated by reduction in habitat availability or breeding success[369].

365 Threatened Species Scientific Committee (2015)
366 Fancourt (2016); Cunningham *et al.* (2022)
367 Fancourt (2016); Fancourt (2015)
368 McGregor *et al.* (2014); Hamer (2019)
369 Threatened Species Scientific Committee (2015); Fancourt *et al.* (2015)

Consideration should be given to the historical extinction on the mainland as well as the uncertainty surrounding climate induced declines. Due to the recent and continuing decline of the species[370], changes to habitat, particularly natal denning habitat, have been considered as potential impacts within the project region.

The limited nature of the permanent works is such that permanent habitat loss is extremely minor in the context of the broader area (1.02 ha of total habitat loss). Only areas proposed to contain balance tanks and pump stations will constitute permanent habitat loss in that viable habitat will be converted to inviable habitat – these areas comprise 0.06 ha of optimal denning habitat, 0.05ha of suboptimal denning habitat, and 0.91 ha of unsuitable denning habitat – all of which constitute potential foraging habitat - as per the definitions in Table 14 and with the habitat loss outlined in Table 17).

Proportionally, this loss of 1.02 ha of habitat (inclusive of 0.11 ha of potential denning habitat) constitutes 2.91-2.32 % of the average home range of an eastern quoll (35-44 ha, females and males respectively). With the species seemingly absent or persisting in low density within the Project Area, this is likely to represent an even smaller proportion of the average quoll home range in this region. This loss of habitat is not predicted to reduce occupancy or have population level impacts for the species.

Temporary disturbance of 319.83 ha of eastern quoll habitat is not predicted to have population level impacts for the species. Given the propensity of quolls to utilise agricultural and cleared land for dispersal, the area within the Construction Corridor may still be traversed during the construction phase. Minimising the timeframe of active construction in an area and prioritising revegetation will be sufficient to mitigate the possibility of eastern quolls permanently abandoning areas of temporary disturbance.

Temporary disturbance of 8.46 ha of optimal denning habitat will be confined to narrow corridors and will be proportionally small in relation to available optimal habitat within an occupying quoll's home range. It is likely that quolls affected by construction would feasibly be able to select alternate dens within their home range without shifting their range or resulting in changes to population size or density. Pre-clearance checks will identify any active or potential dens within the construction corridor and will be managed to minimise impacts to breeding quolls.

Construction activities

The physical construction of the pipeline may present additional impact pathways to eastern quolls, largely through individuals becoming trapped within open trenching, as well as additional risk of vehicle collision due to increased construction vehicle activity during construction. Mitigation measures will be applied to ensure that there are no residual impacts due to construction activities.

<u>Operation</u>

The greatest risk to this species due to the operation of the scheme is from the potential for changes in land use, as well as clearance and conversion of potential breeding and foraging habitat areas to agricultural land. With an OEMP and Farm WAPs in place, no impacts to this species are anticipated due to the operation of the SWISA.

[370] Fancourt (2016); Cunningham *et al.* (2022)

Spotted-tail quoll

Relevant published threats[371] to spotted-tail quolls include:

- Habitat loss/change
- Population fragmentation
- Competition and predation from introduced predators
- Vehicle collision mortality

Given the species is relatively non-specific in relation to terrestrial habitat use, the entire Project Area is potential habitat for general foraging/dispersal, though abundance is highly correlated with the availability of both denning habitat and prey species and connectivity with continuous forest. With mitigation measures in place for den management, introduced predators, and roadkill, potential impacts are predicted to be limited to conversion of optimal denning habitat and permanent removal of denning habitat for both quolls and their prey species due to infrastructure development. Due to their large home ranges and minimal permanent impact area, a small reduction in optimal denning habitat is not likely to have population level impacts to the species.

Construction

Habitat modification

The limited nature of the permanent works is such that permanent habitat loss is extremely minor in the context of the broader area (1.02 ha of total habitat loss). Only areas proposed to contain balance tanks and pump stations will constitute permanent habitat loss in that viable habitat will be converted to inviable habitat – these areas comprise 0.06 ha of optimal denning habitat, 0.05 ha of suboptimal denning habitat, and 0.91 ha of unsuitable denning habitat – all of which constitute potential foraging habitat - as per the definitions in Table 14 and with the habitat loss outlined in Table 17).

Proportionally, this loss of 1.02 ha of potential denning habitat constitutes approximately 0.53 % of the average home range of a spotted-tail quoll (the home range of a female spotted-tail quoll is estimated to be a minimum of 191 ha[372]). Therefore, this loss of habitat is not predicted to reduce occupancy or have population level impacts for the species.

Temporary disturbance of 8.46 ha of optimal denning habitat will be confined to narrow corridors and will be proportionally small in relation to available optimal habitat within an occupying quoll's home range. It is likely that quolls affected by construction would feasibly be able to select alternate dens within their home range without shifting their range or resulting in changes to population size or density. Pre-clearance checks will identify any active or potential dens within the construction corridor and will be managed to minimise impacts to breeding quolls.

Fragmentation

Temporary disturbance of 8.46 ha of spotted-tail quoll habitat is not predicted to have population level impacts for the species. Given the propensity of quolls to utilise agricultural and cleared land for dispersal, the area within the Construction Corridor may still be traversed during the construction phase and this will not represent a dispersal barrier for the species. Minimising the timeframe of active construction in an area and prioritising revegetation will be sufficient to mitigate the possibility of spotted-tail quolls permanently abandoning areas of temporary disturbance.

Competition and predation from introduced predators

Competition and predation from feral cats are listed as one of the threats to the spotted-tail quoll[373]. Although one study in northwestern Tasmania found no evidence that cat and spotted-tail quoll

[371] Threatened Species Section (2023a); Department of Climate Change, Energy, the Environment & Water (2024h)
[372] Troy (2014)
[373] Department of Environment, Land, Water & Planning (2016a)

abundances are negatively related[374], another found an apparent reciprocal negative association between the abundance of spotted-tail quolls and cats in areas where there is a dense canopy[375]. In this study spotted-tail quolls were found to be more abundant in native forest while cats were more often found on the edges of agricultural land where there is some cover and access to rabbits in open habitats, their favoured prey species[376]. Other factors such as the seasonal availability of young rabbits may influence cat abundance more than habitat[377].

It may be expected that cats will at least to some extent utilise the areas of cleared land within the Construction Corridor, although construction of permanent infrastructure will also constitute habitat removal for feral cats. The linear removal of forest habitat may increase the availability of preferred habitat for cats within the Project Area[378].

Immediate post-construction revegetation to similar structural complexity will provide prey refuge and mitigate the increased predation risk from any increase in cat activity. Given the current high abundance of cats and the already highly modified landscape, it is not likely that this temporary conversion of narrow sections of habitat will result in a long-term increase in cat abundance and thus will not constitute an increase in the threat to eastern quolls in the Project Area.

Predation from foxes, and wild and domestic dogs may supress quoll populations where species coexist. There are no known current occurrences of foxes or wild dogs in the Project Area, although quolls may interact with domestic dogs which can result in mortality. The project is not expected to increase interactions between quolls and dogs, provided there are restrictions prohibiting dogs on site for project-related staff and contractors.

Vehicle collision mortality

Increased traffic throughout the construction phase is not expected to result in a substantial (> 10 %) increase in road mortalities, provided a roadkill mitigation plan is in place for local roads and high-risk areas. Even without mitigation, the predicted increase of 0.2 incidents per year is minimal in the context of the average 17 devil and quoll incidents per year throughout the modelled Project Area (**Attachment F**). This would have no chance of impacting spotted-tail quolls at a population level.

Construction activities

The physical construction of the pipeline may present additional impact pathways to spotted-tail quolls, largely through individuals becoming trapped within open trenching, as well as additional risk of vehicle collision due to increased construction vehicle activity during construction. Mitigation measures will be applied to ensure that there are no residual impacts due to construction activities.

Potential impacts from construction noise at the Great Bend pump station leaves a degree of uncertainty surrounding whether construction activities may disrupt breeding cycles of this species. Ongoing investigations regarding noise modelling, impact mitigation and additional denning opportunities in the area will be addressed in a separate document (in preparation).

Operation

The greatest risk to this species due to the operation of the scheme is from the potential for changes in land use, as well as clearance and conversion of potential breeding and foraging habitat areas to agricultural land. With an OEMP and Farm WAPs in place, no impacts to this species are anticipated due to the operation of the SWISA.

[374] Fancourt *et al.* (2015); Troy (2014)
[375] Lyall (2018)
[376] Lyall (2018)
[377] Lyall (2018)
[378] McGregor *et al.* (2014); Hamer (2019)

Tasmanian devil

The relevant published threats[379] to the Tasmanian devil include:

- Devil facial tumour disease;
- Habitat loss, degradation and fragmentation; and
- Vehicle collision mortality.

Given the species is relatively non-specific in relation to terrestrial habitat use, the entire Project Area is potential habitat for general foraging/dispersal, though presence is highly correlated with the availability of both denning habitat and prey species. With mitigation measures in place for den management, introduced predators and roadkill, potential impacts are predicted to be limited to conversion of optimal denning habitat and permanent removal of denning habitat from infrastructure development. Due to their large home ranges and minimal permanent impact area, a small reduction in optimal denning habitat is not likely to have population level impacts for Tasmanian devils.

Construction

Direct impacts

Clearance will be preceded by pre-clearance surveys; these surveys reduce the risk of direct impact to devils by systematically searching habitat to ensure to dens in use are not impacted.

Devil facial tumour disease

The DFTD was first detected in Narawntapu National Park in 2011[380], with populations persisting in the presence of the disease since then. Populations in the DFTD affected regions have stabilised in the recent decades and the species shows an ability to coexist with the disease, albeit at lower densities[381]. The project is not expected to result in any behavioural changes that may increase the prevalence of the disease in the population, nor reduce habitat to a degree that it will affect population density. The secondary DFTD2 strain is currently restricted to southern Tasmania[382] and has yet to be detected north of Hobart. Given the geographic distance, is not possible that the Proposed Action could introduce DFTD2 to the Project Area.

Habitat loss and fragmentation

Primary threats outlined in the species Recovery Plan, including DFTD and low genetic diversity, have the potential to be exacerbated by reduction in habitat availability or breeding success[383].

The limited nature of the permanent works is such that permanent habitat loss is extremely minor in the context of the broader area (1.02 ha of total habitat loss). Only areas proposed to contain balance tanks and pump stations will constitute permanent habitat loss in that viable habitat will be converted to inviable habitat – these areas comprise 0.06 ha of optimal denning habitat, 0.05 ha of suboptimal denning habitat, and 0.91 ha of unsuitable denning habitat – all of which constitute potential foraging habitat - as per the definitions in Table 14 and with the habitat loss outlined in Table 17.

Proportionally, this loss of 1.02 ha of habitat (inclusive of 0.11 ha of potential denning habitat) constitutes 0.28-0.08 % of the average home range (360-1,315 ha) of a Tasmanian devil[384]. This loss of habitat is not predicted to reduce occupancy or have population level impacts for the species.

Temporary disturbance of 8.46 ha of devil habitat is not predicted to have population level impacts for the species. Given the propensity of devils to utilise agricultural and cleared land for dispersal, the area

[379] Department of Climate Change, Energy, the Environment & Water (2024f)
[380] Lazenby *et al.* (2018); Cunningham *et al.* (2021)
[381] Cunningham *et al.* (2021); Woods *et al.* (2018)
[382] Pye *et al.* (2016)
[383] Department of Primary Industries, Parks, Water & Environment (2010)
[384] Lazenby *et al.* (2018)

within the Construction Corridor may still be traversed during the construction phase and will not represent a dispersal barrier. Minimising the timeframe of active construction in an area and prioritising revegetation will be sufficient to mitigate the possibility of devils permanently abandoning areas of temporary disturbance.

Temporary disturbance to 8.46 ha of optimal denning habitat will be confined to narrow corridors and will be proportionally small in relation to available optimal habitat within an occupying devil's home range. It is likely that devils affected by construction would feasibly be able to select alternate dens within their home range without shifting their range or resulting in changes to population size or density. Pre-clearance checks will identify any active or potential dens within the construction corridor and will be managed to minimise impacts to breeding devils.

Vehicle collision mortality

Increased traffic throughout the construction phase is not expected to result in a substantial (> 10 %) increase in road mortalities, provided a roadkill mitigation plan is in place for local roads and high-risk areas. Even without mitigation, the predicted increase of 0.2 incidents per year is minimal in the context of the average 17 devil and quoll incidents per year throughout the modelled Project Area (**Attachment F**). This would have no chance of impacting Tasmanian devils at a population level.

Construction activities

The process of construction, consisting of excavation and re-filling, will be completed on a local scale within a one-to-three-day period in most cases (with discrete sections open for up to a maximum of two weeks), meaning construction related disturbance timeframes are very low. Temporary removal of groundcover may impact foraging behaviour within the Construction Corridor, although this is not predicted to have permanent or population level impacts for devils or quolls. Due to the relatively narrow corridor, impacted devils and quolls would still have access to foraging habitat within their range. Eastern quolls have relatively smaller home ranges and temporary disturbances may constitute a larger proportion of an individual foraging range, though as they are not territorial a temporary shift in range to avoid construction areas is unlikely to reduce carrying capacity at a local or regional scale.

The physical construction of the pipeline may present additional impact pathways to Tasmanian devils, largely through individuals becoming trapped within open trenching, as well as additional risk of vehicle collision due to increased construction vehicle activity during construction. Mitigation measures will be applied to ensure that there are no residual impacts due to construction activities.

Noise impacts

In light of the known Tasmanian devil dens in the vicinity of the Great Bend pump station, consideration of noise impacts to dasyurids requires consideration.

Noise levels at highway verges reach up to 80 dB; a review of fauna presence along highways in NSW found lower species diversity at road edges, potentially indicating some marsupial species avoid areas close to highways, which could be due to noise sensitivity (noting manifold anthropogenic influences in such cases can make determining proximal causes of impact difficult[385]). In Tasmania, devils and both species of quoll appear to show tolerance of ongoing noise exposure from highways, frequently utilising roads and highway verges for foraging and movement, as can be seen from spotlight surveys and road mortalities (including subadults)[386] - devils can also be found sheltering (and potentially denning) in potential den sites in relatively close proximity (<100 m) to highway noise[387]. These aspects appear to indicate that persistent or intermittent anthropogenic noise (road traffic) is not a significant deterrent

[385] Pocock & Lawrence (2005)
[386] Andersen *et al.* (2017)
[387] North Barker Ecosystem Services (Unpublished data)

on foraging, general movement or juvenile dispersal for this species, and may not render den/shelter sites inviable.

With specific regard to denning/breeding activity, although noise disturbance has been suggested to be a potential impact upon breeding success for devils[388], we are aware of no recorded cases of reproductive failure or abandonment caused by disturbance independent of vegetation removal for devils or quolls - noting such responses to disturbance have been recorded on multiple occasions for sensitive breeding species, such as eagles[389].

Sudden, erratic and acute sounds can be perceived as a threat, prompting a stress response[390]. Previous observations suggest that wild devils experience increased stress in response to man-made metallic sounds[391], and it is reasonable to assume that both the eastern and spotted-tailed quoll may react similarly to sudden or acute sounds. The severity of this kind of noise threat is unknown.

Eastern quolls and Tasmanian devils demonstrate tolerance of anthropogenic noise disturbance in breeding locations, frequently denning in areas of human use (e.g., farmhouses and residential buildings), as well as agricultural areas where surrounding land contains suitable habitat. In addition, for all of the species, noise perception within den sites is likely to be lower than outside noise levels, particularly for underground burrows and those embedded in dense mediums likely to buffer noise (e.g. logs, rock piles). Given that two denning sites, both located within abandoned mine adits occur within 100 m of the existing pump station, which was installed at the site in the late 1960's and has been continually operational for the duration, and appears to be highly active and productive, there appears to be limited reason or evidence to suggest the expected levels of operational noise could have a detrimental impact on denning activity or success.

Further modelling and investigation into the potential for impacts to breeding devils and quolls at this site have been commissioned by TI and will be addressed in a separate study.

Due to the ongoing investigations into the noise impacts on breeding devils and quolls, there is a degree of uncertainty in our assessment of residual significant impacts.

Operation

The greatest risk to this species due to the operation of the scheme is from the potential for changes in land use, as well as clearance and conversion of potential breeding and foraging habitat areas to agricultural land. With an OEMP and Farm WAPs in place, no impacts to this species are anticipated due to the operation of the SWISA.

Mitigation measures

Construction

Habitat

- Areas of optimal and suboptimal habitat must be rehabilitated using propagules from the vegetation community corresponding to the impacted community. Rehabilitation must commence within 30 days of the completion of works (i.e. a staged rehabilitation program throughout the construction phase) to allow for the fastest possible recovery and to minimise disruption to habitat values and to reduce the opportunity for feral cats to colonise recently disturbed pipeline easements. See Section 4.1.1 for further information.
- Minimising the timeframe of active construction in an area and prioritising revegetation will be sufficient to mitigate the possibility of devils or quolls abandoning the area permanently.

[388] Owen & Pemberton (2005)
[389] Threatened Species Section (2023b)
[390] Francis & Barber (2013)
[391] Kingston *et al.* (2014)

Construction activities

Minimising the length and timeframe of open trenches will reduce the disruption to devil and quoll dispersal throughout the construction area. With this in mind, the following measures must be included in the CEMP:

- Measures will be put in place such that if fauna enter any trench, there must be a sufficient number of ramps (with slopes less than 45 degrees) placed within the trench to allow animals to readily vacate the trench;
- The period trenches are open must be minimised to the maximum extent;
- Trenches must not exceed 200 m in length at any location;
- Trenches must be progressively backfilled to cover each days laid pipe;
- Open trenches must have wildlife proof fencing overnight or while operations are not in progress;
- The ends of pipe within trenches or stored pipe must be closed to ensure that fauna cannot enter the pipe; and
- Inspection of trenches prior to commencement of works each morning must occur and removal of wildlife from the trench by appropriately trained personnel. Surveillance of the open trenches in sensitive areas and the removal of wildlife from the trench must be conducted by appropriately trained personnel.

Breeding

Active dens must be managed to ensure that construction does not disrupt breeding devils and quolls or maternal dens. Two potential dens / lay ups are situated within the permanent impact footprint near the [redacted] Initial assessment of these potential dens indicates infrequent use, with an established potential maternal den located nearby. These dens will require monitoring and decommissioning as per a den and burrow management protocol (**Appendix G**).

In addition to the 2 potential den sites, an active maternal devil den was confirmed [redacted] from the Construction Corridor near the existing [redacted] and multiple adult devils were identified from cameras within 500 m, indicating this is an area of high devil density which may be critical habitat for the local population. When considering the relatively small construction footprint and the current infrastructure, it is likely that adverse impacts will be limited to the construction phase. Ongoing construction activity is proposed to occur at the [redacted] with some activities creating high levels of noise disturbance. These noise impacts may be detrimental to devils that are denning/breeding in the area and require further consideration.

- The extent and manner in which noise impacts can be mitigated will be addressed in a separate study. These investigations will include noise impact modelling, as well as further surveys within 500 m of the [redacted] to detect additional denning sites.

Vehicle collision risk

The '*Survey guidelines and management advice for development proposals that may impact on the Tasmanian Devil 2023*'[392] (the *Survey Guidelines*) outlines a process for assessing the potential impacts of developments requiring road usage on Tasmanian devils. This process focuses on identifying and mitigating impacts on devils, but the mitigation measures are also suitable for reducing road mortalities for other native fauna, including quolls. The process involves completing a traffic impact assessment, then, if Tasmanian devil roadkill mortalities are expected to increase by more than 10 % (based on equivalent predicted rise in night-time traffic for existing roads, and general increase in traffic on new roads), a roadkill assessment and roadkill mitigation plan must be completed.

[392] Environment Strategic Business Unit (2023)

A traffic impact assessment was conducted by Ratio Consultants Pty Ltd (**Attachment F**) utilising traffic data from State Highway and arterial roads throughout the Project Area and surrounds. Based on current road use and roadkill rates, and predicted project-related traffic, it is estimated that without mitigation the construction would increase roadkill incidents for all species by less than 1 % of existing rates. This includes an average maximum increase of 0.2 expected incidents involving devils or quolls per year.

This assessment refers only to major and minor arterial roads and does not include vehicle activity on local roads or private land. It could be expected that due to the current low vehicle activity on such roads (expected from farming and residential traffic) that project-related traffic may increase daily activity on these roads by greater than 10 %. Data on current roadkill rates on these roads are not available, though it could be predicted that increased traffic may result in a comparative increased risk of roadkill.

When considering the scale of the Project Area and the large variance in current traffic activity across the Construction Corridor, there may be localised areas of increased roadkill incidents. Traffic analysis predicts that 76 % of total traffic movement would be between dusk and dawn, particularly during winter periods with reduced daylight hours, with these mainly attributed to light vehicles commuting to and from work sites. Particularly in areas of high mammal activity such as the southwest region of the Project Area, this increase in risk from night driving must be strictly restricted to emergency works only. Although it is not predicted that project related traffic will lead to an overall increase of roadkill >10 % on major or arterial roads, it is a roadkill mitigation plan must be implemented across the Project Area for local roads and private land during the construction phase. This strategy is applicable to multiple other MNES, including the eastern barred bandicoot, Tasmanian masked owl, and Tasmanian wedge-tailed eagle.

Measures within the roadkill mitigation strategy (**Appendix H**) include:

- Restrict speed limits for project-related vehicles on local roads and private land to 60 km/h between dusk and dawn, with the exception of:
  - Vehicle movement in high-risk areas (such as within the Warrawee Conservation Area) is prohibited between dusk and dawn unless for emergency works;
  - Restrict operation of heavy vehicle traffic to daylight hours;
- Installing advisory warning signage in high-risk areas (high devil/quoll activity and/or low road verge visibility);
- Monitoring of mortalities along transport and commuting routes. This must include details of when, where, and species (if identifiable). Photos must be taken as part of this monitoring to assist with species identification;
- Remove any roadkill immediately (where safe to do so) to limit the likelihood of predators being attracted to roadside carcasses;
- Provisions for the rescue of injured wildlife through a specialist wildlife carer. If an animal is beyond rehabilitation, it must be euthanised in accordance with the *Best Practice Guidelines for Wildlife Rehabilitation*[393] set out by NRE.
- Reporting of any roadkill incidents.

Introduced predators

Increase in cat activity would likely be isolated to areas where additional edge habitat has been created through the removal of forest. Habitat management to increase structural complexity, such as reducing grazing or managing fire, has been shown to have long-term reduction on cat presence in both natural and production ecosystems[394].

[393] Department of Primary Industries, Parks, Water & Environment (2021b)
[394] Dorph *et al.* (2024),

Due to the narrow Construction Corridor over a large geographical space, removal of cats within the project alignment is unlikely to have a measurable effect on the local cat population in the long term. Low-level culling in open populations has even been shown to increase abundance of cats in some cases[395], therefore unless removal is high intensity, sustained and wide-ranging it would not be considered effective to mitigate increases in cat activity.

In addition to the risk threat of feral cats, interactions with domestic dogs can lead to stress, den abandonment or mortality for quolls and devils[396].

The following measures must be included in the CEMP:

- Immediate revegetation (within 30 days) of cleared areas with vegetation of equal or greater structural complexity to provide refuge for potentially impacted species. See Section 4.1.1 for further information regarding revegetation.
- Project staff and contractors must be prohibited from bringing dogs onto the site.

Post-construction

- Areas of forest cleared within the Construction Corridor will remain treeless post-works but must be rehabilitated with propagules sourced from the local area, comprised of native species from the corresponding vegetation community (**Appendix D**). See Section 4.1.1 for further information regarding revegetation.
- Woody vegetation removed during construction must be piled into windrows or log piles to increase denning potential in the area, as both quolls and devils are known to utilise such landscape features as dens[397].

<u>Operation</u>

Traffic

It is not predicted that the low levels of project related traffic during operation phase will constitute a potential increase in roadkill; however:

- Vehicle restrictions (unless for emergency works) must remain in place for all project vehicles in the Warrawee Conservation Area (and other high-risk areas) between dusk and dawn as this is an area of high activity.

Land use change

The provision of Tasmanian Irrigation water does not allow for landowners to conduct unregulated land clearance. All land irrigated with Tasmanian Irrigation water within the SWISA are subject to rigorous assessment through the Farm WAP process and the provisions of an OEMP. The risk of direct impact to dasyurid species and habitat clearance due to Tasmanian Irrigation water will be managed through the Farm WAP process, with measures in place to ensure that this species is adequately protected by applying exclusion areas and applying buffers from particular agricultural activities.

In order to mitigate the risk of impact to this species during operation of the scheme, the following actions as part of the SWISA OEMP for each SWISA irrigator property are required:

- Application of a Farm WAP for each property within the Operational Area
- Property-wide survey for potential habitat and den locations for these species.
- Application of exclusion areas and buffers from particular agricultural activities (chemical and nutrient spray, and activity changing the land use or environment within 50 m of known dens

[395] Lazenby *et al.* (2015)
[396] Holderness-Roddam & McQuillan (2014); Environment Strategic Business Unit (2023)
[397] Jones *et al.* (2023)

of these species). Any future irrigation use must occur outside of a 50 m buffer of confirmed denning sites.

By identifying distribution of denning sites for these species prior to the commencement of SWISA water application, prescription of buffer and exclusion zones, and through regulation by the Farm WAP process, impacts to this species due to clearance of native vegetation, potential impacts will be mitigated to negligible risk.

If it is determined by the Farm WAP that impacts due to the operation of the SWISA on individual properties are likely to trigger the MNES *Significant Impact Criteria*[398], individual irrigators may need to refer their action independently.

Residual significant impacts

With the above context, survey results, avoidance, impacts, and mitigation measures, an assessment of the residual impacts as a result of the construction and operation of the SWISA against the significant impact criteria[399] is provided below.

Eastern quoll

1) Lead to a long-term decrease in the size of a population

Ground searches and camera trap surveys for eastern quolls were unable to detect the species within the Project Area or the surrounding region. The species has no observation records in the NVA within 500 m of the pipeline alignment, and 3 records within the Project Area (2 of which are roadkill records) (Figure 11), with records being generally sparse in the central north of Tasmania[400]. Efforts in both field and camera surveys, along with positive detection of other native carnivores (spotted-tail quolls and Tasmanian devils) indicate that the area is sparsely or infrequently utilised and therefore does not constitute an important population for the species.

Eastern quolls persist in areas of agricultural mosaic where there is sufficient denning habitat and connectivity with continuous forest, and large areas in the south-west of the Project Area contain suitable habitat. Despite this, the lack of detection of the species indicates that factors other than habitat availability are influencing occupancy in the region. Therefore, there is no chance that changes to habitat availability of this scale would result in a long-term decrease in the size of the population.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures that prevent impact to individuals and subpopulations in the event that this species is located within the SWISA Operational Area.

Therefore, the construction and operation of SWISA **will not** lead to a long-term decrease in the size of a population.

2) Reduce the area of occupancy of the species

The conservation advice for this species[401] estimates the extent of occurrence is between 41,629 km^2 and 47,000 km^2, and the area of occupancy is estimated to be between 2,300 km^2 and 2,556 km^2.

The eastern quoll is likely absent or persists at very low densities within the Project Area. Given the presence of potentially suitable quoll habitat currently unutilised by the species, a small reduction in optimal denning habitat is not likely to be responsible for further reducing the area of occupancy of this species.

[398] Commonwealth of Australia (2013a)
[399] Commonwealth of Australia (2013a)
[400] Natural Values Atlas data – as at 11 of September 2024
[401] Threatened Species Scientific Committee (2015); Woinarski *et al.* (2014); Fancourt *et al.* (2015)

The total area of permanent impact to optimal denning habitat within the Construction Corridor is 0.06 ha, with a further 8.46 ha representing temporary disturbance during construction. The short construction timeframes are not sufficient to permanently exclude quolls from any area. All temporary disturbances will be revegetated post-construction.

The eastern quoll would be able to utilise the revegetated areas for foraging and dispersal. Mosaic habitat not directly detrimental to the species, and conversion from forest may provide foraging opportunities for the species as their presence is correlated with ecotone habitats. Additionally, the impact area is relatively narrow (typically no more than 30 m wide) and spread along the extent of the pipeline alignment, and therefore only a relatively small area of habitat will be modified, spread across multiple quoll home ranges.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that this species and potential foraging and denning habitat is located within the SWISA Operational Area.

Therefore, the construction and operation of the SWISA **will not** reduce the area of occupancy of a population.

3) Fragment an existing population into two or more populations

We are not aware of land clearance and modification of this scale or nature resulting in fragmentation of habitat for this species as it quolls utilise open areas such as pasture and grasslands for foraging, and often use linear features such as roads, corridors and shelterbelts for dispersal. The eastern quoll is likely absent or persists at very low densities within the Project Area. If the species is present in the area, the narrow corridor of clearance (5-30 m) will not constitute a dispersal barrier for eastern quolls.

The largely temporary nature of the proposed action and the very small permanent footprint changes in any one area thus will not fragment the existing population into two or more populations and is unlikely even to have a noticeable impact on individual movements at a local scale.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that this species and potential foraging and denning habitat is located within the SWISA Operational Area to mitigate against fragmentation impacts.

Therefore, the proposed construction and operation of the SWISA **will not** fragment an existing population into two or more populations.

4) Adversely affect habitat critical to the survival of a species

Habitat critical to the survival of the species has not been formally defined in a recovery plan. Eastern quolls are found in a range of vegetation types including open grassland (including farmland), tussock grassland, grassy woodland, dry eucalypt forest, coastal scrub, and alpine heathland, but is typically absent from large tracts of wet eucalypt forest and rainforest[402].

Distribution of eastern quolls is highly correlated with annual rainfall, temperature and seasonality of precipitation[403]. Species distribution models demonstrate the central north coast has low-moderate climactic suitability for eastern quoll habitat, which may explain the paucity of records in the area[404]. Highly suitable habitat for the species in Tasmania exists in the central and east regions of the state. The Project Area and greater central north region do not constitute highly suitable eastern quoll habitat and therefore is not likely to qualify as habitat critical to the survival of the species.

[402] Godsell (1983)
[403] Barlow *et al.* (2021)
[404] Barlow *et al.* (2021)

Eastern quolls are tolerant of open areas and can even benefit from the conversion of forest to pasture or grassland due to their associated increase in prey[405]. Declines due to habitat conversion have instead been attributed to the development of dense monoculture plantation forests[406].

Land clearing of this scale is not expected to have a detrimental impact to the species. The conversion of denning habitat in the Project Area is minimal (0.11 ha of permanent impact) and will increase ecotone habitat preferred for foraging. This does not represent an adverse effect on critical eastern quoll habitat. Temporary impact areas will be rehabilitated post-construction.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that this species and potential foraging and denning habitat is located within the SWISA Operational Area.

With the specified rehabilitation and operational measures in place, the proposed construction and operation of the SWISA **will not** adversely affect habitat critical to the survival of this species.

5) Disrupt the breeding cycle of a population

The eastern quoll is likely absent or persists at very low densities within the Project Area. All construction and operational impacts will be subject to a pre-clearance check and den discovery protocol within the CEMP and OEMP. Should a den be located during the application of this protocol, measures are put in place to ensure that there is no impact to breeding quolls.

Given the uncertainty of occupation and presumed low population density, there is no real chance or possibility that the construction and operation SWISA will disrupt the breeding cycle of eastern quoll at the scale of the population.

Thus, with the recommended mitigation measures in place, the proposed construction and operation of the SWISA **will not** disrupt the breeding cycle of a population.

6) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The total area of permanent impact to optimal denning habitat within the Construction Corridor is 0.06 ha, with a further 8.46 ha representing temporary disturbance during construction. The short construction timeframes are not sufficient to permanently exclude quolls from any area. All temporary disturbances will be revegetated post-construction. Additionally, the impact area is relatively narrow (typically no more than 30 m wide) and spread along the extent of the pipeline alignment, and therefore only a relatively small area of habitat will be modified, spread across multiple quoll home ranges.

Although a small area of habitat will be permanently impacted and a larger area modified due to the construction of the SWISA, this occurs in an already highly modified area. Eastern quolls in Tasmania demonstrate a high level of tolerance in modified landscapes, and their presence is positively associated with areas of agricultural-forest matrix habitats. Due to the minimal permanent impact, assumed low population size in the area, and presence of high-density stronghold populations elsewhere in the state, there is not a real probability that the loss of habitat at this scale will cause the species to decline.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that potential foraging and denning habitat is located within the SWISA Operational Area.

Based on this assessment, the construction and operation of the SWISA **will not** modify, destroy, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline.

[405] Godsell (1983)
[406] Fancourt *et al.* (2013)

7) Result in invasive species that are harmful to the species becoming established in the species' habitat

Competition and predation from feral cats are listed as a major threat to the eastern quoll[407]. Feral cats have not been directly implicated as a causal factor in the large declines in eastern quoll populations over the last 25 years[408], although large scale population impacts such as extreme weather and climactic change have reduced population sizes to a degree where they are more susceptible to other threatening processes inhibiting population recovery, such as introduced predators[409].

Fancourt *et al.* (2015) found that while there was no direct correlation between cat abundance and quoll decline, predation by feral cats may contribute to low levels of juvenile recruitment in low density populations, preventing population recovery after weather induced declines. Presence of cats may be in part responsible for the low prevalence or absence of eastern quolls in the Project Area. When considering the low-moderate climactic suitability of the area as well as the large niche overlap of quoll and cat habitat in agricultural areas, presence of cats is likely to continue to impact eastern quoll recovery.

It may be expected that cats will at least to some extent utilise the habitats generated through the conversion of forest habitat in the Construction Corridor, although construction of permanent infrastructure will also constitute habitat removal for feral cats. Post-construction revegetation to similar structural complexity will aid in mitigating permanent impacts from potential increased cat activity. Given the current high abundance of cats and the already highly modified landscape, it is not likely that this conversion of habitat will result in a further increase in cat abundance and thus will not constitute an increase in the threat to eastern quolls in the Project Area.

There is no likelihood that the Project will result in a new invasive species that are harmful to the species becoming established in the species' habitat. There are no recent credible fox sightings in Tasmania, and the Project is not expected to cause the introduction or spread of foxes in Tasmania.

Therefore, the construction and operation of the SWISA **will not** result in invasive species that are harmful to this species becoming established in the species' habitat.

8) Introduce disease that may cause the species to decline

Disease is seen as a potentially severe threat to the species (particularly on Bruny Island) based on a historical episode of rapid mortality in which the causative pathogen is unknown[410]. Disease is considered less of a threat to the mainland Tasmanian population however on account of the size of the range of the population, population density (relatively low) and genetic diversity. Toxoplasmosis, spread by domestic and feral cats in Australia, is likely present in the Project Area and can infect eastern quolls but has not been shown to reduce survival or reproduction of the species and is unlikely to be responsible for a decline in the species[411].

Currently there is no disease identified as a risk to the species and thus the construction and operation **will not** conceivably introduce any diseases that may cause the species to decline. Numerous similar projects have been undertaken in suitable habitat for the eastern quoll with no known incidences of a disease resulting from the projects.

9) Interfere with the recovery of the species

No recovery plan has been developed for this species, though conservation recommendations have been outlined in the species conservation advice[412]. Threat mitigation recommendations focus on

[407] Threatened Species Scientific Committee (2015)
[408] Fancourt (2016); Cunningham *et al.* (2022)
[409] Fancourt (2016); Fancourt (2015)
[410] Threatened Species Scientific Committee (2015)
[411] Fancourt *et al.* (2014)
[412] Threatened Species Scientific Committee (2015)

research and management of feral cats, captive breeding, translocation and supplementation of populations. As the Project Area is not situated within a region of high climactic suitability, it is unlikely to be a target of future reintroductions. Management of habitat though revegetation of cleared land will aid in mitigating potential increases in cat activity, and the project is not expected to result in long term increases in feral cat abundance throughout the region.

With mitigation measures in place, the construction and operation of the SWISA **will not** interfere with the recovery of the species.

Summary

With the recommended mitigation measures in place, our assessment is that the proposed construction and operation of the SWISA **will not** have significant residual impacts on the eastern quoll.

Spotted-tail quoll

1) Lead to a long-term decrease in the size of an important population.

The Project Area falls within the central north Tasmanian population (Figure 12), designated in the *National Recovery Plan for Spotted-tail Quolls* [413] as an important stronghold and research population[414].

Spotted-tail quolls are wide ranging and although they generally show preference for forest over pasture or grassland, agricultural matrix habitats have also been shown to support high densities of quolls[415]. Minimum home range of female quolls in Tasmania is estimated to be 191 ha, noting that this figure is from a high-density quoll population in the northwest[416]. The total area of permanent impact to optimal quoll denning habitat within the Construction Corridor is 0.06 ha, with a further 8.46 ha representing temporary disturbance during construction. In lower density populations in lower quality habitat such as that found in the Project Area, female quolls are likely to occupy even larger home ranges (550-2,486 ha)[417], meaning the total impact to optimal habitat would be less than 1.67 % of a single female's home range. Considering only 0.06 ha of this represents optimal denning habitat, this will not conceivably lead to population level decreases.

A roadkill mitigation plan will be implemented to minimise the risk of collision with project vehicles during the construction and operation of the SWISA, thus reducing the risk of direct impact to local quoll populations through vehicle collisions.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures that prevent impact to individuals and subpopulations in the event that this species is located within the SWISA Operational Area.

With the proposed mitigation measures in place, the construction and operation of SWISA **will not** lead to a long-term decrease in the size of an important population.

2) Reduce the area of occupancy of an important population.

The subspecies *Dasyurus maculatus maculatus*, is restricted to Tasmania. The species has an estimated population size of ~5,700 individuals in Tasmania as of 2016[418]. The listing statement for this species[419] estimates the extent of occurrence is 75,696 km^2, and the area of occupancy is estimated to be 4,536 km^2.

[413] Department of Environment, Land, Water & Planning (2016a)
[414] Threatened Species Section (2023a)
[415] Troy (2014)
[416] Troy (2014)
[417] Hamer *et al.* (2021)
[418] Threatened Species Section (2023a)
[419] Threatened Species Section (2023a)

The total area of permanent impact to optimal denning habitat within the Construction Corridor is 0.06 ha, with a further 8.46 ha representing temporary disturbance during construction. The short construction timeframes are not sufficient to permanently exclude quolls from any area. All temporary disturbances will be revegetated post-construction.

Spotted-tail quolls are tolerant of fragmented landscapes, as demonstrated by their presence within farmland matrix habitat throughout the Project Area. The presence of areas of suitable denning habitat and patches of structurally complex woody vegetation (shelter belts, linear corridors and small forest islands) facilitate the persistence of quolls in agricultural areas[420]. Given the large home range sizes and minimal impact on optimal denning habitat in the context of the home range of an individual quoll[421], it is likely that impacted quolls would feasibly be able to access alternate denning and hunting territory within their home range without shifting their range or resulting in changes to population size or density. Reduction in vegetation cover in small sections may even increase hunting opportunities as the species is an opportunistic ambush predator and is known to utilise corridors and forest edges for foraging.

Additionally, the impact area is relatively narrow (typically no more than 30 m wide) and spread along the length of the pipeline alignment, and therefore only a relatively small area of habitat will be modified, spread across multiple quoll home ranges.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that this species and potential foraging and denning habitat is located within the SWISA Operational Area.

Therefore, the construction and operation of the SWISA **will not** reduce the area of occupancy of an important population.

3) Fragment an existing important population into two or more populations.

We are not aware of land clearance and modification of this scale or nature resulting in fragmentation of habitat for this species as it quolls can utilise areas within fragmented landscapes, including corridors and edges, for foraging, dispersal and breeding[422]. Given the relative narrowness of Construction Corridor (between 5-30 m), and the ability for spotted-tail quolls to move through fragmented landscapes, the project poses no risk of fragmenting the local population of quolls or the central north population more broadly.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that this species and potential foraging and denning habitat is located within the SWISA Operational Area to mitigate against fragmentation impacts.

Therefore, the proposed construction and operation of the SWISA **will not** fragment an existing important population into two or more populations.

4) Adversely affect habitat critical to the survival of a species.

Habitat critical to the survival of the spotted-tail quoll includes large patches of forest with adequate denning resources and relatively high densities of medium-sized mammalian prey, however, threshold densities of these critical components has not been researched[423]. Spotted-tail quolls are relatively non-specific in their habitat use in Tasmania, with occurrence associated mainly with prey availability and

[420] Troy (2014); Hamer *et al.* (2021)
[421] Hamer *et al.* (2021)
[422] Hendersen *et al.* (2023)
[423] Department of Environment, Land, Water & Planning (2016)

presence of den sites[424]. Although this species can tolerate and even occur at persistent high densities in fragmented landscapes, areas of forest (especially tall forest) are important to the species[425].

In terms of forest, the proposed construction will result in the conversion of 3.74 ha of forest communities within the Construction Corridor, some of which support abundant populations of small to medium-sized prey species. Throughout the majority of the Survey Area, forest is contained within small remnant patches surrounded by modified land. Particularly in the north-east of the Site, quolls persist in very small remnant forest patches entirely separated from contiguous forest. Although the species is present within this highly modified landscape, these forest patches are not representative of habitat critical to the species.

Removal of narrow corridors is not likely to have an adverse effect on prey densities, as small mammals such as bandicoots and rodents are highly tolerant of agricultural matrix habitat, and increased edge habitat may temporarily increase hunting success for predators such as spotted-tail quolls. Even prior to post-construction revegetation, this these corridors will represent valuable foraging territory for the species.

Forests remnants are likely to contain suitable denning habitat for spotted-tail quolls in the form of hollow logs and trees, rocks or dense shrubs and sedges. Presence of denning features is considered a factor in determining critical habitat for the species. Areas of forest cleared within the Construction Corridor will remain treeless post works but will be rehabilitated with grassy and shrubby vegetation present in the local area. This will not necessarily reduce denning availability as felled trees could remain on site in windrows and log piles which can be utilised by quolls. Even in the case that this is unfeasible, with clearance confined to narrow corridors, there is likely to be sufficient alternative denning habitat within the home range of any affected individual quoll and they would not be required to shift their range.

Habitat within the Construction Corridor is not representative of critical habitat for the species, and even so, conversion and temporary clearance of 3.74 ha of forest is not expected to reduce presence of prey species or denning opportunities to such a degree that spotted-tail quolls will abandon an area.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that this species and potential foraging and denning habitat is located within the SWISA Operational Area.

With the specified rehabilitation and operational measures in place, the proposed construction and operation of the SWISA **will not** adversely affect habitat critical to the survival of this species.

5) Disrupt the breeding cycle of an important population.

The proposed Construction Corridor does not encroach within the central north spotted-tail quoll important population area. Even if an important population were to be present within the Survey Area, at a local scale, where suitable dens could be impacted, the large home range of an individual quoll would suggest it is feasible that breeding quolls could locate alternative breeding dens without shifting their home range.

Potential impacts from construction noise at the Great Bend pump station leaves a degree of uncertainty surrounding whether construction activities may disrupt breeding cycles of this species. Ongoing investigations regarding noise modelling, impact mitigation and additional denning opportunities in the area will be addressed in a separate document (in preparation). As it currently stands, there are verified denning structures in this area, however no maternal breeding activities of spotted-tail quolls have been recorded here to date. Prohibiting works within the maternal denning season will limit

[424] Troy (2014)

[425] Troy (2014); Lyall (2018)

impacts to an individual breeding cycle, however it is unknown whether ongoing works outside of the maternal denning period may lead to den abandonment, thus jeopardising future breeding opportunities.

All other construction and operational impacts will be subject to a pre-clearance check and den discovery protocol within the CEMP and OEMP. Should a den be located during the application of this protocol, measures are put in place to ensure that there is no impact to breeding quolls.

As the proposed action will not impact upon any populations of this species, the proposed construction and operation of the SWISA **is unlikely** to disrupt the breeding cycle of an important population of this species, however there is a **level of uncertainty** that requires further investigation.

6) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

The total area of permanent impact to optimal denning habitat within the Construction Corridor is 0.06 ha, with a further 8.46 ha representing temporary disturbance during construction. The short construction timeframes are not sufficient to permanently exclude quolls from any area. All temporary disturbances will be revegetated post-construction. Additionally, the impact area is relatively narrow (typically no more than 30 m wide) and spread along the extent of the pipeline alignment, and therefore only a relatively small area of habitat will be modified, spread across multiple quoll home ranges.

Forest cover is important to the species, and within the total disturbance area only 3.74 ha of forest (both native and silvicultural) will be impacted. Also, although a small area of habitat will be lost and a larger area modified, this occurs in an already highly modified area. Spotted-tail quolls in Tasmania demonstrate a high level of tolerance in modified landscapes, as demonstrated by detections of quolls in agricultural matrix throughout the Survey Area. For these reasons there is not a real probability that the loss of habitat at this scale will cause the species to decline.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that potential foraging and denning habitat is located within the SWISA Operational Area.

Based on this assessment, the construction and operation of the SWISA **will not** modify, destroy, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline.

7) Result in invasive species that are harmful to the species becoming established in the species' habitat.

Competition and predation from feral cats is listed as one of the threats to spotted-tail quoll[426]. Although one study in northwestern Tasmania found no evidence that cat and spotted-tail quoll abundances are negatively related[427], another found an apparent reciprocal negative association between the abundance of spotted-tail quolls and cats in areas where there is a dense canopy[428]. In this study spotted-tail quolls were found to be more abundant in native forest while cats were more often found on the edges of agricultural land where there is some cover and access to rabbits in open habitats, their favoured prey species[429]. Other factors such as the seasonal availability of young rabbits may influence cat abundance more than habitat[430].

It may be expected that cats will at least to some extent utilise the modified habitats generated through the conversion of forest habitat in the Project Area, although construction of permanent infrastructure will also constitute habitat removal for feral cats. Given the current high abundance of cats and the

[426] Department of Environment, Land, Water and Planning (2016a)
[427] Fancourt *et al.* (2015); Troy (2014)
[428] Lyall (2018)
[429] Lyall (2018)
[430] Lyall (2018)

already highly modified landscape, it is not likely that this conversion of habitat will result in an increase in cat presence to a degree that will influence the spotted-tail quoll population.

There is no likelihood that the project will result in a new invasive species that are harmful to the species becoming established in the species' habitat. There are no recent credible fox sightings in Tasmania, and the project is not expected to cause the introduction or spread of foxes in Tasmania.

Therefore, the construction and operation of the SWISA **will not** result in invasive species that are harmful to this species becoming established in the species' habitat.

8) Introduce disease that may cause the species to decline.

There are no diseases identified as a risk to the species in the recovery plan[431], and the construction and operation of the SWISA **will not** conceivably introduce any diseases that may cause the species to decline and is thus not considered to be a risk for the project.

9) Interfere substantially with the recovery of the species.

Recovery objectives for the spotted-tail quoll are outlined in the National Recovery Plan[432]. The focus of the recovery plan is to reduce the impact on threatening processes to halt the decline in the species distribution and abundance. Threat mitigation actions will ensure relevant recovery objectives outlined in the plan relating to introduced predators and road mortality will not be impacted. The clearance and conversion of habitat may be considered to interfere with the objective *"Reduce the rate of habitat loss and fragmentation on private land.",* though this objective focuses on the encouragement of private landholders to enter into covenant agreements to protect quoll habitat. The narrow Construction Corridor will not necessarily preclude landowners from applying voluntary conservation covenants to their property, and as converted land will still represent habitat for spotted-tail quolls, this will not significantly reduce the habitat available for protection.

This construction and operation of the SWISA **will not** substantially interfere with the recovery of the species.

Summary

With the recommended mitigation measures in place, our assessment is that the proposed construction and operation of the SWISA **is unlikely** to have significant residual impacts on the spotted-tail quoll, however there is a **level of uncertainty** surrounding the impact on breeding activities due to noise disturbance at the Great Bend pump station, which is subject to ongoing investigations.

Tasmanian devil

1) Lead to a long-term decrease in the size of a population

A 'population of a species' is defined under the EPBCA as an occurrence of the species in a particular area, including 'a geographically distinct regional population' or 'a population, or collection of local populations, that occurs within a particular bioregion'. The SPRAT profile for Tasmanian devils divides them into two genetically distinct populations[433]:

1) northwestern; and
2) eastern/southwestern

The Construction Corridor (322.96 ha) is within the known geographical and ecological range of the eastern/southwestern population (which in total has a range of 50,630 km^2 [434]) and overlaps with the core range of the species; defined on the Tasmanian Natural Values Atlas as the area within the known

[431] Department of Environment, Land, Water & Planning (2016a)
[432] Department of Environment, Land, Water & Planning (2016a)
[433] Department of Climate Change, Energy, the Environment & Water (2024f)
[434] Department of Climate Change, Energy, the Environment & Water (2024f)

range known to support the highest densities of the species and/or thought to be of greatest importance for the maintenance of breeding populations of the species.

Estimated population of Tasmanian devils was predicted to be ~17,000 individuals as of 2020, with species declines expected to continue due to the spread of DFTD across their range[435].

The total area of permanent impact to optimal devil denning habitat within the Construction Corridor is 0.06 ha, with the remaining 8.46 ha representing temporary disturbance, which will be rehabilitated post-construction. When considered in context of mean devil density in the nearby Narawntapu National Park of 0.31 (0.19-0.51) devils per km^2, the cumulative permanent impacts to devil denning habitat will remove optimal habitat for 0.002 devils[436] (i.e. the total cumulative habitat removed would support far less than a single devil). The project will therefore not lead to a decrease in the size of this devil population as the area within which impacts are contained is simply too small in proportion to the overall population area.

A roadkill mitigation plan will be implemented to minimise the risk of collision with project vehicles during the construction and operation of the SWISA, thus reducing the risk of direct impact to local devil subpopulations through vehicle collisions.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures that prevent impact to individuals and subpopulations in the event that this species is located within the SWISA Operational Area.

With the proposed mitigation measures in place, the construction and operation of SWISA **will not** lead to a long-term decrease in the size of an important population.

2) Reduce the area of occupancy of the species

The Tasmanian devil is found throughout Tasmania, with the exception of offshore islands, as such, the extent of occurrence is equivalent to the area of mainland Tasmania (~64,000 km^2). With devil occurrences continuous across this area, the estimated area of occupancy is also ~64,000 km^2.

The SPRAT profile for Tasmanian devils divides them into two genetically distinct populations[437]:

1) northwestern; and
2) eastern/southwestern

The Construction Corridor (322.96 ha) is within the known geographical and ecological range of the eastern/southwestern population (which in total has a range of 50,630 km^2 [438]) and overlaps with the core range of the species; defined on the Tasmanian Natural Values Atlas as the area within the known range known to support the highest densities of the species and/or thought to be of greatest importance for the maintenance of breeding populations of the species. Home ranges for adult devils range from 360-1,315 ha[439] with younger animals occupying larger home ranges.

Given the large home range sizes and minimal impact (0.08 ha of temporary and permanent impacts) on optimal denning habitat in the context of the home range of an individual devil (0.02 % of the minimum home range), it is likely that impacted individuals would feasibly be able to access alternate denning and hunting territory within their home range without shifting their range or resulting in changes to population size or density.

[435] Cunningham *et al.* (2021)
[436] Lazenby *et al.* (2018)
[437] Department of Climate Change, Energy, the Environment & Water (2024f)
[438] Department of Climate Change, Energy, the Environment & Water (2024f)
[439] Lazenby *et al.* (2018)

Tasmanian devils will therefore continue to utilise the same areas post-construction, and the area of occupancy will not be reduced by the development of the project.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that this species and potential foraging and denning habitat is located within the SWISA Operational Area.

Therefore, the construction and operation of the SWISA **will not** reduce the area of occupancy of a population.

3) Fragment an existing population into two or more populations

Devils are resilient to habitat fragmentation[440]. To fragment a population into two or more populations, this project would have to create a barrier that devils could not/would not cross, for example an extensive open area of open country and isthmus'[441]. Construction instead involves a relatively narrow strip of disturbance, mostly being temporary impacts from the point of the ecology of the devil. Devils readily move through human-modified landscapes and will even select roads for movement and foraging[442], so the project will not fragment the existing population.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that this species and potential foraging and denning habitat is located within the SWISA Operational Area to mitigate against fragmentation impacts.

Therefore, the proposed construction and operation of the SWISA **will not** fragment an existing population into two or more populations.

4) Adversely affect habitat critical to the survival of a species

The Draft Tasmanian Devil Recovery Plan[443] states that critical devil habitat includes 'all disease-free areas within mainland Tasmania with suitable devil habitat', 'all areas of pre-disease core habitat', and 'areas that may be required under the recovery program for the future introduction of Tasmanian devils'.

The entire north coast is in the range of pre-disease core habitat[444]. DFTD has been present in the area since at least 2011[445].

The project has a permanent infrastructure footprint of 1.02 ha. Impact to the remaining 319.83 ha is temporary and will not permanently remove foraging and denning habitat beyond the permanent impact areas. These areas will be rehabilitated post-construction and will continue to provide habitat for both foraging and denning. It is not expected that the project will adversely affect habitat critical to the survival of Tasmanian devil.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that this species and potential foraging and denning habitat is located within the SWISA Operational Area.

With the specified rehabilitation and operational measures in place, the proposed construction and operation of the SWISA **will not** adversely affect habitat critical to the survival of this species.

[440] Andersen *et al.* (2017a)
[441] Thalmann *et al.* (2016)
[442] Andersen *et al.* (2017a)
[443] Department of Primary Industries, Parks, Water & Environment (2010)
[444] Department of Primary Industries, Parks, Water & Environment (2010)
[445] Lazenby *et al.* (2018); Cunningham *et al.* (2021)

5) Disrupt the breeding cycle of a population

Potential impacts from construction noise at [redacted] leaves a degree of uncertainty surrounding whether construction activities may disrupt breeding cycles of this species. Ongoing investigations regarding noise modelling, impact mitigation and additional denning opportunities in the area will be addressed in a separate document (to be completed at a later date). As it currently stands, there are verified denning structures in this area, and confirmed maternal breeding activities of Tasmanian devils has been recorded at one of the den sites in the Survey Area. Prohibiting works within the maternal denning season will limit impacts to an individual breeding cycle, however it is unknown whether ongoing works outside of the maternal denning period may lead to den abandonment, thus jeopardising future breeding opportunities.

All other construction and operational impacts will be subject to a pre-clearance check and den discovery protocol within the CEMP and OEMP. Should a den be located during the application of this protocol, measures are in place to ensure that there are no impacts to breeding quolls.

As the proposed action will not impact upon any populations of this species, the proposed construction and operation of the SWISA **is unlikely** to disrupt the breeding cycle of an important population of this species, however there is a **level of uncertainty** that requires further investigation.

6) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The total area of permanent impact to optimal denning habitat within the Construction Corridor is 0.06 ha, with a further 8.46 ha representing temporary disturbance during construction. The short construction timeframes are not sufficient to permanently exclude devils from any area. All temporary disturbances will be revegetated post-construction. Additionally, the impact area is relatively narrow (typically no more than 30 m wide) and spread along the extent of the pipeline alignment, and therefore only a relatively small area of habitat will be modified, spread across multiple home ranges.

Devils demonstrate a high level of tolerance in modified landscapes, as demonstrated by detections of devils in agricultural matrix throughout the survey area. For these reasons there is not a real probability that the modification of habitat at this scale will cause the species to decline.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures in the event that potential foraging and denning habitat is located within the SWISA Operational Area.

Based on this assessment, the construction and operation of the SWISA **will not** modify, destroy, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline.

7) Result in invasive species that are harmful to the species becoming established in the species' habitat

There is no likelihood that the project will result in an invasive species that are harmful to the species becoming established in the species' habitat. There are no recent credible fox sightings in Tasmania, and the project is not expected to cause the introduction or spread of foxes in Tasmania.

The risk of feral cats to devils is not a consideration due to the likely suppression of cats by devils and the lack of evidence of any detrimental impacts from cats to devils[446].

Therefore, the construction and operation of the SWISA **will not** result in invasive species that are harmful to this species becoming established in the species' habitat.

8) Introduce disease that may cause the species to decline

[446] Fancourt *et al.* (2015)

The presence of DFTD1 in the area was first detected in 2011[447], with populations persisting in the presence of the disease since then. The secondary DFTD2 strain is currently restricted to southern Tasmania[448] and has yet to be detected north of Hobart. Given the geographic distance, is not possible that the construction and operation of the SWISA could introduce DFTD2 to the Project Area.

Thus, the construction and operation of the SWISA **will not** introduce disease that may cause the species to decline.

9) Interfere with the recovery of the species

The main threat to the Tasmanian devil is DFTD, and the recovery of the species is contingent on work to manage this disease and cultivate safeguards against the loss of all wild individuals. Currently the recovery of the Tasmanian devil is based around the work being undertaken by the 'Save the Tasmanian Devil Program'. The draft Tasmanian Devil Recovery Plan[449] identifies the following actions:

1) Maintain and manage insurance populations;
2) Manage DFTD in the wild;
3) Monitor Tasmanian devils;
4) Conduct disease investigations;
5) Manage other threats in the wild;
6) Research and measure habitat variables;
7) Coordinate recovery program; and
8) Communicate with the community and stakeholders.

The project is not expected to interfere with any of these efforts. 'Other threats' in Action 5 include the threat of foxes in Tasmania, collisions with vehicles, habitat loss and illegal culling. As outlined above, the project is unlikely to cause significant habitat loss for devils. Roadkill mitigation measures are to be put in place to limit the potential for collisions from project vehicles. These measures will minimise risks to the component of the local devil population from the increased traffic during construction.

Thus, with the recommended mitigation measures in place, the project **will not** interfere with the recovery of this species.

Summary

With the recommended mitigation measures in place, our assessment is that the proposed construction and operation of the SWISA **is unlikely** to have significant residual impacts on the Tasmanian devil, however there is a **level of uncertainty** surrounding the impact on breeding activities due to noise disturbance at the Great Bend pump station, which is subject to ongoing investigations.

[447] Lazenby *et al.* (2018); Cunningham *et al.* (2021)
[448] Pye *et al.* (2016)
[449] Department of Primary Industries, Parks, Water and Environment (2010)

4.3.1.2 Eastern barred bandicoot *(Perameles gunnii gunnii)*

Context

Conservation status

The Tasmanian subspecies of the eastern barred bandicoot *(Perameles gunnii gunnii)* was listed as vulnerable under the EPBC Act in 2000[450], with conservation advice published in 2008[451]. Prior to the EPBC Act, it was listed as vulnerable under the Commonwealth *Endangered Species Protection Act 1992*[452]. No recovery plan has been developed for the Tasmanian subspecies[453].

The eastern barred bandicoot is not listed under the TSP Act.

Ecology

Eastern barred bandicoots are small marsupials up to around 35 cm long, weighing between 500 and 1,450 g, with distinctive pale bars on their hindquarters[454]. They feed primarily on invertebrates, although will also consume some plants and fungi. They forage in grasslands and grassy woodlands, including on agricultural land, and typically nest above ground in grass-lined nests in tussocks or shrubs.

Average home ranges for the species are 4.29 ha for males and 2.34 ha for females, and individuals are somewhat territorial with little same-sex overlap between ranges[455]. The species is short-lived, surviving 2-3 years. They breed year-round in favourable conditions, producing litters of 1 – 5 young that disperse around three months[456].

Habitat

There is no defined description of habitat critical to the survival of this species, however the eastern barred bandicoot occurs in native grasslands, grassy woodlands and forests, and areas of agricultural and pastural development where there are areas of dense ground cover[457]. Given the relatively restricted range of this species, for the purposes of this assessment, habitat critical to survival of the species is defined as all areas that meet the habitat description above.

Ground cover is considered a critical habitat feature for nesting and shelter, although vegetation structure is more relevant than composition. Bandicoots are relatively non-selective in the types of ground cover they prefer and will utilise areas of weed cover such as blackberry and gorse, as well as native grass and shrub cover. Conversion of forest to agriculture has provided additional habitat for the species, where areas of dense ground cover are dispersed among areas of pasture, crops, and weeds[458].

Population parameters

The most recent population estimates for the eastern barred bandicoots in Tasmania suggest there is 20,000 individuals, which is declining[459]. The species has declined significantly throughout its historical range in the Midlands[460] though is currently considered locally common in some areas of the state due to range expansion. Estimates suggest that there are >10 subpopulations distributed across Tasmania.

450 Commonwealth of Australia (2000)
451 Department of the Environment, Water, Heritage & the Arts (2008a)
452 Department of the Environment, Water, Heritage & the Arts (2008a)
453 Department of Climate Change, Energy, the Environment & Water (2024i)
454 Menkhorst & Seebeck (2023)
455 Mallick *et al.* (2000)
456 Menkhorst & Seebeck (2023)
457 Driessen *et al.* (1996)
458 Mallick *et al.* (1997); Menkhorst & Seebeck (2023)
459 Burbidge *et al.* (2014)
460 Driessen *et al.* (1996); Mallick *et al.* (1997)

According to the Action Plan for Australian Mammals 2012[461], the estimated extent of occurrence of is 602 km^2, and the area of occupancy is estimated to be 16 km^2, both ranges are estimated with a low level of reliability.

Distribution and site significance

The species has 15 observation records on the NVA attributed to within 500 m of the pipeline alignment and a further 108 records attributed to within the Project Area, the most recent being in 2024 [462]. A total of 34 of these records are attributed to roadkill. Figure 20 displays the distribution of eastern barred bandicoot records listed on the NVA in relation to the Project Area.

SWIS management actions

This species was discussed in the referral / preliminary documentation process for the SWIS project[463], however it was deemed to not be at risk of any impacts due to the construction or operation of the SWIS with mitigation measures in place. The development of Farm WAPs was the only management action that was required as a condition of approval of the SWIS as a controlled action.

Threats

The primary listed threats[464] for this species include:

- Clearing of habitat, particularly through the removal of ground cover that may provide shelter. Land clearance in this context refers specifically to clearance of large areas of ground cover in both native and agricultural areas, including weeds;
- Predation by introduced predators such as feral cats, foxes and domestic dogs[465]; and
- Toxoplasmosis, which can be fatal in the species[466]. Toxoplasmosis is spread through cats as the definitive host. Due to the high level of cat activity and the generally high seroprevalence of the disease in Tasmania[467], it can be expected that toxoplasmosis is already present within the Project Area.

Survey methods

Camera surveys were utilised to detect the presence of eastern barred bandicoots across the Project Area. As the species co-occurs with the southern brown bandicoot throughout their range, direct detection techniques are recommended to distinguish between bandicoot species.

Thirty-nine cameras were deployed for an average of 63 nights (range 14 - 93), between December 4th, 2023 and March 6th, 2024, totalling 2,462 trap nights. Survey locations were primarily concentrated within 200 m of the Construction Corridor, spread throughout the Project Area (see camera locations in Figure 17). As the species is predominantly associated with agricultural mosaics, most of the Project Area represents suitable habitat for the species. Although locations were not targeted specifically for eastern barred bandicoots, it was expected that if present, the species would likely be detected in camera surveys.

Survey findings

Camera surveys detected eastern barred bandicoots on 4 occasions over 2,462 total trap nights (<0.01 detections per trap night). Eastern barred bandicoots were detected at only one location at the intersection of a small remnant patch of wet forest and pasture in the southwest of the Project Area (east of Native Plains Road, near Panatana Rivulet). As they are not uniquely patterned, it is unknown if

[461] Burbidge *et al.* (2014)
[462] Natural Values Atlas data – as at 11 of September 2024
[463] Referral EPBC: 2010 / 5327; Tasmanian Irrigation Development Board (2010)
[464] Department of the Environment, Water, Heritage & the Arts (2008a)
[465] Department of the Environment, Water, Heritage & the Arts (2008a); Threatened Species Section (2024k)
[466] Bettiol *et al.* (2000)
[467] Fancourt & Jackson (2014)

this is one or multiple individuals. The lack of detection in other areas does not necessarily relate to the absence of the species, though detection of southern brown bandicoots across the Project Area suggests that eastern barred bandicoots, if present, are likely to persist at very low densities.

Impact pathways

The primary impact pathway to the eastern barred bandicoot relevant to the construction of the SWISA include:

- The clearance of habitat and the removal of ground cover that may provide shelter for bandicoots;
- Mortality due to collision with vehicles;
- Entrapment within construction trenching;
- Predation by introduced predators such as feral cats and domestic dogs[468].

There are no likely operational impact pathways to this species.

Avoidance

Eastern barred bandicoot habitat is ubiquitous across the agricultural, grassland and woodland habitats in the project region, and all habitat with sufficient cover could be potentially suitable for foraging and nesting. As such, beyond minimising the construction footprint, it is unfeasible to adjust the alignment of the Construction Corridor to avoid potential habitat of the eastern barred bandicoot. Priority instead has been given to mitigation of the potential impacts of construction and land clearance.

Impacts

Construction

A total of 319.83 ha (99.68 %) of the impact footprint within the Construction Corridor, from the long-term perspective of eastern barred bandicoot habitat use, represents temporary habitat disturbance, with the extent of the pipeline post-works once more becoming viable habitat for foraging and dispersal. Temporary removal of small areas of ground cover is unlikely to permanently negatively impact the local population of eastern barred bandicoots. Revegetation to similar pre-clearance complexity will allow the persistence of eastern barred bandicoots without reducing occupancy for the species.

During this period of rehabilitation, the recovering ground may not contain suitable foraging habitat due to lack of refugia, though the narrow corridor will not constitute a dispersal barrier for the species. When considering their presumed low density, temporary range shifts away from cleared areas would not have population level impacts as habitat availability is unlikely to be the limiting factor for the bandicoot population in the Project Area.

Removal of trees and shrubs within the construction corridor and surrounding permanent infrastructure will likely benefit the species through increasing foraging habitat, as they are positively associated with the conversion of forest to agriculture[469].

The limited nature of the permanent works is such that permanent habitat loss is extremely minor in the context of the broader area (1.02 ha of total habitat loss). Only areas proposed to contain balance tanks and pump stations will constitute permanent habitat loss in that viable habitat will be converted to inviable habitat.

Proportionally, this loss of 1.02 ha of habitat constitutes 65.96 % of the average home range of a single female eastern barred bandicoot. Despite this, given the presumed low density and presence of suitable habitat throughout the region, it is likely that factors other than habitat availability are influencing the

[468] Department of the Environment, Water, Heritage & the Arts (2008a); Threatened Species Section (2024k)
[469] Mallick *et al.* (1997)

carrying capacity of this population. Therefore, this loss of habitat is not predicted to reduce occupancy or have population level impacts for the species.

Operation

The greatest risk to this species due to the operation of the scheme is from the potential for changes in land use, as well as clearance and conversion of potential breeding and foraging habitat areas to agricultural land. With an OEMP and Farm WAPs in place, no impacts to this species are anticipated due to the operation of the SWISA.

Mitigation measures

Construction

Habitat

The following habitat management measures must be included in the CEMP:

- Native vegetation habitat must be rehabilitated using propagules from the corresponding vegetation community to that which is impacted. Rehabilitation must commence within 30 days of the completion of works (i.e. a staged rehabilitation program throughout the construction phase) to allow for the fastest possible recovery and to minimise disruption to habitat values and to reduce the opportunity for feral cats to colonise recently disturbed pipeline easements. See **Section 4.1.1** for further information.

Construction activities

Minimising the length and timeframe of open trenches will reduce the disruption to eastern barred bandicoot dispersal throughout the construction area. With this in mind, the following measures must be included in the CEMP:

- Measures will be put in place such that if fauna enter any trench, there must be a sufficient number of ramps (with slopes less than 45 degrees) placed within the trench to allow animals to readily vacate the trench;
- The period trenches are open must be minimised to the maximum extent;
- Trenches must not exceed 200 m in length at any location;
- Trenches must be progressively backfilled to cover each days laid pipe;
- Open trenches must have wildlife proof fencing overnight or while operations are not in progress;
- The ends of pipe within trenches or stored pipe must be closed to ensure that fauna cannot enter the pipe; and
- Inspection of trenches prior to commencement of works each morning must occur and removal of wildlife from the trench by appropriately trained personnel. Surveillance of the open trenches in sensitive areas and the removal of wildlife from the trench must be conducted by appropriately trained personnel.

Introduced predators

Clearance of linear corridors has the potential to increase the activity of feral and free roaming cats within the Construction Corridor, which may increase predation risk for eastern barred bandicoots. The high abundance of cats may already be a contributing factor in the scarcity of bandicoots throughout the Project Area. Due to the narrow Project Area over a large geographical space, removal of cats within the Construction Corridor is unlikely to have a measurable effect on the local cat population in the long term. Mitigation of any increase in cat activity can be achieved through the immediate revegetation of cleared areas with vegetation of equal or greater structural complexity to provide refuge for eastern barred bandicoots.

In addition to the risk threat of feral cats, interactions with domestic dogs can lead to stress or mortality for eastern barred bandicoots.

The following measures must be included in the CEMP:

- Immediate revegetation (within 30 days) of cleared areas with vegetation of equal or greater structural complexity to provide refuge for potentially impacted species. See Section 4.1.1 for further information regarding revegetation.
- Project staff and contractors must be prohibited from bringing dogs onto the site.

Roadkill

Application of the roadkill mitigation strategy (**Appendix H**) will sufficiently mitigate the vehicle collision risk to this species.

Operation

Outside of permanent infrastructure, the installation of the pipeline will result in no habitat change post works and/or have a very rapid return to equivalent habitat value (e.g. less than 6 months) facilitated by revegetation commitments. Areas of forest cleared within the Construction Corridor will remain treeless post works but will be rehabilitated with grassy and shrubby vegetation present in the local area. Eastern barred bandicoots are positively associated with the conversion of forest[470] and this will likely increase the foraging area for eastern barred bandicoots.

The provision of Tasmanian Irrigation water does not allow for landowners to conduct unregulated land clearance. All land irrigated with Tasmanian Irrigation water within the SWISA are subject to rigorous assessment through the Farm WAP process and the provisions of an OEMP. The risk of direct impact to eastern barred bandicoots due to Tasmanian Irrigation water will be managed through the Farm WAP process, with measures in place to ensure that this species is adequately protected by applying exclusion areas and applying buffers from particular agricultural activities.

In order to mitigate the risk of impact to this species during operation of the scheme, the following actions as part of the SWISA OEMP are required:

- Application of a Farm WAP for each property within the Operational Area;
- Retain and enhance native vegetation cover in and around habitat sites; and
- Retain and protect connective habitat corridors.

If it is determined by the Farm WAP that impacts due to the operation of the SWISA on individual properties are likely to trigger the MNES *Significant Impact Criteria*[471], individual irrigators may need to refer their action independently.

[470] Mallick *et al.* (1997)
[471] Commonwealth of Australia (2013a)

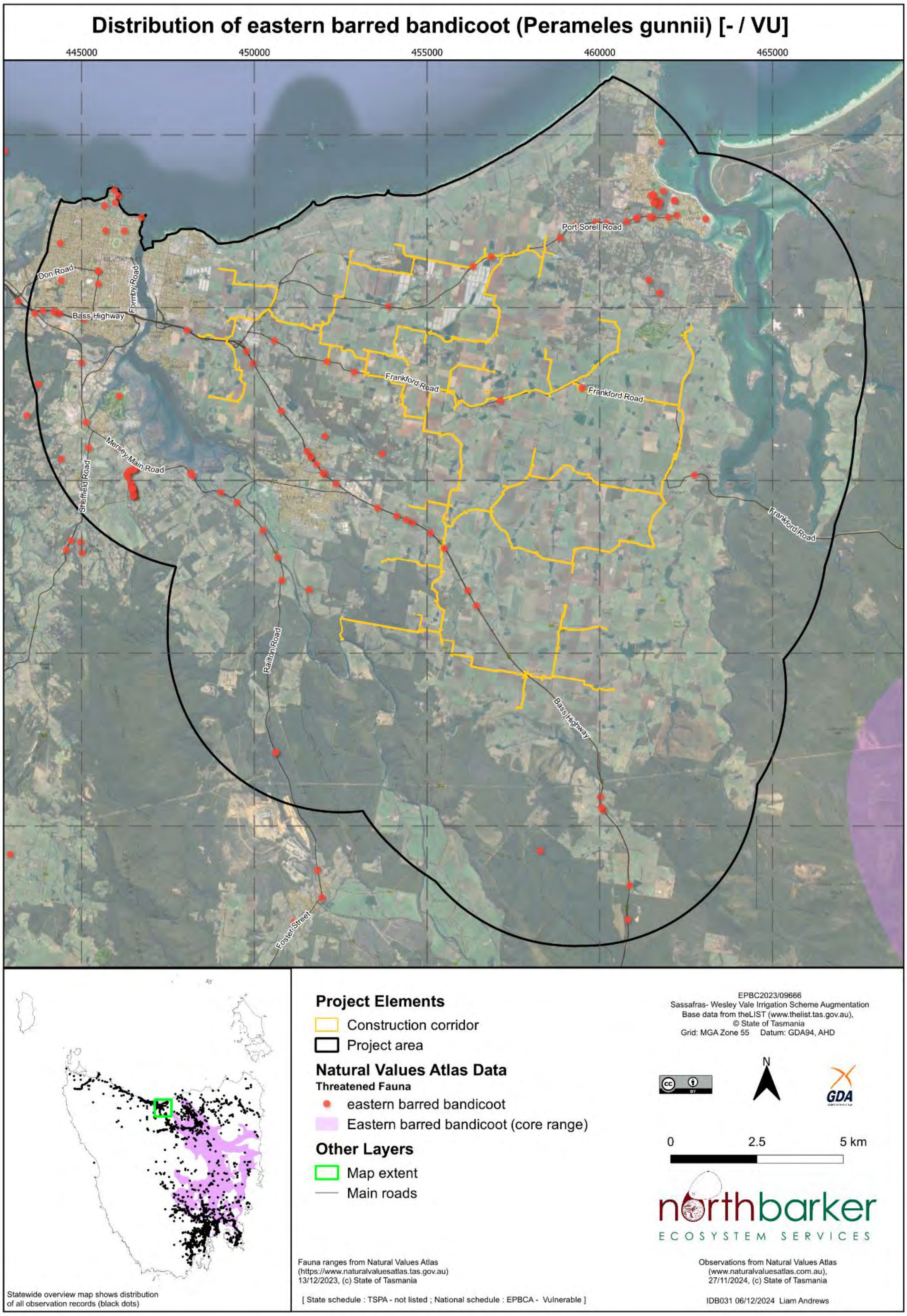

Figure 20: Distribution of the eastern barred bandicoot in relation to the Project Area

Residual significant impacts

With the above context, survey results, avoidance, impacts, and mitigation, an assessment of the residual impacts as a result of the construction and operation of the SWISA against the significant impact criteria[472] is provided below.

1) Lead to a long-term decrease in the size of an important population.

The most recent population estimates for the eastern barred bandicoots in Tasmania suggest there is 20,000 individuals, which is declining[473]. The species has declined significantly throughout its historical range in the Midlands[474] though is currently considered locally common in some areas of the state due to range expansion. Estimates suggest that there are >10 subpopulations distributed across Tasmania. Important populations of eastern barred bandicoots are not defined in Tasmania; however, the Project Area does not fall within the species' core range[475]. The species was only detected in one location across the Survey Area, indicating that the Project Area represents a low-density population.

Land clearance in the form of removal of ground cover is a listed threat to the species. The total impact in the Project Area is 320.86 ha, of which 319.83 ha (99.68 %) is to be revegetated post-construction.

With their relatively small home ranges (0.8-11.9 ha)[476], the permanent removal of 1.02 ha of ground cover represents foraging area for up to 0.53-7.83 individuals, although due to their presumed low density in the area it would likely represent far fewer. Given the species is locally common throughout agricultural areas in the north of Tasmania, habitat availability may not be the limiting factor in the species' current distribution in the region. As such, removal of a relatively small area of habitat will not likely result in a long-term decrease in the size of this population.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures that prevent impact to individuals, subpopulations, and habitat in the event that this species and its habitat are located within the SWISA Operational Area.

With the proposed mitigation measures in place, the construction and operation of SWISA **will not** lead to a long-term decrease in the size of an important population.

2) Reduce the area of occupancy of an important population.

According to the Action Plan for Australian Mammals 2012[477], the estimated extent of occurrence of is 602 km^2, and the area of occupancy is estimated to be 16 km^2, both ranges are estimated with a low level of reliability.

Important populations of eastern barred bandicoots are not defined in Tasmania; however, the Project Area does not fall within the species' core range[478].

Temporary removal of ground cover is unlikely to have a permanent effect on the long-term occupancy of the eastern barred bandicoot, provided revegetation restores or improves ground cover structure. Permanent removal of 1.02 ha of ground cover represents foraging area for up to 8 individuals, although due to their presumed low density and the abundance of suitable habitat in surrounding areas, it could be expected that impacted individuals would be able to shift their range without infringing on the territory of others. Clearance of 3.74 ha of forest may increase the availability of habitat for the species,

[472] Commonwealth of Australia (2013a)
[473] Burbidge *et al.* (2014)
[474] Driessen *et al.* (1996); Mallick *et al.* (1997)
[475] Forest Practices Authority (2022); Threatened Species Section (2024k)
[476] Mallick *et al.* (2000)
[477] Burbidge *et al.* (2014)
[478] Forest Practices Authority (2022); Threatened Species Section (2024k)

as they are positively associated with the conversion of forest to agriculture where suitable ground cover exists.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures that prevent impact to individuals, subpopulations, and habitat in the event that this species and its habitat are located within the SWISA Operational Area.

Therefore, the construction and operation of the SWISA **will not** reduce the area of occupancy of an important population.

3) Fragment an existing important population into two or more populations.

Bandicoots are tolerant of open spaces provided there is suitable shelter nearby, utilising open pasture and suburban lawns for foraging. The permanent impact area (1.02 ha) will not present a dispersal barrier to the species, as proposed sites are surrounded with habitat of equal suitability. The majority of the impact area (319.83 ha) represents a temporary impact on ground cover. This impact is confined to a relatively narrow corridor (5–30 m), which may present a temporary dispersal barrier for the species during construction and trenching. Revegetation post-construction will reestablish connectivity and will not result in fragmentation of the population.

Therefore, the proposed construction and operation of the SWISA **will not** fragment an existing important population into two or more populations.

4) Adversely affect habitat critical to the survival of a species.

There is no defined description of habitat critical to the survival of this species, however the eastern barred bandicoot occurs in native grasslands, grassy woodlands and forests, and areas of agricultural and pastural development where there are areas of dense ground cover[479]. Ground cover is considered a critical habitat feature for nesting and shelter, although vegetation structure is more relevant than composition.

Bandicoots are tolerant of open spaces provided there is suitable shelter nearby, utilising open pasture and suburban lawns for foraging. The permanent impact area (1.02 ha) will not present a dispersal barrier to the species, as proposed sites are surrounded with habitat of equal suitability. The majority of the impact area (319.83 ha) represents a temporary impact on ground cover. This impact is confined to a relatively narrow corridor (5–30 m), which may present a temporary dispersal barrier for the species during construction and trenching. Revegetation post-construction to equal or improved quality of structural ground cover will sufficiently mitigate any potential adverse impact on critical habitat in the long-term.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures that prevent impact to individuals, subpopulations, and habitat in the event that this species and its habitat are located within the SWISA Operational Area.

With the specified rehabilitation and operational measures in place, the proposed construction and operation of the SWISA **will not** adversely affect habitat critical to the survival of this species.

5) Disrupt the breeding cycle of an important population.

Important populations of this species have not been formally determined in Tasmania. Eastern barred bandicoots were shown to be present, but uncommon in the Survey Area, and as such the local population does not likely represent a stronghold population.

[479] Driessen *et al.* (1996)

Eastern barred bandicoots are highly fecund, breeding up to five time per year with litters of 1 – 5 young[480]. Clearance of ground cover may disrupt nesting habitat for the species during construction, though due to their year-round breeding, young weaning age and early maturity (~4 months), this is unlikely to have a population level impact. Local areas will be under construction for short periods only. Given the low population density in the area, it is not likely that habitat availability is a limiting factor impacted bandicoots will be able to move to adjacent habitat during this period. Post-construction revegetation will restore breeding and foraging habitat in the construction corridor within 6 months. Given the short local construction time and high reproduction rate of the species, this is unlikely to have a long-term impact on the eastern barred bandicoot population.

Given the uncertainty of occupation and presumed low population density, there is no real chance or possibility that the construction and operation SWISA will disrupt the breeding cycle of eastern barred bandicoot at the scale of the population.

Thus, the proposed construction and operation of the SWISA **will not** disrupt the breeding cycle of an important population.

6) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Structure of habitat, specifically areas of open canopy and dense ground cover, is the most critical habitat feature for bandicoot habitat suitability. Post-European land use change has allowed eastern barred bandicoots to become locally common in suburban and agricultural areas across the north coast of Tasmania. The Project Area contains a large amount of structurally suitable habitat, though the low number of detections in surveys and the sparse records in the broader area[481] imply that there are factors other than habitat structure determining the occupancy in the area. As such, permanent removal of a small area of bandicoot habitat in a low-density population is not likely to cause the species to decline.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures that prevent impact to individuals, subpopulations, and habitat in the event that this species and its habitat are located within the SWISA Operational Area.

Based on this assessment, the construction and operation of the SWISA **will not** modify, destroy, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline.

7) Result in invasive species that are harmful to the species becoming established in the species' habitat.

There is no likelihood that the Project will result in a new invasive species that are harmful to the species becoming established in the species' habitat. There are no recent credible fox sightings in Tasmania, and the project is not expected to cause the introduction or spread of foxes in Tasmania.

Predation by feral cats is a key threat to the species. Removal of ground cover may increase predation risk for eastern barred bandicoots within the Construction Corridor, therefore it is crucial to manage post-construction cat activity through the revegetation of cleared areas with ground cover of equal or greater complexity. It may be expected that cats will at least to some extent utilise the permanently modified habitats generated through the conversion of forest habitat in the Site, although construction of permanent infrastructure will also constitute habitat removal for feral cats. Given the current high abundance of cats and the already highly modified landscape, it is not likely that this conversion of habitat will result in an increase in cat abundance to a degree that will influence the eastern barred bandicoot population.

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[480] Burbidge *et al.* (2014)

[481] Natural Values Atlas data – as at 11 of September 2024

The operation of the SWISA does not present any impact pathways that could lead to the introduction of invasive species that pose a threat to the eastern barred bandicoot.

Therefore, the construction and operation of the SWISA **will not** result in invasive species that are harmful to this species becoming established in the species' habitat.

8) Introduce disease that may cause the species to decline.

Eastern barred bandicoots can be affected by toxoplasmosis, which can be fatal in the species[482]. Toxoplasmosis is spread through cats as the definitive host. Due to the high level of cat activity and the generally high seroprevalence of the disease in Tasmania[483], it can be expected that toxoplasmosis is already present within the Project Area. Management of cat activity through post-construction revegetation will be sufficient to mitigate increased risk of toxoplasmosis within the Project Area.

The operation of the SWISA does not present any impact pathways that could lead to the introduction of disease that may cause the eastern barred bandicoot to decline.

Thus, the proposed construction and operation of the SWISA **will not** introduce a disease that may cause the species to decline.

9) Interfere substantially with the recovery of the species.

No recovery plan has been developed for the species, though conservation recommendations have been outlined in the species Conservation Advice[484]. Management priority actions relevant to the project include:

- Manage threats to areas of vegetation which may provide habitat for the eastern barred bandicoot (Tasmania).
- Develop and implement a management plan for the control and eradication of feral cats and dogs in the local region.
- Develop and implement suitable hygiene protocols to protect against outbreaks of Toxoplasma gondii parasite.
- Investigate options for linking, enhancing or establishing additional populations.

With the proposed mitigation measures in place, the project is not expected to interfere with objectives relating to predators or disease. Due to the low density of the population in the area, and the region falling outside the core range of the species[485], it is unlikely to be the focus of future reintroductions or sourcing of individuals for translocation. The removal of a small amount of habitat will not preclude the possibility of enhancement of agricultural land for bandicoots in the future.

Permanent impacts to bandicoot habitat are restricted to the footprint of new infrastructure (1.02 ha). Removal of habitat of this scale will not have population level impacts when considering the species persists at very low density within abundant available habitat. Furthermore, conversion of habitat from forest allows for revegetation with habitat more suitable for bandicoots, which may aid in dispersal ad linking populations.

Therefore, the construction and operation of the SWISA **will not** substantially interfere with the recovery of the species.

Summary

With the recommended mitigation measures in place, our assessment is that the proposed construction and operation of the SWISA **will not** have significant residual impacts on the eastern barred bandicoot.

[482] Bettiol *et al.* (2000)
[483] Fancourt & Jackson (2014)
[484] Department of the Environment, Water, Heritage & the Arts (2008a)
[485] Forest Practices Authority (2022); Threatened Species Section (2024k)

4.3.1.3 Swift parrot (*Lathamus discolor*)

Context

Conservation status

Swift parrot is listed as critically endangered under the EPBC Act and endangered under the TSP Act. The species occurs as a single, migratory population[486] and is also listed as a marine species.

> The swift parrot was previously listed as endangered under the Commonwealth *Endangered Species Protection Act 1992* and was transferred to the Commonwealth EPBC Act in June 2000. On the 5th of May 2016, this species was uplisted to critically endangered on the basis of available scientific information. This conclusion was reached from the following assessment criteria:
>
> **Criterion 1** – Population size reduction (reduction in total numbers)
>
> At the time of uplisting, there were no recent estimates of swift parrots in the wild. A 2010 assessment estimated approximately 2,000 mature individuals[487], and the population was thought to be declining at this time. Population modelling that considered the primary threat to this species, sugar gliders, across five scenarios, with results indicating a mean predicted decline of 86.9 % across all models, which is well in excess of the minimum thresholds to qualify as critically endangered. It was determined that swift parrots are likely to undergo a severe reduction in population size in the future, and the primary threat to the species has not ceased, therefore qualifying as **critically endangered**.
>
> **Criterion 2** – Geographic distribution as indicators for either extent of occurrence and/or area of occupancy
>
> Based on the available evidence, it was determined that is there is good evidence to support a restricted distribution and infer ongoing declines in the area of occupancy, area, extent and quality of habitat and number of mature individuals; there is evidence to suggest extreme fluctuations in area of area of occupancy; and swift parrots occupy less than five locations within any single breeding year, thus meeting the criterion for listing as **endangered**.
>
> **Criterion 3** – Population size and decline
>
> At the time of assessment, the total population was likely below 2,000 mature individuals[488] which is considered low and is projected to undergo a continuing decline over the next generation, and because 100 percent of mature individuals are found in a single subpopulation, the species was deemed eligible for listing as **endangered** under this criterion.
>
> **Criterion 4** – Number of mature individuals
>
> This species was deemed as **not eligible** for listing under this criterion as the number of mature individuals is not thought to be low, very low, or extremely low.
>
> **Criterion 5** – Quantitative analysis
>
> At the time of assessment, there was insufficient data to assess this species under this criterion. Therefore, it was **not able to be assessed** for listing under this criterion.
>
> **Threatened Species Scientific Committee (2016)**

[486] Department of Climate Change, Energy, the Environment & Water (2024j)
[487] Garnett *et al.* (2011)
[488] Garnett *et al.* (2011)

Ecology

The swift parrot is a small-medium sized parrot with angular, pointed wings, and a slender tail[489]. It is mostly bright green in colour, with dark blue patches on the crown and a prominent red face and the chin and throat are narrowly bordered with yellow[490]. Individuals are approximately 25 cm in length and have a wingspan between 32 and 36 cm[491].

Swift parrots are usually seen in small groups of up to 30 birds, however they are occasionally seen in larger flocks of several hundred, particularly around an abundant food source[492].

The breeding season occurs between September and January[493], once birds have completed their migration from the southeast of mainland Australia. A typical clutch size is three to six eggs, and incubation lasts for approximately 25 days, with the male providing food for the female during this period. Once hatched, nestlings are fed by the parents until they are two weeks old. Young birds leave the nest after approximately 6 weeks but are not fully independent for another 3 weeks after fledging[494].

Habitat

Foraging

During the breeding season, swift parrots forage primarily on *Eucalyptus globulus* (blue gum) and *E. ovata* (black gum) in Tasmania. More recently, *E. brookeriana* (Brookers gum) has been identified as a foraging resource[495] (this species and black gum are closely related and share overlapping flowering times within the swift parrot breeding season). In Tasmania's northwest, swift parrots tend to feed on blue gums rather than black gum[496].

It has been estimated that in good flowering years in the southeast of the state, up to 10 % of the population may still breed in the northwest of the state, while in poor flowering years, the northwest flowering blue gum resource (which is more consistent but generally less abundant) becomes more important and as much as 50 % of the population may breed here[497].

Breeding

Nests are located in deep hollows with the trunk, branch, or spout of eucalyptus trees (including dead trees), with no evidence suggesting a preference towards a particular eucalypt species, but rather traits of the tree cavities are the main factor that influences whether a tree is likely to be used for nesting[498]. Nest trees typically have a DBH of ≥80 cm, with visible hollows and showing signs of senescence[499]. Potential breeding habitat typically occurs within range (~10 km) of potential foraging habitat. The likelihood of suitable breeding habitat decreases as the distance from viable foraging resources increases, with previous surveys suggesting that swift parrots nest within 10 km of foraging habitat that is sufficient to sustain breeding[500].

Swift parrots reuse nesting sites and individual nest hollows over different years[501], highlighting the importance of nesting areas for the species' long-term viability. The presence of a foraging resource

[489] Higgins (1999)
[490] Threatened Species Scientific Committee (2016b)
[491] Threatened Species Scientific Committee (2016b); Pfennigwerth (2018)
[492] Threatened Species Scientific Committee (2016b)
[493] Mowat *et al.* (2021)
[494] Mowat *et al.* (2021)
[495] Mowat *et al.* (2021)
[496] Forest Practices Authority (2014c)
[497] Mallick *et al.* (2004)
[498] Stojanovic *et al.* (2012); Department of Climate Change, Energy, the Environment & Water (2024j)
[499] Webb *et al.* (2012); Stojanovic *et al.* (2012)
[500] Forest Practices Authority (2014c)
[501] Stojanovic *et al.* (2012); Department of Climate Change, Energy, the Environment & Water (2024j)

influences whether an area is suitable on a year-to-year basis[502]. Both the described foraging and breeding habitat are considered as habitat critical to the survival of swift parrots[503].

Population parameters

The swift parrot occurs as a single panmictic migratory population[504]. Estimating the number of birds within the population from empirical counts is difficult because the species is highly mobile. In 2000, the population was estimated at 2,000 birds, while more recent numbers were estimated at 750 birds with a maximum of 1,000[505]. Using a genetics-based method, the minimum potential population size was recently modelled at below 300[506].

According to the Action Plan for Australian Birds 2020[507], the estimated extent of occurrence of breeding habitat is 71,000 km^2, and the area of occupancy is estimated to be 1,400 km^2, both ranges are estimated with a medium level of reliability. The population is not severely fragmented, however there are fluctuations in the area of occupancy[508].

Distribution and site significance

Swift parrots spend the winter months in south-eastern mainland Australia before migrating to Tasmania in late winter/early spring to breed[509]. On passage to and from the mainland, swift parrots may be observed almost anywhere within the state, as the records from the Tasmanian Natural Values Atlas illustrate[510]. However, the core range for the species is defined as the southeast potential breeding range that is within 10 km of the coast, or areas designated as a swift parrot important breeding area (SPIBA)[511]. In spring, swift parrots take up residence along the southeast coast of Tasmania, including the Tasman and Forestier peninsulas, and Maria and Bruny islands (Figure 21). This range coincides with the natural distribution of their main food-source, blue gums[512].

There are outlying breeding populations of swift parrots along Tasmania's north coast (Figure 21) and these are included in the northwest potential breeding range for the species which occurs in a strip along the north coast of the state, including the Sassafras - Wesley Vale region[513]. The northwest breeding range is defined as the area swift parrots are most likely to breed and is based on known nesting localities, bird foraging observations during breeding season, and extent of nesting and foraging habitat[514]. In total, 18.19 % of the Survey Area (297.08 ha) falls within the northwest breeding range.

The species has 2 observation records on the NVA attributed to within 500 m of the pipeline alignment[515] and a further 87 records attributed to within 5 km, the most recent being in 2023 [516]. Four of these records are purported nests in the Kelcey Tier Green Belt, south of Devonport. Figure 22 displays the distribution of swift parrot records listed on the NVA in relation to the Project Area.

[502] Webb *et al.* (2014)
[503] Department of Climate Change, Energy, the Environment & Water (2024j)
[504] Stojanovic *et al.* (2018)
[505] Webb *et al.* (2021); Mowat *et al.* (2021)
[506] Olah *et al.* (2021)
[507] Webb *et al.* (2021)
[508] Webb *et al.* (2021)
[509] Bryant & Jackson (1999)
[510] Natural Values Atlas data – as at 11 of September 2024
[511] Forest Practices Authority (2010)
[512] Forest Practices Authority (2014c)
[513] Forest Practices Authority (2014c)
[514] Forest Practices Authority (2010)
[515] Natural Values Atlas data – as at 11 of September 2024
[516] Natural Values Atlas data – as at 11 of September 2024

SWIS management actions

This species was discussed in detail in the referral / preliminary documentation process for the SWIS project[517], however it the risk of impact was deemed to be negligible, with avoidance principals applied to potential habitat during construction, and application and monitoring of the Farm WAP process during operation to monitor potential impacts/changes to potential habitat areas.

Threats

Key threats detailed in the *National Recovery Plan for the Swift Parrot*[518] include:

- Habitat loss and alteration. In Tasmania, loss of potential breeding habitat due to conversion for agriculture, native forest logging, and silvicultural activities is a continual threat to the swift parrot[519]. Additional loss of habitat due to legal and illegal firewood collection, fire, trees senescence and dieback, and clearance for residential and industrial development are also ongoing threats to swift parrots.
- Predation by sugar gliders. On the Tasmanian mainland, one of the principal threats to swift parrot is predation by the introduced sugar glider (*Petaurus breviceps*) that can take up to 50 % of breeding females and nestlings in any given season[520]. Measures to protect artificial nests from predation have proved effective[521], however protective measures for nests within trees is still uncertain.
- Collision mortality. Collisions with wire netting, fences, windows, and vehicles can cause mortality to swift parrots, particularly in urban areas[522]. Continuation of urban sprawl is likely to exacerbate the risk of further collision risk.
- Competition. Swift parrots can experience competition for resources from native and non-native birds such as the noisy miner, rainbow lorikeet, and starlings, as well as from other introduced birds and bees. This is most prevalent in in disturbed or fragmented settings.
- The previous recovery plan for swift parrots[523] lists Psittacine Beak and Feather Disease (PBFD) as a potential threat. The PBFD is a potentially deadly disease caused by a circovirus that affects parrots. This disease could have serious implication for the swift parrot should the general health of birds decline from stress associated with competition for nesting and food resources[524]. The PFBD is not listed as a primary threat in the current recovery plan[525], and it is considered a low risk in the Action Plan for Australian Birds 2020[526].
- Climate change may impact swift parrots through changes in seasonality and geographic patterns of flowering, as well as other climate related impacts such as altered rainfall patterns, mainland flowering failures, and wildfires.
- Illegal capture and trading. This has become a major factor in the decline of several threatened flora and fauna species around the world. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is enforceable under the EPBC Act.
- Cumulative impacts. Each of the above threats has the potential to compromise the long-term survival of swift parrots, and where more than one threat is present, the cumulative impact is likely to be far greater than the sum of individual threats.

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[517] Referral EPBC: 2010 / 5327; Tasmanian Irrigation Development Board (2010)
[518] Department of Climate Change, Energy, the Environment & Water (2024j)
[519] Saunders *et al.* (2007); Webb *et al.* (2017); Webb *et al.* (2019)
[520] Webb *et al.* (2021)
[521] Stojanovic *et al.* (2019)
[522] Pfennigwerth (2008); Hingston (2019)
[523] Saunders & Tzaros (2011)
[524] Saunders & Tzaros (2011)
[525] Department of Climate Change, Energy, the Environment & Water (2024j)
[526] Webb *et al.* (2021)

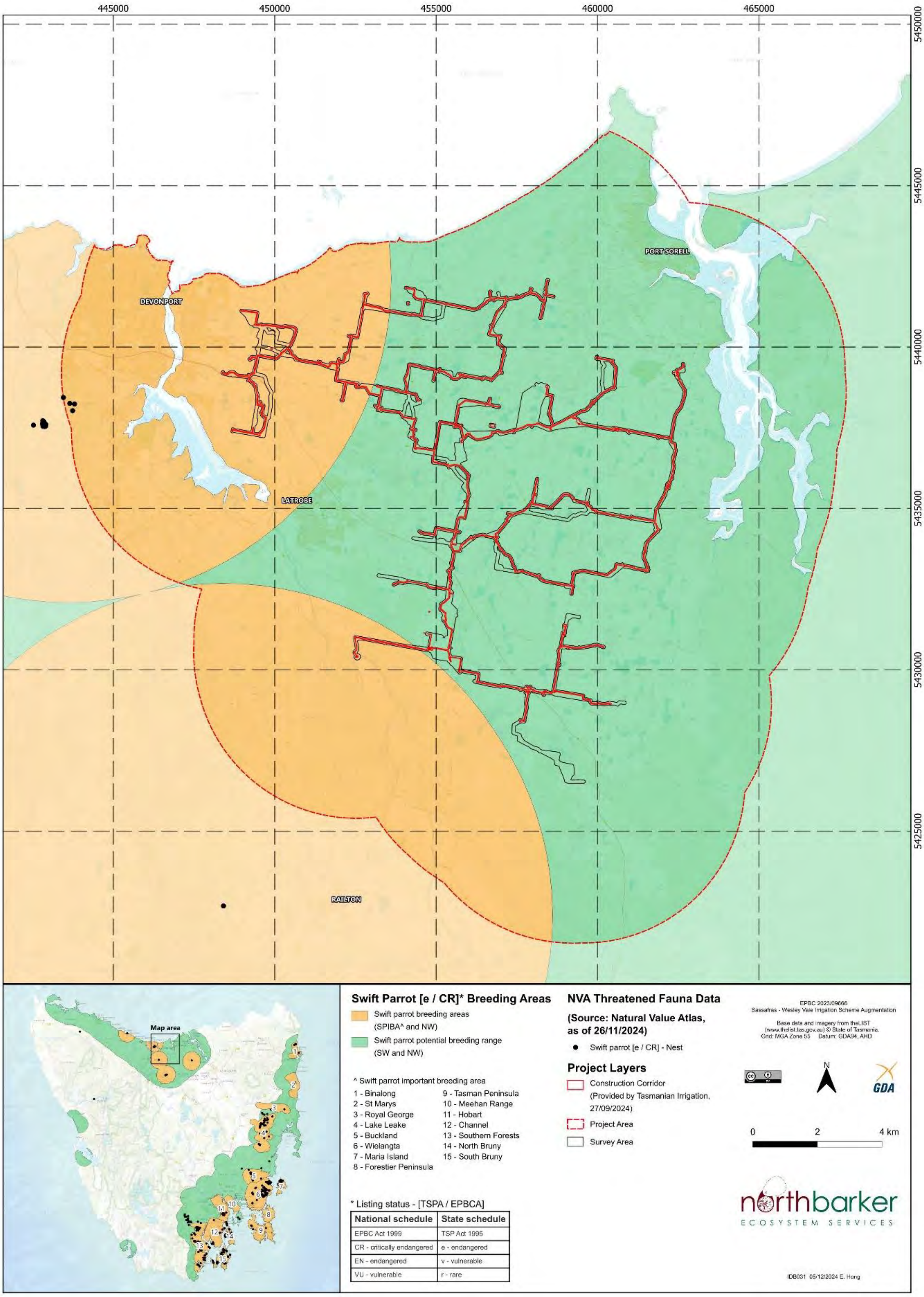

Figure 21: Swift parrot important and potential breeding areas

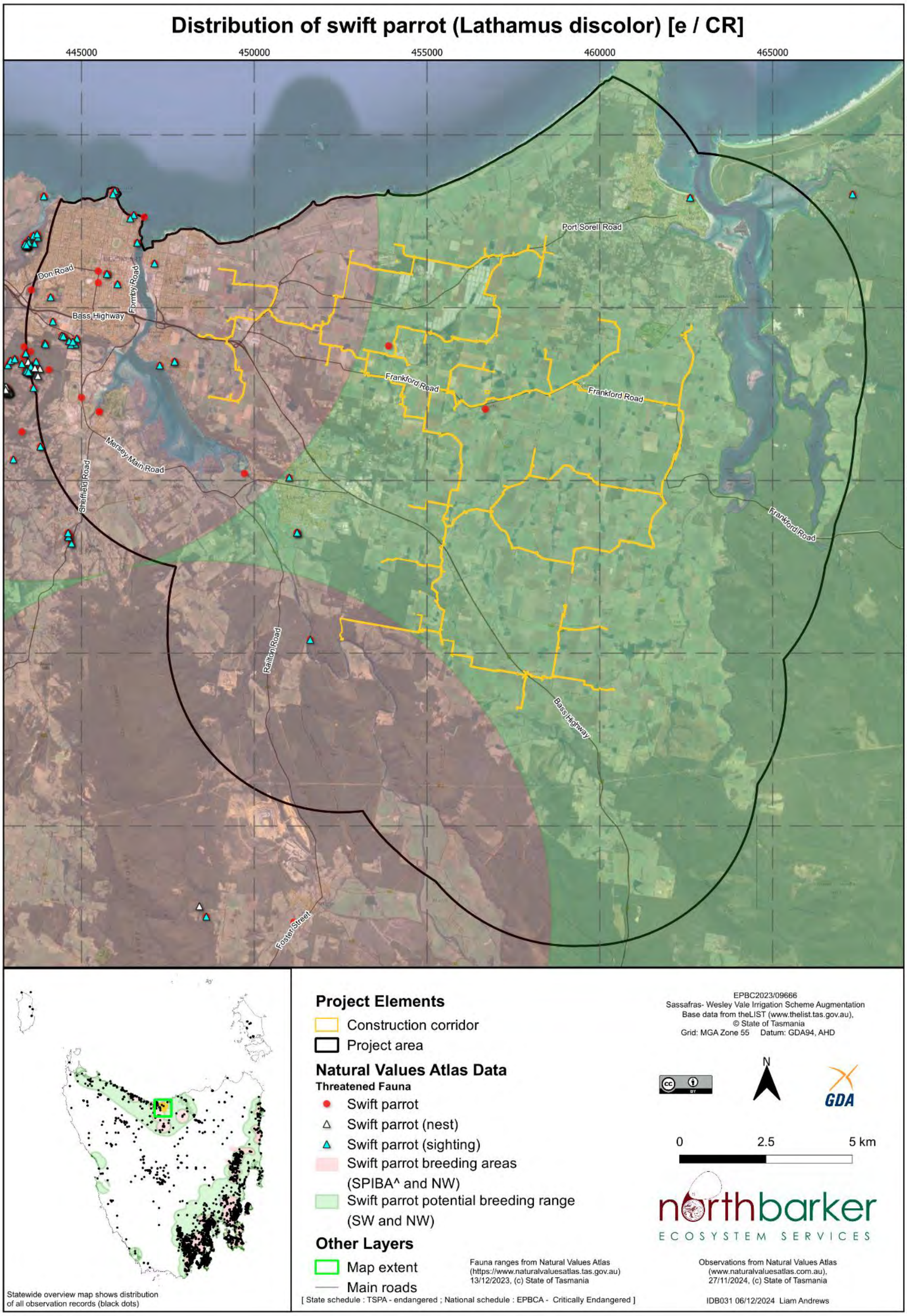

Figure 22: Distribution of the swift parrot in relation to the Project Area

Survey methods

Potential habitat for swift parrots was recorded concurrently with baseline flora and fauna surveys.

Potential hollow bearing trees (potential swift parrot nesting habitat) and areas of foraging habitat as per published descriptions[527] were recorded during field surveys.

Native forest vegetation and native paddock trees were assessed as potential habitat as follows:

- In small areas of potential habitat, individual trees were recorded within the Survey Area;
- Larger areas of potential habitat were mapped as polygons.

Surveys targeting habitat use were not conducted for this project as areas of potential nesting habitat have been prioritised for avoidance, and mitigation measures are proposed to avoid impacts to any nesting parrots.

Survey findings

No naturally occurring blue gum trees or *Eucalyptus globulus* vegetation communities were recorded within the Survey Area. Black gum foraging (*E. ovata*) trees were recorded in numerous locations throughout the Survey Area within DOV and DSC forests, and as individual trees in remanent vegetation or paddock trees. In total 16.89 ha of potential foraging habitat and an additional 101 individual foraging habitat trees (of which 39 may also provide breeding habitat) were recorded within the Survey Area (Table 20). In addition to this, a further 276.44 ha of DOV and 1,833.39 ha of DSC is mapped within the Project Area[528]. These forest types within the broader area may provide additional foraging (and nesting) habitat for swift parrots. It should be noted that 0.20 ha of the area mapped as potential foraging habitat occurs within the Construction Corridor. Any individual foraging habitat trees within this area have been individually recorded in Table 20.

Large (>70 cm DBH) potential hollow bearing trees were also recorded during field surveys, both within forest blocks and remnant vegetation patches, and paddocks in agricultural land. These trees provide potential nesting habitat for swift parrots. A total of 6.87 ha of forest potentially supporting breeding habitat trees and 181 individual breeding habitat trees were recorded within the Survey Area. These trees may also provide breeding habitat for the blue-winged parrot, and a subset of these potential breeding habitat trees and areas may also support the Tasmanian masked owl. It should be noted that 0.23 ha of the area mapped as potential breeding habitat occurs within the Construction Corridor. Any individual potential nesting habitat trees within this area have been individually recorded in Table 20.

[527] Forest Practices Authority (2014c)

[528] Department of Primary Industries, Parks, Water & Environment (2020)

Table 20: Extent of potential breeding and foraging habitat within the Survey Area

Habitat Type	Within Survey Area (exc. Construction Corridor)		Within Construction Corridor	Total	
	Extent of Polygon (ha)	Individual Trees	Individual Trees	Extent of Polygon (ha)	Individual Trees
Foraging Habitat Only	16.07	48	14	16.27	62
Breeding Habitat Only	6.02	132	10	6.25	142
Breeding and Foraging Habitat	0.62	35	4	0.62	39
Total	**22.72**	**215**	**28**	**23.15**	**243**

For contextual purposes, further to the known trees and forested vegetation with the Survey Area and Construction Corridor, and estimation of the availability of trees (which may provide breeding habitat)[529] within the broader area has been modelled using the Forest Practices Authorities mature habitat layer[530]. The stratification of mature habitat is provided in Table 21 and the distribution of habitat classes from within the Project Area is displayed in Figure 23. According to the Forest Practices Authority field-verified assessment criteria[531], due to the mapped availability of mature habitat within 5 km, it can be expected that at a minimum, there are a further 36,389 mature trees (>70 cm DBH) present in the local landscape. This estimate does not take into account the potential for paddock trees, or sporadic large trees within low maturity forest, so is a minimum estimate of available habitat trees (noting the scattered trees recorded within the project area do not even register as viable mature forest habitat in this modelling). Of these 36,389 trees, approximately 12,335 (at a minimum) would be expected to be greater than >70 cm DBH and thus in the optimal size range suitable for the habitat requirements for swift parrot nesting[532] (Table 21).

[529] Noting that this is modelling based upon numerous spatial GIS layers, with various limitations (which are outlined in the source documentation). The modelled habitat is not definitive and requires ground truthing, noting that not all modelled habitat necessarily represents nesting trees, rather that potential nesting habitat is likely present in varying levels of density more broadly throughout a modelled area of mature habitat.
[530] Forest Practices Authority (2016)
[531] Forest Practices Authority (2014c)
[532] Forest Practices Authority (2014c)

Table 21: Mature habitat availability within the local landscape

Potential Nesting Habitat Density Class		Field-based Assessment Criteria	Availability Within Project Area (ha)	Predicted Number of Trees Within Project Area
High	Dry Forest	At least 8 trees per hectare >100 cm DBH	617.33	4,939 >100 cm DBH
	Wet Forest	At least 15 trees per hectare >100 cm DBH or 8 trees per hectare >150 cm DBH	94.71	1,421 >100 cm DBH
	Other Forest	At least 8 trees per hectare >100 cm DBH	39.95	320 >100 cm DBH
		Total	**751.99**	**6,679 trees >100 cm DBH** **(notwithstanding that this could include trees >70 cm DBH)**
Medium	Dry Forest	At least 8 trees per hectare >70 cm DBH	618.10	4,945 >70 cm DBH
	Wet Forest	At least 8 trees per hectare >100 cm DBH	20.70	166 >100 cm DBH
	Other Forest	At least 8 trees per hectare >70 cm DBH	66.61	533 >70 cm DBH
		Total	**705.42**	**5,643 trees >70 cm DBH** **(notwithstanding that this could include trees >100 cm DBH)**
Low	Dry Forest	Trees >70 cm DBH are present, but less than 8 trees per hectare	2,687.77	21,502 >70 cm DBH
	Wet Forest	Trees >100 cm DBH are present, but less than 8 trees per hectare	98.71	790 >100 cm DBH
	Other Forest	Trees >70 cm DBH are present, but less than 8 trees per hectare	220.28	1,762 >70 cm DBH
		Total	**3,006.77**	**Up to 24,054 trees >70 cm DBH** **(notwithstanding that this could include trees >100 cm DBH)**
Negligible / Unsuitable	Dry Forest	No eucalypt trees >70 cm DBH	3,836.01	-
	Wet Forest	No eucalypt trees >100 cm DBH	697.42	
	Other Forest	No eucalypt trees >70 cm DBH	31,944.70	
		Total	**36,478.13**	**Minimum of 12,332 >70 cm DBH and up to 36,376 >70 cm DBH**
Total (High and Medium Class minimum estimate plus upper estimate for Low Class)			**40,942.30**	

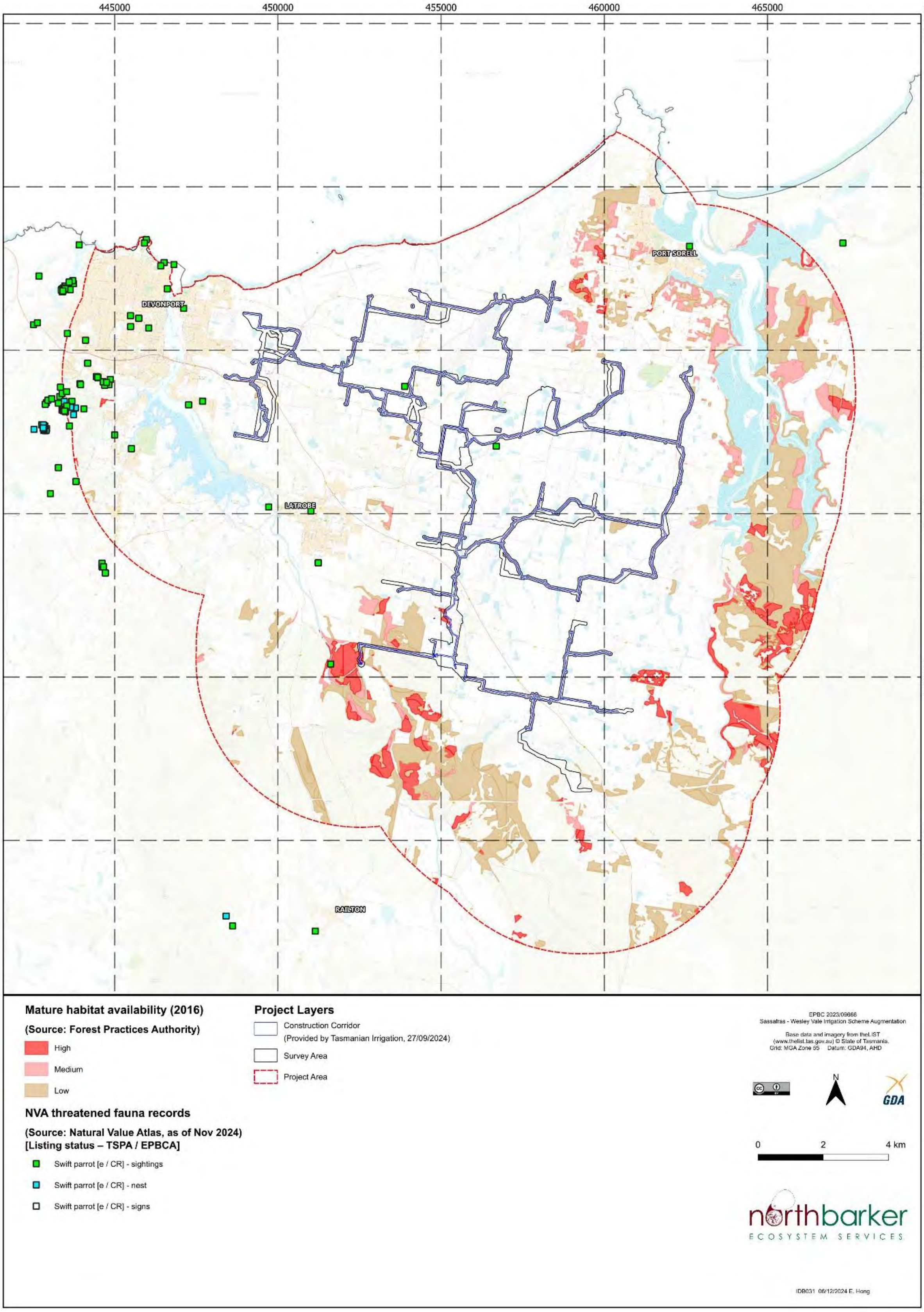

Figure 23: Mature habitat availability and swift parrot records within the Project Area

Impact pathways

Potential impact pathways to the swift parrot relevant to the construction of the SWISA include:

- Habitat loss and alteration through the removal of potential foraging and nesting trees;
- Cumulative impacts due to the ongoing clearance of native forests in the SWISA region.

Potential impact pathways to the swift parrot relevant to the operation of the SWISA include:

- Habitat loss and modification due to agricultural development, conversion of forest to pasture or plantation, and road construction.

Avoidance

The priority is to avoid the need for the removal of large trees with potential to support hollows. A total of 141 of the 181 recorded potential breeding habitat trees (with further scope for avoidance pending arboricultural assessments) and 6.64 ha of forest that may support breeding habitat have been avoided through design, as well as 16.69 ha of potential foraging habitat (0.62 ha of which is both potential breeding and foraging habitat), and 70 out of 101 potential foraging trees.

Impacts

Construction

The construction of the SWISA will directly impact upon 14 potential foraging trees, 10 potential nesting trees, and 4 trees that may provide both nesting and foraging habitat (Table 22). An additional 32 trees (foraging and potential nesting habitat) have a TPZ incursion >10 % and may be at risk of mortality due to impacts to tree roots within the TPZ. All impacted trees are subject to the mitigation measures detailed above to ensure direct impacts to swift parrots is avoided.

In terms of the scale of impact to habitat in the broader area, the loss of a maximum of 60 potential nesting/foraging trees within the Construction Corridor and TPZ incursions represents 0.49 % of the minimum 12,332 potential habitat trees estimated to occur within the Project Area, and 0.16 % of the maximum 36,376 potential habitat trees in the Project Area (Table 21)

The proposed construction is not likely to contribute to increasing threats such as encouraging the spread of sugar gliders or any other species that may provide competition for resources, collision mortality, PFBD, and illegal wildlife capture and trading that may require enforcement under CITES. The construction of the SWISA is unlikely to contribute significantly to the cumulative impacts to habitat in the region due to the limited scale of impacts, and the mitigation measures proposed to reduce potential impacts.

Operation

The greatest risk to this species due to the operation of the scheme is from the potential for changes in land use, as well as clearance and conversion of potential breeding and foraging habitat areas to agricultural land. With an OEMP and Farm WAPs in place, no impacts to this species are anticipated due to the operation of the SWISA.

Table 22: Impacts and avoidance of potential swift parrot habitat

Habitat Type	Total Area of Potential Habitat (ha)	Total Number of Potential Habitat Trees	Construction Corridor		Avoidance Area	
			Number of Potential Habitat Trees	Number of Trees With TPZ Incursion >10 %	Area of Potential Habitat (ha)	Number of Potential Habitat Trees
Foraging	16.27	62	14	6	16.07	42
Breeding	6.25	142	10	19	6.02	113
Breeding and Foraging	0.62	39	4	7	0.62	28
Total	**23.15**	**243**	**28**	**32**	**22.72**	**183**

Mitigation measures

Construction

Designs have been modified to reduce potential impacts to habitat trees by realigning the pipeline to avoid potential hollow-bearing trees; however, not all were able to be avoided during this process due to pinch points in the required alignment and the distribution of the potential habitat trees. A total of 28 trees remain in the proposed Construction Corridor – there may be further scope to avoid some of these through strategic alignment and further narrowing of the Construction Corridor at key pinch points, however this cannot be guaranteed as the extent of avoidance available from such fine-scale measures is not known at this stage and is largely dependent on the on-ground conditions at the time of works.

A further 32 trees have Tree Protection Zone (TPZ) incursion >10 %, as such require specialist arboricultural assessment to determine the impact to the root zones and viability of retention post-construction for trees that are outside of the direct impact footprint (in accordance with the Australian Standard Protection of Trees on Development Sites AS 4970-2009[533]). The following mitigation must be included within the CEMP:

- Trees that are determined as viable for retention must be marked as exclusion areas (including a tree protection zone buffer) on civil contracts and on the ground.

If there are potential habitat trees within the Construction Corridor that cannot be avoided (*i.e.* require removal or structural root damage that would risk treefall), to mitigate potential direct impacts to any swift parrots, the following apply:

- Removal of any potential habitat trees must be completed outside of the breeding season (breeding season is between September and March).
- Tree removal must be conducted in accordance with a habitat tree management and impact mitigation protocol (**Appendix I**) that include pre-clearance checks of potential habitat trees, noting that other fauna protected under various legislation may utilise tree hollows.

Operation

The provision of Tasmanian Irrigation water does not allow for landowners to conduct unregulated land clearance. All land irrigated with Tasmanian Irrigation water within the SWISA are subject to rigorous assessment through the Farm WAP process and the provisions of an OEMP. The risk of direct impact to

[533] Standards Australia (2009)

swift parrots and potential habitat clearance due to Tasmanian Irrigation water will be managed through the Farm WAP process, with measures in place to ensure that this species is adequately protected by applying exclusion areas and applying buffers from particular agricultural activities.

In order to mitigate the risk of impact to this species during operation of the scheme, the following actions as part of the SWISA OEMP for each SWISA irrigator property are required:

- Application of a Farm WAP for each property within the Operational Area
- Property-wide survey for potential nesting and foraging habitat for this species.
- Any potential nesting trees must be subject to a habitat tree management protocol (**Appendix I**) to ascertain whether it is utilised by swift parrots prior to removal and to detail the approved process for retention or removal as determined by its activity status.

If it is determined by the Farm WAP that impacts due to the operation of the SWISA on individual properties are likely to trigger the MNES *Significant Impact Criteria*[534], individual irrigators may need to refer their action independently.

Residual significant impacts

With the above context, survey results, avoidance, impacts, and mitigation, an assessment of the residual impacts as a result of the construction and operation of the SWISA against the significant impact criteria[535] is provided below.

1) Lead to a long-term decrease in the size of a population

The swift parrot occurs as a single panmictic migratory population[536]. Estimating the number of birds within the population from empirical counts is difficult because the species is highly mobile. In 2000, the population was estimated at 2,000 birds, while more recent numbers were estimated at 750 birds with a maximum of 1,000[537]. Using a genetics-based method, the minimum potential population size was recently modelled at below 300[538].

The proposed construction of the SWISA will directly impact 28 trees that meet the definition of critical habitat. Indirect impacts due to root zone incursions may also affect up to 32 potential nesting and/or foraging trees. Assuming a worst-case scenario, 60 potential habitat trees (foraging and nesting) will be lost due to the construction of the SWISA. In terms of the scale of impact to habitat in the broader area, the loss of a maximum of 60 potential nesting / foraging trees within the Construction Corridor and TPZ incursions represents 0.49 % of the minimum 12,332 potential habitat trees estimated to occur within the Project Area, and 0.16 % of the maximum 36,376 potential habitat trees estimated to occur in the Project Area (Table 21).

The scale of these impacts is very minor in context of the broader area and will not prevent swift parrots utilising the Project Area into the future.

In addition to this, all removal of potential habitat trees will occur outside of the breeding season (September to March inclusive) to avoid any direct impact to the swift parrot. With this control in place, the construction of the SWISA will not lead to a long-term decrease in the size of the population.

The greatest risk to this species due to the operation of the scheme is from the potential for changes in land use, as well as clearance and conversion of potential breeding and foraging habitat areas to agricultural land. The provisions of an OEMP and the Farm WAP process will include measures to

[534] Commonwealth of Australia (2013a)
[535] Commonwealth of Australia (2013a)
[536] Stojanovic *et al.* (2018)
[537] Webb *et al.* (2021); Mowat *et al.* (2021)
[538] Olah *et al.* (2021)

mitigate against potential habitat clearance. With an OEMP and Farm WAPs in place, no impacts to this species are anticipated due to the operation of the SWISA.

Thus, the proposed construction and operation of the SWISA **will not** lead to a long-term decrease in the population of the species.

2) Reduce the area of occupancy of the species

According to the Action Plan for Australian Birds 2020[539], the estimated extent of occurrence of breeding habitat is 71,000 km^2, and the area of occupancy is estimated to be 1,400 km^2, both ranges are estimated with a medium level of reliability. The population is not severely fragmented, however there are fluctuations in the area of occupancy[540].

The proposed construction of the SWISA will directly impact 28 trees that meet the definition of critical habitat. Indirect impacts due to root zone incursions may also affect up to 32 potential nesting and/or foraging trees. Assuming a worst-case scenario, 60 potential habitat trees (foraging and nesting) will be lost due to the construction of the SWISA. In terms of the scale of impact to habitat in the broader area, the loss of a maximum of 60 potential nesting / foraging trees within the Construction Corridor and TPZ incursions represents 0.49 % of the minimum 12,332 potential habitat trees estimated to occur within the Project Area, and 0.16 % of the maximum 36,376 potential habitat trees estimated to occur in the Project Area (Table 21).

The scale of these impacts is very minor in context of the broader area and **will not** reduce the area of occupancy in a meaningful way.

The greatest risk to this species due to the operation of the scheme is from the potential for changes in land use, as well as clearance and conversion of potential breeding and foraging habitat areas to agricultural land. The provisions of an OEMP and the Farm WAP process will include measures to mitigate against potential habitat clearance. With an OEMP and Farm WAPs in place, the operation of the scheme **will not** further reduce the area of occupancy of the swift parrot.

3) Fragment an existing population into two or more populations

The swift parrot occurs as a single panmictic migratory population[541]. Estimating the number of birds within the population from empirical counts is difficult because the species is highly mobile. In 2000, the population was estimated at 2,000 birds, while more recent numbers were estimated at 750 birds with a maximum of 1,000[542]. Using a genetics-based method, the minimum potential population size was recently modelled at below 300[543].

Due to the ecology of this species (migratory between seasons, highly nomadic between years in accordance with flowering events, and highly mobile within a season in order to travel between foraging and breeding stands), it is resilient to fragmentation.

The proposed construction and operation of the SWISA will not prevent movement within the species' existing range, thus it **will not** fragment an existing population into two or more populations.

4) Adversely affect habitat critical to the survival of a species

Critical habitat for swift parrots is defined as[544] areas within Tasmania that comprises of both potential foraging habitat (native forest and woodland containing either *Eucalyptus globulus* or *E. ovata* as a dominant, sub-dominant, or low-density species) and potential nesting habitat (forest or woodlands

[539] Webb *et al.* (2021)
[540] Webb *et al.* (2021)
[541] Stojanovic *et al.* (2018)
[542] Webb *et al.* (2021); Mowat *et al.* (2021)
[543] Olah *et al.* (2021)
[544] Department of Climate Change, Energy, the Environment and Water (2024j)

containing hollow-bearing eucalypt trees within ~10 km of potential foraging habitat that is old enough to flower).

The proposed construction of the SWISA will directly impact 28 trees that meet the definition of critical habitat. Indirect impacts due to root zone incursions may also affect up to 32 potential nesting and/or foraging trees. Assuming a worst-case scenario, 60 potential habitat trees (foraging and nesting) will be lost due to the construction of the SWISA. In terms of the scale of impact to habitat in the broader area, the loss of a maximum of 60 potential nesting / foraging trees within the Construction Corridor and TPZ incursions represents 0.49 % of the minimum 12,332 potential habitat trees estimated to occur within the Project Area, and 0.16 % of the maximum 36,376 potential habitat trees estimated to occur in the Project Area (Table 21).

The scale of these impacts is very minor in context of the broader area and **will not** adversely impact the critical habitat within the Project Area to the degree that survival of the species is no longer viable.

The SWISA OEMP and Farm WAP biodiversity module contains measures to ensure critical habitat is preserved, thus there will be no adverse impacts to habitat critical to survival.

Thus, the proposed construction and operation of the SWISA **will not** adversely affect habitat critical to the survival of the swift parrot.

5) Disrupt the breeding cycle of a population

The breeding season occurs between September and January[545], once birds have completed their migration from the southeast of mainland Australia. A typical clutch size is three to six eggs, and incubation lasts for approximately 25 days, with the male providing food for the female during this period. Once hatched, nestlings are fed by the parents until they are two weeks old. Young birds leave the nest after approximately 6 weeks but are not fully independent for another 3 weeks after fledging[546].

All removal of potential habitat trees and habitat areas will occur outside of the breeding season (September to March inclusive) to avoid any direct impact to the swift parrot. With this control in place, the construction of the SWISA **will not** disrupt the breeding cycle of a population.

The greatest risk to this species due to the operation of the scheme is from the potential for changes in land use, as well as clearance and conversion of potential breeding habitat areas, including individual trees to agricultural land. The provisions of an OEMP and the Farm WAP process will include measures to mitigate against breeding habitat clearance. With Farm WAPs in place, no impacts to this species are anticipated due to the operation of the SWISA. With an OEMP and Farm WAPs in place, the operation of the scheme **will not** disrupt the breeding cycle of the swift parrot.

6) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The proposed construction of the SWISA will directly impact 28 trees that meet the definition of critical habitat. Indirect impacts due to root zone incursions may also affect up to 32 potential nesting and/or foraging trees. Assuming a worst-case scenario, 60 potential habitat trees (foraging and nesting) will be lost due to the construction of the SWISA. In terms of the scale of impact to habitat in the broader area, the loss of a maximum of 60 potential nesting / foraging trees within the Construction Corridor and TPZ incursions represents 0.49 % of the minimum 12,332 potential habitat trees estimated to occur within the Project Area, and 0.16 % of the maximum 36,376 potential habitat trees estimated to occur in the Project Area (Table 21).

[545] Mowat *et al.* (2021)
[546] Mowat *et al.* (2021)

The scale of these impacts is very minor in context of the broader area, and will not modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the swift parrot is likely to decline.

During operation, the SWISA OEMP and Farm WAP biodiversity module contains measures to ensure habitat values are preserved, thus there will be no modification, destruction, removal, isolation, or decrease in the availability of habitat to the extent that impacts may lead to species decline.

Based on this assessment, the construction and operation of the SWISA **will not** modify, destroy, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline.

7) Result in invasive species that are harmful to the species becoming established in the species' habitat

Predation by sugar gliders (*Petaurus breviceps*) is listed as a key threat to the species [547]. The threat of sugar gliders is only applicable to breeding habitat for the swift parrots, as the gliders raid nests to prey upon the occupants. Sugar gliders will eat swift parrot eggs, kill chicks and even adult swift parrots[548]

Sugar gliders are widespread across mainland Tasmania and predation by sugar gliders has been recorded at all locations on mainland Tasmania where swift parrots breed. On the Tasmanian mainland the rate of predation has been found to increase with the extent of habitat disturbance from logging[549]. The nearest known NVA record for the sugar glider is 650 m to the west of the Devil Road alignment, near the Mersey River. There are 4 NVA records in total within the Project Area, however distribution is relatively uniform across the north coast, and is likely to be more widespread if survey effort were to be increased.

The proposed construction and operation of the SWISA **will not** result in sugar gliders becoming more prevalent in the broader area.

8) Introduce disease that may cause the species to decline

The previous recovery plan for swift parrots[550] lists Psittacine Beak and Feather Disease as a potential threat. The PBFD is a potentially deadly disease caused by a circovirus that affects parrots. This disease could have serious implication for the swift parrot should the general health of birds decline from stress associated with competition for nesting and food resources[551]. The PFBD is not listed as a primary threat in the current recovery plan[552], and it is considered a low risk in the Action Plan for Australian Birds 2020[553].

The proposed construction and operation of the SWISA is not considered likely to trigger such a process such that the species will decline and there is no evidence to suggest the proposal will encourage the spread of PBFD or any other disease.

Thus, the proposed construction and operation of the SWISA **will not** introduce a disease that may cause the species to decline.

9) Interfere with the recovery of the species

The *National Recovery Plan for the Swift Parrot*[554]outlines the following recovery actions:

1) Maintain known swift parrot breeding and foraging habitat at the local, regional and landscape scales;

[547] Department of Climate Change, Energy, the Environment and Water (2024j); Stojanovic *et al.* (2014); Garnett & Baker (2021)
[548] Stojanovic *et al.* (2014); Garnett & Baker (2021)
[549] Stojanovic *et al.* (2014)
[550] Saunders & Tzaros (2011)
[551] Saunders & Tzaros (2011)
[552] Department of Climate Change, Energy, the Environment and Water (2024j)
[553] Webb *et al.* (2021)
[554] Department of Climate Change, Energy, the Environment and Water (2024j)

2) Reduce impacts from sugar gliders at swift parrot breeding sites;
3) Monitor and manage other sources of mortality;
4) Develop and apply techniques to measure changes in population trajectory in order to measure the success of recovery actions;
5) Improve understanding of foraging and breeding habitat use at a landscape scale in order to better target protection and restoration measures;
6) Engage community and stakeholders in swift parrot conservation; and
7) Coordinate, review and report on recovery progress.

The proposed construction of the SWISA will impact on very minor amounts of potential breeding and foraging habitat (Action 1) which the utilisation is currently unknown (noting that no swift parrots were observed utilising the habitat during field surveys). Even if further surveys were to confirm utilisation of the potential habitat areas by swift parrots, the scale of impacts are so minor that the proposed activities will not prevent the swift parrot from continuing to utilise the Project Area in the future, thus not interfering with this recovery action.

The proposed construction and operation of the SWISA **will not** interfere with any other recovery actions for the swift parrot.

Summary

With the recommended mitigation measures in place, our assessment is that the proposed construction and operation of the SWISA **will not** have significant residual impacts on the swift parrot.

4.3.1.4 Tasmanian masked owl (*Tyto novaehollandiae castanops*)

Context

Conservation status

The Tasmanian masked owl (*Tyto novaehollandiae castanops*) is listed as endangered under the TSP Act and vulnerable under the EPBC Act[555].

On the 19th of August 2010, this species was listed as vulnerable on the basis of available scientific information. This conclusion was reached from the following assessment criteria:

Criterion 1 – Population size reduction (reduction in total numbers)

Due to a lack of baseline surveys and long-term monitoring, at the time of consideration for listing there was insufficient quantitative data to judge whether the subspecies had undergone a reduction of numbers in Tasmania, therefore was **not eligible** for listing under this criterion.

Criterion 2 – Geographic distribution as indicators for either extent of occurrence and/or area of occupancy

Given that the geographic distribution of this species is not limited, with an estimated extent of occurrence of 50,000 km^2, and an area of occupancy of 7,300 km^2 at the time of assessment[556], and geographic distribution is not in a precarious state, this species was **not eligible** for listing under this criterion.

Criterion 3 – Population size and decline

At the time of assessment, the total population was likely between 520 and 1,330 breeding individuals[557] which is considered low, however no data to assess the rate of decline available, the Tasmanian masked owl was **not eligible** for listing under this criterion.

Criterion 4 – Number of mature individuals

This species was deemed as eligible for listing as **vulnerable** under this criterion as the number of mature individuals is low.

Criterion 5 – Quantitative analysis

At the time of assessment, there was insufficient data to assess this species under this criterion. Therefore, it was **not eligible** for listing under this criterion.

Threatened Species Scientific Committee (2010)

Ecology

The Tasmanian masked owl is the largest nocturnal forest owl in Tasmania[558] and weighs up to 1,260 grams and has a wingspan of up to 128 cm, and body length of 47–51 cm. Female owls are typically larger and heavier than males.

The Tasmanian subspecies is mainly greyish-brown above, with white and black spots. The species has a prominent facial disc of pale chestnut-brown to brownish-buff, with a darker chestnut shaded patch around the eyes, extending towards the base of the bill. The rim of the facial disk is very prominent and brown with darker speckles. The eyes are blackish-brown and the bill whitish-cream. Underparts are

[555] In the report this subspecies is referred to in full as 'Tasmanian masked owl' or abbreviated to 'masked owl'
[556] Garnett & Crowley (2000)
[557] Bell & Mooney (1997); Bell *et al.* (1997); Garnett & Crowley (2000); Bell & Mooney (2002)
[558] Young *et al.* (2020)

boldly marked with relatively large dark spots. Legs are feathered and toes greyish-brown to yellowish-grey with long blackish-brown talons. Females are darker than males[559].

Masked owl breeding is reported to be highly seasonal in Tasmania, with most females laying in mid-October to early November, with a fledging period of 10-12 weeks and dependent young for 1-3 months after fledging[560]. However, breeding can happen outside these times and nestlings have been detected in Tasmania as late as May and we are aware of a pair of birds in Tasmania's north deduced to have laid eggs in 2023 as early in the season as September[561]. Such variability is likely a response to short term eruptions in prey availability that occur outside the core breeding period[562].

Habitat

Potential breeding habitat for this species is defined as all areas that have trees with large hollows (≥15 cm entrance diameter), including spouts[563]. Suitable breeding hollows must have an entrance diameter that allows efficient entry and exit and are deep enough to be secure from weather and predators. Suitable hollows must also possess enough volume that an adult and chicks may be housed and contain a base suitable for egg laying and comfortable incubation[564]. Typical breeding habitat trees will often have a DBH >1 m (and a girth at the location of the hollow of approximately 60 cm[565].

Masked owls also utilise hollows for roosting, and maintaining roosting habitat is also potentially important for the persistence of a breeding pair in a territory[566]. Roosting habitat features are however more versatile (they include dense vegetation for example[567]) and are therefore less limited in the landscape than trees with large cavities suitable for breeding.

In terms of foraging requirements, masked owls are somewhat versatile and can switch between prey items depending on prey size and availability[568]. This adaptable approach to prey selection allows for versatility in terms of foraging habitat selection. In agricultural land they hunt introduced rodents and rabbits (which can form an important component of their diet[569]), while in areas of native habitat they select terrestrial animals and native birds[568].

No definition of habitat critical to the survival of the species is provided in the conservation advice or listing advice for the subspecies (and there is no recovery plan)[570]. Given the importance of suitable tree hollows for breeding, typically found in large old trees which are probably quite rare in the landscape[571], old trees and especially areas of old-growth forest that contain them, can be considered critical habitat for the species. These are an important current and future potential resource required by the species for breeding.

This does not however mean that masked owl territories should be comprised of all or even mostly areas of old-growth forest; they are known to utilise fragmented landscapes where different areas of the territory are used for different purposes; for example, forest edges and cleared agricultural land are favoured for foraging and larger more continuous patches of old-growth or mature forest for roosting and nesting[572].

559 Higgins (1999); Lewis (2005)
560 Department of the Environment, Water, Heritage & the Arts (2010c)
561 Threatened Species Scientific Committee (2010)
562 Threatened Species Scientific Committee (2010)
563 Forest Practices Authority (2014b)
564 D. James pers. comm. (2022)
565 Koch *et al.* (2008); Forest Practices Authority (2014b); David James pers. comm.
566 Young *et al.* (2021)
567 Bell and Mooney (2002); Todd (2012)
568 Threatened Species Scientific Committee (2010)
569 Todd (2012)
570 Department of the Environment, Water, Heritage & the Arts (2010c); Threatened Species Scientific Committee (2010)
571 Koch *et al.* (2008)
572 Young *et al.* (2020); Forest Practices Authority (2014b)

Population parameters

The conservation advice for the subspecies does not list any important populations in Tasmania[573]. Todd (2012) states that the subspecies occurs as a single population in Tasmania because of their dispersal capabilities, and the Tasmanian subspecies has been determined to be a distinct population of a biological entity under Section 517 of the EPBC Act. Due to the relatively small population estimates for the subspecies - between 520 and 1,330 breeding birds[574] – and the relatively broad distribution of the subspecies across the state, the entire subspecies population in Tasmanian may be classed as important.

According to the Action Plan for Australian Birds 2020[575], the estimated extent of occurrence is 80,000 km^2, and the area of occupancy is 1,000 km^2, with the extent of occurrence calculated with a high degree of reliability, and the area of occupancy a low degree of reliability[576]. The population is not severely fragmented, nor is it subject to extreme fluctuations in the area of occupancy and extent of occurrence[577].

Distribution and site significance

Masked owls can be found in a wide range of habitats across Tasmania, with owl densities varying geographically[578]. The highest densities are suggested to be in the east and north of Tasmania, while the lowest densities occur at elevations above 600 m ASL[579]. The potential range of the masked owl is the whole state, except the Bass Strait islands. The core range of the masked owl includes all areas that occur at low elevation (<600 m ASL)[578]. Until recently, the emphasis on dry forested habitats, particularly in the east and north of the state[578], has eclipsed the wetter forests in the west of the state in terms of significance for the species. A lack of survey effort in the west has also likely contributed to the paucity of records in that part of the state[580]. Recently, surveys in the west of the state have made increasing use of bioacoustic recorders with positive results, detecting masked owl in a range of wet forest environments; this has elevated the potential significance of the wetter western half of the state for the species[581].

The Project Area is within the core range for this species and there are a number of records of masked owls in the broader area (Figure 24), with 4 occurrences recorded on the NVA attributed to within 500 m of the pipeline alignment (with the most recent occurring in 2001) and a further 39 records within the Project Area[582], the most recent in 2022. There are no known nests within the Project Area, however there are two masked owl nests recorded on the NVA approximately 8 km to the south, near Railton.

SWIS management actions

This species was not discussed in the referral / preliminary documentation process for the SWIS project[583]. As such, no management actions were required as conditions of approval of the SWIS as a controlled action.

[573] Department of the Environment, Water, Heritage & the Arts (2010c)
[574] Bell & Mooney (1997); Bell *et al.* (1997); Garnett & Crowley (2000); Bell & Mooney (2002)
[575] Cisterne *et al.* (2021)
[576] Cisterne *et al.* (2021)
[577] Cisterne *et al.* (2021)
[578] Forest Practices Authority (2014b)
[579] Bell & Mooney (1996); Bell *et al.* (1997); Todd (2012)
[580] Department of the Environment, Water, Heritage & the Arts (2010c)
[581] Gros *et al.* (2023); North Barker Ecosystem Services (various project data); Natural Values Atlas data – as at 11 of September 2024
[582] Natural Values Atlas data – as at 11 of September 2024
[583] Referral EPBC: 2010 / 5327; Tasmanian Irrigation Development Board (2010)

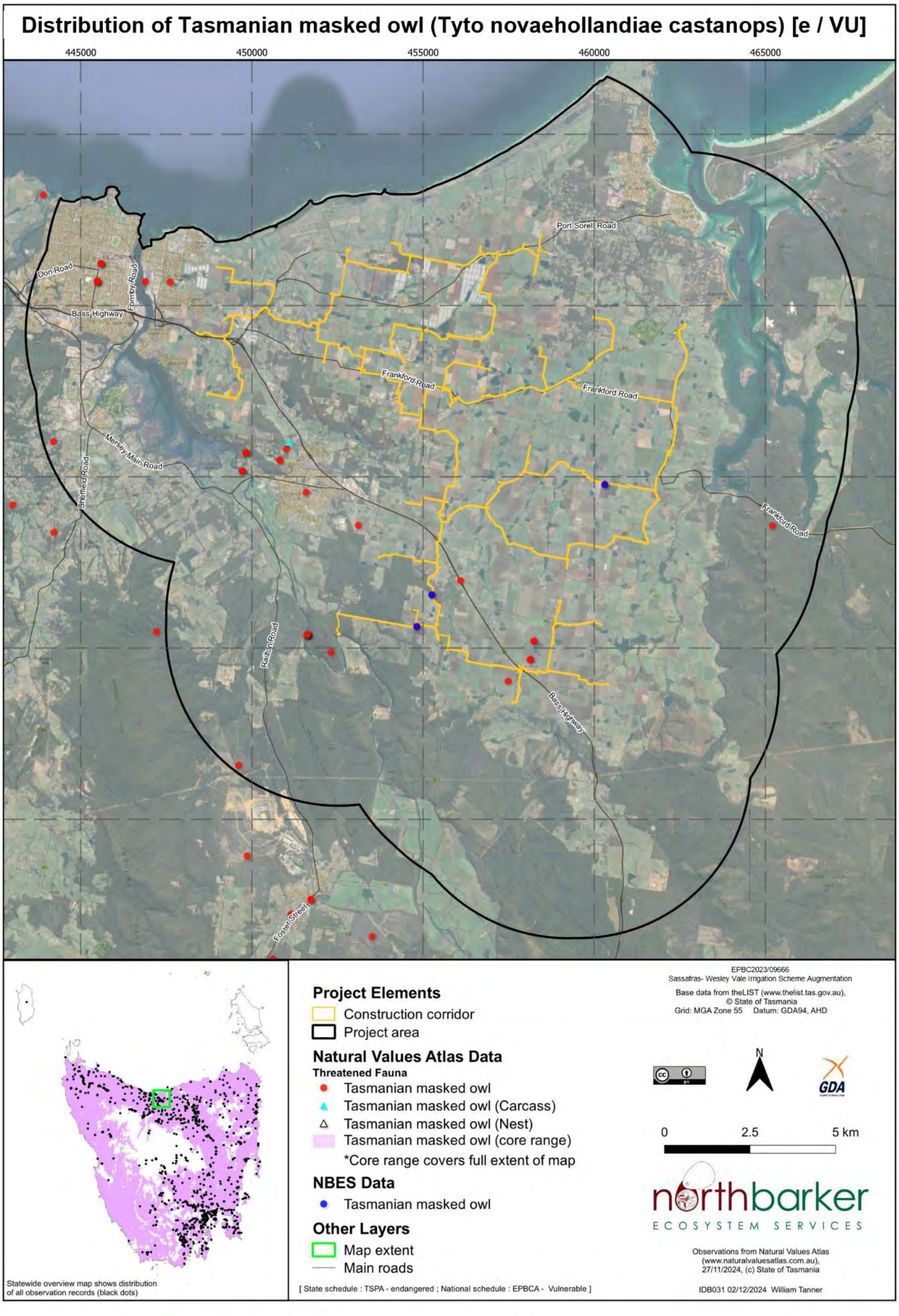

Figure 24: Distribution of the Tasmanian masked owl in relation to the Project Area

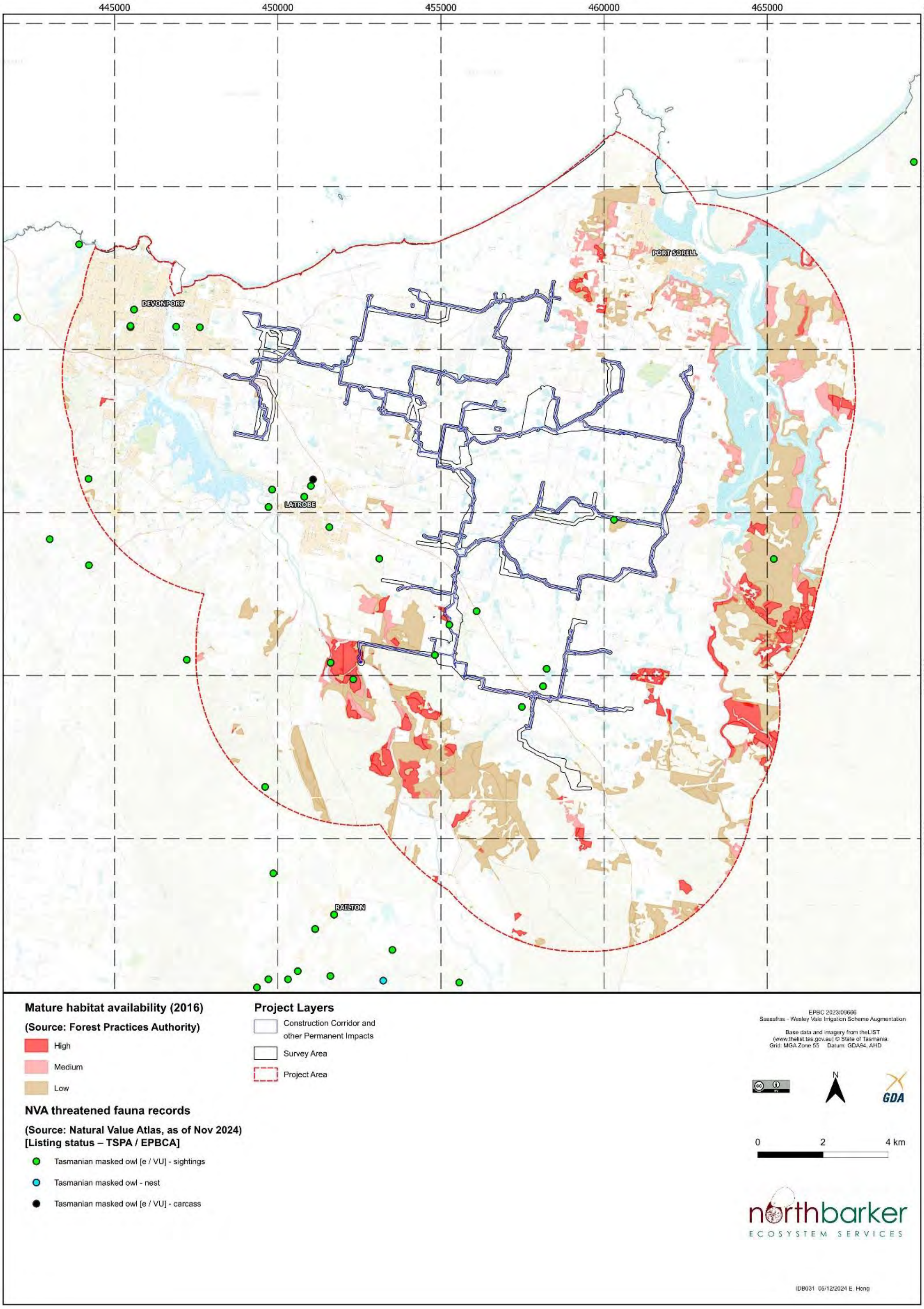

Figure 25: Mature habitat availability and masked owl records within the Project Area

Threats

Principal threats detailed in the conservation advice[584] include:

- Habitat clearing and fragmentation including the conversion of native forest to agriculture and silviculture, removal of large hollow-bearing paddock trees for irrigation systems, and residential development, particularly on the east and north coast's contribute to this primary threat;
- Loss of nesting habitat through tree dieback. Most nest trees utilised by masked owls are estimated to be in excess of 150 years old[585]. Rates of natural senescence and dieback due to climatic changes have increased in recent years[586];
- Secondary poisoning, particularly from rodenticides[587];
- Collision with artificial structures and vehicles; and
- Competition for tree hollows with other hollow-dependent species, notably possums and kookaburras[588].

Survey methods

Nesting tree habitat assessment

Field assessments for potential nesting habitat were conducted by targeting areas of native forest within the Survey Area, noting the presence of potential and significant habitat (trees with large hollows >15 cm entrance diameter and/or a DBH >100 cm)[589]. Ground surveys included examination of habitat for suitability in accordance with the Forest Practices Authority (FPA) guidelines[590], and examination of hollow-bearing trees for evidence of occupation (including pellets, scratching, white-wash, and prey remains).

Habitat suitability within the greater landscape was modelled using the Forest Practices Authority Mature Habitat Layer[589], with ground-based assessments of mature habitat availability determined in accordance with the FPA guidelines (Table 23). The mature habitat availability map[591] identifies areas as high, medium, low, or negligible mature habitat availability, based on aerial photograph interpretation of mature crown density and senescence. Estimates of habitat trees within the Project Area were calculated by multiplying the modelled extent of each mature habitat class within the Project Area by the field-based assessment criteria of each respective class.

[584] Threatened Species Scientific Committee (2010)
[585] Mooney (1997)
[586] Department of the Environment, Water, Heritage & the Arts (2010c); Threatened Species Scientific Committee (2010)
[587] Cisterne *et al.* (2023)
[588] Koch *et al.* (2008)
[589] Forest Practices Authority (2016)
[590] Forest Practices Authority (2014b)
[591] Forest Practices Authority (2016)

Table 23: Mature habitat availability categories as determined from ground-based assessment

Mature Habitat Availability Class	Field-based Assessment Criteria*	
	Dry Forests	Wet Forests
High	At least 8 trees / ha are over 100 cm DBH	At least 15 trees / ha are over 100 cm DBH or 8 trees / ha over 150 cm DBH
Medium	At least 8 trees / ha are greater than 70 cm DBH	At least 8 trees / ha are greater than 100 cm DBH
Low	Trees over 70 cm DBH are present, but comprise less than 8 trees / ha	Trees over 100 cm DBH are present, but comprise less than 8 trees / ha
Negligible	There are no eucalypt trees over 70 cm DBH	There are no eucalypt trees over 100 cm DBH

***A size limit is used to facilitate rapid assessments of mature trees. However, it is acknowledged that in some areas regrowth trees can be ≥100 cm in diameter and some areas smaller trees can provide mature forest features such as hollows. In circumstances where the definitions provided do not meet the intent of the mature habitat availability map, documentation and explanation can be provided with the biodiversity evaluation when management of mature forest habitat is required.**

<u>Call-back surveys</u>

The purpose of undertaking call-back surveys was to determine presence of Tasmanian masked owls within the Project Area. Therefore, call-back surveys were undertaken following recommended guidelines outlined below until the presence of masked owl was detected at which point call-back surveys were concluded.

Survey guidelines have been developed for Australia's threatened birds listed under the EPBC Act[592]. Although the Tasmanian masked owl is not included in these guidelines, its SPRAT profile[593] suggests that the recommendations for the northern Australian subspecies, *T. n. kimberli*, may be relevant. Guidelines for the northern subspecies suggest that broadcast (playback) surveys are effective in suitable habitat, especially in the lead up to breeding season. Whilst the Department of the Environment, Water, Heritage, and the Arts guidelines suggest that playback surveys are most likely to be effective in the lead up to the breeding season[594], in Tasmania there is no peak survey period recommended[595], with the entire year considered viable for surveying[596]. This is supported by the complete lack of seasonality in the effectiveness of the playback method in Tasmania[597], which is consistent with the limited effect of season on owl calling or response to playback noted in other Australian large forest owls, including other subspecies of *T. novaehollandiae*[598].

Call-back surveys for masked owls were conducted only to the extent necessary to determine the presence of the species within the Project Area. The level of survey effort conducted is outlined in Table 24.

Across each of the 7 selected habitat areas a twenty-minute masked owl call-back survey was conducted after sundown. Each twenty-minute survey was broken down into five-minute blocks. For the first five minutes a selection of masked owl recorded noises (screech's and chattering) was broadcast on a UE Boom 3 Bluetooth speaker. Recorded noises were played intermittently to replicate a more natural

592 Department of the Environment, Water, Heritage & the Arts (2010c)
593 Department of Climate Change, Energy, the Environment & Water (2024k)
594 Department of the Environment, Water, Heritage & the Arts (2010c)
595 Threatened Species Section (2024l)
596 Threatened Species Section (2024l)
597 Todd (2012)
598 Debus (1995); Kavanagh (1996)

regularity of calls. The second five minutes of the survey consisted of silent listening in complete darkness for wild owl calls and watching for silhouettes (if moonlight permitted). For the third five minutes of the survey, the recorded sounds were then played again as per the first five minutes, with the additional use of a spotlight to observe any owls that may be perched in nearby trees. The final five minutes of the survey was completed in silence and dark, again listening out for wild owl sounds and looking for any owl silhouettes. Call-back surveys were not undertaken during evenings with moderate to high wind or rain due to the inability to hear calls.

Table 24: Summary of masked owl call-back survey effort

Date	Survey Site	Location Coordinates	Conditions	Personnel	Number of Callbacks
18/12/2023	HT02 – Devil Road	452477E 5430524N	Cloudy, light winds	Ramit Singal Aleida Williams	1 – 20 minutes
18/12/2023	HT13 – Native Plains Road	455223E 5431624N	Partly cloudy, no wind	Ramit Singal Aleida Williams	1 – 20 minutes
21/12/2023	HT03 – Oppenheims Road	460305E 5434776N	Partly cloudy, no wind	Ramit Singal Jesse Lewis	1 – 20 minutes
21/12/2023	HT10 – Mill Road	454302E 5441512N	Partly cloudy, no wind	Ramit Singal Jesse Lewis	1 – 20 minutes
08/01/2024	HT21 – Pardoe Creek	455416E 5439337N	Light rain, no wind	Ramit Singal John Gooderham	1 – 20 minutes
10/01/2024	HT08 – Port Sorell Road	450222E 5439782N	Partly cloudy, no wind	Ramit Singal John Gooderham	1 – 20 minutes
11/01/2024	HT43 – Beer Street	451511E 5439466N	Partly cloudy, light winds	Ramit Singal John Gooderham	1 – 20 minutes

Survey findings

Nesting tree habitat assessment

Sixty-nine large trees/stags that have potential to contain habitat suitable for nesting and/or roosting for Tasmanian masked owl and an additional 5.71 ha of forest likely to contain habitat trees were recorded within the Survey Area. Of these habitat areas, only 3 individual trees occur within the Construction Corridor (Table 25). It should be noted that 0.23 ha of the area mapped as potential nesting habitat occurs within the Construction Corridor. Any individual potential nesting habitat trees within this area have been individually recorded in Table 25

For contextual purposes, further to the known trees and forested vegetation within the Survey Area and Construction Corridor, an estimation of the availability of trees (which may provide suitable breeding habitat) within the broader area has been modelled[599] using the Forest Practices Authorities mature habitat layer[600]. The stratification of mature habitat is provided in Table 23 and the distribution of habitat classes from within the Project Area are displayed in Figure 25. According to the Forest Practices

[599] Noting that this is modelling based upon numerous spatial GIS layers, with various limitations (which are outlined in the source documentation). The modelled habitat is not definitive and requires ground truthing, noting that not all modelled habitat necessarily represents nesting trees, rather that potential nesting habitat is likely present in varying levels of density more broadly throughout a modelled area of mature habitat.
[600] Forest Practices Authority (2016)

Authority field-verified assessment criteria[601], due to the mapped availability of mature habitat within the Project Area, it can be expected that at a minimum, there are a further 36,376 mature trees (>70 cm DBH) present in the local landscape. This estimate does not take into account the potential for paddock trees, or sporadic large trees within low maturity forest, so is a minimum estimate of available habitat trees (noting the scattered trees recorded within the Project Area do not even register as viable mature forest habitat in this modelling). Of these 36,376 trees, approximately 7,634 (at a minimum) would be expected to be greater than >100 cm DBH and thus in the optimal size range suitable for the nesting habitat requirements of the masked owl (Table 26).

Table 25: Extent of potential masked owl nesting habitat within the Survey Area

Habitat Type	Within Survey Area (exc. Construction Corridor)		Within Construction Corridor	Total	
	Extent of Polygon (ha)	Individual Trees	Individual Trees	Extent of Polygon (ha)	Individual Trees
Potential Nesting Habitat	5.48	66	3	5.71	69
Total	**5.48**	**66**	**3**	**5.71**	**69**

Presence of Tasmanian masked owls

Tasmanian Masked owl was recorded on three separate occasions in during the December 2023 - January 2024 survey season at two discrete locations within the Survey Area.

A single bird responded well to the call-back survey within a remnant patch of DOB forest including potential nesting potential habitat trees on Oppenheims Road (HT03).

No other call-back surveys elicited a response from a Tasmanian masked owl, however an owl was seen and heard in the vicinity of the Native Plains Road potential habitat area and call-back site (HT13). This was an unsolicited observation 3 weeks after the call-back survey was undertaken. A second unsolicited an owl was heard calling multiple times (shrieks and chatter) from the same area the night before (11/01/2024). The calls were heard from near Native Plains Road but were discerned to be coming from the vicinity of the Saggers Hill habitat tree area. It is likely that this was the same bird or one of a pair of birds two nights in a row, and that this bird / pair would be utilising the habitat area extending from Native Plains Road to the Mersey River including the Warrawee Conservation Area and the forested areas to the north and south of the alignment.

Tasmanian masked owls have been shown to be utilising the Project Area. Targeted nest surveys were not conducted as any potential impacts to masked owl nests will be detected and mitigated through pre-clearance surveys before construction is started.

[601] Forest Practices Authority (2014b)

Table 26: Mature habitat availability[602] within the local landscape

Potential Nesting Habitat Density Class		Field-based Assessment Criteria	Availability Within Project Area (ha)	Predicted Number of Trees Within Project Area
High	Dry Forest	At least 8 trees per hectare >100 cm DBH	617.33	4,939 >100 cm DBH
	Wet Forest	At least 15 trees per hectare >100 cm DBH or 8 trees per hectare >150 cm DBH	94.71	1,421 >100 cm DBH
	Other Forest	At least 8 trees per hectare >100 cm DBH	39.95	320 >100 cm DBH
		Total	**751.99**	**6,679 trees >100 cm DBH**
Medium	Dry Forest	At least 8 trees per hectare >70 cm DBH	618.10	4,945 >70 cm DBH
	Wet Forest	At least 8 trees per hectare >100 cm DBH	20.70	166 >100 cm DBH
	Other Forest	At least 8 trees per hectare >70 cm DBH	66.61	533 >70 cm DBH
		Total	**705.42**	**166 trees >100 cm DBH (notwithstanding that this could include trees >100 cm DBH in the dry and other forest classes)**
Low	Dry Forest	Trees >70 cm DBH are present, but less than 8 trees per hectare	2,687.77	21,477 >70 cm DBH
	Wet Forest	Trees >100 cm DBH are present, but less than 8 trees per hectare	98.71	801 >100 cm DBH
	Other Forest	Trees >70 cm DBH are present, but less than 8 trees per hectare	220.28	1,776 >70 cm DBH
		Total	**3,006.77**	**Up to 790 trees >100 cm DBH (notwithstanding that this could include trees >100 cm DBH in the dry and other forest classes)**
Negligible / Unsuitable	Dry Forest	No eucalypt trees >70 cm DBH	3,836.01	-
	Wet Forest	No eucalypt trees >100 cm DBH	697.42	
	Other Forest	No eucalypt trees >70 cm DBH	31.944.70	
		Total	**36,478.13**	**Estimated 7,634 >100 cm DBH Or up to 36,376 >70 cm DBH**
Total (High and Medium Class minimum estimate plus upper estimate for Low Class)			**40,942.30**	

602 Forest Practices Authority (2016)

Impact pathways

Potential impact pathways to the Tasmanian masked owl relevant to the construction of the SWISA include:

- Habitat clearing and fragmentation, including the conversion of native forest to agriculture, and the removal of large, hollow-bearing paddock trees for irrigation systems; and
- Loss of nesting habitat through tree dieback.

Potential impact pathways to the Tasmanian masked owl relevant to the operation of the SWISA include:

- Habitat clearing and fragmentation, including the conversion of native forest to agriculture, and the removal of large, hollow-bearing paddock trees for irrigation systems.

Avoidance

The priority is to avoid the need for the removal of large trees with potential to support hollows. Sixty-five of the recorded potential habitat trees and 5.48 ha of forest that may contain potential habitat trees have been avoided through design. A further 11 trees outside of the Construction Corridor have a TPZ overlap >10 % (Table 27). Impacts to these trees may also be avoided, however advice from a qualified arborist regarding the viability of retention is recommended.

Impacts

Construction

Masked owls were confirmed as present within the broader landscape through call-back surveys, however targeted surveys were not conducted due to the high level of difficulty in pinpointing a nest at such a broad scale.

The construction of the SWISA will impact upon 3 potential nesting trees. An additional 9 trees have a TPZ incursion >10 % and may be at risk of mortality (Table 27). All impacted trees are subject to the mitigation measures detailed above to ensure direct impacts to masked owls is avoided.

The proposed construction is not likely to contribute to threats such as increased mortality due to secondary poisoning, collision with structures or vehicles, and increasing competition for tree hollows. The construction of the SWISA is unlikely to contribute significantly to the cumulative impacts to habitat in the region due to the limited scale of impacts, and the mitigation measures proposed to reduce potential impacts.

In terms of the scale of impact to habitat in the broader area, the loss of a maximum of 12 potential nesting trees within the Construction Corridor and TPZ incursions represents 0.16 % of the minimum 7,634 potential habitat trees estimated to occur within the Project Area, and 0.03 % of the maximum 36,376 potential habitat trees in the Project Area (Table 26).

Operation

The greatest risk to this species due to the operation of the scheme is from the potential for changes in land use, as well as clearance and conversion of potential breeding and foraging habitat areas to agricultural land. With an OEMP and Farm WAPs in place, no impacts to this species are anticipated due to the operation of the SWISA.

Table 27: Impacts and avoidance of potential masked owl breeding habitat

Habitat Type	Construction Corridor		Avoidance Area	
	Number of Potential Habitat Trees	Number of Trees With TPZ Incursion >10 %	Area of Potential Habitat (ha)	Number of Potential Habitat Trees
Potential Nesting Habitat	3	9	5.48	57

Mitigation measures

Construction

An arborist assessment that determines the viability of retention for trees that are outside of the direct impact footprint must be conducted for any potential masked owl habitat tree that has a TPZ incursion >10 % (as per the Australian Standard Protection of Trees on Development Sites AS 4970-2009[603]). Trees that are determined as viable for retention must be marked as exclusions (including a tree protection zone buffer) on civil contracts and on the ground.

If there are potential habitat trees within the Construction Corridor that cannot be avoided (*i.e.* require removal or structural root damage that would risk treefall), to mitigate potential direct impacts to any masked owls, the removal of any potential habitat trees must be completed outside of the optimal breeding season (September to February).

Further to this, all potential habitat trees that will be directly impacted, or are not able to be retained due to critical root zone incursions must be subject to a habitat tree management protocol (**Appendix I**) involving targeted hollow use inspections. A combination of survey techniques is recommended to reduce the risk of a nest being overlooked.

This protocol must include the following elements, based on accepted survey advice from NRE:

- Within all areas containing potential habitat trees, conduct two deployments of passive acoustic monitoring (PAM) devices. Each deployment must run for a minimum of three weeks across different seasons (e.g. one in spring and one in summer).
    - Detection range of PAM devices must be accounted for in the survey design period.
    - PAM devices must record for the duration of the night to determine presence/absence of masked owls.
    - Analysis of PAM data must be analysed by a qualified bioacoustics analyst.
- If after the minimum 6 weeks of PAM surveys no owls are detected, trees must be visually inspected prior to decommissioning of any hollows to ensure no other fauna are roosting/nesting inside.
- If PAM indicates that masked owls are present in the landscape, further survey is required to examine potential nesting trees, beginning with:
    - Visual assessment of all trees that are proposed to be removed, as well as all potential habitat trees within 15 m of the proposed Construction Corridor, regardless of whether the tree can be retained.

603 Standards Australia (2009)

  - It is recommended that this is conducted within the core breeding season (October to early November) to maximise the likelihood of observing owls coming and going from trees.
  - Trees must be checked for any signs of nesting or roosting (regurgitated pellets, whitewash, feathers at the base of the tree within the tree's dripline). Lack of these signs does not indicate an absence of nest but the presence of any of these signs can strongly indicate a nest hollow.
  - Hollows must be observed from sunset to several hours after sunset to detect owls exiting from hollows. The aid of a thermal scope/camera may assist in reducing observer error.
  - If the above, less-invasive methods are inconclusive, trees should be tapped firmly (hammer, heavy stick etc) to see if a bird is flushed from the hollow.
  - Finally, as a last resort, consider physical inspection of hollows. This may involve climbing of trees to assess hollow usage. This method is not desirable as it is highly invasive to owls.
- In the event that a nest tree is located during this process, the following applies:
  - The tree must be excluded from clearance, a permanent TPZ exclusion zone must be applied and marked as exclusion zones on civil contracts, and exclusion fencing erected.
  - If current breeding activity of masked owls is likely/confirmed:
    - A temporary 150 m buffer exclusion zone where no works will occur must be applied until fledging has completed (up to 18 weeks), breeding has failed, or additional evidence is available to refute the suspected breeding evidence.
    - Exclusion fencing must be erected by the contractor.
    - A monitoring program is required to inform this process and will need to be determined by the ecologist as to what is most suitable for the particular nesting tree.
  - Once the above requirements are completed and absence has been confirmed by the Ecologist, realignment works can commence within this buffer area (outside of the permanent TPZ exclusion zone).
  - Any tree confirmed as a masked owl nest tree cannot be removed or impacted without tree specific permit from the regulator.

Operation

The provision of Tasmanian Irrigation water does not allow for landowners to conduct unregulated land clearance. All land irrigated with Tasmanian Irrigation water within the SWISA are subject to rigorous assessment through the Farm WAP process and the provisions of an OEMP. The risk of direct impact to Tasmanian masked owls and potential habitat clearance due to Tasmanian Irrigation water will be managed through the Farm WAP process, with measures in place to ensure that this species is adequately protected by applying exclusion areas and applying buffers from particular agricultural activities.

In order to mitigate the risk of impact to this species during operation of the scheme, the following actions as part of the SWISA OEMP for each SWISA irrigator property are required:

- Application of a Farm WAP for each property within the Operational Area.
- Property-wide survey for potential nesting habitat for this species.

- Any potential nesting trees must be subject to a habitat tree management protocol (**Appendix I**) prior to removal.
- Removal of any potential habitat trees must occur outside of the optimal breeding season for masked owls (the optimal breeding season is between September and February).

The application of the SWISA water is anticipated to have negligible impacts to foraging habitat such that specific mitigation measures are not warranted for this aspect.

If it is determined by the Farm WAP that impacts due to the operation of the SWISA on individual properties are likely to trigger the MNES *Significant Impact Criteria*[604], individual irrigators may need to refer their action independently.

Residual significant impacts

With the above context, survey results, avoidance, impacts, and mitigation, an assessment of the residual impacts as a result of the construction and operation of the SWISA against the significant impact criteria[605] is provided below.

1) Lead to a long-term decrease in the size of an important population.

No important populations have been formally identified[606], and although little is known of the local population density we have accepted the possibility that this should be classified as important, noting that a population for this species could either be defined as the entire State of Tasmania, or at the very least a huge regional area such as all lowland areas of the Midlands, east, south and north of Tasmania combined (grouped based on environmental similarity and evident occupation of owls across the area based on Natural Values Atlas records).

A maximum total of 12 mature potential hollow-bearing trees suitable for the masked owl (0.16 % of the minimum potential nesting trees estimated to occur across the broader Project Area) may require to be removed under the proposed development. Although it is considered extremely unlikely (and effectively impossible from the ecological standpoint of this highly territorial species) that every single one of these trees is utilised for nesting and/or roosting by this species, it is assumed to be possible in this case for the purposes of assessment and mitigation.

Any clearance of a potential hollow-bearing masked owl habitat tree will be subject to a habitat tree protocol. The application of this protocol will ensure that there will be no direct impacts to masked owls due to the removal of potential habitat trees and no potential interruption of a breeding event. The availability of viable habitat trees does not appear to be limiting in the local landscape and therefore the potential loss of one or more (very unlikely) trees used for roosting or nesting is likely to be available for replacement in the surrounding landscape, noting that a species that occupies inherently old and potentially unstable trees can be taken to have some internal resilience to occupying new hollows as an adaptation to when their hollows are lost through natural attrition. In addition, potential impacts in this scenario are restricted to a pair or birds at most (given the species is territorial and has very large home ranges[607]) and could not possibly be extrapolated to equal a significant impact on the size of the population as a whole.

Therefore, the proposed construction and operation of the SWISA is **not** considered to have the potential to lead to a long-term decrease in the size of the population of this species.

[604] Commonwealth of Australia (2013a)
[605] Commonwealth of Australia (2013a)
[606] Department of Climate Change, Energy, the Environment and Water (2024k); Threatened Species Scientific Committee (2010)
[607] Young *et al.* (2021)

2) Reduce the area of occupancy of an important population.

No important populations have been formally identified[608], and although little is known of the local population density we have accepted the possibility that this should be classified as important, noting that a population for this species could either be defined as the entire State of Tasmania, or at the very least a huge regional area such as all lowland areas of the Midlands, east, south and north of Tasmania combined (grouped based on environmental similarity and evident occupation of owls across the area based on Natural Values Atlas records).

According to the Action Plan for Australian Birds 2020[609], the estimated extent of occurrence is 80,000 km^2, and the area of occupancy is 1,000 km^2, with the extent of occurrence calculated with a high degree of reliability, and the area of occupancy a low degree of reliability[610].

Given the highly mobile nature of this species, their large home range and the fact any impacts from the project will not render habitat inviable for use after works (at worst a cleared area will still constitute viable foraging and dispersal habitat, as evidenced by all the observation records in cleared land[611], the species will still have the same potential for local occupancy after the completion of works and during operation. With this applicable at even the local level, it cannot conceivably be considered to have a risk of reducing the area of occupancy for the species at a population level.

Thus, the proposed construction and operation of the SWISA **will not** reduce the area of occupancy of an important population.

3) Fragment an existing important population into two or more populations.

According to the Action Plan for Australian Birds 2020[612], the estimated extent of occurrence is 80,000 km^2, and the area of occupancy is 1,000 km^2, with the extent of occurrence calculated with a high degree of reliability, and the area of occupancy a low degree of reliability[613]. The population is not severely fragmented, nor is it subject to extreme fluctuations in the area of occupancy and extent of occurrence[614].

Because of the ecology of this species (highly nomadic, highly mobile and found in a range of environments including modified land and habitat mosaics), they are resilient to fragmentation, with no evidence we know of that fragmentation has ever been reported for the species. Thus, there is no risk of fragmenting an existing population into two or more populations (noting also that a population of the species can only be taken to cover a much greater area than that at risk of impacts from this proposal).

Thus, the proposed construction and operation of the SWISA **will not** fragment and existing important population into two or more populations.

4) Adversely affect habitat critical to the survival of a species.

No definition of habitat critical to the survival of the species is provided in the conservation advice or listing advice for the subspecies (and there is no recovery plan)[615]. Given the importance of suitable tree hollows for breeding, typically found in large old trees which are probably quite rare in the landscape[616], old trees and especially areas of old-growth forest that contain them, can be considered critical habitat

[608] Department of Climate Change, Energy, the Environment and Water (2024k); Threatened Species Scientific Committee (2010)
[609] Cisterne *et al.* (2021)
[610] Cisterne *et al.* (2021)
[611] Natural Values Atlas data – as at 11 of September 2024
[612] Cisterne *et al.* (2021)
[613] Cisterne *et al.* (2021)
[614] Cisterne *et al.* (2021)
[615] Department of Climate Change, Energy, the Environment and Water (2024k); Threatened Species Scientific Committee (2010)
[616] Koch *et al.* (2008)

for the species. These are an important current and future potential resource required by the species for breeding.

Disruption of the use of breeding and roosting habitat elements from the proposal will be prevented via the application of the habitat tree management protocol. Given the extensive availability of equivalent potential habitat trees recorded for the project and not at risk of impacts (with 99.84 % of the estimated potential habitat trees remaining in the Project Area), the project is not considered to have a risk of impacting critical habitat in a way that adversely affects the likely survival of even a local resident pair of birds, let alone the species as a whole.

Thus, the proposed construction and operation of the SWISA **will not** adversely affect habitat critical to the survival of the Tasmanian masked owl.

5) Disrupt the breeding cycle of an important population.

No important populations have been formally identified[617], and although little is known of the local population density; we have accepted the possibility that this should be classified as important.

Provided that the habitat tree protocol is applied, there will be no disruption of the breeding cycle of the population and **no risk** of significant impacts from this aspect – noting that even without the protocol in place the risk of breeding occurring within one of the habitat trees at risk at the same time as works are occurring is considered to be very low.

6) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Given that the maximum of 12 trees that may be impacted represents only 0.16 % of the estimated potential habitat trees across the broader Project Area (and the availability of potential habitat in the wider landscape), the construction and operation of the SWISA will not modify, destroy, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline. Indeed, all impacted areas following works will still constitute viable habitat for the species, and no limited habitat elements are at risk of being lost from the works.

During operation, the SWISA OEMP and Farm WAP biodiversity module contains measures to ensure habitat values are preserved, thus there will be no modification, destruction, removal, isolation, or decrease in the availability of habitat to the extent that impacts may lead to species decline.

Based on this assessment, the construction and operation of the SWISA **will not** modify, destroy, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline.

7) Result in invasive species that are harmful to the species becoming established in the species' habitat.

There is no likelihood that the construction and operation of the SWISA will result in invasive species that are harmful to the species becoming established in the species' habitat. The species uses introduced species extensively as prey items and no introduced species are currently listed as a threat[618].

Thus, the proposed construction and operation of the SWISA **will not** result in invasive species that are harmful to the species becoming established in the species'

8) Introduce disease that may cause the species to decline.

There are no diseases applicable to the nature of works that are listed as threats to the species[619] and no likelihood that the project will introduce disease that may cause the species to decline.

[617] Department of Climate Change, Energy, the Environment and Water (2024k); Threatened Species Scientific Committee (2010)
[618] Department of Climate Change, Energy, the Environment and Water (2024k); Threatened Species Scientific Committee (2010)
[619] Department of Climate Change, Energy, the Environment and Water (2024k); Threatened Species Scientific Committee (2010)

Thus, the proposed construction and operation of the SWISA **will not** introduce a disease that may cause the species to decline.

9) Interfere substantially with the recovery of the species.

There is no recovery plan for this species. Given the action is not anticipated to have even an effect on the likelihood of local persistence of the species, it cannot conceivably be seen to have a likelihood of interfering with the recovery of this species overall.

Therefore, the proposed construction and operation of the SWISA **will not** interfere with any other recovery actions for the Tasmanian masked owl.

Summary

With the recommended mitigation measures in place, our assessment is that the proposed construction and operation of the SWISA **will not** have significant residual impacts on the Tasmanian masked owl.

4.3.1.5 Tasmanian wedge-tailed eagle (*Aquila audax fleayi*)

Context

Conservation status

The Tasmanian wedge-tailed eagle is listed as endangered under the EPBC Act due to:

> On the 16th of July 2000, this species was listed as endangered on the basis of available scientific information. This conclusion was reached from the following reasons:
>
> - The population is less than 1,000 mature individuals;
> - The population may be declining;
> - The population is subject to a number of identified and ongoing threatening processes;
> - It occurs as a single island population; and
> - It is a distinct subspecies.
>
> **Threatened Species Section (2006)**

The Tasmanian wedge-tailed eagle is also listed under the TSP Act. It was initially listed as vulnerable; however, it was elevated to endangered in 2001 due to an estimated low breeding population, and ongoing threatening processes such as persecution and habitat and nest disturbance[620].

Ecology

As is the case with many raptor species, female wedge-tailed eagles are larger than the males. The body length ranges from 100-110 cm, with a wingspan ranging between 1.9 m and 2.3 m, and a body mass between 3.0 kg and 5.5 kg[621].

The eagle breeding season[622] spans from the beginning of July until the end of January and is extended into February in seasons where breeding progress is later than normal, which is determined annually by the FPA around November[623].

Wedge-tailed eagles hunt and scavenge on a wide variety of fauna including fish, reptiles, birds, and mammals, and hunt is a range of habitats, with most prey items weighing less than 1 kg[624]. The subspecies has been recorded hunting over most types of Tasmanian terrestrial habitat including coastal heath, dry woodland, temperate rainforest, dwarf coniferous forest, sub-alpine forest, grassland and cleared land[625].

Wedge-tailed eagles are thought to have a lifespan of approximately 25 years, with first breeding occurring at around 5 years[626]. They are territorial breeders and are monogamous, forming pairs for life; however, if one of the pair dies, the surviving bird will find a new mate if available[627]. A single territory may contain numerous nests and perch sites; however, only one nest within a territory is active within any one year[628].

Habitat

Tasmanian wedge-tailed eagles' nest in a range of old-growth native forests and are dependent on forest for nesting. This species requires large, sheltered trees for nesting and is highly sensitive to

620 Threatened Species Section (2023b)
621 Threatened Species Section (2023b)
622 Forest Practices Authority (2023); Environment Protection Authority (2023)
623 Forest Practices Authority (2023)
624 Threatened Species Section (2023b)
625 Gaffney & Mooney (1992)
626 Bell & Mooney (1998)
627 Mooney & Holdsworth (1991)
628 Mooney & Holdsworth (1991)

anthropogenic disturbances during the breeding season. Territories can contain up to five alternate nests typically clustered in a territory and usually close to each (but may be up to 1 km apart where habitat is locally restricted). Due to territorial competition for resources, nests for wedge-tailed eagles in separate territories have not been recorded closer than about 1.8 km, even in very productive territories[629].

There is no current recovery plan for this species (expired in 2010)[630], however this is still the adopted recovery plan until an updated recovery plan is published. In this plan, critical habitat for the Tasmanian wedge-tailed eagle is defined as forests of predominantly old-growth trees greater than 10 ha in area and occurring on sites sheltered from prevailing strong winds[631]. The FPA's nesting habitat suitability model presents the most reliable map of potential nesting habitat. By considering topography and aspect it defines the most likely areas of habitat. The model does however not consistently predict nests, with ~60 % of the eagle nests (both wedge-tailed and white-bellied sea eagle) known from within the Project Area occur in areas modelled as low quality nesting habitat (ie. modelled habitat value is ≤3).

Population parameters

The Tasmanian subspecies of the wedge-tailed eagle occurs only in Tasmania and as a single population[632]. It has been estimated that the total population in the state is between ~1,000 and ~1,500 individuals but ongoing work is required to improve the accuracy and robustness of this range[633]. Indeed, it is likely that current numbers are significantly higher than most documented estimates and potentially several times greater[634].

According to the Action Plan for Australian Birds 2020[635], the estimated extent of occurrence is 71,000 km^2, and the area of occupancy is 8,520 km^2, both ranges are estimated with a medium level of reliability. The population is not severely fragmented, nor is it subject to extreme fluctuations in the area of occupancy and extent of occurrence[636].

Distribution and site significance

The subspecies occurs throughout the state of Tasmania (Figure 26). Territory sizes have been estimated from the known nest distribution and range from 20–30 km^2 in the drier, more fertile and open habitats of the lowlands, to much larger territories of 1,200 km^2 in the highlands and in the western regions[637].

Nesting habitat within the SWISA Project Area is considered low when using the eagle habitat suitability model developed by the FPA due to the lack of dense forest patches and sheltered gullies and valleys. The SWISA landscape is relatively flat, with shallow undulations, and is heavily modified for agriculture. Despite this suboptimal landscape, a number of eagles still nest in the limited forest patches available and likely thrive off using the open plains of farmland for foraging.

There are 10 records of wedge-tailed eagles within 500 m of the pipeline alignment, and a further 109 recorded occurrence within 5 km of the pipeline alignment. There are seven nests attributed to wedge-tailed eagle nests within the Project Area, as well as 6 attributed to eagle spp. and 13 white-bellied sea-eagle nests[638]. It is possible that these nests may be shared across both species between seasons. Five of these nests are within 500 m direct distance of the Survey Area. An additional 8 nests are within 1,000 m of the Survey Area.

[629] Jason Wiersma pers. comm. (2023)
[630] Threatened Species Section (2006)
[631] Threatened Species Section (2006)
[632] Threatened Species Section (2006)
[633] Threatened Species Section (2023b)
[634] N. Mooney pers. comm. (2024)
[635] Mooney *et al.* (2021)
[636] Mooney *et al.* (2021)
[637] Bell & Mooney (1998)
[638] Natural Values Atlas data – as at 11 of September 2024

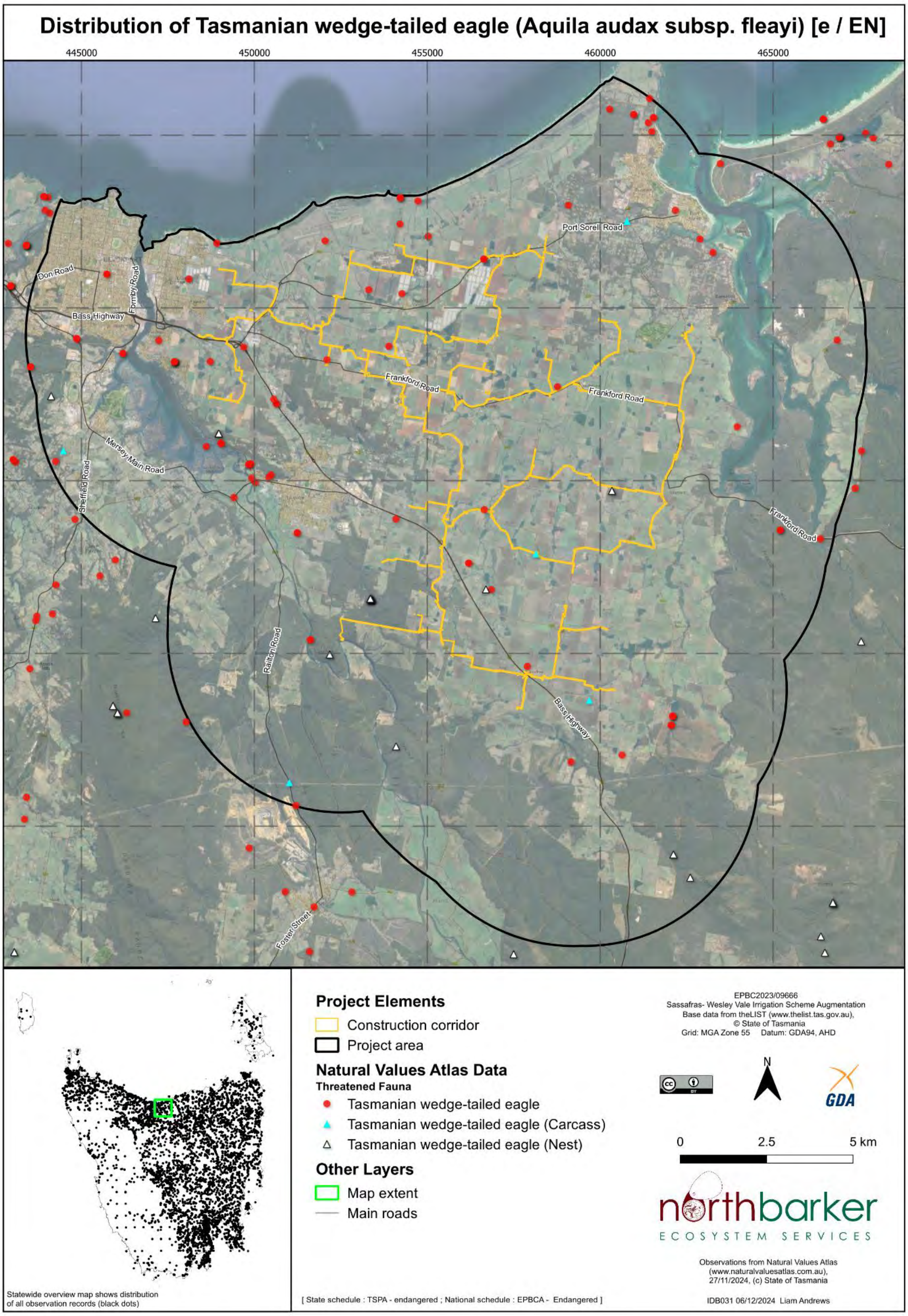

Figure 26: Distribution of the Tasmanian wedge-tailed eagle in relation to the Project Area

SWIS management actions

This species was briefly discussed in the natural values assessment for the SWIS project[639], however was not deemed to present a risk to the construction of the SWIS. No management actions were required as conditions of approval of the SWIS as a controlled action.

Threats

Multiple threatening processes are listed within the TSP Act listing statement[640] and SPRAT profile[641] for the Tasmanian wedge-tailed eagle, including:

- Habitat loss, through the clearing of nesting (and potential nesting) habitat as a result of change land use (ie agriculture, silviculture, residential and industrial development).
- Breeding and nest disturbance. This is considered to be a significant and ongoing threat. Nest disturbance can be triggered by either visual or aural cues, including activities as innocuous as bushwalking, mountain biking, or photography enthusiasts, as well as more invasive activities such as motor biking, firewood cutting, forest harvesting, and helicopter flights. Inappropriate inspection and monitoring of nests can also lead to nest abandonment and reduced breeding success. Nest disturbance is the primary threat that the SWISA project poses to this species.
- Collision with artificial structures such as power lines, wind turbines, motor vehicles, and aircraft;
- Persecution and poisoning. Rodenticides and lead poisoning from ingested shot fragments present a significant risk to eagles. Eagles are also subject to persecution by shooting, although documented cases have declined since the 1980's, but it is not clear whether this is due to a decline in persecution or reduced rates of detection and reporting.
- Increase threat of climate change and climate related events such as loss of habitat through dieback, wildfires, and other severe weather events.

Survey methods

Aerial nest search

Background research and planning

As an exploratory desktop process, all habitat within this search area was considered against the suitability index of the FPA eagle habitat model[642]. Whilst this model provides guidance for areas of highest eagle nesting potential, it is best practice to consider all habitats within a survey area when conducting the aerial search, to ensure the model has not misrepresented habitat patches and to establish if nests are present outside of areas mapped as highly suitable. Within partly modified environments such as the current survey area, marginal habitats can include wildlife habitat clumps and streamside reserves adjacent to forest and agriculture operations. It was thus proposed to search the entire area to determine habitat suitability and to detect any nest sites with surveys conduct in accordance with relevant survey guidelines[643].

A desktop assessment was conducted to review all known eagle nests within the search area and in close proximity to the search area boundary. This assessment aimed to determine the last recorded status of each nest and assess the accuracy of their locations. Prior to the 2024 survey, ten eagle nests were known to occur within 1.5 km of the alignment (at the time of survey) based on data from the NVA[644].

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639 Scientists, Engineers, Managers & Facilitators (2009)
640 Threatened Species Section (2023b)
641 Department of Climate Change, Energy, the Environment and Water (2024l)
642 Forest Practices Authority (2023)
643 Department of the Environment, Water, Heritage, and the Arts (2010b)
644 Natural Values Atlas data – as at 11 of September 2024

Survey team

The nest search was undertaken on the 9-10/02/2023 according to FPA standards by Erin Harris (NBES) and Adam Hardy (Raptor Care North West), with Aleida Williams (NBES) as an additional spotter. Erin and Adam are both experienced in aerial and ground eagle nest surveying and the identification of suitable habitats. Flights were conducted by Helicopter Resources Pty Ltd., with pilot and Hoey Stobart who has flown numerous eagle nest surveys in the past.

A total of 8 hours was spent searching the nest survey area (to a buffer of 1.5 km around the proposed alignment at that time). The weather was optimal for the duration of the survey, with winds trending from light to moderate.

Aerial survey method

The survey involved slow flying (5-10 knots) above the tree canopy or, where possible, below the adjacent canopy level, such as through gullies. Transects were flown over the whole area to ensure complete coverage (*i.e.* not just those areas predicted by the FPA model) but additional survey effort was concentrated on high quality potential habitat. All known nest locations (as determined by the NVA database) within the nest survey area were visited to verify condition and presence. Any previously recorded nests that could not be found (using their recorded position and spatial accuracy as a guide), were also searched for within surrounding suitable trees and habitat until it was considered that continued searching would be futile.

Once a nest was located, its condition and features were described in-situ with the assistance of 10 x 40-50 mm binoculars, enabling the observers to remain distant from the nest. Nest checks were limited to the time necessary to verify presence and condition (typically less than 1-2 minutes in an area) in order to reduce risks to local birds and the observers while hovering near the canopy. To further reduce potential disturbance, all nest observations were photographed using a Canon 5D Mark2 camera with a manual optical zoom and the location only recorded (using a handheld non-differential GPS, Garmin GPSMap 64s) if the previously recorded position had low reported spatial accuracy or the nest was a new record.

To complement the in-situ observations, images of each nest were later examined to further inform the condition assessment. Condition characteristics included: fresh green leaves, stick tone (brown or grey), white-wash, algal smears, nest shape (flat-topped or bowl), down/feathers, and prey remains. The integrity of the nest was then given a classification based on it being prime, viable, derelict or remnant. These factors represent the viability of the nest for breeding.

The integrity of each nest was then classified as either excellent, good, average, or poor. These classifications not only indicate the condition of the nest, derived from the assessment forms of the FPA, the categories used in this survey are more indicative of the time since the nest's last use and its likelihood of future use. Here, 'excellent' denotes nests in excellent condition and likely to have been used for breeding in recent years, while 'poor' signifies those least likely to be active based on their condition.

All ‘not found’ nests must be considered present until they have been determined as ‘absent’ through either:

- A complementary ground search;
- Three consecutive aerial nest searches; or
- Expert assessment confirming that they have indeed fallen.

Limitations

Owing to the large size of the project area, it was not feasible to check every individual tree, nor to conduct multiple passes of all potentially suitable habitat. Therefore, there is a possibility that nests may have been missed owing to being obscured from view by other trees or dense canopy cover.

Additionally, we avoided built-up areas and urban areas close to occupied dwellings to reduce disturbance to the public and abide by aviation regulations.

To minimise the chance of missing a nest, we used three observers and pilots with extensive experience in low-level flying. Moreover, when navigating through various types of vegetation, the altitude at which observations were made varied depending on canopy cover and topography. For instance, in areas with sparse canopy cover, observations were made at higher altitudes to maximise visibility, whereas in areas with dense canopy cover, lower flights under the canopy (where possible) were conducted, with particular attention given to areas of high habitat suitability.

Tree and nest heights are estimates only, and generally judged between the three observers.

Eagle nest viewshed modelling

Following the aerial survey, a viewshed analysis was undertaken for all new and previously recorded nest locations. The viewshed analysis was undertaken in GIS modelling to determine project infrastructure/alignment visibility in relation to the locations of the nests under investigation. Within a 1 km radius, two separate models were run for each nest to explore the potential visibility for two different scenarios:

1. A non-vegetated landscape (*i.e.* topographic constraints only, informed by a digital elevation model [DEM] only)
2. A vegetated landscape (DEM plus canopy height [DEMCHM - LIDAR data from the LIST])

The resulting viewsheds were post-processed to provide an indication of ground surface area visible from a nest and demonstrate whether the extant vegetation provides additional screening to topographic constraints (noting that because vegetation is ephemeral it cannot be relied on as a screen indefinitely).

The GIS methodology used to determine the viewsheds is described below.

Datasets

Non-vegetated landscape (DEM only)

- A 2 m DEM was compiled for the Project Area and its surrounds, with a DEM covering each nest location downloaded respectively from ELVIS (https://elevation.fsdf.org.au/).

Vegetated landscape (DEMCHM)

- The DEMCHM model was created by combining the DEM data with a 2 m LiDAR derived Canopy Height Model (CHM).
- This additional DEMCHM model approximated the canopy height of vegetation draped over the raw DEM and allows comparison of the viewshed in vegetated and hypothetical unvegetated states.

Visibility Analysis

The viewpoint was then created to compute the following viewsheds using the visibility analysis tool in QGIS (Visibility Analysis QGIS plugin version 1.9). For all viewshed scenarios, the target height was set to 1.8 m with a 1,000 m radius from each nest site, with nest record accuracy added to constraints buffers.

- The first viewshed assumed a non-vegetated landscape (DEM only) and the observer height was the field verified nest height.
- The second viewshed assumed a vegetated landscape (DEMCHM) that included extant canopy heights. The difference between the vegetated and non-vegetated landscapes was calculated, if the vegetation was height was greater than 1.8 m it was assumed that this would provide

screening, and the associated visible pixels of the canopy removed. The observer height was set to the height value of the nest.

The raster outputs were converted to polygons (QGIS vectorisation), with polygons assigned binary values indicating visibility.

Survey findings

The aerial survey covered approximately 200 km^2, targeting areas of modelled habitat and forest remnants. A map of the flight path is provided in Figure 27.

The aerial nest search established that 11 eagle nests are located within 1.5 km of the Construction Corridor at the time of survey. Three nests were new nest records and eight were confirmed known nests (Figure 28, Table 28).

Two previously recorded nests were not relocated. To be formally listed as absent on the NVA they need to have either not been relocated during three consecutive aerial and/or ground searches, or be subject to expert assessment.

An additional nest was observed from the ground during a realignment survey, taking the total number of nests within 1.5 km of the pipeline to 12.

Only seven nests (Nest ID: 3142, 2344, 2766, 3369,1261, 2593, 853) of the twelve located are within 1,000 m of the Construction Corridor.

Four nests (Nest ID: 3142, 2344, 2766, and 3369) are within 500 m direct distance of the Construction Corridor. Nests 3142, 2344, and 2766 are within 250 m of each other. Nest 3142 is 40 m southwest of Nest 2344, within a remnant patch of DOB. Nest 2766 is separated from these two by a pine plantation and is 235 m east of Nest 2344, and 260 m northeast of Nest 3142 (Figure 28). It is unlikely that these three nests would be utilised at the same time.

Nest 1261 is outside of 500 m direct distance to the Construction Corridor but is within 1,000 m and within line-of-sight of the Construction Corridor when vegetation is removed from the viewshed model (**Appendix J**). This nest is within a forested area, and if vegetation is included in the viewshed, the Construction Corridor is not within line-of-sight, ie it is not visible from the nest.

Nest 2593 is situated on a southeast facing forested hillside within the Warrawee Conservation Area. It is 550 m from the Construction Corridor at its nearest point (at Great bend pumpstation). Viewshed modelling (**Appendix J**) shows that the Construction Corridor is close (within 50 m) to ground visible from the nest based on topography but excluding vegetation. However, the Construction Corridor is not visible from the nest when vegetation (in this case forest) is taken into account.

The remaining six nests (including one nest within 1,000 m of the construction corridor) are not within 500 m direct distance or 1,000 m line-of-sight of the Construction Corridor. The two nest locations of the previously recorded nests that were not relocated are not within 500 m direct distance or 1,000 m line-of-sight of the Construction Corridor. Nest viewsheds are presented in **Appendix J**.

All recorded nests, with the exception of Nest 1281, were deemed to be in good or excellent condition (Table 28). Photos and detailed descriptions of each nest are provided in **Appendix K**.

It must be noted that aerial nest searches are considered to be current for a duration of two years[645].

[645] Forest Practices Authority (2023)

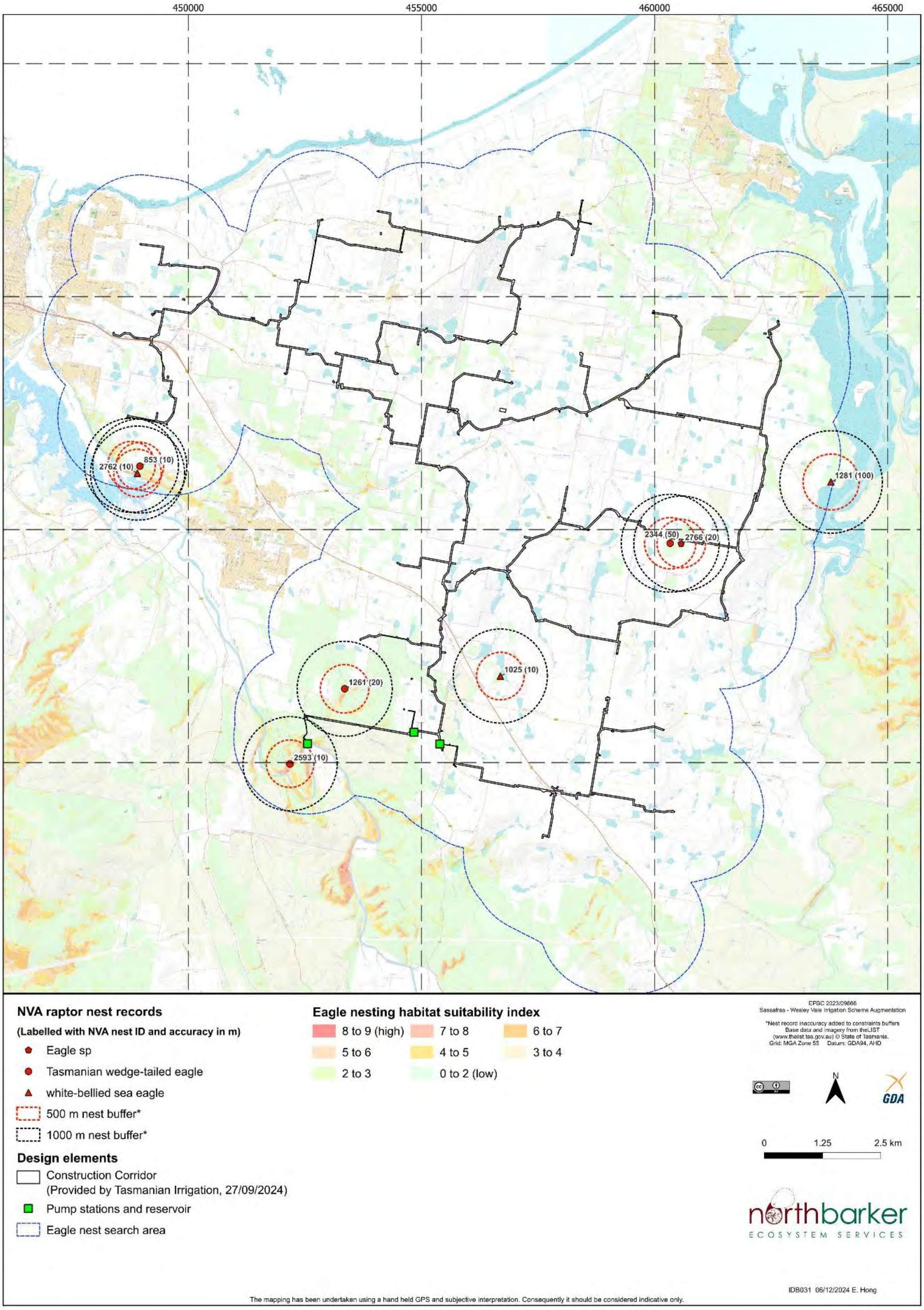

Figure 27: Eagle nest survey map, with existing known nests displayed

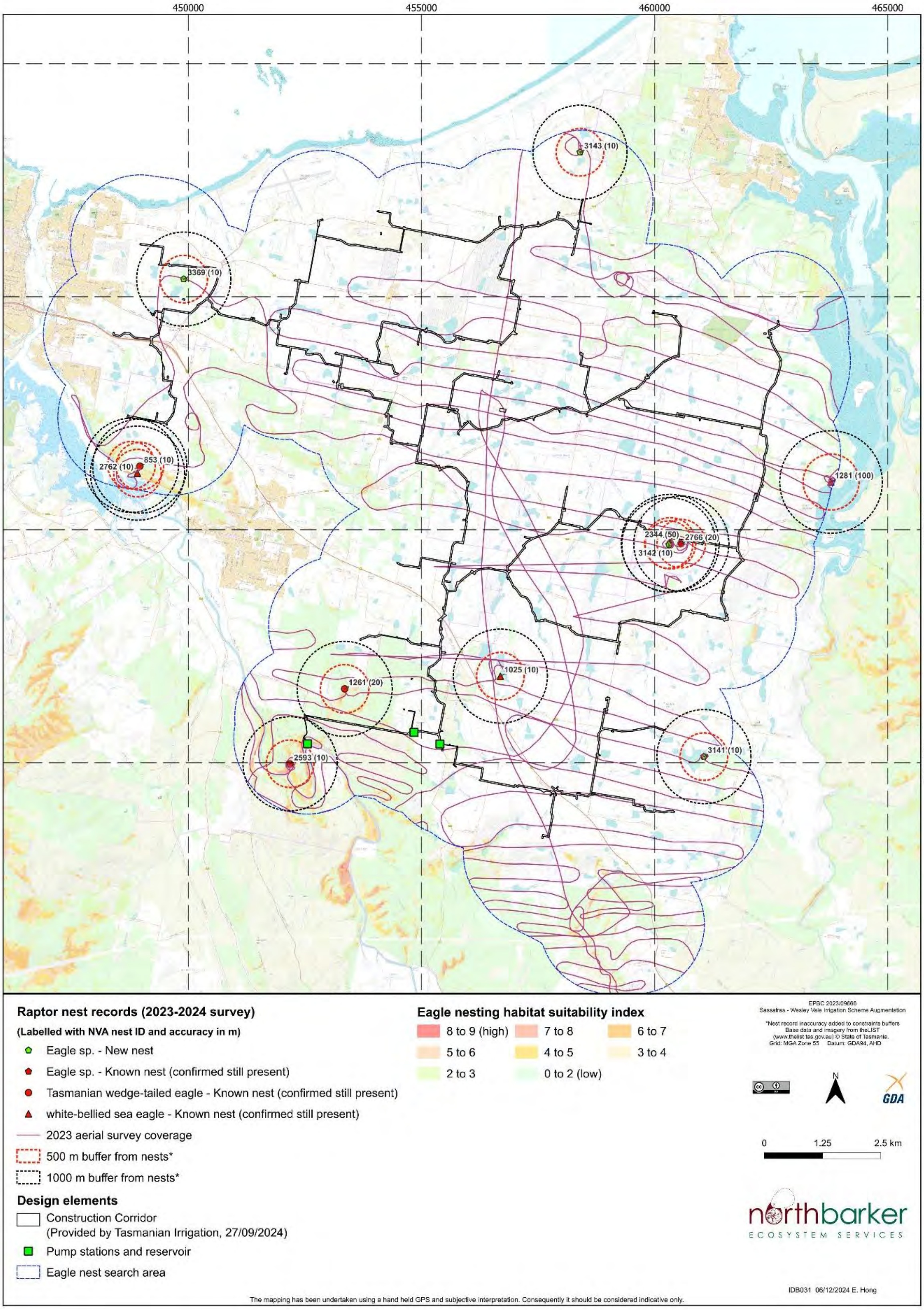

Figure 28: Eagle nest survey results

Table 28: Nest details from aerial nest search and 2023 integrity classifications. WTE = wedge-tailed eagle, WBSE = white-bellied sea eagle

Nest ID	Easting	Northing	Position Accuracy	500 m Direct Distance	1,000 m Line-of-Sight	Nest Condition	Likely Species	Description
532	448781	5436372	10	No	No	N/A	WBSE	**Nest not found.** Recorded in 1985. Nest not found during ground search undertaken in 2020 by E Harris.
853	448960	5436361	10	No	**No** (not within line-of-sight)	Good	WTE	This nest has a lot of white-wash on adjacent branches and a very flat top. It was likely active during the last breeding season. Algal leaching is present under this nest. The nest is roughly 18 m up a 25 m high *E. obliqua.* Nests 2762 and 853 are with 160 m of each other. A pair of white-bellied sea eagles was observed near to these nests during the survey in February 2023.
1024	456579	5431949	10	No	No	N/A	WBSE	**Nest not found.** Nest record within 150 m of nest 1025
1025	456692	5431854	10	No	No	Good	WBSE	This nest is in a 31 m height exposed stag roughly 28 m high. The nest is bleached with a slight bowl. Nearby nest #1024 could not be found.
1261	453353	5431584	20	No	**Yes (Excluding Vegetation)**	Good	WTE	This nest is large and slightly sloping with a lot of loose sticks underneath and a small amount of algal leeching. White-wash is present on the adjacent branches. This nest is roughly 29 m up a 35 m high *E. obliqua.* This nest is heading towards being derelict if its structure keeps deteriorating.
1281	463782	5436023	100	No	No	Poor	WBSE	This nest was hard to spot under the canopy. It is roughly 20 m up a 24 m high *E. viminalis.* The sticks on this nest are bleached and loose on top and sloping has started to occur.
2344	460335	5434707	50	**Yes**	**Yes (Excluding Vegetation)**	Good	WTE	A small, bleached nest roughly 14 m up an 18 m high *E. obliqua.* The nest has a slight bowl with old dry green leaves in the centre.

Nest ID	Easting	Northing	Position Accuracy	500 m Direct Distance	1,000 m Line-of-Sight	Nest Condition	Likely Species	Description
2593	452178	5429970	10	No	**No** (not within line-of-sight)	Excellent	WTE	This nest is roughly 27 m up a 35 m high *E. obliqua* and was obscured by the canopy. The nest appeared to have a slight bowl in it with brown leaves and sticks.
2762	448906	5436210	10	No	No	Good	WBSE	This large nest has been added to over the years and is not very large and in two large clumps of material. Two adult WBSE were perched near this nest and it has been noted as being active this year. This nest is roughly 17 m up a 24 m high *E. obliqua* and is starting to slope a lot. Nests 2762 and 853 are with 160 m of each other. A pair of white-bellied sea eagles was observed near to these nests during the survey in February 2023.
2766	460570	5434697	20	**Yes**	**Yes (Excluding Vegetation)**	Excellent	Unknown	This nest is roughly 15 m up a 20 m high *E. obliqua.* This nest has a flat top with brown leaves and white-wash on adjacent branch.
3141	461056	5430131	10	No	No	Good	Unknown	A moderate sized nest in a remnant patch of native vegetation by a dam. This nest is roughly 28 m up a 35 m high *E. obliqua.* This nest has a slight bowl and is bleached underneath.
3142	460309	5434678	10	**Yes**	**Yes (Excluding Vegetation)**	Good	Unknown	A medium sized bleached nest with loose sticks on one side where sloping has occurred. This nest was found within 50 m of nest #2344 and is roughly 16 m up a 21 m high *E. obliqua.*
3143	458402	5443100	10	No	No	Excellent	Unknown	A large robust nest in an *E. viminalis.*
3369	449900	5440377	10	**Yes**	**Yes (Excluding Vegetation)**	Good	Unknown	Small nest located in the primary fork of a relatively small *E. obliqua.* This nest was found during a realignment survey and was viewed from the ground only. The vegetation in the immediate surround was in the process of being logged at the time of discovery.

Impact pathways

Potential impact pathways to the Tasmanian wedge-tailed eagle relevant to the construction of the SWISA include:

- Habitat loss through the clearing of nesting (and potential nesting) habitat; and
- Breeding and nest disturbance.

Potential impact pathways to the Tasmanian wedge-tailed eagle relevant to the operation of the SWISA include:

- Habitat loss through the clearing of nesting (and potential nesting) habitat as a result of change of land use due to agriculture.

Avoidance

Due to the number of nests throughout the landscape, it was not possible to completely avoid areas within 500 m and/or 1,000 m line-of-sight from known eagle nests. Although complete avoidance hasn't been possible, realignments have ensured that the number of known nests immediately adjacent (or within viewshed) to the works area is the minimum that can be achieved with the spatial requirements of the project, and importantly no nests require direct removal from the proposed alignment.

Impacts

<u>Construction</u>

This species uses the surrounding areas for both nesting and foraging. It is likely the site extends over a number of territories based on the distance between nests and the size of the proposed pipeline. Given the ubiquity of land for flying over (including while searching for food) and the proposal not proposing any aerial obstructions, the proposal does not present any potential impact pathways in relation to collisions nor flight obstructions.

Direct clearance of nests is also not a potential impact pathway. Due to the nature of the pipeline being laid underground and the pipeline avoiding all known eagle nests (*i.e.* not requiring direct clearance/removal of nest trees) there are no expected direct impacts to eagles.

Disruption of an active nest within a particular breeding season is a possible impact pathway for nests within 500 m direct distance or 1,000 m line-of-sight of the proposed works. The primary approach to mitigation for this aspect will be to conduct works within these radii outside of the eagle breeding season (eagle management constraint period). Failing that, a process informed by annual nest activity assessments will apply. For nests that are inactive in a given year or beyond the specific constraints radii, disruption of a breeding event will not be a potential impact pathway.

Impacts due to the presence of permanent infrastructure are not considered to present a disturbance to eagles, with audible impacts expected to be negligible. The only site within 1,000 m of a nest that could conceivably pose an audible disturbance is the pump station at Great Bend (Nest 2593).

Nest 2593 is situated on a southeast facing forested hillside within the Warrawee Conservation Area approximately 530 m SW of the Construction Corridor. It is 550 m from the Construction Corridor at its nearest point (Great Bend pumpstation). Viewshed modelling (**Figure J8** of **Appendix J**) shows that the Construction Corridor is within 50 m to visible ground from the nest based on topography but excluding vegetation. The Construction Corridor is not visible from the nest when vegetation (in this case forest) is taken into account. There may be noise impacts during the construction phase to this nest; however, given the position of the nest in a southeast facing gully (and on the other side of the ridge) in an area that is already subject to periodic mechanical noise from nearby forestry activities, the potential impact from construction noise is unlikely to present a significant threat to nest abandonment. The level of noise impact to this nest will be quantified with supplementary noise modelling (currently under assessment). Noise dampening measures are proposed at this location to reduce potential impacts.

Three nests occur within 200 m of the Construction Corridor along Oppenheims Road (Nests 2344, 2766, and 3142). As detailed above, it is highly unlikely that all three of these nests are occupied concurrently. The Construction Corridor is located at the edge of the DOB remnant that two of these nests are situated in, however there will be no conversion of this habitat type due to the construction of the pipeline (construction will occur in a cleared easement adjacent to Oppenheims Road). There will be conversion of a pine plantation adjacent to the remnant forest, however this plantation does not provide any viable habitat for wedge-tailed eagles. Avoidance of this area is not possible due to landowner constraints

Nest 1261 is outside of 500 m direct distance to the Construction Corridor but is within 1,000 m and within line-of-sight of the Construction Corridor when vegetation is removed from the viewshed model This nest is within a forested area, and if vegetation is included in the viewshed, the Construction Corridor is not within line-of-sight ie it is not visible from the nest. The Construction Corridor is immediately adjacent to forest (DOB and WOL) with canopy trees > 15 m to the north (nest direction). This vegetation will obscure construction works from view from the nest. Nevertheless, as this visibility from the nest relies on the presence of the current vegetation, line of sight visibility must be checked prior to construction.

In terms of visual disturbance from new infrastructure in the landscape, such passive infrastructure as far as we are aware is not specified as a potential impact pathway or threat. All new infrastructure will be coloured appropriately as to blend into the landscape as much as possible and not provide visual obstruction.

Although not a listed threat, vehicle collision may present a risk of impact due to prey availability on roads and road verges (carcasses).

Operation

The scope of maintenance will vary from scheme-wide to single sites, and from routine and scheduled to emergency. Maintenance within 500 m or 1,000 m line-of-sight of an active nest within a given season may be a potential impact pathway as breeding disruption. Ongoing (routine) maintenance is expected to be minimal, with operations and maintenance typically restricted to 1 light vehicle (operating in daylight hours, weekdays only). Routine maintenance of permanent above ground infrastructure is likely to occur once a fortnight (up to weekly in some situations), while routine maintenance is unlikely to be required on pipeline (below ground) infrastructure. As this may need to occur within the breeding season, and potentially when a nest in the vicinity has been confirmed active, or within the period from the beginning of the breeding season up until a nest check can be conducted, the exceptional circumstances mitigation measure will apply in those scenarios to minimise the potential for impacts.

Major maintenance will be periodic at the primary asset sites (pump stations and balance tanks). This will include the use of light and heavy vehicles over a period of up to a week, in daylight hours. Pump stations will typically have annual maintenance with 2 or 3 light vehicles, and significant maintenance involving some heavy vehicles (1-2) every 5-10 years. The balance tank will typically require additional maintenance every 10-20 years, which may include heavy vehicles and heavy plant for up to a week.

A nest search was undertaken in 2023, and mitigation measures and protocols can be undertaken for nests recorded as appropriate. However, over the operational lifetime of the scheme, eagle nest locations are likely to change as some nests are abandoned, and new nests are built. Therefore, in order to determine potential operational impacts to eagle nests in the future, regular nest searches will be required.

Changes in land use and land clearance beyond 1,000 m of a nest, the potential for the introduction of weeds and disease, and changes to water quality and flow regimes, are not considered to be a risk to the persistence of wedge-tailed eagles throughout the broader landscape (nor significant impacts in general), as their existing ranges within the local landscape already include a multitude of variations within these variables and the scope for change is simply too small in the context of eagle home range and population size (see discussion above of minor changes in vegetation extents and concentration of works in already cleared agriculture land), as well as in the context of over-arching project mitigation measures such as weed and hygiene management and aquatic crossing protocols.

In terms of operational infrastructure, the Great Bend pump station is an existing piece of infrastructure and will not introduce a new type of disturbance to the area during operation of the SWISA. All other operational infrastructure are currently outside of any eagle nest management constraint areas, and the operation of these facilities will not contribute to potential nest disturbance. Eagles may choose to nest near these infrastructure in the future, however operational requirements need not change if eagles have opted to nest in the vicinity of existing infrastructure.

Mitigation measures

For the purposes of the following sections the following terms are defined:

Active eagle nest means any Tasmanian wedge-tailed eagle nest site unless the nest site has had an activity check conducted by either the Forest Practices Authority or a suitably qualified eagle specialist and determined to be inactive.

Aerial nest search means an 'aerial search' conducted by a team with at least two suitably qualified eagle specialists, and one additional observer using helicopters to identify and record the location of Tasmanian wedge-tailed eagle nests, and as described in the Fauna Technical Note 1: Eagle Nest Searching, Activity checking and Nest Management[646].

Eagle management constraint period refers to the eagle breeding season which spans from 1st July until the 31st of January, unless advice surrounding a lengthened breeding season into February is provided by the FPA through their annual update in November[647].

Eagle nest activity assessment refers to a check of known eagle nests by a suitably qualified eagle specialist during the eagle management constraint period to determine the activity status of the nest. Eagle nest surveys must be undertaken in the breeding season, with timeframes informed by either the FPA or a suitably qualified eagle specialist (optimal timeframes for assessment are typically around October/November)

Suitably qualified eagle specialist means a person who has attended and passed an eagle management course organised or approved by the FPA with at least 5 years' experience in eagle nest management.

<u>Construction</u>

The primary need for mitigation is in relation to the risk of disrupting a breeding event by undertaking works around an active nest within the eagle management constraint period. In order to minimise the risk of disturbing an active nest, the following constraints are required:

- No construction works to be conducted within 1,000 m of an active eagle nest during the eagle management constraint period unless the works are not visible from any active eagle nest (see viewshed analysis in **Appendix J**).
- No construction works to be conducted within 500 m or 1,000 m line-of-sight of an active eagle nest during the eagle management constraint period (except to avert serious threat to life, property, or the environment) unless an eagle nest activity assessment has been conducted and the nest is conclusively deemed to be inactive for that particular eagle management constraint period.
  Therefore, works within 500 m direct distance or 1,000 m line-of-sight of in the vicinity of a nest will, by default, not be undertaken from the commencement of any eagle management

[646] Forest Practices Authority (2023)
[647] Forest Practices Authority (2023)

constraint period (July 1st) until an eagle nest activity assessment proves a nest is inactive for that season (i.e. each nest will be assumed to be active for a season until proven otherwise, and constraints applied accordingly until an eagle nest activity assessment is undertaken). If a nest is deemed in active, the constraints can be lifted for the remainder of that season around that nest.
- No clearance and conversion of potential nesting habitat (old growth native forest with adequate shelter and large trees suitable for nesting) is to occur within 200 m of a known eagle nest, regardless of the activity status of the nest.
- Any blasting works must be authorised by TI. Blasting works must not occur within the eagle management constraint period, and works must demonstrate that there will be no impacts to eagles through noise and vibration. This may include the provision of noise and vibration modelling.

Aerial eagle nest searches are valid for two years. The current nest search is valid until 10/02/2025. If construction of the SWISA is likely to continue beyond this date, then a new nest search of a 1,250 m buffer of the Construction Corridor must be undertaken outside of the eagle management constraint period and subsequently every two years until construction is completed. Viewshed modelling of any new nests within 500–1,000 m from the Construction Corridor is required to determine if the nest is within line-of-sight of construction activities. Any nest within 500 m, or 1,000 m and line-of-sight of the Construction Corridor must be subject to the eagle management constraint period and mitigation eagle nest management measures as above.

Application of the roadkill mitigation strategy (**Appendix H**) will sufficiently mitigate the vehicle collision risk to this species.

<u>Operation</u>

During the operation of the SWISA, maintenance of infrastructure will vary from scheme-wide to single sites, and from routine and scheduled to emergency. Maintenance within 500 m or 1,000 m line-of-sight of an active nest within the eagle management constraint period may be a potential impact pathway as breeding disruption. The primary need for mitigation is in relation to the risk of disrupting a breeding event during maintenance works around an active nest within a given breeding season. In order to minimise the risk of disturbing an active nest, the following constraints are required:

- Planned maintenance within 500 m or 1,000 m line-of-sight of any active eagle nest must not be conducted during the eagle management constraint period.
- In the event that unplanned repair work or maintenance must be undertaken during eagle management constraint period (unless the repair work is urgently required to avert serious threat to life, property or the environment), the following measures are required:
    i) Unless a nest activity assessment has been undertaken for all nests within 1,250 m of the location, assume that all known nests are active eagle nests;
    ii) Ensure that, before entering the works area, all workers are aware of the location of all active eagle nests;
    iii) Ensure that no person or vehicle enters any area within 200 m of an active eagle nest;
    iv) Ensure that no person looks directly towards an active eagle nest while they are within 1,000 m of an active eagle nest;
    v) Ensure that, unless not visible from any active eagle nest, no heavy vehicles and no more than 2 light vehicles enter any area within 1,000 m of an active eagle nest, and that in any seven-day period, no vehicle enters within 1,000 m of an active eagle nest more than twice;
    vi) Ensure that no heavy vehicles, and no more than 2 light vehicles, enter any area within 500 m of an active eagle nest in any seven-day period, or enters within 500 m of an active eagle nest more than twice;
    vii) Ensure that, in any seven-day period, unless not visible from any active eagle nest, no vehicle remains within 1,000 m of an active eagle nest any longer than 30 minutes and that

regardless of visibility, no vehicle remains within 500 m of an active eagle nest any longer than 30 minutes, unless a suitably qualified eagle specialist has provided prior written agreement to the use of vehicles for longer than 30 minutes, specifying the required safeguards and mitigation measures and justification that harm will not result from the presence of the vehicles for longer than 30 minutes;

    viii) If safety requirements allow, instruct workers to not wear hi-visibility clothing while in the allowed proximity to an active eagle nest;
    ix) Ensure that no vehicle is parked within sight of an active eagle nest; and
    x) Ensure workers always remain within 5 m of one another (to the degree possible) and no work breaks are conducted while within 500 m of an active eagle nest.

  - In the event that ii) to x) are not achievable, and/or one or more eagles are noted on or around a nest during works (or the nest is already known or assumed to be active when the exceptional circumstances have been triggered), NRE as the State regulator must be notified immediately and a nest-specific management plan prepared by the proponent to the satisfaction of the regulator, with further mitigation measures to be implemented to the degree practicable on a case-by-case basis. These measures may include:
    - If possible/deemed necessary, the works to cease immediately – until the nesting season is finished and/or the nest is deemed inactive; and
    - If the nature of the works is such that they cannot cease, suitably qualified ecologist/s must be present to observe and monitor the eagle(s) for signs of distress and disruption of breeding activity and advise the contractors accordingly of periods when work can occur.
- If a nest activity assessment has been undertaken prior to necessary unplanned repair work or maintenance during the eagle management constraint period and the nest is deemed as inactive, then the eagle management constraint period does not apply and i) to x) are not relevant.

In the event that unplanned repair work or maintenance must be undertaken in the vicinity if an active eagle nest during the eagle management constraint period, and that repair work is urgently required to avert serious threat to life, property or the environment, the approval must adhere to the operational requirements detailed above as closely as possible while giving priority to avert the serious threat to life, property or the environment.

An aerial eagle nest search must be conducted every two years for the lifetime of the SWISA in order to inform planning and managing unplanned infrastructure maintenance and repair. Viewshed modelling of any nest within 500-1,000 m from any infrastructure is required to determine if the nest is within line-of-sight of construction activities. Any nest within 500 m, or 1,000 m and line-of-sight of the infrastructure will be subject to the eagle management constraint period and constraints as above.

The provision of Tasmanian Irrigation water does not allow for landowners to conduct unregulated land clearance. All land irrigated with Tasmanian Irrigation water within the SWISA are subject to rigorous assessment through the Farm WAP process and the provisions of an OEMP. The risk of direct impact to Tasmanian wedge-tailed eagles and potential habitat clearance due to Tasmanian Irrigation water will be managed through the Farm WAP process, with measures in place to ensure that this species is adequately protected by applying exclusion areas and applying buffers from particular agricultural activities.

In order to mitigate the risk of impact to this species during operation of the scheme, the following actions as part of the SWISA for each SWISA irrigator property are required:

- Application of a Farm WAP for each property within the Operational Area.
- Property-wide survey for eagle nests.
- No removal of vegetation within 1,000 m of an active eagle nest to occur within the eagle management constraint period.
- No change in land use with 500 m direct distance of an eagle nest.

The application of the SWISA water is not anticipated to have any impacts to foraging habitat as foraging habitat is ubiquitous across the broader Project Area, thus specific mitigation measures are not warranted for this aspect.

If it is determined by the Farm WAP that impacts due to the operation of the SWISA on individual properties are likely to trigger the MNES *Significant Impact Criteria*[648], individual irrigators may need to refer their action independently.

Residual significant impacts

With the above context, survey results, avoidance, impacts, and mitigation, an assessment of the residual impacts as a result of the construction and operation of the SWISA against the significant impact criteria[649] is provided below.

1) Lead to a long-term decrease in the size of a population

The Tasmanian subspecies of the wedge-tailed eagle occurs only in Tasmania and as a single population[650]. It has been estimated that the total population in the state is between ~1,000 and ~1,500 individuals but ongoing work is required to improve the accuracy and robustness of this range[651].

The scale of the proposed works **will not** lead to the long-term decrease in the size of a population. The commitment to limiting construction within 500 m direct distance and 1,000 m line-of-sight of active eagle nests to outside of the eagle management constraint period will mitigate the risk of nest abandonment in the area and eliminate any potential impacts of the project on local recruitment and breeding productivity – noting that even if these nests were impacted it would not necessarily constitute an impact at the population level.

2) Reduce the area of occupancy of the species

According to the Action Plan for Australian Birds 2020[652], the estimated extent of occurrence is 71,000 km^2, and the area of occupancy is 8,520 km^2, both ranges are estimated with a medium level of reliability. The population is not severely fragmented, nor is it subject to extreme fluctuations in the area of occupancy and extent of occurrence[653].

The small scale of permanent vegetation clearance **will not** reduce the area of occupancy for this species in any meaningful way as the entirety of the footprint will still be viable habitat after works. No nesting trees will be removed nor impacted, ample foraging habitat will remain post-construction, and all of the habitat will remain equally suitable for flying over, hunting, dispersal, etc.

3) Fragment an existing population into two or more populations

The Tasmanian wedge-tailed eagle population is not severely fragmented, nor is it subject to extreme fluctuations in the area of occupancy and extent of occurrence[654].

The proposed construction and operation of the SWISA **will not** fragment an existing population into two or more populations. As this species is a strong flyer and has the capacity to fly between habitat patches; as such it can be expected to be less vulnerable to habitat fragmentation than sedentary and terrestrial species. Indeed, no equivalent project has ever been documented to have a fragmentation effect, and an extremely large barrier (such as Bass Strait) would be required to fragment a population into two or more populations.

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[648] Commonwealth of Australia (2013a)
[649] Commonwealth of Australia (2013a)
[650] Threatened Species Section (2006)
[651] Threatened Species Section (2023b)
[652] Mooney *et al.* (2021)
[653] Mooney *et al.* (2021)
[654] Mooney *et al.* (2021)

4) Adversely affect habitat critical to the survival of a species

Critical habitat for the Tasmanian wedge-tailed eagle is defined as forests of predominantly old-growth trees greater than 10 ha in area and occurring on sites sheltered from prevailing strong winds[655].

As there will be no impacts to mature trees or old growth forest likely to support a nest of this species and the project has a commitment to protect potential breeding activity with seasonal constraints on works around nests, no habitat critical to the survival of this species will be impacted due to the proposed construction of the SWISA.

Application of an OEMP and Farm WAPs to individual irrigators land will ensure that no loss of habitat critical survival will occur as a result of the operation of the SWISA.

Thus, the construction and operation of the SWISA **will not** adversely affect habitat critical to the survival of the Tasmanian wedge-tailed eagle.

5) Disrupt the breeding cycle of a population

Breeding and nest disturbance is considered to be a significant and ongoing threat to wedge-tailed eagles[656]. Nest disturbance can be triggered by either visual or aural cues, including activities as innocuous as bushwalking, mountain biking, or photography enthusiasts, as well as more invasive activities such as motor biking, firewood cutting, forest harvesting, and helicopter flights. Inappropriate inspection and monitoring of nests can also lead to nest abandonment and reduced breeding success.

Limiting construction works to outside of the eagle management constraint period around active nests for the wedge-tailed eagle eliminates the possibility of disrupting the breeding cycle of this species.

Thus, the proposed construction and operation of the SWISA **will not** disrupt the breeding cycle of a population.

6) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The construction and operation of the SWISA will not facilitate a change in land use that will affect foraging habitat for this species to a meaningful degree as essentially any habitat can be searched for prey and flown over in search of prey – nor will it lead to the clearing of potential nesting habitat, as any potential areas would be on land that is unsuitable for irrigation.

Thus, the proposed construction and operation of the SWISA **will not** modify, destroy, remove, isolate, or decrease the availability of habitat such that this species is likely to decline.

7) Result in invasive species that are harmful to the species becoming established in the species' habitat

There is no likelihood that the construction and operation of the SWISA will result in invasive species that are harmful to the species becoming established in the species' habitat – numerous invasive species are already present in the area provide prey opportunities or merely have a benign presence in relation to eagles.

Thus, the proposed construction and operation of the SWISA **will not** result in invasive species that are harmful to the species becoming established in the species' habitat.

8) Introduce disease that may cause the species to decline

There is no likelihood that the proposed construction and operation of the SWISA will introduce disease that may cause this species to decline, and no disease is considered to be a risk to the species in the context of the proposed action.

655 Threatened Species Section (2006)
656 Threatened Species Section (2023b)

Thus, the proposed construction and operation of the SWISA **will not** introduce disease that may cause the species to decline.

9) Interfere with the recovery of the species

There is no current recovery plan for this species (expired in 2010)[657], however this is still the adopted recovery plan until an updated recovery plan is published.

Recovery of this species is primarily dependent upon the protection of existing critical habitat and breeding opportunities. The habitat within the footprint is not considered critical and the suboptimal habitat in the area will only be impacted temporarily and thus will not affect recovery.

Thus, the proposed construction and operation of the SWISA **will not** interfere with the recovery of the species.

Summary

With the commitment to complete works within 500 m direct distance and 1,000 m line-of-sight of active eagle nests outside of the eagle management constraint period, and with annual eagle nest activity assessments conducted during the construction phase to inform potential construction exclusion areas, the construction of the SWISA **will not** have significant residual impacts on the Tasmanian wedge-tailed eagle.

Application of an OEMP and Farm WAPs to individual irrigators land will ensure that the operation of the SWISA **will not** have significant residual impacts on the Tasmanian wedge-tailed eagle.

[657] Threatened Species Section (2006)

4.3.1.6 Central north burrowing crayfish (*Engaeus granulatus*)

Context

Conservation status

The central north burrowing crayfish (CNBC) is listed as endangered under the EPBC Act and the TSP Act.

> On the 15th of November 2005, this species was listed as endangered on the basis of available scientific information. This conclusion was reached from the following assessment criteria:
>
> **Criterion 1** – Population size reduction (reduction in total numbers)
>
> On the basis of habitat change alone, it is possible to argue that the species would have experienced a serious decline in the past 100 years with a potential decline greater than 80% over any ten year period or three generations. However, due to a lack of baseline surveys and long-term monitoring, at the time of consideration for listing there was insufficient quantitative data to judge whether the species had undergone a reduction of numbers in Tasmania, therefore was **not eligible** for listing under this criterion.
>
> **Criterion 2** – Geographic distribution is precarious for the survival of the species and is very restricted, restricted or limited
>
> The geographic distribution of the central north burrowing crayfish is currently very restricted with the species being confined to seven geographically isolated locations. This distribution is precarious for the survival of the species. This species is eligible for listing as **endangered** under this criterion.
>
> **Criterion 3** – The estimated total number of mature individuals is limited to a particular degree and: (a) evidence suggests that the number will continue to decline at a particular rate; or (b) the number is likely to continue to decline and its geographic distribution is precarious for its survival
>
> Population estimates for the central north burrowing crayfish are based on detailed population density information available for other *Engaeus* species. There is insufficient quantitative data on this species to assess the population size against this criterion, therefore was **not eligible** for listing under this criterion.
>
> **Criterion 4** – Number of mature individuals
>
> This species was deemed as eligible for listing as **vulnerable** under this criterion as the number of mature individuals is low.
>
> **Criterion 5** – Probability of extinction in the wild
>
> At the time of assessment, there was insufficient data to assess this species under this criterion. Therefore, it was **not eligible** for listing under this criterion.
>
> **Threatened Species Scientific Committee (2005)**

Ecology[658]

The CNBC is one of 33 species of freshwater crayfish found in Tasmania. It is a small sized invertebrate (average body length of less than 10 cm)[659] and has a much reduced tail (as they are no longer free-swimming). Unlike most freshwater crayfish that live in free-flowing water, the CNBC spends most of its

[658] Richardson (2024) – **Appendix L**
[659] Department of the Environment, Water, Heritage & the Arts (2008b)

life within a burrow system, only venturing out occasionally[660] and feeding mostly on decaying organic matter in the soil and the occasional small worm or grub[661]. It is extremely rare to find an animal without excavating the burrows and the only evidence of their presence is the burrows and / or chimneys of pelleted soil at the burrow entrance created when the burrows are excavated.

Crayfish must leave their burrows to mate, and juvenile crayfish must disperse away from the parental burrow. Dispersal of the juvenile CNBC from the female burrows thorough waterways occurs when water levels are high. Circumstantial evidence (capture of females carrying eggs, or with old egg cases[662]) suggests a spring-summer breeding season (perhaps with spring rains providing the opportunity for males to seek out female burrows) and juvenile dispersal with autumn rains.

The CNBC lives in complex and extensive burrow systems connected to the water table. This species mostly digs type 2 burrows[663], i.e. burrows that derive their water from the water table and so must extend down to the lowest point that the water table drops to in typical dry seasons. Thus, the depth of burrow systems at any point will depend on water table movement at that point. In drains and permanently wet places burrows will not be deeper than 1 m, but in open pasture they may be more than 2 m deep. Similarly, the horizontal extent of a burrow system depends on the local hydrology; in permanently wet places the burrows often ramify horizontally over 2-3 m^2, with many entrances, but where the water table can be deep the burrows are much more constrained horizontally, with perhaps 2-4 entrances within a square metre, and the burrow descending more or less vertically below that.

Burrowing crayfish are generally colony-forming, and each individual has its own burrow. Without excavation it is impossible to know how many individual crayfish are present, or how many individuals' burrows, from the number of chimneys observed on the surface.

In considering what constitutes a "colony", the key criterion must be the opportunity for colony members to interact with each other. With no data on dispersal, maximum distance between burrows within a colony is a speculative 10 m and an arbitrary figure of 20 burrow entrances could be taken as a minimum colony size[664]. However, it must be stressed that these figures have no data to support them.

The spatial extent of what appears to be a "colony" is dependent on the local hydrology. In permanently wet places burrow systems are contiguous and will fill the available habitat. It is unknown whether contiguous burrows interconnect below ground. In drier sites burrow density is low and systems may be metres apart. Estimates of the density of crayfish are derived from burrow counts and assumptions about burrow occupancy. Burrow densities of 0.78-0.55 burrows per m^2 have been recorded for the CNBC in swampy habitat at a site on Stony Rise, Devonport[665]. Numbers at the densest sites in the SWISA area are likely to be similar.

Crayfish must leave their burrows to mate, and juvenile crayfish must disperse away from the parental burrow. However, it is common to find suitable CNBC habitat that has no burrows, therefore there must be a limit to the distance burrowing crayfish can disperse. Dispersal along the edges of water courses is very likely, but colonisation of isolated wet patches probably happens rarely, perhaps in flood events. There are no data on the dispersal of CNBC or any other Tasmanian burrowing crayfish, however circumstantial evidence that they are able to colonise the new habitat 150 m away in less than 10 years[666].

[660] Horwitz (1990)
[661] Department of Primary Industries & Water (2007)
[662] Horwitz (1990); Richardson (2024) – **Appendix L**
[663] Horwitz & Richardson (1986); Richardson (2024) – **Appendix L**
[664] Richardson (2024) – **Appendix L**
[665] Doran & Richardson (2009)
[666] Richardson (2024) – **Appendix L**

Habitat

The type locality for the CNBC was described as:

> *The type locality for E. granulatus consists of a creek approximately 2-3 m wide flowing slowly through a wet sclerophyll forest (which is dominated by Eucalyptus spp. and contains numerous ferns along the bank). This species occupies type 2 burrows in flood plains or in the bank of the creek, upstream from the mouth[667].*

In the process of listing the CNBC under the EPBC Act (Doran 2004) the habitat was described as:

> *The species occupies seeps, wetlands and stream banks.*

The CNBC are found in close proximity to streams and springs, largely on natural low lying damp areas, where the soil is high in organic matter. They are associated with riparian vegetation, usually tea-tree swamp and remnants, but in the modified environments within their range they can also be associated with non-native vegetation if aquatic conditions are suitable[668]. As such they are also known from artificial water courses, drains, and damp areas within areas of previous natural CNBC habitat. They are less likely to occur in artificially constructed wet areas such as farm dams and in areas with no hydrological flow[669]. No critical habitat has been described for the CNBC, and there do not appear to be any habitat characteristics that are uniquely necessary for its occurrence.

The CNBC, and burrowing crayfish in general, are seriously affected by pugging of the soil by cattle[670]. Where cattle are regularly accessing waterlogged areas, such as at watering point, it is safe to assume that crayfish will not be present. While the CNBC is tolerant of non-native vegetation, such as grazed pasture or blackberry thickets, it does not seem to persist under a dense cover of tussock-forming grasses and sedges such as cocksfoot (*Dactylis glomerata*) or *Glyceria maxima,* perhaps due to their dense root mat inhibiting burrowing[671].

Population parameters

For the purposes of CNBC population estimates, "population" refers to the number of animals within the species' range. Population numbers of CNBC have been estimated by applying density figures derived from other well studied *Engaeus* species to the area of occupancy for this species[672]. Current estimates of total population are between 74,400 and 392,200 individuals[673]. This is an increase in the population size range estimates cited in the Commonwealth listing advice due to an increase in known extent and area of occupancy of this species[674]. Extent of occurrence is estimated at 514.9 km^2 with an area of occupancy of only 0.96 km^2 [675]. Population numbers are extremely low for an invertebrate species, particularly considering the range (extent of occurrence) over which it is found[676].

For the purposes of assessment of CNBC under the EPBC Act, a "population" is defined as an occurrence of the species, and any population/occurrence is considered as an important population[677]. Existing

[667] Horwitz (1990); Richardson (2024) – **Appendix L**
[668] Department of Sustainability, Environment, Water, Population & Communities (2011b)
[669] Richardson (2024) – **Appendix L**
[670] Doran (2000); Doran (2004); Richardson (2024) – **Appendix L**
[671] Richardson (2024) – **Appendix L**
[672] Richardson *et al.* (2008), Threatened Species Scientific Committee (2005)
[673] Richardson *et al.* (2008)
[674] Richardson *et al.* (2008)
[675] Richardson *et al.* (2008)
[676] Threatened Species Scientific Committee (2005)
[677] Department of Sustainability, Environment, Water, Population & Communities (2011b)

populations in this sense are generally small colonies[678] with limited connectivity between individual populations[679].

Distribution and site significance

The CNBC only occurs in central north Tasmania in a triangular area running southwest from Port Sorell to the Railton area and north to Quoiba, near Devonport. The area is bounded approximately to the east and west by the Asbestos Range and the Mersey River respectively, and to the north by the coast, extending about 20 km in land[680] (Figure 29).

Much of the range of the CNBC is characterised by fertile soils overlying Tertiary basalts, and subsequently much of its range has been extensively cleared for agricultural uses. As a result, populations are largely restricted to isolated fragmented habitat areas. Furthermore, as 90 % of its known habitat range is on private land, the species is poorly represented in reserves[681].

At least four other *Engaeus* species overlap the margins of the CNBC range: *E. fossor* in the west, *E. cunicularius* along the northern coast strip, *E. nulloporius* in the south, and *E. mairener* to the east (Figure 30). It is now known that *E. mairener*, particularly, overlaps well into the eastern half of the CNBC range[682]. In addition, recent collections have revealed an undescribed species of *Engaeus* in the Latrobe area[683]. The two localities from which this species is known are both cleared paddocks, where it digs very deep burrows, suggesting that it may have been missed in previous surveys and its distribution is likely to be greater than currently known.

The entirety of the Project Area is within the core range of the CNBC and as the habitat availability for this species has been so greatly reduced, any suitable habitat is of significant value. As the habitats used by the CNBC and the chimneys it constructs are similar to the neighbouring common species, the species of burrowing crayfish cannot be determined without excavation. It is likely that crayfish burrows in the SWISA Project Area are mostly those of the CNBC, but the presence of *E. mairener* cannot be discounted and the undescribed *Engaeus* sp. from the Latrobe could possibly be present. Because of the difficulty and undesirability of excavating burrows, in practice it is precautionary to assume that all burrows in the SWISA Project Area are those of the CNBC.

SWIS management actions

A low likelihood of significant impact to this species was concluded in the referral / preliminary documentation process for the SWIS project[684]. As such, the following management actions were required as conditions of approval of the SWIS as a controlled action:

- A Construction Environmental Management Plan to be completed and implemented until the completion of construction activities including measures to protect known locations and habitat for burrowing crayfish.
- Farm Water Access Plans developed for each property receiving irrigation water must include property-based ecological surveys including components relevant to known populations and habitat before allocation of irrigation water. Farm WAPs must include recommendations for enhancing and maintaining local populations on each property.
- Farm WAPs must include measures to protect habitat sites form physical disturbance, contaminated run off and erosion and sedimentation, and maintain and enhance habitat sites
- Water quality and CNBC habitat condition monitoring.

[678] Richardson *et al.* (2008)
[679] Department of Sustainability, Environment, Water, Population & Communities (2011b)
[680] Richardson *et al.* (2008)
[681] Richardson *et al.* (2008)
[682] Richardson (2024) – **Appendix L**
[683] Richardson (in prep)
[684] Referral EPBC: 2010 / 5327; Tasmanian Irrigation Development Board (2010)

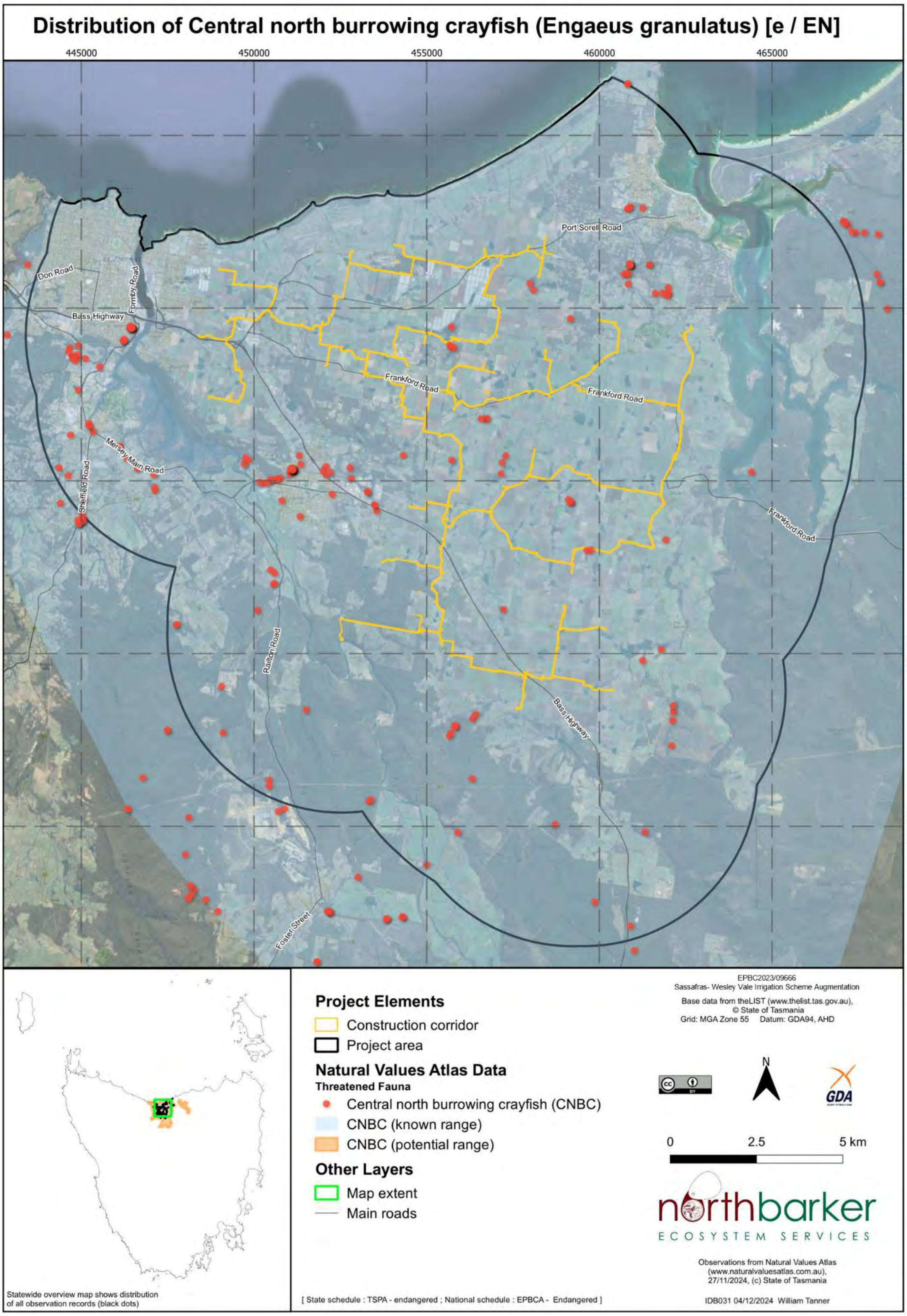

Figure 29: Distribution of the central north burrowing crayfish in relation to the Project Area

Figure 30: Range overlap of *Engaeus* species (NVA records) in the vicinity of the Project Area

Threats

While the CNBC is apparently tolerant to some level of landscape modification, occurring naturally in small and scattered colonies within agricultural surrounds, severe and prolonged disturbance is likely to eliminate local populations (colonies). Furthermore, as burrowing crayfish have a relatively poor ability to disperse and are therefore sensitive to habitat disturbance and fragmentation[685]. With an estimated area of occupancy of less than 1 km, reduction of suitable habitat area poses the greatest threat to this species. As such the main threats to the CNBC are listed as[686]:

- Habitat modification from agriculture, forestry, and urban development activities resulting in clearing of riparian vegetation and drainage of swampy areas;
- Trampling and soil compaction by stock at the edge of waterways;
- Dam construction and similar processes that eliminate waterlogged soils;
- Establishment of roads and associated drainage;
- Degradation of riverbank integrity and enhanced erosion;
- Habitat degradation via weeds especially gorse and blackberry;
- Inappropriate application of pesticides and fertilisers;
- Poor waste management;
- Alteration to water quality and quantity;
- Frequent high fire intensity; and
- Competition for resources and introduction of disease and parasites by introduced freshwater yabby (*Cherax destructor*).

Recovery Plan

At present there is no recovery plan for this species, however the conservation advice[687] for this species recommends that the priority recovery and threat abatement actions required for this species are:

- Monitor population trends; and
- Determine specific threats to known colonies and appropriate actions to abate them.

A recovery plan has been prepared for burrowing crayfish in Tasmania[688]. This plan covers four species of burrowing crayfish endemic to Tasmania but does not include the CNBC. The plan recommends the following recovery actions needed:

- Assessment of habitat (particularly for *E. martigener*);
- Improvement of reservation status for all species;
- Habitat management within agricultural areas;
- Habitat management within forestry and commercial harvesting areas;
- Habitat management within urban and other areas;
- Community involvement and education; and
- Population and habitat monitoring, combined with the results of actions 1-6 (as above).

The CNBC conservation advice recommends adding the CNBC to this recovery plan[689].

Opportunities for advancement in knowledge and conservation of the species

Impact assessments for this species (below) have been based on the conservative position that all evidence of presence of burrowing crayfish within the Project Area belong to the threatened species *E. granulatus* despite the species' identity not having been confirmed at any location. Positive identification of the burrowing crayfish currently relies on excavation and identification by an expert.

685 Richardson (2008)
686 Department of the Environment, Water, Heritage & the Arts (2008b); Richardson *et al.* (2008)
687 Department of the Environment, Water, Heritage & the Arts (2008b)
688 Doran (2000)
689 Department of the Environment, Water, Heritage & the Arts (2008b)

This has its own inherent impact on this endangered species. However, a species-specific assay has recently been developed for a threatened Western Australian burrowing crayfish species, demonstrating the usefulness of eDNA biomonitoring for detection of freshwater crayfish[690]. Once a species-specific assay has been developed, soil or water can be tested for the presence of the target DNA, and therefore the presence of the target species can be determined without excavating the species (though it should be noted that eDNA may not always give 100 % detection efficiency). The technology exists in Tasmania to develop a CNBC-specific assay which would allow field testing of burrowing crayfish chimneys within the range of the CNBC. As the SWISA Project Area is entirely within the range of the CNBC but also overlaps with 3 common burrowing crayfish species, eDNA biomonitoring would be a useful tool to help determine if burrowing crayfish colonies are those of the endangered CNBC or a common relative. Thus, potential impacts to CNBC can be assessed with greater confidence. It is strongly recommended that TI consider commissioning the development of CNBC-specific assay and protocols for eDNA monitoring of the CNBC as this would not only facilitate the avoidance and assessment of impacts to CNBC, but also enhance the knowledge of distribution, population specifics, and conservation of this cryptic species.

Survey methods

Survey guidelines to determine presence of CNBC recommend searching potential CNBC habitat for above ground evidence of burrowing crayfish, i.e. chimneys, pellets, or burrow entrances[691]. The ideal time of year to detect burrowing crayfish presence is after the start of autumn rain when the ground is damp enough for burrowing crayfish to become active and produce pellets and/or chimneys as a product of burrow excavation[692]. While evidence of burrowing crayfish may be present during drier months, chimneys often dry out and disintegrate, or in the agricultural environment of the Project Area, are destroyed by livestock.

Opportunistic observations of crayfish burrows were recorded during all field surveys of the pipeline alignment and realignment options.

A targeted survey of potential burrowing crayfish habitat was undertaken in May 2024. Potential habitat was identified during prior field surveys and additional waterways and damp areas (natural and artificial) identified from desktop sources[693]. Each area was visited by an ecologist and searched thoroughly for a minimum 10 minutes/100 m^2 (exceeding recommended search effort 60 minutes/10,000 m^2 [694]). Detecting chimneys was limited by dense vegetation (such as blackberry, gorse, dense grass or other herbaceous species) and disturbance by cattle.

Further investigation into the species of burrowing crayfish present within colonies recorded was not undertaken. Species identification requires excavation of burrows and extraction of animals for identification. As the entirety of the Project Area is within the core range of the CNBC, a conservative approach was taken that any evidence of burrowing crayfish would be treated as presence of the CNBC until proven otherwise.

All areas of potential habitat were described in terms of key factors listed as requirements for CNBC habitat, namely proximity to a surface water source, presence of surface water, vegetation type, and level and type of disturbance.

[690] Dawkins *et al.* (2024)
[691] Department of State Growth (2014); Department of Sustainability, Environment, Water, Population & Communities (2011b)
[692] A. Richardson pers. comm. (2023)
[693] Land Information System Tasmania (2024)
[694] Department of Sustainability, Environment, Water, Population & Communities (2011b)

Survey findings

In excess of 2,000 burrowing crayfish chimneys were recorded at total of 56 locations from the 87 potential CNBC habitat areas where the presence of chimney could be assessed (Table 29). The number of chimneys at any one location ranged from 1 to 100's. The largest colony was made up of 600 (± 300) chimneys and covered 0.2 ha. A selection of chimneys is illustrated in Plate 37a-h.

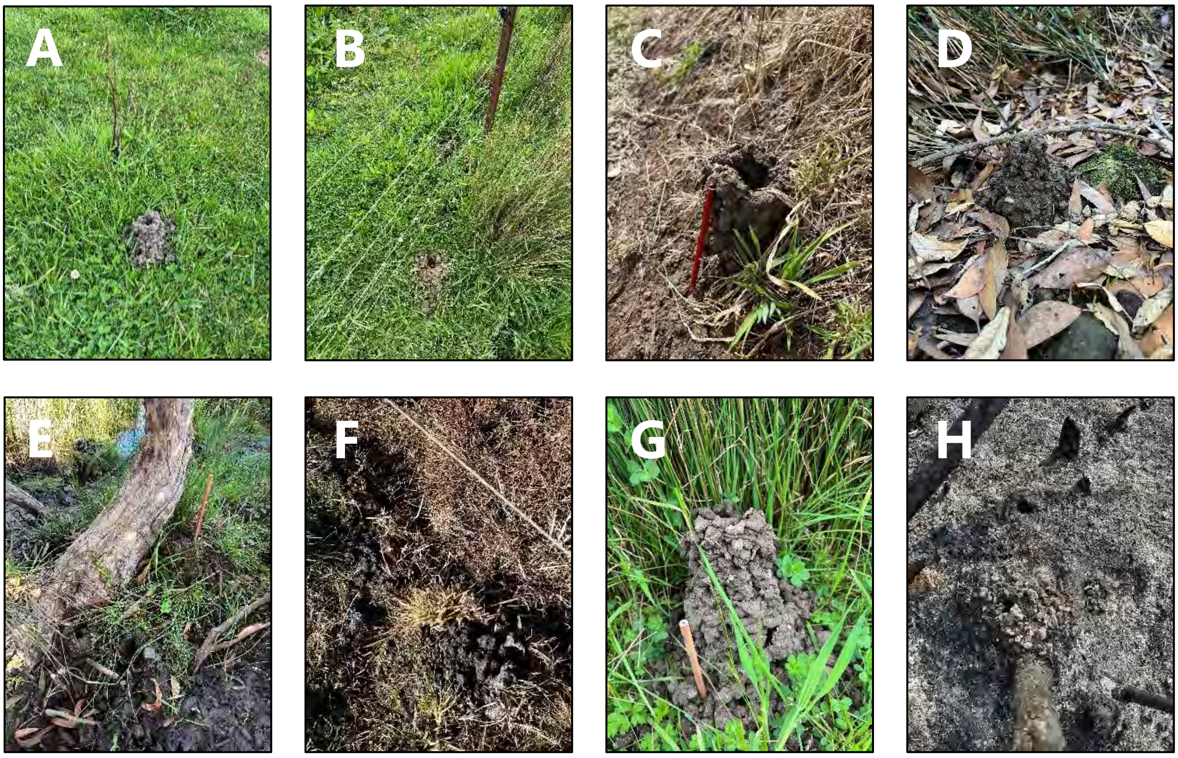

Plate 37a-h: Burrowing crayfish chimneys / burrows recorded within the SWIAA Project Area.

Potential CNBC habitat has been mapped throughout the Project Area (**Attachment D**) and includes all habitat where burrowing crayfish may occur based on the characteristics of the habitat areas where chimneys were recorded during targeted surveys. Potential habitat includes all stream edges, riparian vegetation, and seasonally wet drainage lines and damp areas

Unsuitable potential habitat includes all drainage lines and damp areas that have been permanently modified for example heavily pugged areas (Plate 38), ploughed, cropped (Plate 39), dense cover of tussock-forming grasses and sedges such as cocksfoot (Plate 40)or reed sweetgrass perhaps because their dense root mat inhibits burrowing, or dense biomass cover (Plate 41). Surveyed habitat areas determined to be unsuitable were excluded from mapping and impact analysis.

Plate 38: Heavily pugged by livestock

Plate 39: Continually cropped area

Plate 40: Dense cocksfoot biomass

Plate 41: Long-term dense non-native biomass

CNBC potential habitat within the Project Area can be differentiated into the following habitat types:

- Optimal undisturbed habitat within native vegetation such as wet *Eucalyptus obliqua* forest (WOB) in gullies and *Eucalyptus ovata* forest (DOV) (Plate 42),
- Damp remnant *Melaleuca ericifolia* (NME) patches on drainage lines (Plate 43, Plate 44). These remanent vegetation areas had an intact canopy but were moderately disturbed by livestock access.
- Highly modified (suboptimal) areas within or adjacent to drainage lines within paddocks, or roadside ditches (Plate 45, Plate 46). These habitat areas were predominantly made up of exotic plant species such as pasture grasses, blackberry, and gorse, though often mixed with native rushes (*Juncus* species) that are associated with damp areas. Burrowing crayfish colonies were often associated with the occasional remanent *M. ericifolia* or *A. melanoxylon* tree remaining on a drainage line.

The distribution of habitat types, and the occurrence of burrowing crayfish chimneys located within each is provided in Table 29.

Table 29: Habitat types of burrowing crayfish colonies recorded in within the Survey Area

Habitat Type	Total Number of Habitat Areas (% of total potential habitat areas)	Number of Locations of Chimneys (% of habitat areas in which chimneys were located#)
Optimal undisturbed habitat within native vegetation	5 (4.67 %)	4 (80.00 %)
Damp areas within remnant *Melaleuca ericifolia*	22^ (20.56 %)	14 (77.78 %)
Highly modified areas within or adjacent to drainage lines within paddocks	80* (74.76 %)	38 (59.38 %)
Total	**107**	**56 (64.37 %)**

^ Presence/absence of burrowing crayfish chimneys was unable to be determined at 4 habitat areas due to high biomass
*** Presence/absence of burrowing crayfish chimneys was unable to be determined at 20 habitat areas due to high biomass**
 # Percent of potential habitat areas that had burrowing crayfish present is calculated using only areas where the presence/absence of chimneys could be determined. Habitat areas the presence/absence of chimneys could not be concluded are excluded from statistics

Plate 42: Burrowing crayfish burrows recorded in undisturbed WOB vegetation near Warrawee Conservation Area

Plate 43: Damp remnant *Melaleuca ericifolia* patches on drainage lines

Plate 44: Damp areas with intact canopy

Plate 45: Burrowing crayfish burrows recorded in highly modified (suboptimal) habitat areas such as roadside ditches

Plate 46: Burrowing crayfish burrows recorded in highly modified (suboptimal) habitat areas within or adjacent to drainage lines within paddocks

Plate 47: Burrowing crayfish persist infrequently in unfenced livestock paddocks

Plate 48: Burrowing crayfish were recorded more often within livestock paddocks protected by fences or blackberry thickets

Very few CNBC habitat areas remain in undisturbed native vegetation within the Project Area. Only five habitat areas (4.67 % of total habitat surveyed) were identified (Table 29, Plate 44). Burrowing crayfish were recorded in 80.00 % of the optimal undisturbed habitat areas identified within the Survey Area.

Small patches of *Melaleuca ericifolia* on drainage lines (Plate 43) are a feature of the Project Area and represent remnants of what was likely to be a widespread vegetation community prior to clearing for agriculture. Within the Survey Area, 22 areas of potential CNBC habitat of this type were identified, and burrowing crayfish colonies were located at 14 of the areas surveyed (77.78 % of suitable habitat of this type, Table 29).

The majority (74.76 %) of potential CNBC habitat areas identified within the Project Area are highly modified areas within the agricultural landscape (Table 29). This is not unexpected as the landscape within which the Project Area lies is indeed highly modified and there is very little remaining native vegetation. Of the areas of this habitat type surveyed, 59.38 % have BCF chimneys present. While modified habitat areas are generally as described above, the degree of disturbance varies depending on the surrounding land use, and whether the area has been fenced off from livestock or not. Chimneys were located in some areas that had been heavily grazed and/or the ground disturbed by livestock (Plate 47), however in areas that have some protection from livestock, such as fencing or blackberry patches, burrowing crayfish chimneys were found almost exclusively in the protected areas (Plate 48).

The findings of the targeted burrowing crayfish surveys show that although potential CNBC habitat is throughout the Project Area, not all potential habitat is occupied. Of the potential CNBC habitat areas where presence/absence of chimneys was able to be determined, 64.37 % were occupied by burrowing crayfish (Table 29).

In addition to the 87 potential habitat areas that the presence/absence of crayfish burrows could be determined, 20 potential CNBC habitat areas could not be surveyed as the vegetation was too dense to ascertain the presence of burrowing crayfish. As it has been shown during these surveys that burrowing crayfish colonies can be present beneath dense vegetation that provides shelter and protection from stock impacts within this landscape, it is highly likely that crayfish colonies could exist in these habitat areas and therefore their presence cannot be discounted until their absence can be shown.

Impact pathways

Potential impact pathways relevant to the construction of the SWISA include:

- Destruction of individual CNBC or colonies by excavation during construction;
- Habitat modification resulting in clearing of riparian vegetation and drainage of swampy areas;
- Soil compaction by machinery at the edge of waterways;
- Habitat degradation via weeds, particularly increase in persistent biomass and tussock forming species; and
- Alteration to water quality and quantity.

Potential impact pathways relevant to the operation of the SWISA include:

- Habitat modification resulting in clearing of riparian vegetation and drainage of swampy areas;
- Trampling and soil compaction by stock at the edge of waterways;
- Dam construction and similar processes that eliminate waterlogged soils;
- Changes to drainage;
- Degradation of riverbank integrity and enhanced erosion;
- Inappropriate application of pesticides and fertilisers;
- Poor waste management; and
- Alteration to water quality and quantity.

Avoidance

Alignment of the Construction Corridor has been adjusted to minimise the impact of construction on known locations of and potential habitat for burrowing crayfish. The alignment of the pipeline has been adjusted to avoid the locations of all but 11 (of a total 56) known locations of burrowing crayfish (Table 30).

Further mitigation of impacts to CNBC by avoidance has been achieved by alteration of the specified construction methodology in areas of burrowing crayfish habitat and known locations. Instead of trenching and laying pipe, the pipeline alignment will be horizontally directionally drilled at a depth of a minimum of 5 m (recommended depth to avoid impact to crayfish, maximum depth of CNBC burrow is 2 m[695]) where practical and feasible at known locations of burrowing crayfish. This will effectively avoid impact crayfish individuals by excluding ground-breaking works and machinery from the drill locations.

As a result of construction method mitigation in addition to Construction Corridor realignments, a total of 51 burrowing crayfish locations have been avoided (Table 30). In addition, 20.26 ha of the 22.18 ha of CNBC habitat mapped within the Survey Area has been avoided.

Presence/absence of burrowing crayfish could not be determined for 15 potential habitat areas within the Construction Corridor due to dense vegetation.

[695] Richardson (2024) – **Appendix L**

Table 30: Impacts and avoidance of potential central north burrowing crayfish habitat and occurrences

	Total Recorded in Survey Area	Within Construction Corridor		Avoidance Total
		Before Mitigation	With Construction Mitigation	
Extent of Habitat (ha) ***No. of Habitat Areas***	22.18 *166*	3.16 *58**	**1.92** ***48***	20.26 (91.34 %) *118*
Number of Burrowing Crayfish Locations	56	11*	**5 (Total 9 chimneys)**	51

***Burrowing crayfish were located within 21 habitat areas that are intersected by the Construction Corridor; however the Construction Corridor has been realigned to avoid 10 locations and only 11 locations of burrowing crayfish remain within the Construction Corridor**

Impacts

The following assessment of impacts is based on the conservative position that all evidence of presence of burrowing crayfish may be the threatened species *E. granulatus* despite the species of crayfish not having been confirmed at any location.

Construction

Direct Impacts

In excess of 2,000 chimneys from 56 locations were recorded during targeted surveys. All but five locations from which a total of nine chimneys were recorded have been avoided through realignment or construction methodology (Table 30). As such all locations of burrowing crayfish with a burrow density that fits the definition of a colony (following A. Richardson [2024][696]: >4 burrows/16 m^2) have been avoided. The remaining five burrowing crayfish locations have 1-4 chimneys recorded per site and thus do not constitute burrowing crayfish colonies. The observed chimneys are potentially the burrow entrances of one individual[696] (certainly the chimneys at two sites belong to one individual: two chimneys within 5 cm, 1 new and 1 previous season). Nevertheless, the impact on the 4-7 individuals within the Construction Corridor can be mitigated by removing and relocating any animals during construction (the CNBC Salvage and Relocation Protocol [**Appendix M**] outlined in mitigation section below).

The presence / absence of burrowing crayfish at 15 of potential habitat areas in which the Construction Corridor intersects could not be determined due to the thick vegetation cover. Potential impact to any crayfish that may occur in these areas may be avoided be avoided in some instances through micro siting and on-ground impact minimisation measures. Potential impact to burrowing crayfish within habitat areas that are intersected by the Construction Corridor or cannot be micro sited will be cleared and searched for evidence of burrowing crayfish prior to construction.

An additional 32 habitat areas where no evidence of burrowing crayfish was recorded during the May 2024 surveys (Table 4) intersect with the Construction Corridor (10 of which had burrowing crayfish locations recorded outside of the Construction Corridor). Nevertheless, a CNBC salvage and relocation protocol (**Appendix M**) will apply, and any unanticipated discoveries of burrowing crayfish will follow this protocol in order to minimise burrowing crayfish impacts.

[696] Richardson (2024) – **Appendix L**

With the implementation of mitigation processes and protocols, direct impact losses of burrowing crayfish will be negligible.

Habitat modification

The proposed Construction Corridor, which is the limit of the habitat impacts, contains 3.16 ha of potential CNBC habitat across 58 habitat areas (Table 30). Specific pipeline construction methods (horizontal directional drilling) will further reduce the habitat impact area to 1.92 ha of potential habitat (consisting of 1.81 ha of suboptimal habitat and 0.11 ha of optimal and damp remnant habitat) across 48 habitat areas. The entirety of this impact area represents temporary habitat disturbance, with the extent of the pipeline post-works once more becoming viable habitat for burrowing crayfish. Temporary removal of small areas of ground cover and excavation of earth is unlikely to permanently negatively impact the potential for burrowing crayfish to colonise the disturbed area. This is evident within the Project Area where burrowing crayfish burrows have been recorded around infrastructure (e.g. property outlets) installed for the SWIS over 10 years ago.

It is likely that habitat areas that are parallel to the Construction Corridor can be avoided by on-ground micros siting of the Construction Corridor. Impact to habitat areas that the Construction Corridor crosses can also be reduced by minimising the width of the corridor to the smallest possible width. The majority of habitat areas are highly modified damp agricultural habitats and will rehabilitate quickly (within 6 months) back to its current status.

Surveys have shown that burrowing crayfish do not inhabit all potential available habitat (even in optimal and remnant habitats). Temporary habitat modification will not decrease the habitat availability.

Permanent above-ground infrastructure impact areas (balance tanks and pump stations) will not impact habitat for CNBC.

Soil Compaction

Due to the linear nature of this project, heavy machinery or long-term vehicle movement in any one area will not be sustained for a long enough period to compact the earth. In addition, tracked vehicles' soil compaction will be minimal as their weight is spread on tracks. Nevertheless, potential for soil compaction to impact CNBC can be further mitigated by minimising vehicle movement around burrowing crayfish habitat.

Habitat degradation: weeds

While the Conservation Advice[697] for this species lists habitat degradation via weeds, especially gorse and blackberry as a main threat, in this landscape woody weeds appear to be less of a threat than the establishment and dominance of tussock or root-mat forming herbaceous non-native species in damp areas. The CNBC does not seem to persist under a dense cover of tussock-forming grasses and sedges such as cocksfoot or reed sweetgrass perhaps because their root mat inhibits burrowing[698]. Impacts of herbaceous non-native species due to construction activities can be mitigated through the application of a weed and hygiene management plan (**Section 4.4.5.1**).

Woody weed species such as gorse and blackberry appear to provide protection for burrowing crayfish colonies against the detrimental impacts of livestock trampling. As such they must not be removed in burrowing crayfish habitat areas within potential livestock impact zones unless the area is fenced to maintain critical protection to habitat.

[697] Department of the Environment, Water, Heritage & the Arts (2008b)
[698] Richardson (2024) – **Appendix L**

Change in hydrology and water quality

Construction of the pipeline represents temporary a disturbance to hydrology in habitat areas, returning to pre-works state post-construction.

Operation

The Project Area exists within an already highly modified agricultural environment and the majority of SWSA irrigators are already using SWIS water. It is clear that burrowing crayfish persist within the SWIS irrigation district and monitoring of CNBC colonies report no impact during the first 6 years of operation of the SWIS[699]. Therefore, the greatest risk to the species is change in land use due to the provision of SWISA water. With an OEMP and Farm WAPs in place, no impacts to this species are anticipated due to the operation of the SWISA.

Habitat modification and direct impacts

The greatest risk to this species due to the operation of the scheme is the potential for changes in land use resulting in vegetation clearing and altered hydrology of habitat areas, particularly of riparian vegetation and swampy areas. Larger remanent patches (>0.5 ha) of native vegetation on drainage lines and wet areas (e.g. DOV and NME) and wet forest on natural watercourses that have not had ongoing livestock access are of particular value as CNBC habitat. Change in land use resulting in clearing, draining, or allowing access to life stock would be detrimental to CNBC if present and reduce the quality of habitat for potential colonisation. Removal of riparian vegetation, particularly in conjunction with unregulated stock access can also lead to degradation of riverbank integrity and enhanced erosion.

Clearing small patches of native vegetation (e.g. one tree and shrubs and ferns) on drainage lines within paddocks will also have direct impact on burrowing crayfish habitat quality (Plate 49). While the CNBC is tolerant of non-native vegetation, such as grazed pasture, these remnant patches provide higher quality habitat and increase protection from agricultural processes and livestock. In addition to clearing native remnants on drainage lines and water courses, maintenance removal of non-native herbaceous vegetation of farm drains by scraping topsoil is also an inherent risk to burrowing crayfish (Plate 50). Crayfish will persist in burrows that have been intersected by earthmoving machinery (Plate 45), however if excavation is too deep, and / or conditions are not tolerable for survival (e.g. dry, hot) burrowing crayfish may not survive interference.

Changes to drainage, dam construction, and similar processes that eliminate waterlogged soils or seasonal surface water will adversely impact CNBC habitat and colonies. Conversely, increased water runoff will enlarge the area of suitable habitat in drains and other poorly drained areas. Existing patches of *Juncus* in paddocks which currently have occasional burrows may support growing colonies of crayfish with additional water input[700].

The risk of direct impact to CNBC individuals and habitat clearance due to Tasmanian Irrigation water will be managed through the provisions of an OEMP and the Farm WAP process in line with those undertaken for the SWIS. As such habitat modification and direct impacts to CNBC will be mitigated to a negligible impact.

Trampling and soil compaction by stock

The CNBC, and burrowing crayfish in general, are seriously affected by pugging of the soil by cattle[701]. Where cattle regularly access waterlogged areas such as at watering points, natural water sources, and winter wet areas, the ground can become seriously disturbed, pugged, and compacted (Plate 51). Excluding livestock from drainage lines and wet areas particularly in times when the ground is waterlogged, reduces the impact to crayfish colonies and habitat. This is evident within the Project Area

[699] Tasmanian Irrigation (2018)
[700] Richardson (2024) – **Appendix L**
[701] Doran (2000); Doran (2004); Richardson (2024) – **Appendix L**

with natural protection of blackberry thickets, and livestock exclusion fencing (Plate 52). However, in this agricultural landscape, excluding livestock grazing in areas with permanent water and high nutrient load will encourage a high biomass production of herbaceous non-native weeds which in their own right could impact on burrowing crayfish habitat without control.

An OEMP and Farm WAP requirements will ensure impacts to this species by stock and associated weed threats are minimised.

Inappropriate application of pesticides and fertilisers, alteration to water quality, poor waste management

In the agricultural setting where many burrowing crayfish were recorded, the inappropriate application of pesticides and fertilisers either directly to crayfish colonies or indirectly through soil, water or aerial drift is a high risk and likely to impact burrowing crayfish (Plate 53). The magnitude of tolerance to chemical application by CNBC is unknown. In addition, alteration to water quality due to poor waste management, chemical application, or erosion control are also likely to impact the CNBC, though tolerances are also unknown.

The provisions of an OEMP and Farm WAP requirements, with a water monitoring program included will ensure impacts to this species by alteration of water quality, inappropriate application of chemicals and fertilisers, and waste management are minimised.

Competition for resources and introduction of disease and parasites by introduced freshwater yabby

This introduced freshwater yabby is not known from within 5 km of the Project Area, nor the source water, the Mersey River. The provision of SWISA water will not result in the introduction of this introduced yabby species to the Project Area.

Plate 49: Cleared remnant of *Melaleuca ericifolia* on drainage lines

Plate 50: Burrowing crayfish chimneys recorded within a drainage line that has had topsoil and vegetation scraped exposing crayfish burrows

Plate 51: Pugging by cattle when allowed access to wet areas precludes the persistence of burrowing crayfish

Plate 52: Hundreds of chimneys were observed under and within cattle exclusion fencing of drainage lines but not outside

Plate 53: Burrowing crayfish burrows adjacent to cropping and in an area that has been sprayed with herbicide. It was unclear at the time of survey if these burrows are active

Mitigation measures

Construction

Unavoidable Removal of Crayfish

Designs have been modified to reduce potential impacts to burrowing crayfish by realigning the pipeline to avoid known burrowing crayfish locations. All except 5 locations from which a total of 9 chimneys remain in the proposed Construction Corridor and cannot be avoided by horizontal directional drilling.

The priority is to avoid known burrows through micro siting of the pipeline alignment during construction.

If avoidance is not possible, these burrowing crayfish sites will be excavated during the trenching process. A standard operating procedure for the salvage and relocation of CNBC has been established previously and undertaken successfully[702]. A CNBC Salvage and Relocation Protocol for SWISA has been based on this precedent (**Appendix M**) and includes the following measures to ensure best possible survival of exhumed crayfish:

- Timing of works: May-August inclusive (may vary depending on the season) to ensure best survival rates of animals, and to avoid trenching works within the breeding season. No trenching works will occur within habitat for this species during the breeding season (spring-summer).
- Application of the protocol is not required where HDD avoidance measures are applied;
- Responsible personnel;
- Hygiene prescriptions;
- Handling and transportation of animals;
- Relocation to a new site (preferably within the same habitat area), outside the Construction Corridor; and
- Monitoring.

Burrowing Crayfish Habitat Management

In total 58 potential habitat areas intersect with the Construction Corridor. A construction CNBC Salvage and Relocation Protocol must cover all potential burrowing crayfish habitat areas intersecting with the Construction Corridor and must include the following provisions:

Pre-construction

- All site workers must be trained to be able to identify burrowing crayfish habitat elements;
- Any habitat areas that were unable to be surveyed for crayfish presence and that can't be avoided by narrowing corridor; Construction Corridor is to be cleared of vegetation and searched for chimneys. This must be conducted between May and November to allow for the highest probability of chimney detection. The CNBC Salvage and Relocation Protocol must be applied to any new colonies discovered. Absence of crayfish will be treated as potential habitat as follows:

  Prior to ground-breaking activity

  - Site inspections must be conducted by a suitably qualified ecologist[703] to identify additional crayfish burrows and confirm extent of known colonies. Slashing and

[702] Richardson (2024) – **Appendix L**

[703] Suitably qualified ecologist (for the purpose of preparing and implementing environmental management plans) means a consultancy or individual who has relevant professional qualifications, permits, and ethics approval, and at least 3 years of work experience writing and implementing management plans for the relevant protected matter; has implemented and reported on management plans for the habitat of the particular protected matter; can demonstrate the efficacy of those management plans, and in the event of ineffective measures, can demonstrate and implement corrective actions and solutions to achieve the desired outcomes; and can give authoritative assessment and advice on offset management to improve the habitat quality of the protected matter using relevant protocols, standards, methods and/or literature.

removal of biomass within the Construction Corridor may be required prior to inspection;
- o The Construction Corridor must be clearly demarcated and narrowed to the minimum extent through any identified CNBC habitat. Exclusion zone fencing of habitat outside the Construction Corridor must be erected prior to any breaking of ground.
- o A 5 m exclusion zone must be erected around:
    - All identified burrowing crayfish locations within 20 m of the Construction Corridor;
    - All burrowing crayfish habitat patches within 20 m of the Construction Corridor where habitat is not being impacted; and
    - The above habitat types, even in areas where directional drilling rather than excavation will occur.
- o This must be checked by a suitably qualified ecologist prior to ground-breaking activity.

During construction

- Vehicle traffic through habitat areas must be strictly controlled. Access to construction sites must be contained within the Construction Corridor, or on pre-existing roads and tracks. Vehicles must not be parked within potential habitat areas unless required directly for construction;
- Vegetation removal must only occur to the extent necessary to complete construction;
- Weed and hygiene mitigation measures must be applied, as per **Section 4.4.5.1**.
- Watercourses must not be impeded (i.e. preventing flow of water) by construction activities;
- Replacement of soils must be from the same source location to prevent cross-contamination and spread of weeds and pathogens (i.e. no foreign material to be used to in fill trenches);
- The CNBC Salvage and Relocation Protocol must be applied to all areas of known impacts to CNBC and potential habitat areas;
- In the event of an unanticipated burrowing crayfish discovery, all works must cease in the area until the CNBC Salvage and Relocation Protocol is undertaken; and
- Upon completion of works within a habitat area, the habitat area must be fenced off and no vehicles are to enter to prevent soil compaction.

Post-construction

- Habitat areas must be fenced until rehabilitation is complete; and
- Any known, discovered, or relocation areas of burrowing crayfish must be fenced, managed, and monitored in conjunction with the landowner(s) and the provisions of the OEMP and Farm WAP.

<u>Operation</u>

Routine Maintenance of SWISA Infrastructure by TI

- The construction protocols outlined above will also apply to ongoing maintenance of SWISA infrastructure through the lifetime of the scheme.
- Known burrowing crayfish locations must be recorded and lodged the Farm WAP process, however if routine maintenance is scheduled to occur prior to a property assessment/reassessment of CNBC habitat, then pre-works checks of maintenance areas with CNBC habitat must be undertaken by a suitably qualified ecologist in the optimal search period (May-October) prior to maintenance commencing.

Application of SWISA water

The application of the SWISA water is anticipated to have negligible impacts to the CNBC.

The Project Area exists within an already highly modified agricultural environment and the majority of SWISA irrigators are existing customers using SWIS water. It is clear that burrowing crayfish persist within the SWIS irrigation district and monitoring of CNBC colonies report no impact during the first 6 years of operation of the SWIS[704].

The provision of Tasmanian Irrigation water does not allow for landowners to conduct unregulated land clearance. All land irrigated with Tasmanian Irrigation water within the SWISA are subject to rigorous assessment through the Farm WAP process and the provisions of an OEMP. The risk of direct impact to the CNBC due to Tasmanian Irrigation water will be managed through the Farm WAP process, with measures in place to ensure that this species is adequately protected by applying exclusion areas and applying buffers from particular agricultural activities. Monitoring and auditing will allow for corrective actions to be established in the event that prescribed actions are not effective to the degree required.

At a minimum, the Farm WAP must:

- Be developed for each property that is purchasing SWISA water;
- Conduct a property-wide ecological survey (by a suitably qualified ecologist) for:
    - Occurrence of burrowing crayfish; and
    - Areas of potential habitat for the CNBC, including assessment of condition and importance to CNBC (high quality, native, undisturbed areas more important to the species than highly modified and disturbed habitat).
        - Burrowing crayfish habitat includes any damp area where ground water comes to the surface for at least part of the year. Potential habitat is constrained by excessive and ongoing disturbance. While all habitat in which burrowing crayfish have been recorded will be afforded the protection outlined, it is not necessarily practical or essential for the recovery of the species to protect all potential habitat for the species on every property. Habitat assessments and recommendations for each property must be made by a suitably qualified ecologist and potential habitat (where no burrowing crayfish were recorded) protection will be prioritised as follows:
            a) Patches of native vegetation on natural water courses or damp areas (e.g. *Melaleuca ericifolia, Acacia melanoxylon,* and *Eucalyptus ovata* vegetation communities);
            b) Water courses (permanent flowing or winter-wet, natural or constructed) with native vegetation elements, e.g. one or more *Melaleuca ericifolia, Acacia melanoxylon, Eucalyptus ovata* tree with native shrub, sedge/rush, or fern understory elements;
            c) Artificial drainage lines with native rushes and pasture grass in the vicinity of, and on the same drainage system as, a known burrowing crayfish colony;
            d) While burrowing crayfish have been recorded in damp rushy paddocks, these areas are not a priority to protect without known presence of crayfish.
- Develop regulations and measures to protect known burrowing crayfish sites and potential CNBC habitat sites from physical disturbance, weed invasion, contamination, alteration of hydrology, and erosion and sedimentation, including:
    - Barrier protection from livestock grazing or trampling (may be seasonal).
        - Barrier protection from livestock grazing or trampling will be best determined for potential habitats case-by-case in order to manage detrimental effects of both stock impacts and weed biomass. Permanent exclusion of grazing in high nutrient, permanently damp environments is likely to lead to high weed

[704] Tasmanian Irrigation (2018)

biomass production more than in seasonally damp, lower nutrient areas. Seasonal grazing (during the dry season) will reduce biomass while excluding livestock impacts when the ground is wet and burrowing crayfish are active.
    - Provide alternative water sources for livestock to prevent impact on natural water sources;
    - Exclusion of heavy machinery use within 5 m of known burrowing crayfish sites;
    - Conduct weed and invasive plant control programs in areas of known burrowing crayfish colonies;
    - No chemical spraying within 5 m of known burrowing crayfish sites;
    - No fertiliser application within 5 m of known burrowing crayfish sites; and
    - Stabilisation of waterways, drainage lines, and waterbody banks.
- Necessary routine maintenance of drainage lines involving clearance of vegetation or scraping topsoil to be undertaken in May-September when soil is damp, and temperatures are lower in order to reduce the likelihood of desiccation and mortality of individuals inhabiting impacted burrows.

Monitoring

Monitoring of SWISA operations must be included in the provisions of the OEMP, with monitoring of the following to be included:

- Surface water quality, including nutrient load;
- Burrowing crayfish habitat monitoring undertaken at known burrowing crayfish locations for a minimum of 5 years; and
- Corrective actions to be developed and undertaken if monitoring indicates unsatisfactory results.
- Monitor extent and population of any occurrences of the introduced freshwater yabby.

If it is determined by the Farm WAP that impacts due to the operation of the SWISA on individual properties are likely to trigger the MNES *Significant Impact Criteria*[705], individual irrigators may need to refer their action independently.

Residual significant impacts

With the above context, survey results, avoidance, impacts, and mitigation, an assessment of the residual impacts as a result of the construction and operation of the SWISA against the significant impact criteria[706] is provided below.

1) Lead to a long-term decrease in the size of a population

For the purposes of assessment of the CNBC under the EPBC Act, a 'population' is defined as an occurrence of the species, and any population/occurrence is considered as an important population[707]. Existing populations in this sense are generally small colonies[708] with limited connectivity between individual populations[709].

All known occurrences of burrowing crayfish which may be *Engaeus granulatus* have been avoided through design with the exception of a maximum of 7 chimney sites across five locations. If these individuals cannot be avoided through micro siting of the alignment, they will be salvaged and relocated within the habitat area but outside construction impacts. Habitat areas within the Construction Corridor where the presence of burrowing crayfish is unknown will be cleared and surveyed during the optimal survey period (May to October) to eliminate further risk of impacts to unknown occurrences of this

[705] Commonwealth of Australia (2013a)
[706] Commonwealth of Australia (2013a)
[707] Department of Sustainability, Environment, Water, Population & Communities (2011b)
[708] Richardson *et al.* (2008)
[709] Department of Sustainability, Environment, Water, Population & Communities (2011b)

species. If any additional burrowing crayfish chimneys (individuals or colonies) are discovered within the impact area (Construction Corridor) these will also be salvaged and relocated.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include requirement for further survey and requisite protection measures to prevent direct impact or indirect impacts that could lead to a decrease in size of a colony within the SWISA Operational Area.

With the recommended mitigation measures in place, the construction and operation of SWISA **will not** lead to a long-term decrease in the size of a population.

2) Reduce the area of occupancy of the species

According to most recent (2008[710]) published population estimates, the extent of occurrence of this species is estimated at 514.9 km^2 with an area of occupancy of only 0.96 km^2, with estimates of total population numbers between 74,400 and 392,200 individuals[711]. Burrowing crayfish are not highly mobile remaining restricted to their colony limits, with the potential opportunity for dispersal occurring only when juvenile crayfish leave the parental burrow[712]. Impact to known occurrences of burrowing crayfish which may be *Engaeus granulatus* have been avoided through design with the exception of a maximum of 7 chimney sites across five locations. If these individuals cannot be avoided through micro siting of the alignment, they will be salvaged and relocated within the habitat area but outside of construction impacts. Therefore, the known area occupancy will not be reduced.

The total impact area to potential habitat for this species is a maximum 1.92 ha of which 1.81 ha is suboptimal habitat and 0.11 ha is optimal and damp remnant habitat, across 48 habitat areas (Table 30). All habitat impacts are temporary will be rehabilitated post-construction. With pre-clearance surveys in place, the risk of reducing any additional areas of occupancy will be eliminated through implementing further controls to ensure a population is not impacted.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures to prevent the reduction of area of occupancy of CNBC within the SWISA Operational Area.

With the recommended mitigation measures in place, the construction and operation of the SWISA **will not** reduce the area of occupancy of a population.

3) Fragment an existing population into two or more populations

For the purposes of assessment of the CNBC under the EPBC Act, a 'population' is defined as an occurrence of the species, and any population/occurrence is considered as an important population[713]. Existing populations in this sense are generally small colonies[714] with limited connectivity between individual populations[715].

Impact to known occurrences of burrowing crayfish which may be *Engaeus granulatus* have been avoided through design with the exception of a maximum of 7 chimney sites across five locations. If these individuals cannot be avoided through micro siting of the alignment, they will be salvaged and relocated together (in the event that more than one individual will be exhumed) within the habitat area but outside construction impact area. The excavated habitat will remain viable as habitat post-construction. Therefore, no population will be fragmented.

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[710] Richardson *et al.* (2008)
[711] Richardson *et al.* (2008)
[712] Horwitz (1990)
[713] Department of Sustainability, Environment, Water, Population & Communities (2011b)
[714] Richardson *et al.* (2008)
[715] Department of Sustainability, Environment, Water, Population & Communities (2011b)

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures to prevent any impact to and potential CNBC population within the SWISA Operational Area.

With the recommended mitigation measures in place, the proposed construction and operation of the SWISA **will not** fragment an existing population into two or more populations.

4) Adversely affect habitat critical to the survival of a species

There is no published definition of critical habitat for this species, however in the process of listing the CNBC under the EPBC Act[716] the habitat was described as 'seeps, wetlands and stream banks. It should be noted that this definition of suitable habitat is widespread throughout northern and eastern Tasmania however the range of this species is restricted to its discrete area of occurrence (Figure 29).

The total impact area to potential habitat for this species during construction is a maximum 1.92 ha of which 1.81 ha is suboptimal habitat and 0.11 ha is optimal and damp remnant habitat (Table 30). All habitat impacts are temporary, will be rehabilitated post-construction, and this species is known to recolonise areas post-soil and vegetation disturbance. Further to this, 91.34 % of potential habitat that has been verified within the Survey Area that could support this species will be avoided during construction.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures for potential habitat for this species within the SWISA Operational Area. Potential habitat will be assessed, and protection measures attributed based on the quality and importance for the species. Moreover, habitat quality and availability may improve within the Project Area as a result if the SWISA due to the need to develop biodiversity action plans within the Farm WAP.

With the recommended mitigation measures in place, the proposed construction and operation of the SWISA **will not** affect habitat critical to the survival of this species.

5) Disrupt the breeding cycle of a population

All known occurrences of burrowing crayfish which may be *Engaeus granulatus* have been avoided through design with the exception of a maximum of 7 chimney sites across five locations. If these individuals are required to be exhumed, they will be salvaged and relocated within the habitat area away from construction impacts, the CNBC Salvage and Relocation Protocol stipulates that this must be completed during winter/spring to reduce the chance of mortality. Although information on the breeding cycles of CNBC is lacking, circumstantial evidence suggests a spring-summer breeding season (perhaps with spring rains providing the opportunity for males to seek out female burrows) and juvenile dispersal with autumn rains. Thus, winter (May to October) removal of any burrowing crayfish will reduce likelihood of disruption to breeding cycle.

During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include measures for further survey and requisite protection measures for burrowing crayfish colonies and potential habitat for this species within the SWISA Operational Area.

Thus, with the recommended mitigation measure in place, the proposed construction and operation of the SWISA **will not** disrupt the breeding cycle of a population.

6) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The total impact area to potential habitat for this species during construction is a maximum 1.92 ha of which 1.81 ha is suboptimal habitat and 0.11 ha is optimal and damp remnant habitat (Table 30). All

[716] Doran (2004)

habitat impacts are temporary will be rehabilitated post-construction. Further to this, 91.34 % of potential habitat that has been verified within the Survey Area that could support this species will be avoided during construction. This area in only a subset of the habitat available within the SWISA Operational Area.

The SWISA Operational Area already constitutes a highly modified landscape and the majority of the SWISA irrigators are existing customers using SWIS water. During the operational phase, all SWISA irrigators land is subject to the provisions of an OEMP which includes the TI Farm WAP process. This process will include property-wide surveys and requisite protection measures for potential habitat for this species within the SWISA Operational Area. Potential habitat will be assessed, and protection measures attributed based on the quality and importance for the species.

Based on this assessment, the construction and operation of the SWISA **will not** modify, destroy, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline.

7) Result in invasive species that are harmful to the species becoming established in the species' habitat

This introduced freshwater yabby is not known from within 5 km of the Project Area, nor the source water, the Mersey River.

Weed species, particularly tussock or mat-forming species at high biomass, pose a risk to this species. With this potential risk in mind, TI are committed to implementing a project specific weed and hygiene management plan (**Section 4.4.5.1**) within the CEMP to prevent the introduction of weeds to the landscape and to contain existing infestations. Ongoing monitoring and audits will be a component of this management plan.

With this measure in place, the construction and operation of the SWISA **will not** result in invasive species that are harmful to this species becoming established in the species' habitat.

8) Introduce disease that may cause the species to decline

There are no diseases applicable to the nature of works that are listed as threats to the species[717] and no likelihood that the project will introduce disease that may cause the species to decline.

Thus, the proposed construction and operation of the SWISA **will not** introduce a disease that may cause the species to decline.

9) Interfere with the recovery of the species

At present there is no recovery plan for this species, however the conservation advice[718] for this species recommends that the CNBC be added to the recovery plan existing for four other burrowing crayfish in Tasmania[719] and that the priority recovery and threat abatement actions required for this species are:

- Monitor population trends; and
- Determine specific threats to known colonies and appropriate actions to abate them.

While the proposed action **will not** interfere with the recovery recommendations, it has (and will continue to) contributed to actions recommended in the existing recovery plans of other threatened burrowing crayfish species through conducting extension surveys and threat assessments, and habitat management within agricultural areas.

Summary

The construction and operation of the SWISA **will not** have a significant residual impact on the central north burrowing crayfish.

[717] Department of Climate Change, Energy, the Environment and Water (2024m)
[718] Department of the Environment, Water, Heritage & the Arts (2008b)
[719] Doran (2000)

4.3.1.7 Green and gold frog (*Litoria raniformis*)

Context

Conservation status

The green and gold frog (*Litoria raniformis*) was listed as vulnerable under the EPBC Act in 2000[720], with conservation advice published in 2008[721]. Prior to the EPBC Act, it was listed as vulnerable under the Commonwealth *Endangered Species Protection Act 1992*[722].

The green and gold frog is also listed as vulnerable under the TSP Act as it meets the following listing criteria:

- A1 - there has been an observed reduction of the population in the form of a decline in area of occupancy of at least 20 % over the last ten years and a decline in the quality of habitat; and
- C1 & C2 - the population is estimated to number less than 10,000 mature individuals and is expected to continue to decline by at least 10 % within ten years, and no population is estimated to be larger than 1,000 mature individuals.

The green and gold frog is also listed as a priority species by the Australian Government Threatened Species Action Plan 2022-2032[723] which includes new objectives to prevent new extinctions and to protect and conserve 30 % of Australia's land and oceans. Priority actions listed for green and gold frog are:

- Maintain and restore sufficient water flow in the rivers to ensure regular flooding of billabongs and wetlands and to support breeding events;
- Remove exotic fish species from waterbodies inhabited by green and gold frogs;
- Eradication of introduced species (e.g., pigs) which degrade potential riparian habitat;
- Prevent overgrazing of potential terrestrial habitat and infilling of waterbodies;
- Maintain and restore emergent aquatic vegetation and ground cover around waterways where green and gold frogs are found; and
- Prevent spread of waterborne pathogens (e.g., chytrid fungus).

Ecology

The green and gold frog is a large frog (up to 80 mm long, weighing up to 40 g)[724]. The green and gold frog is active both during the day and the night during warmer months and is the only Tasmanian frog which can be seen basking out of water amongst vegetation or on rocks and logs[725]. Frogs typically stay close to the water line (>90 % of frogs recorded within 5 m of the water line), often amongst aquatic vegetation or in the adjacent terrestrial zone[726].

Green and gold frogs can move long distances (over 1 km in a single day[727]) however, research shows a behaviour trend of breeding site fidelity with individual frogs remaining at their original waterbody, and a maximum dispersal range of 430 m reported for an individual moving from a permanent pool to an ephemeral stream tributary[728]. Furthermore, a lack of inter-wetland movement by green and gold frogs has been observed within agricultural landscapes with frogs at waterbodies with heavy vegetation

[720] Commonwealth of Australia (2000)
[721] Department of Climate Change, Energy, the Environment & Water (2024n)
[722] Department of the Environment, Water, Heritage & the Arts (2008c)
[723] Department of Climate Change, Energy, the Environment, & Water (2022)
[724] Threatened Species Unit (2001)
[725] Threatened Species Unit (2001)
[726] Heard *et al.* (2010)
[727] Heard *et al.* (2004); Clemann & Gillespie (2012)
[728] Garvey (2024) – **Appendix N**

found to remain in-situ while frogs at vegetation poor dams quickly move into adjacent patches of remnant vegetation (dry sclerophyll woodland) post breeding[729].

If green and gold frog do migrate from drying sites to waterbodies with more favourable conditions, they usually move on rainy nights[730]. The species is most active during the breeding season[731] and will move across diverse habitats including wetlands, urban-fringes, industrial forestry, and agricultural spaces[732].

During dry and/or colder periods, the green and gold frog shelters under fallen timber, ground debris, and fringing vegetation[733]. They have a varied diet, which includes insects, lizards, fish, tadpoles, and other frogs (including smaller green and gold frogs)[734].

The green and gold frog breeds in spring and summer (between September and February) when males can be heard calling. The mating call is a very distinctive series of grunts and growls. Breeding occurs in permanent freshwater lagoons, ideally with complex and emergent vegetation. Females can breed in their first year and can lay an average of 3,300 eggs[735]. Egg clusters are laid on the water surface, or up to 50 cm below it, and rapidly sink. Tadpoles hatch after 2–4 days and are large, agile swimmers but often hide amongst vegetation at the margins of waterbodies. Metamorphosis of tadpoles generally takes around 3 months but may take up to 12 months in some circumstances[736]. Development can be delayed until the following spring where eggs have been laid late in the season[737].

Adults are known to live for four years; however, the green and gold frog has low adult survival rates. Older frogs tend to be larger, producing more offspring than smaller, younger frogs[738].

<u>Habitat</u>

Habitat loss and fragmentation are considered a key threat for the green and gold frog[739]. No critical habitat as defined under section 207A of the EPBC Act has been identified or included in the Register of Critical Habitat[740]. Due to their biphasic life history, green and gold frogs require both aquatic breeding and terrestrial foraging, shelter, and dispersal habitat.

Aquatic breeding habitat

Typically, green and gold frogs breed successfully in permanent freshwater bodies with emergent vegetation[741]. However, breeding success in ephemeral water bodies is possible during favourable seasons, provided the water body remains intact and does not dry out. They exhibit a preference for breeding in still water or slow-flowing habitats where water is shallow enough to contain submergent and marginal emergent aquatic vegetation for egg attachment and tadpole sanctuary, yet deep enough to avoid drying out if ephemeral. Adult frogs also require refuge opportunities under logs or rocks, and minimal predators for both adults and their eggs and tadpoles[742]. The species has been recorded in coastal swamps, marshes, dune swales, lagoons, lakes and other estuary wetlands as well as around

[729] Garvey (2024) – **Appendix N**
[730] Wassens *et al.* (2008); Heard & Scroggie (2009)
[731] Sanders (2021)
[732] Garvey (2024) – **Appendix N**
[733] Wassens *et al.* (2008)
[734] Cogger (2014)
[735] Department of Climate Change, Energy, the Environment & Water (2024n)
[736] Department of Climate Change, Energy, the Environment & Water (2024o)
[737] Garvey (2024) – **Appendix N**
[738] Department of Climate Change, Energy, the Environment & Water (2024n)
[739] Department of Climate Change, Energy, the Environment & Water (2024n)
[740] Department of Climate Change, Energy, the Environment & Water (2024n)
[741] Department of the Environment, Water, Heritage & the Arts (2009); Department of Environment, Land, Water & Planning (2017); Heard *et al.* (2010)
[742] Department of the Environment, Water, Heritage & the Arts (2009); Heard *et al.* (2008), (2010) & (2012); Wassens *et al.* (2010); Forest Practices Authority (2014d); Department of Environment, Land, Water & Planning (2017)

riverine floodplain wetlands, billabongs and ponds in slow flowing or ephemeral streams[743]. Constructed water bodies such as stormwater detention basins, farm dams, areas bunded by earthworks and by road or rail structures, drains, ditches and other excavated areas that can capture water (including quarries and brick pits) have also been used as breeding habitat[744]. Smaller or less obvious structures have also been observed in use, such as water tanks, bunded safety areas surrounding industrial chemical storage areas, wells, irrigation pits, water troughs, laundry tubs and old bathtubs[745].

Despite the common association of green and gold frogs with the presence of abundant riparian vegetation (native and non-native) and vegetative complexity along watercourses, green and gold frogs are also found in highly modified environments such as the SWISA Project Area. The following is an assessment of current guidelines and threat assessment to green and gold frogs in relation to highly modified environments (taken from Dr Tim Garvey [2024] and references therein[746]):

> Despite […] the prescription of emergent and aquatic vegetation for significant green and gold frog habitat in state and Commonwealth guidelines, green and gold frogs have been observed to occupy, and successfully reproduce at watercourses lacking riparian vegetation, and which have experienced significant disturbance (Garvey *et al.*, 2022; Garvey pers obv.). Within heavily modified agricultural landscapes green and gold frogs were found in equal abundance at farm dams with no riparian vegetation present as those with abundant vegetation (Garvey *et al.*, 2022).
>
> The importance placed on the presence of riparian vegetation for green and gold frogs (and similar pond-breeding amphibians) has resulted in skewed conservation policy and management actions which prioritise an idealised aquatic habitat, while ignoring the broad spectrum of conditions green and gold frogs are practically found to occupy and ignoring critical terrestrial (non-breeding) habitat. Where riparian vegetation is not sufficient, adjacent terrestrial habitat (remnant vegetation, woodlands) provides suitable space to fulfil the bi-phasic lifecycle of green and gold frogs (Garvey *et al.*, 2022), providing foraging areas and refuges to overwinter (Trenham and Shaffer, 2005; Harper, Rittenhouse and Semlitsch, 2008; Sawatzky, Martin and Fahrig, 2019).
>
> Within pastoral Australian landscapes the presence of isolated wetlands in the form of manmade farm dams, improve landscape connectivity for endemic green and gold frogs populations (Garvey *et al.*, 2022). Dams are a common landscape feature which frequently exhibit limited riparian vegetations and evidence of heavily disturbance from livestock and machinery intrusion. Farm dams with limited vegetation and evidence of significant frequent disturbance are not likely fulfill the criteria required for designation as significant green and gold frogs habitat, however they provide accessible aquatic habitat for local amphibian communities and increase wider wetland connectivity across the modified landscape. The presence of adjacent remnant vegetation patches in agricultural matrixes provides off-breeding season terrestrial habitat where farm-dams fail to provide sufficient riparian vegetation. The loss of farm dams in modified Australian systems increases inter-wetland and aquatic-terrestrial habitat distances, raising the likelihood of local green and gold frogs population declines.
>
> **Dr Tim Garvey - Appendix N**

[743] Department of State Growth (2015); Clemann & Gillespie (2012)
[744] Department of State Growth (2015); Clemann & Gillespie (2012)
[745] Department of State Growth (2015)
[746] Garvey (2024) – **Appendix N**

Terrestrial habitat

Green and gold frog preferred foraging habitat generally contains flowering plants and grasses while refuge habitats typically include areas where frogs can shelter from predators and climatic extremes. Remnant vegetation (such as woodlands) adjacent to breeding habitat is ideal, however refuge areas can include dumped materials (e.g. sheet iron, fibro, concrete and bricks) [747].

In agricultural settings, frogs at waterbodies with heavy vegetation have been found to remain in-situ throughout the breeding season, however frogs at vegetation poor dams quickly move into adjacent patches of remnant vegetation (dry sclerophyll woodland) post breeding event[748]. Green and gold frogs hibernate in the winter months in warm, moist areas such as the mud at the, under logs, rock, and debris, beneath thick vegetation, or bottom of ponds [749].

In addition to waterbodies used for breeding, and surrounding refuge and foraging habitats, land connecting waterbodies is important for dispersal of this species. Movement between waterbodies is important for maintaining populations[750]. This dispersal habitats include corridors of native vegetation, drainage lines, and pasture land, but also stormwater culverts, swales, periodically damp areas, easements, laneways, and open grassy areas[751].

<u>Population parameters</u>

Population number estimates of green and gold frogs in Tasmania are difficult to quantify due to fluctuating abundance year to year and unknow breeding sites[752]. Nevertheless, in 2001 population numbers were estimated at 5,000-10,000[753], with more recent data not available. Likewise, the extent of occurrence of this species is poorly understood, with estimates in 1999 suggesting that the extent of occurrence is ~45,000 km^2 [754], however this is likely to be less given the declining population trends.

According to the significant impact guidelines[755] for this species, any viable population is considered to be an important population. A viable population is one which is not isolated from other populations or water bodies, such that it can interact with nearby populations or can establish new populations when water bodies fill and become available.

[747] Department of State Growth (2015); Clemann & Gillespie (2012)
[748] Garvey (2024) – **Appendix N**
[749] Department of State Growth (2015); Clemann & Gillespie (2012)
[750] Department of the Environment, Water, Heritage & the Arts (2009)
[751] Garvey (2021); Department of the Environment, Water, Heritage & the Arts (2009)
[752] Threatened Species Unit (2001)
[753] Threatened Species Unit (2001)
[754] Mahony (1999)
[755] Department of Climate Change, Energy, the Environment & Water (2024n)

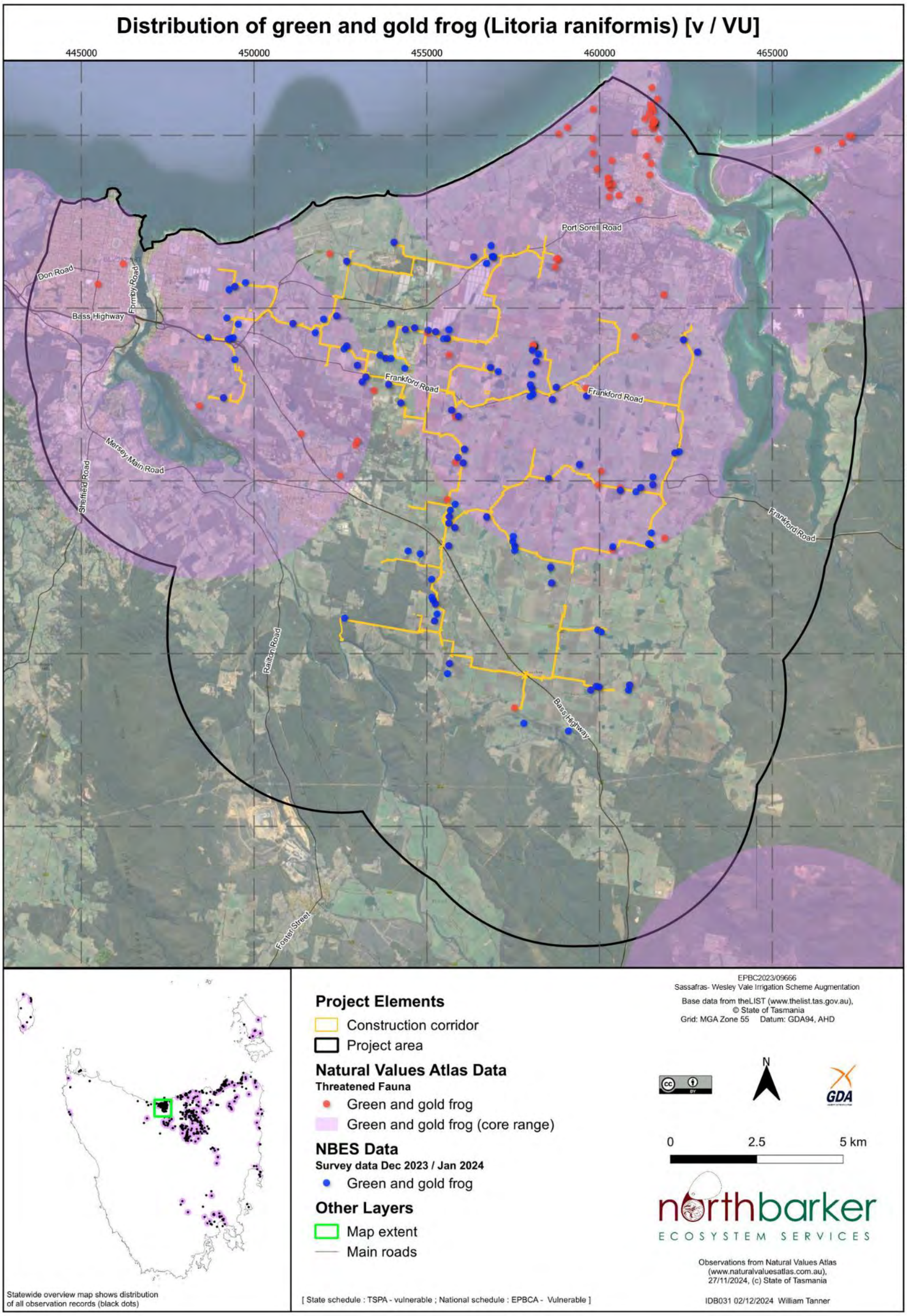

Figure 31: Distribution of the green and gold frog in relation to the Project Area

Distribution and site significance

The green and gold frog was once one of the most common frogs in many parts of southeastern Australia, however its range has declined markedly, and loss of populations has resulted in a fragmented, disjunct distribution[756]. In Tasmania, the species occurs in lowland areas in the south-east (where it is very rare) and north (where it is relatively common) (Figure 31). It has declined significantly (over 20 %) in range and abundance over the last 30 years, having mostly disappeared from the Midlands, Derwent Valley, much of the Hobart region, and parts of the north-west coast (although historical records are also less common in that region)[757]. This decline is primarily attributed to habitat loss and modification, a reduction in available aquatic habitat due to climate change, and the introduction of the chytrid fungus disease (*Batrachochytrium dendrobatidis*) - an infectious disease that affects amphibians worldwide, including Tasmania.

The green and gold frog is known from the Project Area, particularly the northern half, with 17records within 500 m of the Construction Corridor and a further 44 records within the Project Area[758]). As such the Project Area overlaps with areas of core range for this species (as defined on the Tasmanian Natural Values Atlas [informed by the FPA] as being all areas within 2 km of a known record from any time or place[759]) and the entire Project Area is within green and gold frog potential range within (Figure 31).

SWIS management actions

Potential impacts to this species were identified in the referral / preliminary documentation process for the SWIS project[760]. As such, the following management actions were required as conditions of approval of the SWIS as a controlled action:

- A CEMP to be completed and implemented until the completion of construction activities including measures to protect habitat for green and gold frogs;
- Farm WAPs developed for each property receiving irrigation water must include property-based ecological surveys including components relevant to known populations and potential habitat before allocation of irrigation water. Farm WAPs must include recommendations for enhancing and maintaining local populations on each property;
- Farm WAPs must include measures to protect habitat sites form physical disturbance, contaminated run off and erosion and sedimentation, and maintain and enhance habitat sites; and
- Targeted monitoring program for pest fishes species, and control and eradication strategies investigated if incursions into green and gold habitat sites are found.

Threats

The key threats detailed by the conservation advice for *Litoria raniformis*[761] include:

- Human disturbance resulting in direct mortality and stress / encroachment from human activities. Processes and activities related to human activity include:
    - o Habitat loss, degradation, and fragmentation. Most of the species' historic range has been subjected to land clearing for agriculture, urbanisation, and industrial development, as well as changed hydrological regimes, including draining of wetlands. The green and gold frog is a relatively mobile species that relies on habitat connectivity for the proper functioning of population networks;
    - o Altered hydrology, including modified flow regimes and groundwater extraction. Changes in hydrology have had a major impact on the green and gold frog, which is

[756] Clemann and Gillespie (2012).
[757] Threatened Species Section (2024m)
[758] Natural Values Atlas data – as at 11 of September 2024
[759] Forest Practices Authority (2022)
[760] Referral EPBC: 2010 / 5327; Tasmanian Irrigation Development Board (2010)
[761] Department of Climate Change, Energy, the Environment & Water (2024n)

dependent on clusters of semi-permanent / permanent waterbodies in the temperate south; and
  - Pollution. The green and gold frog is considered to be susceptible to pollutants from agriculture and urban development, as glyphosate herbicides, water pollution and increased sediment loads from run-off negatively impact frog mortality and egg and tadpole development.
- Exotic invasive species, problematic native species, pathogens and disease including:
  - Disease, in particular chytridiomycosis caused by the fungal pathogen *Batrachochytrium dendrobatidis* (chytrid fungus). Chytrid causes death of frogs, and rapid population decline to green and gold frogs has been reported in association with the spread of chytrid fungus;
  - Competition and predation by introduced invasive fish species. Several species of invasive fish are known to prey upon the eggs and tadpoles of the green and gold frog;
  - Habitat damage by livestock. Livestock can damage the edges of waterbodies used for breeding, reduce water quality in the margins, and remove or reduce vegetation used by the green and gold frog for shelter and/or connectivity corridors; and
  - Predation from foxes (*Vulpes vulpes*) & feral cats (*Felis catus*).
- Climate change and severe weather, increase in drought frequency/severity. The green and gold frog has a narrow window of opportunity for breeding and any stochastic event (such as drought) that prevents breeding for more than a year is likely to have a significant detrimental effect. Droughts that result in temporary or permanent loss of previously permanent waterbodies or annually inundated areas will result in decreased recruitment, hinder dispersal, and potentially lead to local extinction; and
- Increase in fire frequency/severity that cause biodiversity decline. Fires can adversely affect aquatic breeding habitat, increasing water temperature and altering water chemistry. Sediment/ash runoff "slugs" that can form in waterways following rainfall can result in reduced the availability of refugia for tadpoles and promote toxic algal that can deoxygenate the water and cause egg and tadpole death.

Chytrid infection

Chytrid fungus causes the disease known as chytridiomycosis or chytrid infection. The fungus infects the skin of frogs destroying its structure and function and can ultimately cause death. The Tasmanian Department of Primary Industries, Parks, Water, and Environment has conducted sampling of frog populations across key areas of Tasmania[762] and chytrid fungus has been positively confirmed within the Rubicon catchment at Hawley Beach; within the Project Area and within 5 km of the Construction Corridor[763]. Given the highly disturbed agricultural landscape within the Project Area and the interconnectivity of the water bodies, water ways, and drains (which provide habitat linkages and connectivity for frog movement within the landscape), it is assumed that chytrid fungus is present within the Project Area (see further discussion in **Section 4.4.2.2**).

The susceptibility of the green and gold frog is not straightforward, and it appears that longer durations of warmer temperatures are likely to reduce the severity of chytrid infection, making local extirpations less likely at lower altitudes[764]. Waterbodies that have relatively warm water temperatures, with the shallows free from tall shading vegetation, and slightly saline and/or alkaline conditions are also unfavourable to chytrid[765]. Furthermore, green and gold frogs have been regularly reported to bask

[762] Phillips *et al.* (2010)
[763] Department of Natural Resources & Environment (2024a)
[764] Garvey (2024) – **Appendix N**
[765] Department of Climate Change, Energy, the Environment & Water (2024n)

along shorelines during the spring and summer, and it is possible that this behaviour serves as an additional anti-fungal role for the species via raising their body-temperature[766].

Sites with characteristics that are unfavourable to chytrid are critical to persistence in temperate southern Australia[767].

Recovery Plan

According to the *National Recovery Plan for the Green and Gold Frog*[768], the long-term objective of recovery is to achieve a down-listing of the green and gold frog from vulnerable nationally to a lower threat category based on the IUCN 2001 Red List categories and criteria. This down-listing should be achieved within 10 years of the Plan's adoption.

Within the life span of this recovery plan, the specific objectives for recovery of the green and gold frog are to:

1. Secure extant populations of green and gold frogs, particularly those occurring in known breeding habitats, and improve their viability through increases in size and/or area of occurrence;
2. Determine distribution, biology and ecology of the green and gold frogs, and identify causes of the decline of the species across its geographic range;
3. Address known or predicted threatening processes, and implement appropriate management practices where possible to ensure that land use activities do not threaten the survival of the green and gold frog; and
4. Increase community awareness of and support for green and gold frog conservation.

Survey methods

During preliminary field surveys and desktop assessments, ~100 waterbodies and all farm dams were identified as potential green and gold frog breeding habitat.

Targeted green and gold frog surveys were undertaken in order to:

a) Record green and gold frog presence and ascertain distribution within the Project Area; and
b) Assess breeding habitat suitability of water bodies.

Green and gold frogs and habitat assessments were also recorded opportunistically during other natural values field surveys.

Green and gold frog presence

The 2023/24 targeted fauna surveys (Table 4) were carried out in accordance with:

- Survey guidelines in *Background paper to the EPBC Act Policy Statement 3.14 – Significant Impact Guidelines for the vulnerable growling grass frog (Litoria raniformis)*[769]
- *Guidelines for designing surveys for the vulnerable green and gold frog* (*Litoria raniformis*)[770]
- *Guidelines for Natural Values Surveys – Terrestrial Development Proposals*[771]

Prior to field surveys, potential green and gold frog breeding habitat (potentially suitable waterbodies) were grouped together into breeding habitat zones. A breeding habitat zone is comprised of waterbodies that are within 2 km of each other and joined by a water course, allowing for frog dispersal. A total of 43 breeding habitat zones were established. Priority was given to determining

[766] Garvey (2024) – **Appendix N**
[767] Department of Climate Change, Energy, the Environment & Water (2024n)
[768] Clemann and Gillespie (2012)
[769] Department of the Environment, Water, Heritage & the Arts (2008c)
[770] Department of Primary Industries, Parks, Water & Environment (Undated)
[771] Department of Primary Industries, Parks, Water & Environment (2019)

presence/absence of green and gold frogs within habitat zones, with a secondary focus on each individual water body.

Following survey guidelines set out by the above resources, targeted green and gold frog surveys included audio and visual surveys during the day and night and were conducted by both ground surveys and passive acoustic monitoring devices as outlined below. All surveys were undertaken during the green and gold frog breeding season, between the 4th of December 2023 and the 30th of January 2024.

Green and gold frog presence at a breeding habitat site was recorded if green and gold frogs were seen or heard during ground surveys or recorded by a passive acoustic monitoring device. Green and gold frog absence from a water body was only considered valid if confirmed by 3 daytime and 3 night time ground survey visits, or a minimum of 7 days song meter recording. Sites that were visited multiple times and no green and gold frogs detected but survey effort did not meet the above requirements were recorded as green and gold frogs 'not detected' rather than absent.

Ground Surveys

Survey sites (potential habitat) were visited up to six times, three daytime and three night time. If green and gold frogs were recorded at a site, the site was not revisited. Surveys were conducted for a minimum of 20 minutes and commenced with an unsolicited listening period at a distance from the waterbody so not to disturb any basking green and gold frogs. The listening period was then followed by a call-back period where a selection of vocal recordings of green and gold frogs were played over a speaker to elicit a response. If no green and gold frogs were heard, then visual surveys were undertaken around the edges of the waterbody scanning vegetation along the water margins and across the water surface out as far as possible. Where possible the entire circumference of the water body was surveyed. For larger water bodies, rivers and creeks, sections of the waterbody were surveyed to at least 50 m. Both night and day surveys followed this same technique.

During the survey period mean daytime temperature was 23 ºC and night time temperature was 14 ºC. Night time surveys were undertaken between 9.30 pm (~1 hour after sunset) and 1 am. Ground surveys were not undertaken during very wet or windy weather. A total of 20-person day/nights were spent undertaking ground surveys 102 farm dams.

Audio Surveys

Passive acoustic monitoring devices were strategically used during the targeted survey period. Devices were deployed preferentially to sites within breeding habitat zones that had no positive green and gold frog records during initial or consequent ground surveys. The aim, therefore, of using passive acoustic monitoring was to gain a robust negative survey result for breeding habitat zones where it appeared green and gold frogs may be absent.

Sites were initially ground surveyed as above and a habitat assessment was conducted concurrently.

Five Wildlife Acoustics Song Meter Micros were used to determine green and gold frog presence/absence at 22 waterbodies. Acoustic monitoring devices were deployed within close proximity to suitable habitats for a minimum of 7 days after which they were retrieved, data collected, reset, and redeployed to another site. Devices were set to record for 10 minutes every hour on the hour and ran for 24 hours a day.

The software Raven Pro 1.6 was used to visualise the passive acoustic monitoring datasets as spectrograms which were manually scanned for animal vocalisations. The manual annotations were completed by NBES Acoustic Ecologist, Harsha Nagaraj, using the following spectrogram parameters: Window size 1,500 samples, 0.115 s, overlap 50 %, fast Fourier transform size 2,048 samples, and a Hann window for a spectrum filter bandwidth of 12.5 Hz. Every 10-minute block of every hour was analysed manually to determine the acoustic presence of green and gold frogs. A green and gold frog was considered to be acoustically present if there were 2 or more calls present in the recordings.

Breeding habitat suitability

The current literature on green and gold frogs was reviewed and the following six core elements determined to be required for optimal breeding habitat for the green and gold frog [772]:

1) Permanent waterbodies with little to no risk of drying up;
2) Typically, >1.5 m deep to ensure permanence;
3) Still or slow-flowing water bodies;
4) Complex vegetation structure of at least >1 m^2 containing submergent plants such as *Myriophyllum* spp., *Ornduffia reniformis*, *Liparophyllum exaltatum* and *Potamogeton* spp. for eggs to attach to and tadpoles to hide under;
5) Vegetation around the margins of the waterbody for adults to shelter and bask, this often includes vegetation species such as *Typha* spp., *Eleocharis* spp., and *Juncus* spp.; and
6) No observed aquatic predators of both tadpoles and adult frogs.

An additional 15 habitat elements were identified as supporting suitable breeding and non-breeding habitat for green and gold frogs, these include:

1) Shallow edges with gradual slope into depth;
2) Emergent vegetation (>1 m^2);
3) Floating vegetation (>1 m^2);
4) Variation in aquatic vegetation;
5) Rocks or wood in or around the water's edge for hiding under or basking on;
6) Leaf litter; bare soil/ exposed mud when water level is low (40 % coverage);
7) Variation in marginal vegetation;
8) Shrubs and trees within 20 m of edge;
9) Lack of development in adjacent terrestrial zone (i.e. roads and buildings);
10) Water body size >0.3 ha (roughly 60 m sides);
11) Water body size >1.5 ha (roughly 125 m sides);
12) Connectivity to other wetlands <300 m;
13) Connectivity to other wetlands <2 km;
14) Vegetated/river link to wetlands;
15) Previous green and gold frog records within 1 km (not adding to score).

Each water body was scored against the 6 core breeding habitat elements and the 15 habitat elements as a presence (1) / absence (0) score. Presence of aquatic predators was considered as a factor that will diminish the likelihood of breeding success primarily due to predation risk even if all other core elements are present. It is important to note that quality breeding habitat for frogs is compromised by certain exotic predators such as fish and eels. Therefore, presence of aquatic predators was scored as -1, absence as 1, and undetermined presence as 0.

The core habitat score, and thus breeding habitat suitability, was based on the six core elements only with each water body receiving a core breeding habitat score between 1 and 6 for breeding suitability (Table 31). Optimal breeding habitats (high) were those with a score of 6, good (moderate) breeding habitats were those scored 5, and suboptimal habitats with low quality breeding habitat were scored 4 or less.

A low breeding habitat suitability score does not preclude green and gold frogs from occurring within a water body. The total score of 21 elements gives an indication of green and gold frog habitability.

It should also be noted that habitat scores represent a static point in time and vary with time and season.

[772] Department of the Environment, Water, Heritage & the Arts (2009); Heard *et al.* (2008), (2010) & (2012); Wassens *et al.* (2010); Forest Practices Authority (2014d); Department of Environment, Land, Water and Planning (2017)

Table 31: Habitat quality criteria for breeding green and gold frogs in the project area

High	Moderate	Low
Core Score 6 Optimal habitat comprising all six core habitat requirements greatly enhancing the probability of successful breeding. This type of habitat demonstrates a high potential for being utilised by the species for breeding, creating favourable conditions conducive to reproductive success.	**Core Score 5** Near-optimal habitat comprising the majority of the six core habitat requirements, though not meeting all criteria. This type of habitat may be deemed suitable for breeding in some years, suggesting varying levels of adequacy for reproductive activities.	**Core Score 4 and below** Suboptimal habitats lacking two or more of the six core habitat requirements or has presence of aquatic predators, which is likely to impede the green and gold frog's ability to attempt or successfully breed. While there is a possibility that this habitat may be utilized by the species, it is more likely to serve as a means for dispersal rather than optimal breeding conditions.

Landowner water use surveys

Landowners were surveyed to gain an understanding of current and future dam water use. These surveys were undertaken by TI[773]. This was a qualitative survey and sought to gain the following relevant water use information.

In order to understand how dam water use (input/output of scheme water to dams) may affect green and gold frogs, the following information was collected for dams and waterbodies that had confirmed green and gold frog presence in the 2023/2024 breeding season:

- Number of water draw down events 5 m or more below full level;
- How long (months) was this lower level held;
- If this is typical water use.

In order to understand how the provision of SWISA water may change dam water use and understand the potential future impact of dam use on green and gold frogs, the following information was collected on dams of 40 landowners/properties:

- How water in dams is currently used and for what purpose;
- Whether the provision of SWISA water will change the way dam water is used;
- If the way dam water is used will change, will changes result in more or less water being held in dams.

Survey findings

Where possible water bodies were surveyed for green and gold frog presence and breeding habitat suitability scored between the 4th of December 2023 and the 30th of January 2024. It was not possible to survey water bodies where landowner permission was not granted.

Green and gold frog distribution

Green and gold frogs were recorded at total of 63 sites during targeted breeding season surveys (Figure 32). These were predominantly audio records (from ground and song meter surveys) with only three sightings. Frogs were heard in abundance with 1 to many frogs calling in one time period. Green and gold frogs were not recorded at the same water body on every visit and they were most likely to be heard calling in the evening when weather conditions were cool and still. Green and gold frog absence was confirmed for 13 water bodies.

[773] Tasmanian Irrigation Landowner Water Use Survey Report (2024) – **Appendix O**

In addition to targeted survey results, green and gold frog sightings (Plate 54) were recorded incidentally at 3 additional locations (total 5 frogs) during natural values assessment surveys. These were all recorded in dispersal corridors associated with water bodies in which green and gold frogs were recorded in during breeding season targeted surveys.

The addition of 66 records green and gold frog to the known population represents a seven-fold increase in the number of green and gold frog records within 5 km of the Project Area. This corresponds to a recorded increase in this green and gold frog population's range, distribution, numbers estimate (Figure 32).

The grouping of water bodies that are within 2 km of each other and joined by a water course into breeding habitat zones allows for frog dispersal capabilities. Within a breeding habitat zone, it is reasonable to expect that frogs will be able to disperse and use other water bodies within the breeding habitat zone. Therefore, for a breeding habitat zone to be recorded as having no presence of green and gold frogs, there can be no positive records of green and gold frogs within that zone. In this way green and gold frog distribution can be determined within zones rather than specific sites.

Of the 43 breeding habitat zones defined, green and gold frogs were recorded in 36, and confirmed absent in 1 (Table 32). In the remaining 6 breeding habitat zones either green and gold frogs were not detected but not confirmed absent or were unable to be surveyed. Due to the paucity of green and gold frog records within the Project Area prior to this survey, the anticipation prior to these surveys was that green and gold frogs would be determined to be absent from many habitat zones and could be excluded from the project's impact assessment. This, however, was not the case with only one distinct breeding habitat zone near Warrawee Conservation Area (Figure 32) having a valid negative green and gold frog absence. Therefore, green and gold frogs are assumed to be present throughout the Project Area and any water body is potential breeding habitat for this species.

Table 32: Summary of results of targeted green and gold frog surveys within the SWISA Project Area. Full data set is in Appendix P

	Confirmed Green and Gold Frog Presence	Unconfirmed Result	Confirmed Green and Gold Frog Absent
Number of breeding habitat zones	36	7	1

Plate 54: Green and gold frog recorded at Tullamona Creek near Oppenheims Road

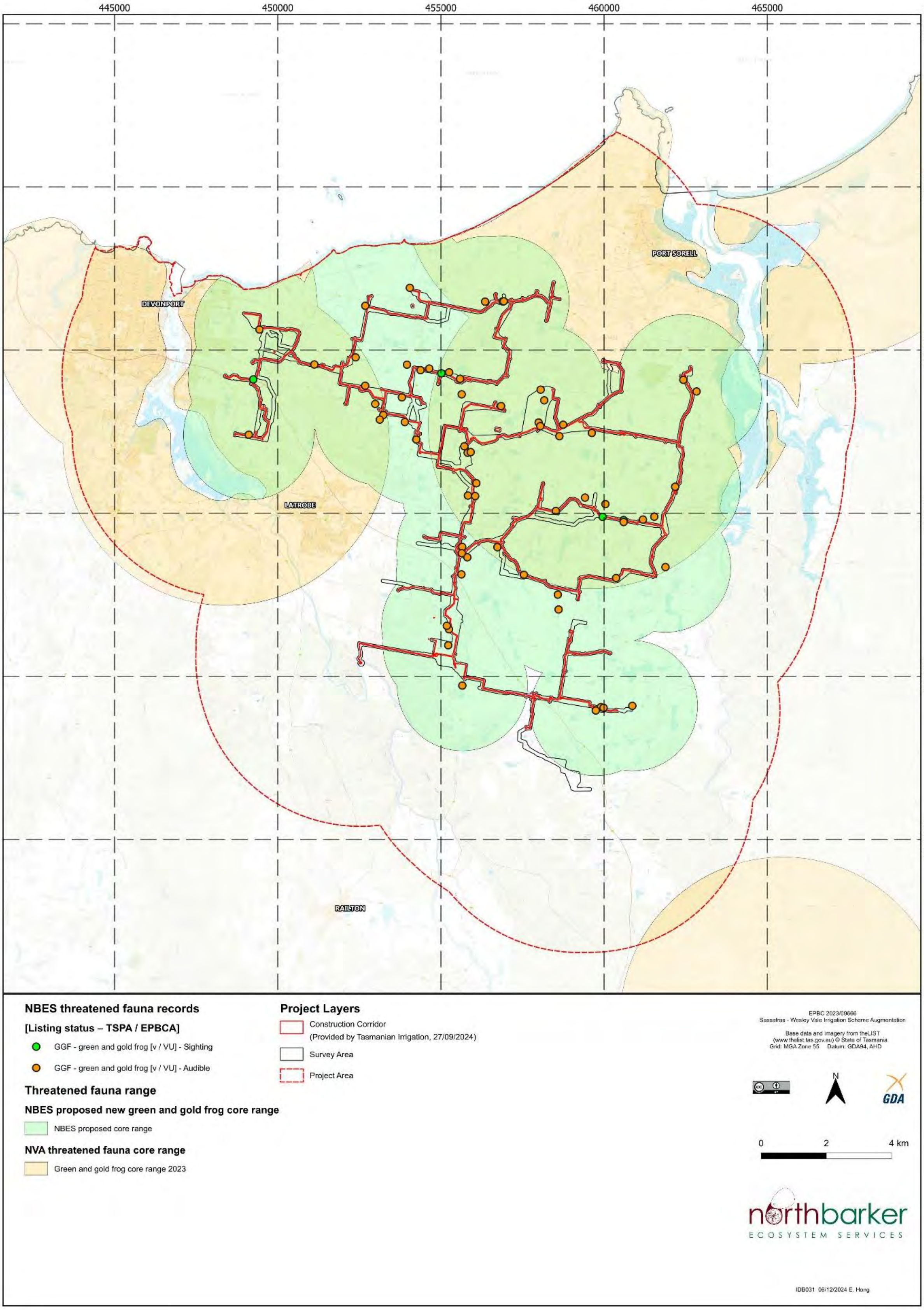

Figure 32: Green and gold frog records 2023/2024 breeding season and associated core range extension

Water body habitat values

Across the 102 water bodies scored for breeding habitat suitability, 25 habitats were considered optimal for breeding based on the scoring system (Table 33, Plate 55). A further 35 were considered near optimal (Plate 56) and the remaining 42 were considered suboptimal (Plate 57). The results from each waterbody can be found in **Appendix P**.

When combining the presence of green and gold frogs with the breeding habitat scores it is apparent green and gold frogs were recorded in waterbodies that were scored across the range of optimal-suboptimal (Table 33). This suggests that the breeding habitat core score matrix used here does not adequately represent the potential for green and gold frogs to use a given water body. The scoring matrix was determined based on published literature[774], however it may be that what criteria are generally considered essential for breeding habitat do not hold equal weight in the Project Area's modified environment. This supports the observation that green and gold frogs occupy and successfully reproduce at watercourses lacking riparian vegetation or have experienced significant disturbance, and that within heavily modified agricultural landscapes green and gold frogs can be found in equal abundance at farm dams with no riparian vegetation present as those with abundant vegetation[775]. Therefore, it can be concluded that within this agricultural environment it is the presence of water that is required for breeding opportunity, not the necessarily the presence of habitat diversity and other presumed core elements. Nevertheless, a higher core score is likely to result in improved breeding outcomes and healthy populations, and the presence of introduced fish predators remains likely to have a detrimental effect on green and gold frog populations, particularly in waterbodies that lack habitat diversity to provide shelter for eggs and tadpoles.

Table 33: Number of waterbodies within each of the breeding habitat categories and relationship with green and gold frog presence

	Optimal Breeding Habitat Core Score (6)	Moderate Breeding Habitat Core Score (5)	Suboptimal Optimal Breeding Habitat Core Score (<5)
Total number of dams	25	35	42
Number of dams with green and gold frogs recorded Present/Absent (% of waterbodies with green and gold frogs present)	17/3 (85.00 %)	20/5 (80.00 %)	23/5 (90.00 %)

The total habitat matrix score shows a similar lack of correlation with green and gold frog presence as core habitat score (**Appendix P**).

Within the agricultural environment, where farm dams are critical breeding habitat, water draw down in dams can cause a disconnect between fringing emergent vegetation and the water level. However, given the above observations and discussion on breeding habitat requirements, water draw down effect on habitat is not likely to impact green and gold frogs. Qualitative assessment of water use from farm dams that had confirmed presence or absence of green and gold frog shows no correlation between green and gold frog presence with decreased water draw down events (Figure 33, **Appendix P**).

[774] Department of the Environment, Water, Heritage, and the Arts (2009); Heard *et al.* (2008), (2010) & (2012); Wassens *et al.* (2010); Forest Practices Authority (2014d); Department of Environment, Land, Water and Planning (2017)
[775] Garvey (2024) – **Appendix N**

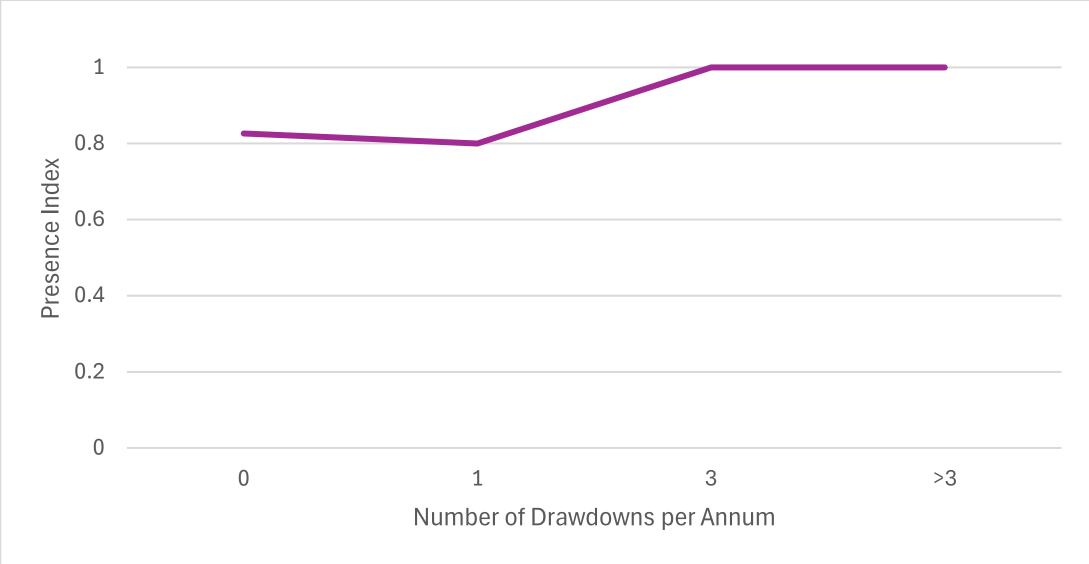

Figure 33: Correlation between the number of farm dam water drawdown events and the presence / absence of green and gold frog within a potential breeding site

Plate 55: Optimal green and gold frog habitat

Plate 56: Suboptimal green and gold frog habitat

Plate 57: Unsuitable green and gold frog habitat

Plate 58: Impact of dam draw down to green and gold frog habitat

Terrestrial habitat

Green and gold frogs require terrestrial habitat for foraging, shelter, and dispersal.

Green and gold frogs were recorded incidentally at 3 locations outside breeding habitat sites during general natural values surveys. However, these were all recorded within 20 m of breeding or dispersal habitat and during breeding season. It should be noted that no incidental records of green and gold frogs were recorded during subsequent ground surveys outside of the breeding season.

Critical dispersal habitat along drainage lines and water courses, and between water bodies less than 200 m apart has been mapped specially as dispersal habitat. A total of 47 areas covering 8.30 ha was mapped within the Survey Area (Table 34), though this is not an indication of the area of dispersal habitat at the landscape level. A total of 41 dispersal habitat areas covering 1.89 ha are within the final Construction Corridor footprint (Table 34).

A total of 153 breeding habitat areas have been mapped within 200 m of the Construction Corridor. When these areas are buffered, 134.10 ha of the Construction Corridor falls within this buffered area; however, in the highly modified environment through which the pipeline is aligned, only 2.50 ha of that area is native vegetation (98.82 % is modified agricultural land). This native vegetation is likely to constitute habitat used for shelter and foraging.

Table 34: Extent of green and gold frog dispersal habitat within the Survey Area

	Within Survey Area (Total)	Within Construction Corridor		Avoidance Total
		Before Mitigation	With Construction Mitigation	
Number of Dispersal Habitat Areas	47	41	**29**	38
Dispersal Habitat Area (ha)	8.30	1.89	**1.71**	6.59

Future water use changes with SWISA

The results of the landowner survey on current and future (SWISA) water use are presented in **Appendix O.** The likely change in how farm dams are used to store water is likely to be negligible or improved from a green and gold frog habitat perspective according to landowner surveys. Across the 40 landowners/properties surveyed, water use of 187 dams was considered (Table 35). Of these 187 dams, landowners reported the water use from half (94 dams) is unlikely to change with SWISA water. Landowners reported the water use from the remaining dams (93 dams) is likely to change with SWISA water provision; however, the change is likely to be a positive change in terms of green and gold frog breeding impact as all likely change in water use for these dams will be the result in more water held in dams with less water withdrawn over the summer (Table 35). The increase in water held in dams over summer will occur mostly due to the provision of additional water through SWISA facilitating direct irrigation which will preclude the need to store water in dams before removing for use.

Table 35: Likely water use change of farm dams with SWISA water (summarised from Appendix P)

	Total Number of Dams
No Change	94
More Water Stored	93
Less Water Stored	0
Total	**187**

Impact pathways

Construction

Potential impact pathways to green and gold frog relevant to the construction of the SWISA are:

- Direct impact to individuals resulting in mortality;
- Habitat loss, degradation, and fragmentation due to land clearing and changed hydrological regimes;
- Altered hydrology, including modified flow regimes and groundwater extraction;
- Water pollution and increased sediment loads from run-off; and
- Disease, in particular chytridiomycosis caused by the fungal pathogen *Batrachochytrium dendrobatidis*.

Operation

Potential impact pathways to green and gold frog relevant to the operation of the SWISA are:

- Altered hydrology of breeding habitat leading to disruption of breeding;
- Habitat loss, degradation, and fragmentation due to land clearing and changed hydrological regimes;
- Habitat damage by livestock, degradation of wetlands and water quality through stock damage;
- Water pollution and increased sediment loads from run-off;
- Application of agricultural chemicals, including fertilisers;
- Disease, in particular chytridiomycosis caused by the fungal pathogen *Batrachochytrium dendrobatidis*;
- Competition and predation by introduced invasive fish species;
- Drought.

Avoidance

Alignment of the Construction Corridor has been adjusted to minimise the impact of construction on green and gold frog habitat. No area of the Construction Corridor, nor any permanent infrastructure (property outlets, scour valves) will impact on aquatic breeding habitat areas.

Terrestrial dispersal habitat has been avoided where possible and practicable. Further reduction of impacts to green and gold frog dispersal habitat has been achieved by alteration of the specified construction methodology in areas of known burrowing crayfish locations. Instead of trenching and laying pipe, the pipeline alignment will be horizontally directionally drilled. This will effectively exclude ground-breaking works and machinery within these dispersal habitat areas. As a result of construction method mitigation in addition to Construction Corridor realignments, a total of 6.59 ha of the 8.30 ha of green and gold frog habitat mapped within the Survey Area has been avoided (Table 34).

Impacts

<u>Construction</u>

Direct Impacts

Individual frogs may be directly impacted during construction if they venture into the Construction Corridor during construction activities. Direct impact resulting in mortality can occur due to animal strike by machinery, vehicles, or people. Mortality may occur if frogs are trapped in pipeline trenches.

Although green and gold frogs can range kilometres between breeding habitat areas, studies have shown that they show a high breeding site fidelity with individual frogs remaining at their original water body and a maximum dispersal of 430 m reported for an individual moving from a permanent pool to an ephemeral stream tributary[776]. Furthermore, a lack of inter-wetland movement of green and gold frogs has been observed within agricultural landscapes with frogs at waterbodies with heavy vegetation found to remain in-situ throughout the monitoring period while frogs at vegetation poor dams quickly moving into adjacent patches of remnant vegetation (dry sclerophyll woodland) post breeding[777]. Frogs are highly mobile during breeding season but outside the breeding season and in colder periods, the green and gold frog take shelter under fallen timber, ground debris, and fringing vegetation[778]. Therefore, the greatest risk of encountering a green and gold frog is in areas immediately surrounding water bodies, particularly in remanent vegetation, and within dispersal habitat corridors connecting water bodies, during the breeding season.

With the implementation of mitigation processes and protocols during construction, direct impact losses of green and gold frogs will be negligible.

[776] Garvey (2024) – **Appendix N**
[777] Garvey (2024) – **Appendix N**
[778] Wassens *et al.* (2008)

Habitat modification

Breeding habitat

Construction of the SWISA will not impact any water bodies that constitute breeding habitat. Water bodies and fringing vegetation will not be disturbed. Any unanticipated impacts will be avoided with the implementation mitigation processes and protocols during construction.

Terrestrial habitat

The proposed Construction Corridor, which is the limit of the habitat impacts, contains 1.89 ha of dispersal habitat (i.e. dispersal corridors) across 41 sites (Table 34). Specific pipeline construction methods (horizontal directional drilling) will further reduce the habitat impact area to 1.71 ha of dispersal habitat across 29 sites.

It is likely that the construction impact to terrestrial habitat areas within the Construction Corridor can be further reduced by minimising the width of the corridor to the smallest possible width and on-ground micros siting of the pipeline within dispersal habitat.

The entirety of the impact area represents temporary habitat disturbance, with the extent of the Construction Corridor post-works once more becoming viable dispersal habitat for frogs. Temporary removal of ground cover and excavation of earth is will not permanently negatively impact the potential for frogs to utilise the disturbed area immediately post construction or when rehabilitated. This is evident within the Project Area where green and gold frogs have been recorded in disturbed areas such as crop paddocks adjacent to water ways.

The majority (98.82 %) of terrestrial habitat within the Construction Corridor is highly modified damp agricultural habitats and will rehabilitate quickly (within 6 months) back to its current status.

There are no permanent impact areas (balance tank, pump station) within 500 m of any green and gold frog dispersal or breeding habitat.

Water pollution and increased sediment loads from run-off

Construction earthworks for pipeline and scour valves around water bodies and water courses have the potential to increase water pollution and sediment loads. Measures must be put in place to manage this risk.

Chytrid infection

Chytrid fungus has been positively confirmed within the Rubicon catchment at Hawley Beach; within the Project Area and within 5 km of the Construction Corridor[779]. Given the highly disturbed agricultural landscape within the Project Area and the interconnectivity of the water bodies, water ways, and drains (which provide habitat linkages and connectivity for frog movement within the landscape), it is assumed that chytrid fungus is present within the Project Area.

The severity of chytrid infection is likely to be at lower altitudes such as at the Project Area[780]. In addition, the relatively shallow water of farm dams in open areas is likely to be warmer water in temperature, further tempering the severity of chytrid infection[781].

Given the assumption that chytrid is already present in the Project Area and the likely low impact of the fungus on frogs in this environment, construction of the SWISA will not impact green and gold frog populations through the spread of the chytrid fungus. Nevertheless, in accordance with the Threat Abatement Plan[782], the introduction of pathogens, pests and diseases by construction activities and

[779] Department of Natural Resources & Environment (2024a)
[780] Garvey (2024) – **Appendix N**
[781] Department of Climate Change, Energy, the Environment & Water (2024n)
[782] Department of the Environment and Energy (2016)

movement of vehicles into and within the Project Area will be mitigated by strict hygiene controls through the application of a weed and hygiene management plan (**Section 4.4.5.1**).

Operation

The Project Area exists within an already highly modified agricultural environment and the majority of SWISA irrigators are already using SWIS water. It is clear that green and gold frogs persist, and in 2023/2024 were abundant, within the SWIS irrigation district. Therefore, the greatest risk to the species is change in water and land use due to the provision of SWISA water. With an OEMP and Farm WAPs in place, no impacts to this species are anticipated due to the operation of the SWISA.

Altered hydrology and vegetation of breeding habitat leading to disruption of breeding

Green and gold frog presence and breeding habitat surveys support previous observations that in highly modified environments, green and gold frogs can be found in equal abundance at farm dams with no riparian vegetation present as those with abundant vegetation. In addition, no correlation between green and gold frog presence with decreased water draw down events was evident, with green and gold frogs occurring in dams across a range of water use frequency and volume (Figure 33). Therefore, it can be concluded that farming practices and dam water use under SWIS do not have a negative impact on green and gold frogs. It appears that within this modified agricultural environment it is the presence of water that is required for breeding opportunity.

Landowner surveys suggest that irrigator use of farm dams (green and gold frog breeding habitat) is unlikely to change with the SWISA. Moreover, surveys reported that if dam water use does change, it is likely to be a positive outcome for green and gold frogs during breeding season, as the change in water use across the dams in question is likely to result in more water being retained in dams over summer, with less draw down of water for farm use, and potential top up if evaporation occurs. This means an increase in water level stability.

Changes in dam water levels are not likely to prevent adult frogs from dispersing to refuge areas[783]; and given that landowner surveys indicated that dam water use is unlikely to change with the SWISA, and dams are likely to be at their lowest levels in late summer, which is after tadpoles have developed, the use of SWISA water is not likely to substantially impact on the dispersal of juveniles.

Therefore, the operation of the SWISA is unlikely to negatively impact on breeding events if water bodies in any condition remain available throughout the breeding season.

Habitat loss, degradation, and fragmentation due to land clearing and changed hydrological regimes

The presence of remnant vegetation patches adjacent to farm dams in agricultural matrices provides off-breeding season terrestrial habitat where farm-dams fail to provide sufficient riparian vegetation[784]. The loss of aquatic habitat elements and adjacent terrestrial habitat together will have a cumulative impact. Therefore, within the SWISA Project Area, where green and gold frogs were found in breeding habitat areas with a lower core habitat score, loss of adjacent vegetation, particularly native or structurally complex, has the potential to negatively impact the local green and gold frog population.

The risk of impacts to green and gold frogs through habitat clearance due to the provision of SWISA water will be managed through the provisions of an OEMP and the Farm WAP process in line with those undertaken for the SWIS. As such habitat modification will be mitigated to a negligible impact.

Habitat damage by livestock, degradation of wetlands and water quality through stock damage

Livestock can damage the edges of waterbodies used for breeding, reduce water quality in the margins, and remove or reduce vegetation used by the green and gold frog for shelter and / or connectivity corridors. However, periodic light grazing can be beneficial at sites where dense weeds or thick

[783] Garvey (2024) – **Appendix N**
[784] Garvey (2024) – **Appendix N**

vegetation is present. Light grazing can open such areas and improve habitat quality adjacent to waterbodies for foraging and dispersal[785]. Excluding livestock from farms dams and drainage lines will reduce the impact habitat and water quality, however, in this agricultural landscape, excluding livestock grazing in areas with permanent water and high nutrient load will encourage a high biomass production of herbaceous non-native weeds which in their own right could impact on green and gold frog habitat without control.

An OEMP and Farm WAP requirements will ensure impacts to this species by stock and associated weed threats are minimised.

Inappropriate application of pesticides and fertilisers, alteration to water quality, and poor waste management

In the agricultural setting where many green and gold frogs were recorded, the inappropriate application of pesticides and fertilisers to breeding habitat and adjacent terrestrial habitat through soil, water, or aerial drift is a high risk and likely to impact the local populations of the species. The magnitude of tolerance to chemical application by green and gold frogs is unknown. In addition, alteration to water quality due to poor waste management, chemical application, or erosion control is also likely to impact the green and gold frog, though tolerances are also unknown.

The provisions of an OEMP and Farm WAP requirements, with a water monitoring program included will ensure impacts to this species by alteration of water quality, inappropriate application of chemicals and fertilisers, and waste management are minimised.

Disease, in particular chytrid fungus

The assumed presence of chytrid within the Project Area, and the likely low impact of the fungus on frogs in this environment are discussed above in the construction impacts section. The operation of the SWISA within an already highly modified agricultural environment where the majority of SWSA irrigators are already using SWIS water will not further spread or exacerbate the impact of chytrid beyond that to which it already exists in the local environment.

Competition and predation by introduced invasive fish species

The introduction of invasive predatory species such as the mosquitofish (*Gambusia holbrooki*,), European carp (*Cyprinus carpio*), and the redfin perch (*Perca fluviatilis*) are likely to have a detrimental effect on local green and gold frog populations. The mosquitofish in particular are known to prey on green and gold frogs. However, the green and gold frog can co-exist with high densities of mosquitofish when complex aquatic vegetation is present, suggesting that vegetation provides protection for tadpoles and eggs[786]. Therefore, maintaining aquatic vegetation volume and complexity will alleviate the potential risk posed by incursion of pest fish into water bodies utilised by green and gold frogs.

Operation of the SWISA will not result in the introduction of pest fish, however monitoring will be undertaken to determine if they are present. A targeted monitoring program for pest fish species to detect incursion of pest fish, and control and eradication strategies if incursions into green and gold habitat sites are found, will ensure the potential impacts to green and gold frogs caused by the introduction of pest fish are minimised.

Climate change and increase drought frequency

Droughts that result in temporary or permanent loss of previously permanent waterbodies or annually inundated areas will result in decreased recruitment, hinder dispersal, and potentially lead to local extinction[787]. However, landowner surveys[788] reported that if dam water use changes with the SWISA, it

[785] Heard *et al.* (2008)
[786] Heard *et al.* (2004)
[787] Department of Climate Change, Energy, the Environment & Water (2024n)
[788] Garvey (2024) – **Appendix N**

is likely that dams will be kept at a higher water level than previously, and in some cases be topped up to keep levels high as natural evaporation occurs. Therefore, the provision of SWISA water will not only provide water surety to farmers but also to green and gold frog habitat and as such will be a positive outcome for green and gold frog survival and breeding success.

Mitigation measures

Construction

Green and gold frog direct impact and habitat management

Green and gold frogs are a mobile species and are likely to move into the Construction Corridor but may be unable to move out during construction without assistance. The greatest risk of encountering a green and gold frog is in areas immediately surrounding water bodies, particularly in remnant vegetation, and within dispersal habitat corridors connecting water bodies.

A Green and Gold Frog Habitat Management Protocol for the SWISA has been developed on this premise (**Appendix Q**). This protocol also applies to the relocation of additional native frog species protected under the Tasmanian *Nature Conservation (Wildlife) Regulations 2021*.

The Green and Gold Frog Direct Impact and Habitat Management Protocol must cover all habitat areas where the likelihood of encountering a green and gold frog is high. The protocol must apply to the following survey parameters:

Pre-construction

- Ensure that all relevant permits and approvals have been obtained (including permits to relocated species listed under Schedule 1, 5 or 8 of the Tasmanian *Nature Conservation (Wildlife) Regulations 2021*) prior to the commencement of works;
- All site workers (contractors) must be trained to be able to identify green and gold frogs and relevant habitat elements;
- Stop work measures and follow-up actions must be clearly communicated to all contractors in the event that an unanticipated occurrence of a green and gold frog is recorded during construction activities.

Protocol application area

- The protocol survey area is defined as the Construction Corridor, and a 20 m buffer of the Construction Corridor; and
- The protocol application area is defined as a 20 m buffer of all breeding and dispersal habitat that occurs within the protocol survey area.

Prior to ground-breaking activity

- The Construction Corridor must be clearly demarcated and narrowed to the minimum extent through any identified dispersal habitat or priority (high quality) terrestrial habitat. Exclusion zone fencing of these habitat types outside the Construction Corridor must be erected prior to any breaking of ground;
- A 5 m exclusion zone must be erected around:
    - All green and gold frog dispersal habitat and priority (high quality) terrestrial habitat within 20 m of the Construction Corridor; and
    - The above habitat types, even in areas where horizontal directional drilling rather than excavation will occur.
- Exclusion zones must be checked by a suitably qualified ecologist prior to ground-breaking activity;
- No more than two protocol application areas can be active at any given time; and
- Pre-clearance surveys to be undertaken as described below.

Pre-clearance survey

- Green and gold frogs have been confirmed within the Project Area therefore the purpose of pre-clearance surveys is to locate and remove any frogs that are potentially at risk of mortality through direct construction impact.
- Pre-clearance surveys for green and gold frogs must be undertaken within the protocol application area by a suitably qualified ecologist[789] immediately prior to (the day of) any construction activity being undertaken within 100 m of the protocol application area. Given that green and gold frogs can move long distances in a single day[790], and they exhibit high levels of site fidelity[791], individual frogs may require removal more than once in a single day. A suitably qualified ecologist must remain present at the construction area to manage the relocation of any frogs for the duration of works;
- Pre-clearance checks are not bound by seasonal constraints (i.e. breeding season) and are required throughout the duration of the year;
- Vehicle access within the protocol application area is prohibited until a pre-clearance check has been conducted;
- Any frogs must be relocated to a water body within the same habitat system, a minimum of 100 m from the survey area (unless suitable habitat is not available, in which case a habitat area can be selected at the discretion of the ecologist) following the animal handling procedure detailed below.
- In the event that frogs are present in a high density (i.e. more than 5 frogs within a protocol application area[792]), frog-proof fencing will be installed to prevent ingress of frogs into the construction area after relocation has taken place. Exclusion fencing must remain in place for the duration of the works in a given protocol application area. The design and parameters of the exclusion fencing will be developed in collaboration with a suitably qualified ecologist and will incorporate findings from published trials[793].

  Relevant guidelines, threat abatement plans, and recovery plans do not indicate a threshold where fencing is required; however, the *Significant Impact Guidelines for the Vulnerable Growling Grass Frog (Litoria raniformis)*[794] suggests that frog fencing is a suitable method to implement. The efficacy of this method has not been widely tested to date; however recent trials of amphibian fencing recommends fences are a minimum of 40 cm tall with a 10 cm overhang[795] to maximise success and to prevent frogs from entering a works area.
- In areas where exclusion fencing is required, a suitably qualified ecologist must be present during all construction activities within the applicable protocol application area to manage and relocate frogs as required.
- When handling frogs, a new set of well-rinsed single use, non-powdered vinyl gloves must be used for each animal.
- Frogs are to be transported in a single use clean and dry individual container (i.e., one frog per container). A new container must be used for each animal and no containers are to be reused.

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[789] Suitably qualified ecologist (for the purpose of preparing and implementing environmental management plans) means a consultancy or individual who has relevant professional qualifications, permits, and ethics approval, and at least 3 years of work experience writing and implementing management plans for the relevant protected matter; has implemented and reported on management plans for the habitat of the particular protected matter; can demonstrate the efficacy of those management plans, and in the event of ineffective measures, can demonstrate and implement corrective actions and solutions to achieve the desired outcomes; and can give authoritative assessment and advice on offset management to improve the habitat quality of the protected matter using relevant protocols, standards, methods and/or literature.

[790] Department of Climate Change, Energy, the Environment & Water (2024n)

[791] Heard & Scroggie (2009)

[792] This figure is based on observed densities during field surveys, understanding levels of practicality during construction, as well as the heightened risk of frogs re-entering the construction area after being relocated as green and gold frogs display high fidelity.

[793] Conan *et al.* (2023); Gould *et al.* (2024)

[794] Department of the Environment, Water, Heritage & the Arts (2009)

[795] Conan *et al.* (2023); Gould *et al.* (2024)

The transport container must be cleaned and dried with an amphibian friendly chemical between frogs.
- A register of searches must be kept up to date, as well as videos or photos of each capture and relocation, which will also need to be recorded on a register for permit submission. The register must include the species, time/date, location, relocation area, and any additional information collected at the time of capture.
- Dead amphibians or live animals showing clinical signs of chytrid disease must be collected using gloves and are to be preserved in a container with 70 % ethanol for later investigation and disease diagnosis. Injured or sick animals may need to be euthanised under stipulations of the permit to take and must be followed using NRE's *Best Practice Guidelines for Wildlife Rehabilitation*[796]. This can only be conducted under approval from the NRE Wildlife Services (Ph: (03) 6165 4305 or email wildlife.services@nre.tas.gov.au).

During construction

- Pre-clearance checks must be conducted daily as per the method above;
- No more than two protocol application areas can be active at any given time;
- A suitably qualified ecologist must be available at any time when construction is being undertaken, noting that multiple works areas may be active at a given time, to address any potential incidents and to implement relocation procedures in the event that a contractor identifies a green and gold frog in the vicinity of a works area.
- All personnel, equipment, materials, or machinery entering the works area must be cleaned in accordance with hygiene protocols to minimise the risk of introducing or spreading chytrid fungus (see **Section 4.4.5.1**);
- Vehicle traffic through habitat areas must be strictly controlled. Access to construction sites must be contained within the Construction Corridor, or on pre-existing roads and tracks. Vehicles must not be parked within the protocol application area unless required directly for construction;
- Vegetation removal must only occur to the extent necessary to complete construction;
- Watercourses must not be impeded (i.e. preventing flow of water) by construction activities;
- Replacement of soils must be from the same source location to prevent cross-contamination and spread of weeds and pathogens (i.e. no foreign material to be used to in fill trenches);
- Upon completion of works within a protocol application area, no vehicles are to re-enter the area without having a pre-clearance check completed.

Post-construction

- Rehabilitation of disturbed vegetation must commence within 30 days with the aim to replace or improve loss of habitat areas, particularly within mapped dispersal areas. This must adhere to revegetation requirements detailed in **Section 4.1.1**.

Reporting

- Any reporting requirements associated with relevant permits must be completed in a timely manner, or as specified the permit conditions.

Operation

Routine maintenance

The Green and Gold Frog Direct Impact and Habitat Management Protocol outlined above must also apply to ongoing maintenance of SWISA infrastructure through the lifetime of the scheme as detailed in Table 1.

[796] Department of Primary Industries, Parks, Water & Environment (2021b)

Application of SWISA water

The application of the SWISA water is anticipated to have negligible impacts to the green and gold frog.

The Project Area exists within an already highly modified agricultural environment and the majority of SWISA irrigators are existing customers using SWIS water. It is clear that green and gold frogs persist within the SWIS irrigation district.

The provision of Tasmanian Irrigation water does not allow for landowners to conduct unregulated land clearance. All land irrigated with Tasmanian Irrigation water within the SWISA are subject to rigorous assessment through the Farm WAP process and the provisions of an OEMP. The risk of direct impact to the green and gold frogs due to Tasmanian Irrigation water will be managed through the Farm WAP process, with measures in place to ensure that this species is adequately protected by applying exclusion areas and applying buffers from particular agricultural activities. Monitoring and auditing will allow for corrective actions to be established in the event that prescribed actions are not effective to the degree required.

At a minimum, a Farm WAP must:

- Be developed for each property that is purchasing SWISA water;
- Conduct a property-wide ecological survey (by a suitably qualified ecologist) for:
    - Breeding habitat, including assessment of condition and importance to green and gold frogs.
- Develop regulations and measures to protect all likely green and gold frog breeding habitat and adjacent terrestrial habitat from physical disturbance, weed invasion, contamination, alteration of hydrology, and erosion and sedimentation, including:
    - Retention of a minimum of two metres of standing water in the basin of the waterbody identified as containing habitat to allow green and gold frog adults and larvae to persist at the site until the end of the season;
    - Physical removal of floating aquatic and riparian vegetation must be prohibited.
    - Barrier protection from livestock grazing;
        - Barrier protection from livestock grazing or trampling will be best determined in breeding habitat areas on a case-by-case basis in order to manage detrimental effects of both stock impacts and weed biomass. Permanent exclusion of grazing in high nutrient, permanently damp environments is likely to lead to high weed biomass production more than in seasonally damp, lower nutrient areas. Seasonal grazing (during the dry season) will reduce biomass while excluding livestock impacts when the ground is wet.
    - Provide alternative water sources for livestock to prevent impact to dam vegetation and water quality;
    - Exclusion of heavy machinery use within 10 m of green and gold frog breeding habitat;
    - Minimisation of mechanical disturbance from vehicle intrusion onto the shoreline to reduce the potential for sedimentation of the waterbody;
    - No chemical spraying within 10 m of green and gold frog breeding habitat;
    - No fertiliser application within 10 m of green and gold frog breeding habitat; and
    - Stabilisation of waterways, drainage lines, and waterbody banks.

Monitoring

Monitoring of SWISA operations must be included in the provisions of the Farm WAP, with monitoring of the following must be included:

- Green and gold frog population and habitat monitoring undertaken at known green and gold frog sites for a minimum of 5 years, which includes:

  - Surface water quality of green and gold frog breeding and dispersal habitat, including nutrient load;
  - Targeted monitoring program for pest fish species, and control and eradication strategies investigated if incursions into green and gold habitat sites are found;
  - Monitoring of chytrid fungus.
- Corrective actions must be developed if monitoring indicates the desired outcomes are not being met.

If it is determined by the Farm WAP that impacts due to the operation of the SWISA on individual properties are likely to trigger the MNES *Significant Impact Criteria*[797], individual irrigators may need to refer their action independently.

Residual significant impacts

With the above context, survey results, avoidance, impacts, and mitigation, an assessment of the residual impacts as a result of the construction and operation of the SWISA against the significant impact criteria[798] is provided below.

1) Lead to a long-term decrease in the size of an important population.

According to the significant impact guidelines[799] for this species, any viable population is considered to be an important population. A viable population is one which is not isolated from other populations or water bodies, such that it can interact with nearby populations or can establish new populations when water bodies fill and become available.

Application of pre-clearance and during construction protocols to search for and relocate individual frogs will eliminate the likely direct impact of construction of the SWISA on the species. The construction of the SWISA will impact area to 1.71 ha of dispersal habitat within the Construction Corridor (Table 34); however, the entirety of this impact area represents temporary habitat disturbance, with the extent of the Construction Corridor post-works once more becoming viable dispersal habitat for frogs. Temporary removal of ground cover and excavation of earth is will not permanently negatively impact the potential for frogs to utilise the disturbed area immediately post-construction or when rehabilitated. No breeding habitat will be impacted during construction.

The greatest risk to this species due to the operation of the scheme is from the potential for change in habitat availability caused by changes in the way farm dams are used for water storage, and clearance and conversion of aquatic and terrestrial habitat.

Landowner surveys suggest that irrigator use of farm dams (green and gold frog breeding habitat) is unlikely to change with the SWISA (Table 35, **Appendix O**). Moreover, surveys reported that if dam water use does change, it is likely to be a positive outcome for green and gold frogs during breeding season, as the change in water use across the dams in question is likely to result in more water being retained in dams over summer, with less draw down of water for farm use, and potential top up if evaporation occurs. This means an increase in water level stability. The operation of the SWISA will not impact on dispersal of frogs and tadpoles across the landscape as adult frogs are able to move freely between reduced water levels and refuge, and the period of lowest water level is likely to occur after tadpoles have developed[800].

Clearance and conversion of aquatic and terrestrial habitat and other potentially critically threatening operational processes will be managed through the Farm WAP process.

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[797] Commonwealth of Australia (2013a)
[798] Commonwealth of Australia (2013a)
[799] Department of Climate Change, Energy, the Environment & Water (2024n)
[800] Garvey (2024) – **Appendix N**

Thus, the proposed construction and operation of the SWISA **will not** lead to a long-term decrease in the population of the species.

2) Reduce the area of occupancy of an important population.

The extent of occurrence of this species is poorly understood, with estimates in 1999 suggesting that the extent of occurrence is ~45,000 km^2 [801], however this is likely to be less given the declining population trends.

The addition of green and gold frog records from targeted surveys for this project represents a seven-fold increase in the number of green and gold frog records within 5 km of the Project Area. This corresponds to a recorded increase in this green and gold frog population's range, distribution, numbers estimate (Figure 32). The Project Area exists within an already highly modified agricultural environment and the majority of SWISA irrigators are already using SWIS water. It is clear that green and gold frogs persist, and in 2023/2024 were abundant, within the SWIS irrigation district.

Construction impact to terrestrial habitat area (1.71 ha of dispersal habitat; Table 34) represents temporary habitat disturbance, with the extent of the Construction Corridor post-works once more becoming viable habitat for frogs. Temporary removal of ground cover and excavation of earth is will not permanently negatively impact the potential for frogs to utilise the disturbed area immediately post construction or when rehabilitated. No breeding habitat will be impacted during construction.

Clearance and conversion of aquatic and terrestrial habitat will be managed through the provisions of the OEMP, including the Farm WAP process, and thus will mitigate the risk of reduction in area of occupancy of green and gold frogs in the Project Area.

Landowner surveys suggest that irrigator use of farm dams (green and gold frog breeding habitat) is unlikely to change with the SWISA (Table 35, **Appendix O**). Moreover, surveys reported that if dam water use does change, it is likely to be a positive outcome for green and gold frogs during breeding season, as the change in water use across the dams in question is likely to result in more water being retained in dams over summer, with less draw down of water for farm use, and potential top up if evaporation occurs. This means an increase in water level stability and green and gold frog breeding habitat permanency.

Thus, the proposed construction and operation of the SWISA **will not** further reduce the area of occupancy of the green and gold frog but may facilitate the expansion of the species by providing greater breeding habitat surety.

3) Fragment an existing important population into two or more populations.

Within the highly modified agricultural landscape of the Project Area, farm dams are a frequent feature. Farm dams in this landscape are critical breeding habitat for green and gold frogs despite frequently exhibiting limited riparian vegetation and evidence of disturbance. Farm dams with limited vegetation and evidence of significant frequent disturbance are not likely fulfill the criteria required for designation as significant green and gold frog habitat, however they provide accessible aquatic habitat for local amphibian communities and increase wider wetland connectivity across the modified landscape[802]. The presence of adjacent remnant vegetation patches in agricultural matrixes provides off-breeding season terrestrial habitat where farm-dams fail to provide sufficient riparian vegetation.

Operation of the SWISA will not impact on the availably of farm dams as breeding habitat as irrigator use of farm dams is unlikely to change with the SWISA (**Appendix O**). Vegetation clearance and other operational impacts that may cause the loss of breeding habitat or dispersal habitat critical to main connectivity between sub populations will be managed through the OEMP and Farm WAP process.

[801] Mahony (1999)

[802] Garvey (2024) – **Appendix N**

Construction impact to terrestrial habitat area (1.71 ha of dispersal habitat, Table 34) represents temporary habitat disturbance, with the extent of the Construction Corridor post-works once more becoming viable habitat for frogs. Temporary removal of ground cover and excavation of earth is will not permanently negatively impact the potential for frogs to utilise the disturbed area immediately post construction or when rehabilitated and will not result in fragmentation of an important population.

Thus, the proposed construction and operation of the SWISA **will not** fragment and existing important population into two or more populations.

4) Adversely affect habitat critical to the survival of a species.

No definition of habitat critical to the survival of the species is provided in the conservation advice or listing advice for the green and gold frog[803]. Due to their biphasic life history, green and gold frogs require both aquatic breeding and terrestrial foraging, shelter, and dispersal habitat. Breeding habitat requires water to be present for the duration of the breeding season though breeding success in ephemeral water bodies is possible during favourable seasons, provided the water body remains intact and does not dry out.

Where riparian vegetation does not to provide sufficient shelter for adult green and gold frogs, adjacent terrestrial habitat (remnant vegetation, woodlands) becomes critical, providing suitable habitat for foraging areas and refuges to overwinter[804].

Operation of the SWISA will not adversely affect breeding habitat as irrigator use of farm dams is unlikely to change with the SWISA (**Appendix O**). The operation of the SWISA is not likely to impact on dispersal of frogs and tadpoles across the landscape as adult frogs are able to move freely between reduced water levels and refuge, and the period of lowest water level is likely to occur after tadpoles have developed. Vegetation clearance and other operational impacts that may cause the loss of breeding habitat or terrestrial habitat critical to the biphasic life history of green and gold frogs will be managed through the OEMP and Farm WAP process.

Construction impact to terrestrial habitat area (1.71 ha of dispersal habitat; Table 34) represents temporary habitat disturbance, with the extent of the Construction Corridor post-works once more becoming viable habitat for frogs. Temporary removal of ground cover and excavation of earth is will not permanently negatively impact the potential for frogs to utilise the disturbed area immediately post construction or when rehabilitated.

Thus, the proposed construction and operation of the SWISA **will not** adversely affect habitat critical to the survival of the green and gold frog.

5) Disrupt the breeding cycle of an important population.

The green and gold frog breeds in spring and summer, between September and February. Breeding occurs in water bodies that remain intact and does not dry out over the breeding season presence of complex and emergent vegetation appears favourable but not essential to breeding success[805]. Females can breed in their first year and can lay an average of 3,300 eggs[806]. Tadpoles hatch after 2–4 days and metamorphosis of tadpoles generally takes around 3 months but may take up to 12 months in some circumstances[807]. Development can be delayed until the following spring where eggs have been laid late in the season[808].

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[803] Department of Climate Change, Energy, the Environment and Water (2024n); Threatened Species Scientific Committee (2001)
[804] Garvey (2024) – **Appendix N**
[805] Garvey (2024) – **Appendix N**
[806] Department of Climate Change, Energy, the Environment & Water (2024n)
[807] Department of Climate Change, Energy, the Environment & Water (2024o)
[808] Garvey (2024) – **Appendix N**

The construction of the SWISA will not directly impact on any areas of breeding habitat, and the application of the Green and Gold Frog Habitat Management Protocol will mitigate direct impact to breeding individuals.

Water draw down out of farm dams used to store SWISA water may result in result in a disruption of a breeding cycle, however no correlation between green and gold frog presence with decreased water draw down events was evident from results of breeding season surveys. Green and gold frogs occurred in dams across a range of water use frequency and volume. Therefore, it can be concluded that farming practices and dam water use under SWIS have not have a negative impact on green and gold frogs breeding activities. In addition, irrigator use of farm dams is unlikely to change with the SWISA (**Appendix O**), in which case disruption of breeding cycle due to the operation of SWISA will not occur.

Nevertheless, regulations and measures to protect green and gold frog breeding will be imposed through the OEMP and Farm WAP process including retention of a minimum of two metres of standing water in the basin of the waterbody to allow green and gold frog adults and tadpoles to persist at the site until the end of the season. In addition, green and gold frog population and habitat monitoring will be undertaken at known green and gold frog sites for a minimum of 5 years and corrective actions will be implemented if monitoring indicates desired outcomes and targets are not being met.

Therefore, there is **no risk** of significant impacts from the operation of the SWISA on disrupting the breeding cycle of this population of green and gold frogs.

6) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Construction impact to terrestrial habitat area (1.71 ha of dispersal habitat; Table 34) represents temporary habitat disturbance, with the extent of the Construction Corridor post-works once more becoming viable habitat for frogs. Temporary removal of ground cover and excavation of earth is will not permanently negatively impact the potential for frogs to utilise the disturbed area immediately post-construction or when rehabilitated. There are no permanent impact areas (balance tank, pump station) within 500 m of any green and gold frog dispersal or breeding habitat. No breeding habitat will be impacted during construction.

Landowner surveys suggest that irrigator use of farm dams (green and gold frog breeding habitat) is unlikely to change with the SWISA (Table 35; **Appendix O**). Moreover, surveys reported that if dam water use does change, the change in water use across the dams in question is likely to result in more water being retained in dams over summer, with less draw down of water for farm use, and potential top up if evaporation occurs. This means an increase in water level stability and increase in quality of habitat for breeding.

Vegetation clearance and other operational impacts that may cause the loss of modify, destroy, remove, isolate or decrease the availability or quality of habitat for green and gold frogs will be managed through the OEMP and Farm WAP process.

Thus, the proposed construction and operation of the SWISA **will not** modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

7) Result in invasive species that are harmful to the species becoming established in the species' habitat.

Competition and predation by introduced invasive fish species is listed as a key threat to the species[809].

[809] Department of Climate Change, Energy, the Environment & Water (2024n)

The introduction of invasive predatory species such as the mosquitofish, European carp, and the redfin perch are likely to have a detrimental effect on local green and gold frog populations. The mosquitofish in particular are known to prey on green and gold frogs[810].

Operation of the SWISA will not result in the introduction of pest fish, however monitoring will be undertaken to determine if they are present. A targeted monitoring program for pest fish species to detect incursion of pest fish, and control and eradication strategies if incursions into green and gold habitat sites are found, will ensure the potential impacts to green and gold frogs caused by the introduction of pest fish are minimised.

The application of a weed and hygiene management plan (**Section 4.4.5.1**) will aid in mitigating the loss and reduction of quality of breeding and terrestrial habitat through the introduction of weeds.

Thus, the proposed construction and operation of the SWISA **will not** result in an invasive species becoming established in the species' habitat.

8) Introduce disease that may cause the species to decline.

Chytrid fungus has been positively confirmed within the Rubicon catchment at Hawley Beach; within the Project Area and within 5 km of the Construction Corridor[811]. Given the highly disturbed agricultural landscape within the Project Area and the interconnectivity of the water bodies, water ways, and drains (which provide habitat linkages and connectivity for frog movement within the landscape), it is assumed that chytrid fungus is present within the Project Area.

It is likely that green and gold frogs are abundant within the Project Area despite the presence of chytrid due to the unfavourable nature of water bodies for the chytrid fungus. The severity of chytrid infection is likely to be at lower altitudes such as at the Project Area[812]. In addition, the relatively shallow water of farm dams in open areas is likely to be warmer water in temperature, further tempering the severity of chytrid infection[813].

Nevertheless, the introduction of pathogens, pests and diseases by construction activities and movement of vehicles into and within the Project Area will be controlled during construction with strict hygiene controls through the application of a weed and hygiene management plan (**Section 4.4.5.1**), and monitoring for chytrid and corrective actions implemented if monitoring indicates desired outcomes are not being achieved during the operation of the SWISA.

Thus, the proposed construction and operation of the SWISA **will not** introduce a disease that may cause the species to decline.

9) Interfere substantially with the recovery of the species.

The Specific Objectives of the National Recovery Plan[814] for the green and gold frog are to:

1. Secure extant populations of green and gold frogs, particularly those occurring in known breeding habitats, and improve their viability through increases in size and / or area of occurrence.
2. Determine distribution, biology and ecology of the green and gold frog, and identify causes of the decline of the species across its geographic range.
3. Address known or predicted threatening processes and implement appropriate management practices where possible to ensure that land use activities do not threaten the survival of the green and gold frog.
4. Increase community awareness of and support for green and gold frog conservation.

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[810] Heard et al. (2004)
[811] Department of Natural Resources & Environment (2024a)
[812] Garvey (2024) – **Appendix M**
[813] Department of Climate Change, Energy, the Environment & Water (2024n)
[814] Clemann & Gillespie (2012)

The green and gold frog is also listed as a priority species by the Threatened Species Action Plan 2022-2032[815] which includes new objectives to prevent new extinctions and to protect and conserve 30 % of Australia's land and oceans. Priority actions listed for green and gold frog are:

1. Maintain and restore sufficient water flow in the rivers to ensure regular flooding of billabongs and wetlands and to support breeding events;
2. Remove exotic fish species from waterbodies inhabited by green and gold frogs;
3. Eradication of introduced species (e.g., pigs) which degrade potential riparian habitat;
4. Prevent overgrazing of potential terrestrial habitat and infilling of waterbodies;
5. Maintain and restore emergent aquatic vegetation and ground cover around waterways where green and gold frogs are found; and
6. Prevent spread of waterborne pathogens (e.g., chytrid fungus).

The proposed construction and operation of the SWISA will not substantially interfere with any of these actions or objectives but will actively address a number of the actions and objectives during operation of the scheme through the OEMP and Farm WAP processes. All priority actions for green and gold frog listed in the Threatened Species Action Plan 2022-2032[816], with the exception of eradication of introduced species, will be undertaken within the Project Area during the operation of the SWISA. Furthermore, the operation of the SWISA may provide opportunities to contribute to the species recovery through active engagement with landowners and SWISA irrigators. Therefore, the proposed construction and operation of the SWISA **will not** interfere with any other recovery actions for the green and gold frog.

Summary

The construction and operation of the SWISA **will not** have a significant residual impact on the green and gold frog.

[815] Department of Climate Change, Energy, the Environment, & Water (2022)
[816] Department of Climate Change, Energy, the Environment, & Water (2022)

4.3.1.8 Blue-winged parrot (*Neophema chrysostoma*)

Context

Conservation Status

Blue-winged parrots are not listed under the TSP Act, however, they have been listed under the EPBC Act as Marine since 2000 and were recently listed under the EPBC Act as Vulnerable, as of March 31st, 2023[817]. This listing is the result of a 30-50 % decline in the blue-winged parrot population in the last 11 years[818]. This species does not currently have an approved recovery plan; however, conservation and recovery actions are detailed in the approved conservation advice[819].

Ecology

Blue-winged parrots are a small, slender parrot growing up to 24 cm in length and weighing less than 50 g[820]. They have an olive-green head and upper body, grading to light green on the fore-neck. The upper tail is green-blue with yellow sides and underparts, and occasionally an orange belly. The species gets its name from the large blue patch on the wings[821].

Breeding occurs in the spring and summer months. Nests are made in tree hollows (in live or dead trees) preferably with a vertical opening; however, blue-winged parrots have also been known to use knot-holes in the upper side of horizontal branches[822]. A clutch of 4-6 eggs are laid on a bed of decaying wood[823]. The eggs are incubated by the female and leaves the nest to be fed by the male. Bost parents feed the nestlings. Breeding pairs are monogamous.

Habitat

In Tasmania, blue-winged parrots inhabit a range of habitats from coastal, sub-coastal and inland areas, through to semi-arid zones. They tend to favour grasslands and grassy woodlands and are often found near wetlands both near the coast and in semi-arid zones[824]. The species can also be seen in altered environments such as airfields, golf-courses and paddocks. Pairs or small parties of blue-winged parrots forage mainly near or on the ground for seeds of a wide range of native and introduced grasses, herbs and shrubs[825].

Habitat critical to the survival of the blue-winged parrot is defined as[826]:

- Foraging and staging habitats found from coastal, sub-coastal and inland areas, right through to semi-arid zones including grasslands, grassy woodlands and semi-arid chenopod shrubland with native and introduced grasses, herbs and shrubs.
- Wetlands both near the coast and in semi-arid zones used for foraging and staging.
- Eucalypt forests and woodlands within the breeding range in Tasmania, coastal southeastern South Australia and southern Victoria.
- Live and dead trees and stumps with suitable hollows within the breeding range.

Habitat critical to the survival should not be cleared, fragmented or degraded. Any known or likely habitat should be considered as habitat critical to the survival of the species. Additionally, areas that are not currently occupied by the species due to recent disturbance (e.g. fire, grazing or human activity),

817 Department of Climate Change, Energy, the Environment & Water (2024p)
818 Holdsworth *et al.* (2021)
819 Department of Climate Change, Energy, the Environment & Water (2023)
820 Department of Climate Change, Energy, the Environment & Water (2023)
821 Higgins (1999)
822 Koch *et al.* (2008); Department of Climate Change, Energy, the Environment & Water (2023)
823 Higgins (1999)
824 Higgins (1999); Holdsworth *et al.* (2021)
825 Higgins (1999)
826 Department of Climate Change, Energy, the Environment & Water (2023)

but should became suitable again in the future, should also be considered habitat critical to the survival of the species[827].

Population parameters

The blue-winged parrot population has been reported to have declined by 30–50 % in the last 11 years[818]. There are currently an estimated 10,000 (range 7,500–15,000) mature blue-winged parrots in the wild with a declining trend[818]. This species primarily breeds on mainland Australia in southern Victoria, south of the Great Dividing Range. Although, some birds do breed in the far southeast of South Australia and in Tasmania. Blue-winged parrots are partial migrants to Tasmania with some of the population migrating across Bass Strait in spring to breed[828].

According to the Action Plan for Australian Birds 2020[829], the estimated extent of occurrence is 170,000 km^2, and the area of occupancy is estimated to be 11,000 km^2, both ranges are estimated with a medium to high degree of reliability. The population is not severely fragmented, and not subject to extreme fluctuations in the extent of occurrence and area of occupancy, subpopulations or mature individuals[830].

The blue-winged parrot are assumed to form two breeding subpopulations, the Victorian and Tasmanian subpopulations. They are assumed to be separate but may mix[831]. As there is no formal definition of what constitutes an important population of this species, it is assumed that each subpopulation is an important population. It is thought that the Tasmanian subpopulation is the larger of the two, estimated to contain 6,000 birds[832].

Distribution and site significance

Blue-winged parrots primarily breed on mainland Australia south of the Great Dividing Range in southern Victoria, and sometimes in the far southeast of South Australia[833]. In Tasmania, breeding occurs in the States northwest, east and central region, although they can occur across the entire state. They require suitable hollows to breed in and inhabit a wide range of habitats, favouring grassland, grassy woodlands, wetland areas and eucalyptus forests and woodlands, much the same as the swift parrot.

A variable number of birds will migrate across Bass Strait in winter, making a non-stop flight to mainland Tasmania.

There are 63 NVA records of the blue-winged parrot within 5 km of the Project Area (Figure 34), 5 of which are within 500 m[834]. This species was also incidentally observed within the Project Area during the 2023/24 field surveys.

827 Department of Climate Change, Energy, the Environment & Water (2023)
828 Department of Climate Change, Energy, the Environment & Water (2023)
829 Holdsworth *et al.* (2021)
830 Holdsworth *et al.* (2021)
831 Holdsworth *et al.* (2021)
832 Holdsworth *et al.* (2021)
833 Department of Climate Change, Energy, the Environment & Water (2023)
834 Natural Values Atlas data – as at 11 of September 2024

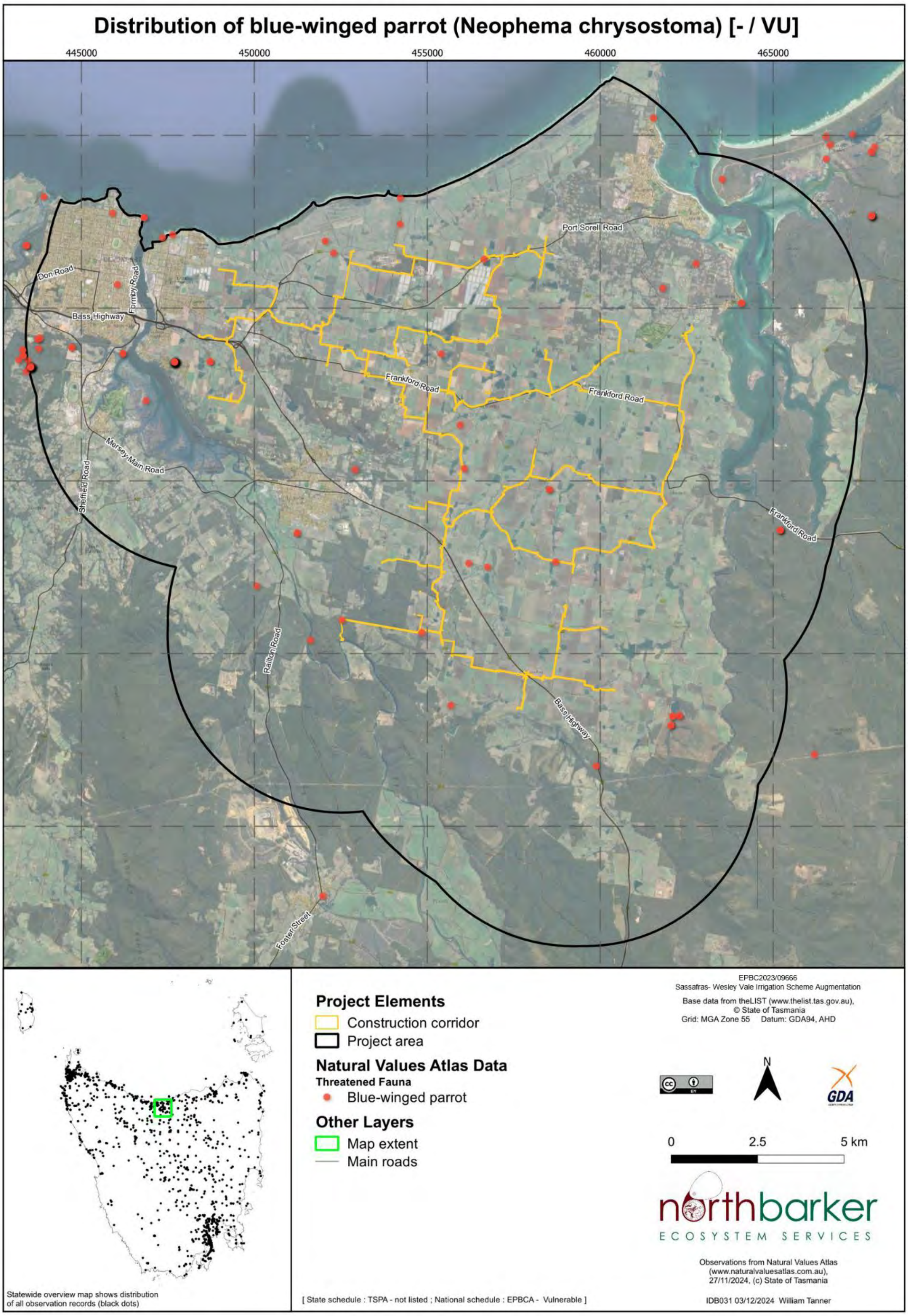

Figure 34: Distribution of the blue-winged parrot in relation to the Project Area

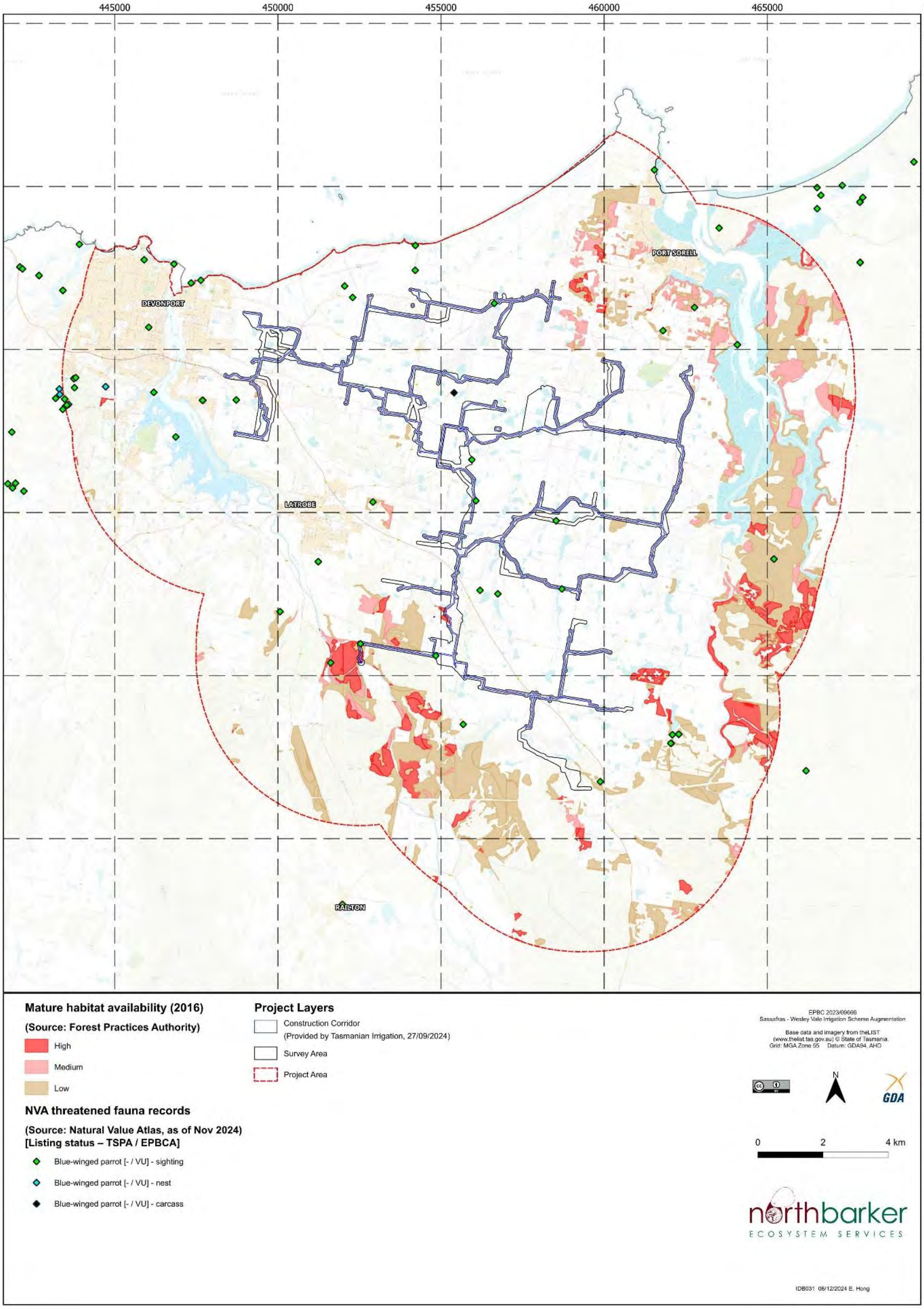

Figure 35: Mature habitat availability and blue-winged parrot records within the Project Area

Threats

Key threatening processes to the blue-winged parrot detailed in the approved conservation advice[835] includes:

- Habitat loss and alteration, largely due to over-clearing of native vegetation and the subsequent degradation of remnant vegetation[836], and degradation of foraging habitat due to domestic livestock grazing, which damages soil structure and can lead to a reduction in understorey habitat and can reduce foraging resources and shelter, which may lead to increases predation[837].
- Invasive weeds that may alter the floristic and structural characteristics of habitat, thus altering resource availability.
- Inappropriate fire regimes.
- Climate change may impact blue-winged parrots through changes in seasonality and geographic patterns of flowering and productivity, as well as other climate related impacts such as altered rainfall patterns, heatwaves, sea level rise (which may alter foraging and staging grounds in coastal saltmarshes) and wildfires.
- Predation by sugar gliders. Nest predation by the introduced sugar glider (*Petaurus breviceps*) may pose a threat to blue-winged parrots breeding in Tasmania as inferred by research on the threat posed to swift parrots[838].
- Predation by cats and foxes.
- Competition. Blue-winged parrots can experience competition for nesting habitat from native and non-native birds such as the noisy miner, rainbow lorikeet, and starlings, as well as from other native and introduced birds, bees, and arboreal mammals.
- Psittacine Beak and Feather Disease. The PBFD is a potentially deadly disease caused by a circovirus that affects parrots. This disease could have serious implication for the blue-winged parrot should the general health of birds decline from stress associated with competition for nesting and food resources. The PFBD is listed as a low threat to blue-winged parrots in the approved conservation advice[839] and in the Action Plan for Australian Birds 2020[840].

Survey methods

Potential habitat for blue-winged parrots was recorded concurrently with baseline flora and fauna surveys.

Potential hollow bearing trees (potential blue-winged parrot nesting habitat) as per published descriptions[841] were recorded during field surveys.

Native forest vegetation and native paddock trees were assessed as potential habitat as follows:

- In small areas of potential habitat, individual trees were recorded within the Survey Area;
- Larger areas of potential habitat were mapped as polygons.

Surveys targeting habitat use were not conducted for this project as areas of potential nesting habitat have been prioritised for avoidance, and mitigation measures are proposed to avoid impacts to any nesting parrots.

[835] Department of Climate Change, Energy, the Environment & Water (2023)
[836] Stevens (2001)
[837] Seddon *et al.* (2003); Olsen *et al.* (2005); Willson & Bignall (2009)
[838] Stojanovic *et al.* (2014)
[839] Department of Climate Change, Energy, the Environment & Water (2023)
[840] Holdsworth *et al.* (2021))
[841] Koch *et al.* (2008); Department of Climate Change, Energy, the Environment & Water (2023)

Survey findings

Large (>70 cm DBH) potential hollow bearing trees were recorded during field surveys, both within forest blocks and remnant vegetation patches, and paddocks in agricultural land. These trees provide potential nesting habitat for blue-winged parrots. A total of 6.87 ha of forest potentially supporting breeding habitat trees and 181 individual breeding habitat trees were recorded within the Survey Area (Table 36). These trees may also provide breeding habitat for the swift parrot, and a subset of these potential breeding habitat trees and areas may also support the Tasmanian masked owl. It should be noted that 0.23 ha of the area mapped as potential breeding habitat occurs within the Construction Corridor. Any individual potential nesting habitat trees within this area have been individually recorded in (Table 36).

Table 36: Extent of potential blue-winged parrot breeding habitat within the Survey Area

Habitat Type	Within Survey Area (exc. Construction Corridor)		Within Construction Corridor	Total	
	Extent of Polygon (ha)	Individual Trees	Individual Trees	Extent of Polygon (ha)	Individual Trees
Breeding Habitat	6.64	167	14	6.87	181
Total	**6.64**	**167**	**14**	**6.87**	**181**

For contextual purposes, further to the known trees and forested vegetation within the Survey Area and Construction Corridor, an estimation of the availability of trees (which may provide breeding habitat) within the broader area has been modelled[842] using the Forest Practices Authorities mature habitat layer[843]. The stratification of mature habitat is provided in Table 37 and the distribution of habitat classes from within the Project Area are displayed in Figure 35. According to the Forest Practices Authority field-verified assessment criteria[844], due to the mapped availability of mature habitat within the Project Area, it can be expected that at a maximum, there are a further 36,376 mature trees (>70 cm DBH) present in the local landscape. This estimate does not take into account the potential for paddock trees, or sporadic large trees within low maturity forest, so is a minimum estimate of available habitat trees (noting the scattered trees recorded within the project area do not even register as viable mature forest habitat in this modelling). Of these 36,376 trees, approximately 12,332 (at a minimum) would be expected to be greater than >70 cm DBH and thus in the optimal size range suitable for the habitat requirements for blue-winged parrot nesting[845] (Table 37).

Incidental observations of the blue-winged parrot were made at 6 locations either within the Survey Area, or in the immediate vicinity of the Survey Area. One of these observations was of a flock of approximately 60 birds near Chapel Road. Other observation locations include Native Plains Road, Saggers Hill, Devil Road, and near Wesley Vale Road. Observations were of perched and foraging birds only, with no observed hollow usage recorded.

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[842] Noting that this is modelling based upon numerous spatial GIS layers, with various limitations (which are outlined in the source documentation). The modelled habitat is not definitive and requires ground truthing, noting that not all modelled habitat necessarily represents nesting trees, rather that potential nesting habitat is likely present in varying levels of density more broadly throughout a modelled area of mature habitat.

[843] Forest Practices Authority (2016)

[844] Forest Practices Authority (2014c)

[845] Forest Practices Authority (2014c)

Table 37: Mature habitat availability within the local landscape

Potential Nesting Habitat Density Class		Field-based Assessment Criteria	Availability Within Project Area (ha)	Predicted Number of Trees Within Project Area
High	Dry Forest	At least 8 trees per hectare >100 cm DBH	617.33	4,939 >100 cm DBH
	Wet Forest	At least 15 trees per hectare >100 cm DBH or 8 trees per hectare >150 cm DBH	94.71	1,421 >100 cm DBH
	Other Forest	At least 8 trees per hectare >100 cm DBH	39.95	320 >100 cm DBH
		Total	**751.99**	**6,679 trees >100 cm DBH** **(notwithstanding that this could include trees >70 cm DBH)**
Medium	Dry Forest	At least 8 trees per hectare >70 cm DBH	618.10	4,945 >70 cm DBH
	Wet Forest	At least 8 trees per hectare >100 cm DBH	20.70	166 >100 cm DBH
	Other Forest	At least 8 trees per hectare >70 cm DBH	66.61	533 >70 cm DBH
		Total	**705.42**	**5,643 trees >70 cm DBH** **(notwithstanding that this could include trees >100 cm DBH)**
Low	Dry Forest	Trees >70 cm DBH are present, but less than 8 trees per hectare	2,687.77	21,502 >70 cm DBH
	Wet Forest	Trees >100 cm DBH are present, but less than 8 trees per hectare	98.71	790 >100 cm DBH
	Other Forest	Trees >70 cm DBH are present, but less than 8 trees per hectare	220.28	1,762 >70 cm DBH
		Total	**3,006.76**	**Up to 24,054 trees >70 cm DBH** **(notwithstanding that this could include trees >100 cm DBH)**
Negligible / Unsuitable	Dry Forest	No eucalypt trees >70 cm DBH	3,836.01	-
	Wet Forest	No eucalypt trees >100 cm DBH	697.42	
	Other Forest	No eucalypt trees >70 cm DBH	31,944.70	
		Total	**36,478.13**	**Minimum of 12,332 >70 cm DBH and up to 36,376 >70 cm DBH**
Total (High and Medium Class minimum estimate plus upper estimate for Low Class)			**40,942.30**	

Impact pathways

Potential impact pathways to blue-winged parrot relevant to the construction of the SWISA are:

- Habitat loss and alteration, largely due to over-clearing of native vegetation and the subsequent degradation of remnant vegetation[846], and degradation of foraging habitat due to domestic livestock grazing; and
- Invasive weeds that may alter the floristic and structural characteristics of habitat, thus altering resource availability.

Potential impact pathways to blue-winged parrot relevant to the operation of the SWISA are:

- Habitat loss and alteration, largely due to over-clearing of native vegetation and the subsequent degradation of remnant vegetation[847], and degradation of foraging habitat due to domestic livestock grazing.

Avoidance

The priority is to avoid the need for the removal of large trees with potential to support hollows. A total of 141 of the 181 recorded potential breeding habitat trees (with further scope for avoidance pending arboricultural assessments) and 6.64 ha of forest that may support breeding habitat have been avoided through design (Table 38).

Impacts

Construction

In terms of the scale of impact to habitat in the broader area, the loss of a maximum of 40 potential nesting trees within the Construction Corridor and TPZ incursions represents 0.32 % of the minimum 12,332 potential habitat trees estimated to occur within the Project Area, and 0.11 % of the maximum 36,376 potential habitat trees in the Project Area (Table 37).

The proposed construction is not likely to contribute to increasing threats such as encouraging the spread of sugar gliders or any other species that may provide competition for resources, and PFBD. The construction of the SWISA is unlikely to contribute significantly to the cumulative impacts to habitat in the region due to the limited scale of impacts, and the mitigation measures proposed to reduce potential impacts.

Table 38: Impacts and avoidance of potential blue-winged parrot habitat

Habitat Type	Total Area of Potential Habitat (ha)	Total Number of Potential Habitat Trees	Construction Corridor			Avoidance Area	
			Area of Potential Habitat (ha)	Number of Potential Habitat Trees	Number of Trees With TPZ Incursion >10 %	Area of Potential Habitat (ha)	Number of Potential Habitat Trees
Breeding	6.87	181	0.23	14	26	6.64	141
Total	**6.87**	**181**	**0.23**	**14**	**26**	**6.64**	**141**

[846] Stevens (2001)
[847] Stevens (2001)

Operation

The greatest risk to this species due to the operation of the scheme is from the potential for changes in land use, as well as clearance and conversion of potential breeding and foraging habitat areas to agricultural land. With an OEMP and Farm WAPs in place, no impacts to this species are anticipated due to the operation of the SWISA.

Mitigation measures

Construction

Designs have been modified to reduce potential impacts to habitat trees by realigning the pipeline to avoid potential hollow-bearing trees; however, not all were able to be avoided during this process due to pinch points in the required alignment and the distribution of the potential habitat trees. A total of 14 trees remain in the proposed Construction Corridor (Table 38) – there may be further scope to avoid some of these through strategic alignment and further narrowing of the Construction Corridor at key pinch points, however this cannot be guaranteed as the extent of avoidance available from such fine-scale measures is not known at this stage and is largely dependent on the on-ground conditions at the time of works.

Breeding habitat

A further 26 potential habitat trees have TPZ incursions >10 % (Table 38), as such require specialist arboricultural assessment to determine the impact to the root zones and viability of retention post-construction for trees that are outside of the direct impact footprint (in accordance with the Australian Standard Protection of Trees on Development Sites AS 4970-2009[848]). The following mitigation measures must be included within the CEMP:

- Trees that are determined as viable for retention must be marked as exclusions (including a tree protection zone buffer) on civil contracts and on the ground.

If there are potential habitat trees within the Construction Corridor that cannot be avoided (*i.e.* require removal or structural root damage that would risk treefall), to mitigate potential direct impacts to any blue-winged parrots, the following apply:

- The removal of any potential habitat trees must be completed outside of the breeding season (September to March).
- Tree removal must be conducted outside of the breeding season for this species[849] (October-February) to eliminate the risk of disrupting a breeding cycle of the species. This will align with the breeding seasons of the swift parrot and the Tasmanian masked owl.
- Tree removal must be conducted in accordance with a habitat tree management and impact mitigation protocol (**Appendix I**) that include pre-clearance checks of potential habitat trees, noting that other fauna protected under various legislation may utilise tree hollows.

Foraging habitat

The following habitat management measures must be included in the CEMP:

- Native vegetation habitat must be rehabilitated using propagules from the corresponding vegetation community to that which is impacted. Rehabilitation must commence within 30 days of the completion of works (i.e. a staged rehabilitation program throughout the construction phase) to allow for the fastest possible recovery and to minimise disruption to foraging habitat values. See **Section 4.1.1** for further information.

Operation

[848] Standards Australia (2009)
[849] Higgins (1999)

The provision of Tasmanian Irrigation water does not allow for landowners to conduct unregulated land clearance. All land irrigated with Tasmanian Irrigation water within the SWISA are subject to rigorous assessment through the Farm WAP process and the provisions of an OEMP. The risk of direct impact to Tasmanian masked owls and potential habitat clearance due to Tasmanian Irrigation water will be managed through the Farm WAP process, with measures in place to ensure that this species is adequately protected by applying exclusion areas and applying buffers from particular agricultural activities.

In order to mitigate the risk of impact to this species during operation of the scheme, the following actions as part of the SWISA for each SWISA irrigator property are required:

- Application of a Farm WAP for each property within the Operational Area.
- Property-wide survey for potential habitat for this species.
- Any potential nesting trees must be subject to a habitat tree management protocol (**Appendix I**) to ascertain whether it is utilised by blue-winged parrots and to detail the approved process for retention or removal as determined by its activity status.

The application of the SWISA water is anticipated to have negligible impacts to foraging habitat such that specific mitigation measures are not warranted for this aspect.

If it is determined by the Farm WAP that impacts due to the operation of the SWISA on individual properties are likely to trigger the MNES *Significant Impact Criteria*[850], individual irrigators may need to refer their action independently.

Residual significant impacts

With the above context, survey results, avoidance, impacts, and mitigation, an assessment of the residual impacts as a result of the construction and operation of the SWISA against the significant impact criteria[851] is provided below.

1) Lead to a long-term decrease in the size of an important population.

The blue-winged parrot are assumed to form two breeding subpopulations, the Victorian and Tasmanian subpopulations. They are assumed to be separate but may mix[852]. As there is no formal definition of what constitutes an important population of this species, it is assumed that each subpopulation is an important population. It is thought that the Tasmanian subpopulation is the larger of the two, estimated to contain 6,000 birds[853].

The proposed construction of the SWISA will directly impact 14 trees and up to 0.23 ha of forest that meet the definition of critical habitat. Indirect impacts due to root zone incursions may also affect up to an additional 26 potential nesting trees. Assuming a worst-case scenario, 40 potential habitat trees and 0.23 ha of potential nesting habitat will be lost due to the construction of the SWISA. In terms of the scale of impact to habitat available in the broader area, the loss of a maximum of 40 potential nesting trees within the Construction Corridor and trees with TPZ incursions represents 0.32 % of the minimum 12,332 potential habitat trees estimated to occur within the Project Area, and 0.11 % of the maximum 36,376 potential habitat trees estimated to occur in the Project Area (Table 37). Impact to 0.23 ha of mature forest that may support hollow bearing trees represents 0.02 % of the medium and high maturity forest within the Project Area.

The scale of these impacts is very minor in context of the broader area and will not prevent blue-winged parrots utilising the Project Area into the future, nor lead to a long-term decrease in the size of the Tasmanian subpopulation.

[850] Commonwealth of Australia (2013a)
[851] Commonwealth of Australia (2013a)
[852] Holdsworth *et al.* (2021)
[853] Holdsworth *et al.* (2021)

The greatest risk to this species due to the operation of the scheme is from the potential for changes in land use, as well as clearance and conversion of potential breeding and foraging habitat areas to agricultural land. If it is determined by the Farm WAP that impacts due to the operation of the SWISA on individual properties are likely to trigger the MNES *Significant Impact Criteria*[854], individual irrigators may need to refer their action independently. With Farm WAPs in place, no impacts to this species are anticipated due to the operation of the SWISA.

Thus, the proposed construction and operation of the SWISA **will not** lead to a long-term decrease in the population of the species.

2) Reduce the area of occupancy of an important population.

The blue-winged parrot are assumed to form two breeding subpopulations, the Victorian and Tasmanian subpopulations. They are assumed to be separate but may mix[855]. As there is no formal definition of what constitutes an important population of this species, it is assumed that each subpopulation is an important population. It is thought that the Tasmanian subpopulation is the larger of the two, estimated to contain 6,000 birds[856].

According to the Action Plan for Australian Birds 2020[857], area of occupancy is estimated to be 11,000 km^2 (which covers both subpopulations).

The proposed construction of the SWISA will directly impact 14 trees and up to 0.23 ha of forest that meet the definition of critical habitat. Indirect impacts due to root zone incursions may also affect up to an additional 26 potential nesting trees. Assuming a worst-case scenario, 40 potential habitat trees and 0.23 ha of potential nesting habitat will be lost due to the construction of the SWISA. In terms of the scale of impact to habitat available in the broader area, the loss of a maximum of 40 potential nesting trees within the Construction Corridor and trees with TPZ incursions represents 0.32 % of the minimum 12,332 potential habitat trees estimated to occur within the Project Area, and 0.11 % of the maximum 36,376 potential habitat trees estimated to occur in the Project Area (Table 37). Impact to 0.23 ha of mature forest that may support hollow bearing trees represents 0.02 % of the medium and high maturity forest within the Project Area.

The scale of these impacts is very minor in context of the broader area and **will not** reduce the area of occupancy in a meaningful way.

The greatest risk to this species due to the operation of the scheme is from the potential for changes in land use, as well as clearance and conversion of potential breeding and foraging habitat areas to agricultural land. The provisions of an OEMP and the Farm WAP process will include measures to mitigate against potential habitat clearance. With an OEMP and Farm WAPs in place, the operation of the scheme **will not** further reduce the area of occupancy of the blue-winged parrot.

3) Fragment an existing important population into two or more populations.

The blue-winged parrot are assumed to form two breeding subpopulations, the Victorian and Tasmanian subpopulations. They are assumed to be separate but may mix[858]. As there is no formal definition of what constitutes an important population of this species, it is assumed that each subpopulation is an important population. It is thought that the Tasmanian subpopulation is the larger of the two, estimated to contain 6,000 birds[859].

[854] Commonwealth of Australia (2013a)
[855] Holdsworth *et al.* (2021)
[856] Holdsworth *et al.* (2021)
[857] Holdsworth *et al.* (2021)
[858] Holdsworth *et al.* (2021)
[859] Holdsworth *et al.* (2021)

The proposed construction and operation of the SWISA will not prevent movement within the species' existing range, thus it **will not** fragment an existing population into two or more populations.

4) Adversely affect habitat critical to the survival of a species.

Habitat critical to the survival of the blue-winged parrot is defined as[860]:

- Foraging and staging habitats found from coastal, sub-coastal and inland areas, right through to semi-arid zones including grasslands, grassy woodlands and semi-arid chenopod shrubland with native and introduced grasses, herbs and shrubs.
- Wetlands both near the coast and in semi-arid zones used for foraging and staging.
- Eucalypt forests and woodlands within the breeding range in Tasmania, coastal southeastern South Australia and southern Victoria.
- Live and dead trees and stumps with suitable hollows within the breeding range.

The proposed construction of the SWISA will directly impact 14 trees and up to 0.23 ha of forest that meet the definition of critical habitat. Indirect impacts due to root zone incursions may also affect up to an additional 26 potential nesting trees. Assuming a worst-case scenario, 40 potential habitat trees and 0.23 ha of potential nesting habitat will be lost due to the construction of the SWISA. In terms of the scale of impact to habitat available in the broader area, the loss of a maximum of 40 potential nesting trees within the Construction Corridor and trees with TPZ incursions represents 0.32 % of the minimum 12,332 potential habitat trees estimated to occur within the Project Area, and 0.11 % of the maximum 36,376 potential habitat trees estimated to occur in the Project Area (Table 37). Impact to 0.23 ha of mature forest that may support hollow bearing trees represents 0.02 % of the medium and high maturity forest within the Project Area.

The scale of these impacts is very minor in context of the broader area and **will not** adversely impact the critical habitat within the Project Area to the degree that survival of the species is no longer viable.

The SWISA OEMP and Farm WAP biodiversity module contains measures to ensure critical habitat is preserved, thus there will be no adverse impacts to habitat critical to survival.

Thus, the proposed construction and operation of the SWISA **will not** adversely affect habitat critical to the survival of the blue-winged parrot.

5) Disrupt the breeding cycle of an important population.

The blue-winged parrot are assumed to form two breeding subpopulations, the Victorian and Tasmanian subpopulations. They are assumed to be separate but may mix[861]. As there is no formal definition of what constitutes an important population of this species, it is assumed that each subpopulation is an important population. It it thought that the Tasmanian subpopulation is the larger of the two, estimated to contain 6,000 birds[862].

All potential nesting habitat trees that require removal will be removed outside of the breeding season for this species[863] (October-February) for this species, thus the Construction of the SWISA **will not** interrupt the breeding cycle of the blue-winged parrot.

The greatest risk to this species due to the operation of the scheme is from the potential for changes in land use, as well as clearance and conversion of potential breeding habitat areas, including individual trees to agricultural land. The provisions of an OEMP and the Farm WAP process will include measures to mitigate against breeding habitat clearance. With Farm WAPs in place, no impacts to this species are

[860] Department of Climate Change, Energy, the Environment & Water (2023)
[861] Holdsworth *et al.* (2021)
[862] Holdsworth *et al.* (2021)
[863] Higgins (1999)

anticipated due to the operation of the SWISA. With an OEMP and Farm WAPs in place, the operation of the scheme **will not** disrupt the breeding cycle of the blue-winged parrot.

6) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

The proposed construction of the SWISA will directly impact 14 trees and up to 0.23 ha of forest that meet the definition of critical habitat. Indirect impacts due to root zone incursions may also affect up to an additional 23 potential nesting trees. Assuming a worst-case scenario, 40 potential habitat trees and 0.23 ha of potential nesting habitat will be lost due to the construction of the SWISA. In terms of the scale of impact to habitat available in the broader area, the loss of a maximum of 40 potential nesting trees within the Construction Corridor and trees with TPZ incursions represents 0.32 % of the minimum 12,332 potential habitat trees estimated to occur within the Project Area, and 0.11 % of the maximum 36,376 potential habitat trees estimated to occur in the Project Area (Table 37). Impact to 0.23 ha of mature forest that may support hollow bearing trees represents 0.02 % of the medium and high maturity forest within the Project Area.

The scale of these impacts is very minor in context of the broader area, and **will not** modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the blue-winged parrot is likely to decline.

During operation, the SWISA OEMP and Farm WAP biodiversity module contains measures to ensure habitat values are preserved, thus there will be no modification, destruction, removal, isolation, or decrease in the availability of habitat to the extent that impacts may lead to species decline.

Based on this assessment, the construction and operation of the SWISA **will not** modify, destroy, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline.

7) Result in invasive species that are harmful to the species becoming established in the species' habitat.

Predation by sugar gliders is listed as a key threat to the species [864]. The threat of sugar gliders is only applicable to breeding habitat for the blue-winged parrot, as the gliders raid nests to prey upon the occupants. Sugar gliders will eat parrot eggs, kill chicks and even adult birds[865]

Sugar gliders are widespread across mainland Tasmania and predation by sugar gliders has been recorded at all locations on mainland Tasmania where swift parrots breed. On the Tasmanian mainland the rate of predation has been found to increase with the extent of habitat disturbance from logging[866]. The nearest known NVA record for the sugar glider is 650 m to the west of the Devil Road alignment, near the Mersey River. There are 4 NVA records in total within the Project Area, however distribution is relatively uniform across the north coast, and is likely to be more widespread if survey effort were to be increased.

The proposed construction and operation of the SWISA will not result in sugar gliders becoming more prevalent in the broader area.

The application of a weed and hygiene management plan will aid in mitigating the loss and reduction of quality of potential foraging habitat through the introduction of weeds.

Thus, the proposed construction and operation of the SWISA **will not** result in an invasive species becoming established in the species' habitat.

[864] Department of Climate Change, Energy, the Environment & Water (2023); Holdsworth *et al.* (2021)
[865] Stojanovic *et al.* (2014); Holdsworth *et al.* (2021)
[866] Stojanovic *et al.* (2014)

8) Introduce disease that may cause the species to decline.

The PBFD is a potentially deadly disease caused by a circovirus that affects parrots. This disease could have serious implication for the swift parrot should the general health of birds decline from stress associated with competition for nesting and food resources[867]. The PFBD is listed as a low threat to blue-winged parrots in the approved conservation advice[868] and in the Action Plan for Australian Birds 2020[869].

The proposed construction and operation of the SWISA is **will not** trigger such a process such that the species will decline and there is no evidence to suggest the proposal will encourage the spread of PBFD or any other disease.

9) Interfere substantially with the recovery of the species.

No recovery plan has been developed for the species, though conservation recommendations have been outlined in the species conservation advice[870]. Key conservation and recovery actions relevant to the project include:

- Cease all land clearing of habitat critical for the survival of blue-winged parrot.
- Establish new habitat patches in areas where native vegetation cover is lacking.
- Promote ecological management of woodland remnants on private and public land.
- Protect and enhance feeding and breeding habitat, including preparation of management plans for key habitat across the winter range.
- Restore degraded grasslands and grassy woodlands habitat to support the recovery of blue-winged parrot. For example:
    - Undertake revegetation, using a diverse mix of locally appropriate native species, focussing on expanding and connecting existing remnants;
    - Target restoration works near suitable nesting habitat to encourage growth of feeding habitat.
- Raise public awareness of the importance of large old/mature trees (particularly isolated paddock trees and hollow-bearing trees, live and dead) and undertaking restoration and revegetation to replace cohorts of trees where they have been removed from the landscape, particularly in areas adjacent to and connecting woodland remnants.

Additional conservation and recovery actions are detailed in the conservation advice for this species[871]. The proposed construction and operation of the SWISA will not substantially interfere with any of these actions and may provide opportunities to contribute to the species recovery through active engagement with landowners and SWISA irrigators. Areas of potential habitat that are impacted due the construction of the SWISA will be revegetated post-construction and will remain as potential foraging habitat into the future.

The proposed construction and operation of the SWISA **will not** interfere with any other recovery actions for the blue-winged parrot.

Summary

With the recommended mitigation measures in place, our assessment is that the proposed construction and operation of the SWISA **will not** have significant residual impacts on the blue-winged parrot.

[867] Department of Climate Change, Energy, the Environment & Water (2023)
[868] Department of Climate Change, Energy, the Environment & Water (2023)
[869] Holdsworth *et al.* (2021))
[870] Department of Climate Change, Energy, the Environment & Water (2023)
[871] Department of Climate Change, Energy, the Environment & Water (2023)

4.3.1.9 Other listed fauna MNES

An additional 60 species are predicted to occur based on potential habitat availability[872] within the Project Area. These species are discussed in further detail in **Attachment C**. A breakdown of the fauna MNES with potential to occur is summarised in Table 39.

Table 39: Summary of additional fauna MNES predicted to occur in the Project Area[873]

Category	Number of Species
Mammals	2
Avifauna	35
Crustaceans	1
Fish & Sharks	3
Reptiles & Amphibians	1
Migratory Avifauna*	14
Migratory Marine**	4

*** Including terrestrial and wetland species. Excludes species previously listed in the avifauna category**

**** Excludes species listed in the mammal and fish/sharks category**

4.3.2 TSP Act listed and other significant fauna

This section details other threatened fauna species that are known to occur within 500 m of the Project Area[874] that have a moderate or higher likelihood of occurrence (excluding those which are also listed under the EPBC Act). Note that none of these species were recorded during field assessments for this project. An additional 5 species are known to occur within the Project Area[875]. Two of these species are aquatic mammals which have no chance of occurrence, one is an exclusively coastal mollusc, two are invertebrates with extremely restricted ranges, one is a migratory species, and the final is a wetland inhabiting species. None of these species are at risk of impacts from the SWISA project, and as such are not considered further in this report.

For species with a moderate likelihood of presence, specific habitat requirements, local context, and assessment of the likelihood of impact is given in the subsections below.

4.3.2.1 Grey goshawk (*Accipiter novaehollandiae*)

Conservation status

The grey goshawk is listed as endangered under the TSP Act. It is not listed under the EPBC Act.

Habitat

This species nests in mature wet forests, usually in the vicinity of watercourses[876]. Nests are typically located in large blackwood, eucalyptus, silver wattle, myrtle, or sassafras trees. Nests tend to be situated beneath the shady crown of the tree, built in a fork. One pair typically have multiple nests in a territory. Grey goshawks hunt from a perch in the canopy and require a relatively open structure understorey to

[872] Department of Climate Change, Energy, the Environment & Water (2024a)
[873] Excluding those species discussed in **Section 4.3.1**
[874] Department of Natural Resources & Environment (2024)
[875] Department of Natural Resources & Environment (2024)
[876] Bryant & Jackson (1999)

allow for flight beneath the tree canopy to capture animals. Grey goshawks will feed on small mammals such as ring-tail possums as well as small birds, reptiles, invertebrates, and introduced fauna, particularly rabbits.

Population parameters

Population data is scarce for this species. The only published population data estimate less than 110 breeding pairs[879], however this estimate is taken from a 1988 study[877]. Current estimates suggest a recovery of the population to approximately 200 breeding pairs, due at least in part to the strengthening of gun laws in the 1990's which saw a reduction in persecution[878].

Distribution and site significance

The grey goshawk is known to breed predominantly in wet forests in the southeast of Tasmania, and across the forests of the northeast and northwest. The north coast region contains numerous hotspots for this species, with swampy flats containing blackwoods identified as a key habitat[879].

The species has 9 observation records on the NVA attributed to within 500 m of the pipeline alignment[880] and a further 65 records attributed to within 5 km, the most recent being in 2023 [881].

Threats

The main listed threat to grey goshawks is habitat clearing and fragmentation. Other threats include shooting, power line collision, and secondary poisoning[882].

Although there has been clearance of high-quality breeding habitat for the species in the north of the state, such actions have increased occurrences of the introduced rabbit and blackbird, and Tasmanian native-hen which are substitutes for natural forest prey[883]. However, these benefits have likely been reduced by recent intensive clearing that has removed habitat remnants necessary for breeding[883].

Assessment of impact

Nesting habitat for this species is generally sparse throughout the Survey Area, with pockets of wet forest in the Great Bend area containing suitable habitat for this species. No nests were recorded during field surveys, nor are they likely to have been overlooked. The construction of the SWISA is not likely to contribute to a meaningful loss of viable nesting habitat.

The entire Project Area is viable foraging habitat; however, the proposed construction of the SWISA will not diminish the availability of foraging habitat in any meaningful way.

4.3.2.2 White-bellied sea eagle (*Haliaeetus leucogaster*)

Conservation status

The white-bellied sea-eagle is listed as vulnerable under the TSP Act. It is not listed under the EPBC Act.

Habitat

In Tasmania, most nest sites occur within 5 km of the coast or large estuaries; however, breeding pairs have been observed farther inland on large rivers, lakes and dams[884]. Nests are constructed in tall live

[877] Mooney & Holdsworth (1988)
[878] Mooney (2018)
[879] Bryant & Jackson (1999)
[880] Natural Values Atlas data – as at 11 of September 2024
[881] Natural Values Atlas data – as at 11 of September 2024
[882] Bryant & Jackson (1999)
[883] Mooney (2018)
[884] Threatened Species Section (2006); Threatened Species Section (2023)

or dead trees in mature forests or more rarely on sea cliffs and rock stacks where predators are absent. Birds will also nest in low coastal scrub where cliffs or tall trees are not available[885].

As for wedge-tailed eagles, the white-bellied sea-eagle breeding season spans from the beginning of July until the end of January[886], and is extended into February in seasons where breeding progress is later than normal, which is determined annually by the Forest Practices Authority around November. Birds hunt both over land and water; large estuaries and convoluted coastlines are the favoured sites for both nesting and foraging[887].

Population parameters

Previous population estimates for the white-bellied sea-eagle in Tasmania were approximately 840 individuals and 280 breeding birds[888]. Eagle nest records have doubled since this time however, suggesting that this is a significant underestimate of the current population size[889]. In Tasmania, white-bellied sea-eagles occur around the coast, and inland along larger rivers, lakes and dams. The species is commonly recorded on most of Tasmania's nearshore islands including on King, Flinders, Maria, and Bruny Islands and many Bass Strait islands[890].

Distribution and site significance

There are 6 records of the white-bellied sea-eagle within 500 m of the pipeline alignment, and an additional 251 records within the Project Area, the majority of which are incidental sightings. There are 9 confirmed white-bellied sea-eagle nests within the Project Area, as well as 6 unattributed eagle nests and 8 wedge-tailed eagle nests[891].

Threats

Threats listed on the DCCEEW Species Profile and Threats Database for the wedge-tailed eagle also apply to the white-bellied sea-eagle. These include the loss of nesting habitat and disturbance of nesting birds and, to a lesser degree, persecution by humans[892]. Also listed are non-target and secondary poisoning; collisions with vehicles, overhead wires (powerlines), fences, wind turbines, and electrocution.

Breeding success is thought to be declining due to the increased disturbance of nesting pairs; however, white-bellied sea-eagles are not thought to be as shy a nester as the wedge-tailed eagle and are often more tolerant of nearby disturbance.

Assessment of impact

With the mitigation measures described in **Section 4.3.1.5** for the Tasmanian wedge-tailed eagle applied, there will be no impact to white-bellied sea-eagle nests or disruption of breeding activities.

The entire Project Area is viable foraging habitat; however, the proposed construction of the SWISA will not diminish the availability of foraging habitat in any meaningful way.

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[885] Marchant & Higgins (1993)
[886] Forest Practices Authority (2023); Environment Protection Authority (2023)
[887] Threatened Species Section (2006)
[888] Department of Primary Industries, Parks, Water & Environment (2003a); Threatened Species Section (2023c)
[889] Threatened Species Section (2023c)
[890] Natural Values Atlas data – as at 11 of September 2024
[891] Natural Values Atlas data – as at 11 of September 2024
[892] Department of Climate Change, Energy, the Environment & Water (2024l)

4.4 INTRODUCED PLANTS, PESTS, AND PATHOGENS

4.4.1 Weeds

Any occurrence of weeds listed as 'declared' under the Tasmanian *Biosecurity Act 2019* was recorded when encountered, as was any occurrence of significant weeds listed as 'environmental' under by the NRE Invasive Species Branch[893]. Weeds are a common feature in the agricultural landscape and declared weeds must be treated as potentially present throughout the Survey Area for the purposes of management and mitigation.

Chilean needle grass (*Nassella neesiana*) is known to occur in an area on Frankford Road within the Survey Area. This area is managed as part of the Department of State Growth's Priority Weed Program. No Chilean needle grass was recorded at this site during the ground surveys as it was not possible to identify whether it was present. It was evident that there has been grassy weed control undertaken in the area recently (Plate 59). Nevertheless, appropriate weed hygiene is required for this species to prevent spread and/or re-establishment.

Twelve introduced flora species listed as 'declared' under the Tasmanian *Biosecurity Act 2019* were recorded within the Survey Area (for distribution of weeds, see maps in **Attachment D**).

Plate 59: Treated Chilean needle grass along the verge of Frankford Road

[893] Department of Natural Resources & Environment (2024b)

4.4.1.1 Declared weeds

Declared weeds and weeds of national significance (WoNS) recorded across the Survey Area are discussed in Table 40 with the relevant legislative status identified.

Table 40: Declared weeds recorded in the Survey Area

Species	Status Under the Tasmanian *Biosecurity Act 2019*	Weeds of National Significance	Comments
Carduus tenuiflorus winged thistle	Class B	No	This species was recorded from two locations, one a dense patch containing a large number of plants adjacent to the pipeline alignment within a paddock near Saggers Hill, and one along a fence line north of Winspears Road (Plate 60).
Cytisus scoparius English broom	Class B	**Yes**	English broom was recorded at one location at the interface between paddock and native bushland, adjacent to apple orchards on Native Plains Road (Plate 61). A number of other declared weeds occur at this location.
Erica lusitanica Spanish heath	Class B	No	A small number of Spanish heath (Plate 62) were recorded at several locations along roadsides and fence lines throughout the Survey Area. This species is widespread along roadsides in the broader region[894].
Foeniculum vulgare fennel	Class B	No	Fennel was recorded in occasional patches along Oppenheims Road, on the roadside and in agricultural land (Plate 63).
Genista monspessulana Montpellier broom	Class B	**Yes**	Montpellier broom was recorded around the proposed site of the Saggers Hill reservoir. No mature plants were observed; however, seedlings were abundant throughout the pasture grass beneath trees. Mature plants were also recorded adjacent to apple orchards on Native Plains Road (Plate 64).
Hypericum perforatum subsp. *veronense* perforated St Johns-wort	Class A	No	One patch (16 m^2) was recorded on Beer Street adjacent to a driveway.
Ilex aquifolium holly	Class A[895]	No	Holly was recorded at three locations within the survey area. The two main populations are on Knights Creek and the gully running into Knights Creek. At both these sites there are numerous mature trees and recruits (Plate 65). This area is no longer within the Construction Corridor and is not at risk of any construction disturbance.

[894] Natural Values Atlas data – as at 11 of September 2024

[895] In absence of a statutory management plan for this species, the precautionary approach is taken and is treated as a Class A weed under the Tasmanian *Biosecurity Act 2019*.

Species	Status Under the Tasmanian *Biosecurity Act 2019*	Weeds of National Significance	Comments
Lycium ferocissimum African boxthorn	Class B	**Yes**	African boxthorn was recorded at one location under native forest at the interface with agricultural land in the far west of the Survey Area.
Rubus fruticosus blackberry	Class B	**Yes**	Blackberry is widespread and abundant throughout agricultural lands of the Survey Area. This species is particularly prevalent along fence lines, agricultural drains, and wet areas, and under damp areas of remnant vegetation such as *Melaleuca ericifolia* swamp forest (Plate 66).
Salix X fragilis var. fragilis crack willow	Class B	**Yes**	Crack willow occurs as isolated infestations along creeks and rivers and occasional large individual trees on agricultural land near farm dams and drains. The main infestation is on the Mersey River opposite the Great Bend pump station (Plate 63, Plate 67), with smaller infestations on the Eastford, Pardoe, and Tullamona creeks.
Senecio jacobaea ragwort	Class B	No	Ragwort was recorded from a single location within farmland between Cornelius Road and Knights Creek. Scattered individuals occur in remnant vegetation and paddocks in this area.
Ulex europaeus gorse	Class A (Devonport) Class B (Latrobe)	**Yes**	Gorse occurs as localised infestations at a number of locations throughout the Survey Area. It was recorded predominantly within the margins of native forest patches at the interface with agricultural land (Plate 68).

4.4.1.2 Non-declared weeds

As well as declared weeds, several notable 'environmental' weeds occur throughout the Survey Area. These species are largely widespread agricultural weeds:

- *Cirsium vulgare* (spear thistle)
- *Crataegus monogyna* (hawthorn)
- *Rosa rubiginosa* (briar rose)
- *Typha latifolia* (cumbungi)
- *Vinca major* (blue periwinkle)
- *Watsonia meriana* var. *bulbillifera* (watsonia)

Plate 60: Winged thistle recorded near Winspears Road

Plate 61: English broom recorded near Native Plains Road

Plate 62: Spanish heath seedlings along a roadside

Plate 63: Fennel and small crack willow

Plate 64: Montpellier broom

Plate 65: Holly bushes within a forest remnant

Plate 66: Dense blackberry along a drainage line

Plate 67: Crack willow on the Mersey River

Plate 68: Gorse infestation on forest/agricultural interface

4.4.2 Pathogens

4.4.2.1 *Phytophthora cinnamomi*

Commonly referred to as dieback or root rot fungus, *Phytophthora cinnamomi* (PC) is a soil-borne fungus exotic to Tasmania. The fungus is pathogenic, requiring plant tissue as a food source. High degrees of susceptibility to PC are known to occur within members of the Epacridaceae and Proteaceae[896]. When infected, susceptible species display a characteristic progression of morphological traits, beginning with leaf yellowing, progressing to substantive dieback (browning), and ending in death. Other potentially fatal processes, such as drought, can cause similar visual symptoms to PC, but the impact of drought at a given location tends to vary less within and between species. Thus, a mosaic of symptomatic and healthy plants can be a good indicator of the presence of PC, in particular if symptoms are concentrated in susceptible species and in moist locations.

The project area is within the altitudinal and rainfall range for PC and there are five previous records of PC within 5 km of the Survey Area, last recorded in 2017[897], none of these records are within the irrigation district.

No signs of PC were observed during our field surveys; however, it may be presence in low abundance.

4.4.2.2 Chytrid fungus

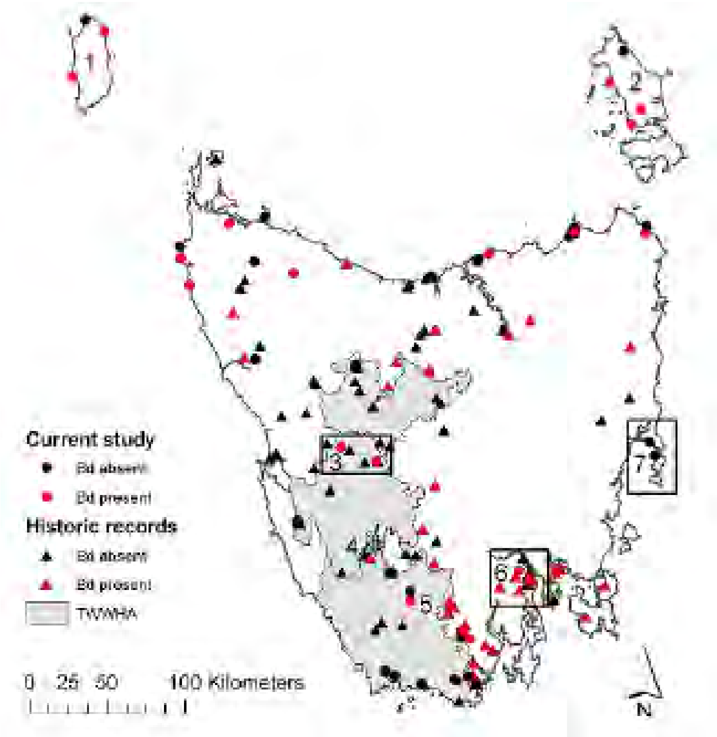
Chytrid fungus (*Batrachochytrium dendrobatidis*) causes the infectious disease, chytridiomycosis, which is affecting amphibians worldwide, including Tasmania. The spread of the pathogen is likely to be promoted by human activity and in Tasmania it has been associated with gravel roads near waterbodies.

[896] Podger & Brown (1990); Barker & Wardlaw (1995)
[897] Department of Natural Resources & Environment (2024a)

One record (from 2004) of chytrid fungus has been recorded near Hawley Beach, on the edge of the Project Area. Sporadic records of chytrid fungus are scattered across waterways throughout northern Tasmania[898] (Figure 36).

When 100 different predictive models were averaged, the environmental suitability of central north Tasmania for chytrid occurrence was found to be very high (effectively being part of the most suitable regions of Tasmania), with suitability showing a positive relationship with precipitation, moderated negatively by temperature variability (Figure 37). Given that the modelling indicates the Project Area is highly suitable for the occurrence of chytrid, further targeted surveys for the pathogen were considered unnecessary for this proposal as it is likely already present throughout.

A conservative mitigation approach of managing for its *likely* presence in aquatic areas has been adopted instead, with this revolving around hygiene measures to prevent introduction (if absent) and/or limit the potential for spreading chytrid from one location to the next should it be present. The implementation of hygiene measures will be included in a weed and hygiene management plan (**Section 4.4.5.1**) and will apply to the entire Project Area. While general hygiene measures will be adopted throughout the scheme area, targeted washdown procedures with respect to chytrid fungus need only apply in instances where works intersect with an area suitable for its occurrence and expression (i.e. waterways and dams).

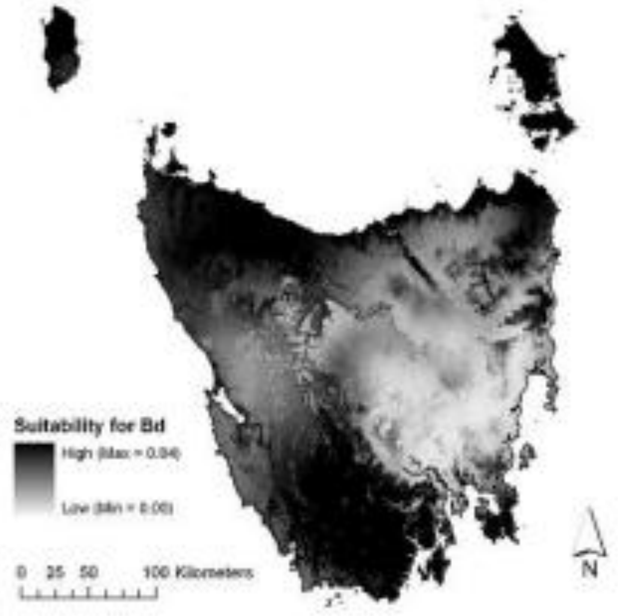


Source: Philips *et al.* (2010) (Noting historic records within the study were collated from additional sources referenced within)

Numbers on figures are referred to in the source text; 1= King Island, 2=Flinders Island, 3=Lyell Highway, 4=Strathgordon, 5= Scotts Peak Dam Road, 6= Hobart region, 7= Freycinet Peninsula. TWWHA = Tasmanian Wilderness World Heritage Area

Figure 36: Distribution of *Batrachochytrium dendrobatidis* in Tasmania

[898] Natural Values Atlas data – as at 11 of September 2024



Source: Philips *et al.* (2010)

Figure 37: Average suitability (based on 100 models) for occurrence of *Batrachochytrium dendrobatidis* occurrence in Tasmania

4.4.2.3 Devil facial tumour disease

The occurrence of DFTD is documented throughout parts of Tasmania according to the most recent distribution maps[899] (Figure 15, Figure 16). The scope of the proposal will not conceivably cause further spread or virility of this disease within the Tasmanian devil population and was thus not targeted for testing and identification in the current assessment.

4.4.2.4 Toxoplasmosis

Toxoplasmosis gondii is a parasite that has been reported to be a significant cause of morbidity and mortality in marsupials. Impacts of toxoplasmosis on marsupials can include blindness, ataxia, incoordination, head tilt, and limb paralysis. Cats are a common host of this parasite, although it is thought that all endothermic vertebrates are capable of acting as hosts. It is likely that it is present throughout the irrigation district as feral cats are effectively ubiquitous in such environments; however, the proposed actions are unlikely to cause the further spread of the parasite nor vectors and thus it was not targeted with surveys in the current study.

4.4.3 Introduced fauna

4.4.3.1 Feral cats, dogs, and foxes

Feral and free-roaming cats are common within agricultural matrix landscapes across Tasmania. Predation by feral cats has been a causal factor in the extinction of at least 16 mammals in Australia[900] and can have further non-lethal impacts through competition and disease transmission. Birds also comprise a significant amount of the diet of feral cats in Australia[901]. Cats are a listed threat to 4 MNES species likely to occur within the Project Area (eastern barred bandicoot, eastern quoll, spotted-tail quoll, blue-winged parrot).

[899] Department of Natural Resources & Environment (2018); Kozakiewicz *et al.* (2021)
[900] Woolley *et al.* (2019)
[901] Woinarski *et al.* (2017)

Camera surveys detected feral or free roaming cats on 106 occasions over 2462 trap nights (0.044 per trap night) (Table 41). Image review identified at least 37 individuals across 39 cameras, with cats detected at 54% of the survey locations. This indicates that cats are common and abundant throughout the Project Area. Cameras captured evidence of predation by feral cats on four occasions, including the capture of an unidentified bird and a southern brown bandicoot carcass.

Table 41: Summary of observations of feral and free roaming cats from secondary remote camera survey

Vegetation Group	Number of Cameras	Trap Nights	Locations Detected	Total Nights Observed	Total Observations	Mean Observations Per Trap Night	Mean No. Individuals Per Site
Dry eucalypt forest and woodland	19	1280	11	57	71	0.059	1.05
Modified land	10	463	5	10	13	0.028	0.7
Non eucalypt forest and woodland	2	135	2	8	10	0.074	2.5
Other natural environments	1	74	1	7	8	0.108	2
Scrub, heathland and coastal complexes	2	109	0	0	0	0.000	0
Wet eucalypt forest and woodland	5	401	2	4	4	0.010	0.6

Predation from foxes, and wild and domestic dogs affects quoll populations where species coexist. There are no known current occurrences of foxes or wild dogs in the Project Area, although quolls may interact with domestic dogs which can result in mortality. The project is not expected to increase interactions between quolls and dogs, provided there are restrictions prohibiting dogs on site for project-related staff and contractors.

4.4.4 Impacts

4.4.4.1 Weeds

The construction of vehicle access tracks, clearance of vegetation and the use of vehicles and heavy machinery brings with it the risk of the introduction of introduced plant species. New tracks are conduits for the spread of generalist species capable of utilising the modified and disturbed environments of access tracks. Heavy machinery and other vehicles can spread seed along roads if adequate controls are not in place. The disturbance of new areas and the access by vehicles and machinery will bring a risk of weed species being introduced to the site, as well as spreading the weeds that are currently known from the Project Area. Weeds are prevalent across the Project Area in varying frequencies and densities.

4.4.4.2 Pathogens

Phytophthora cinnamomi

As with weeds, the construction of new tracks, clearance of vegetation and the use of vehicles and heavy machinery brings with it the risk of the introduction of plant pathogens. As the Project Area is currently free of any visible signs of PC infection, any introduction of this pathogen would be highly detrimental.

Chytrid fungus

The severity of chytrid infection is likely to be at lower altitudes such as at the Project Area[902]. In addition, the relatively shallow water of farm dams in open areas is likely to be warmer water in temperature, further tempering the severity of chytrid infection[903].

Given the assumption that chytrid is already present in the Project Area and the likely low impact of the fungus on frogs in this environment, construction of the SWISA will not impact green and gold frog populations through the spread of the chytrid fungus. Nevertheless activities must be in accordance with the chytrid Threat Abatement Plan[904], and the introduction of pathogens, pests and diseases by construction activities and movement of vehicles into and within the Project Area will be mitigated by strict hygiene controls through the application of a weed and hygiene management plan (**Section 4.4.5.1**).

4.4.4.3 Introduced fauna

As feral and free-roaming cats are already present and common in the area, it is not a requirement to directly control the feral cat population. However, activities that increase cat predation and/or competition to listed species could be considered to be interfering with the recovery of a species. Cats are more likely to be recorded at vegetation edges or along linear features such as road verges, shelterbelts or riparian vegetation, than they are in open areas or within vegetation patches[905]. This is generally assumed to be related to both prey abundance (e.g. herbivores foraging in open pasture or grasslands) and hunting success (cover for predators)[906]. The linear removal of forest habitat may therefore increase the availability of preferred habitat for cats within the Project Area[907]. Vegetation rehabilitation requirements within the CEMP will be sufficient to mitigate this risk of creating additional cat habitat.

There are no current known populations of foxes in Tasmania, with no recorded sightings since 2009. The Project will not constitute any activity that may introduce the species to the state, and as such is not considered a potential impact to any threated species in the Project Area. Domestic and/or free-roaming dogs were detected on cameras across the study region, these are likely associated with farming or pet animals. Interactions with dogs is a listed threat for multiple MNES species found in the study area, and can result in stress, injury or death. Construction is not likely to increase interactions between wildlife and resident dogs, although the project may be considered to increase predation risk if project staff or contractors bring additional dogs on site.

4.4.5 Mitigation measures

4.4.5.1 Weeds and pathogens

A weed and hygiene management plan specific to the SWISA project is required to mitigate the risk of the introduction of new weeds and to contain the existing infestations. The plan must address the following areas:

Objectives and legal requirements

Containment and prevention of spread of all declared weeds and identified pathogens across the entire Project area.

[902] Garvey (2024) – **Appendix N**
[903] Department of Climate Change, Energy, the Environment & Water (2024n)
[904] Department of the Environment and Energy (2016
[905] Doherty *et al.* (2014); Hamer (2019)
[906] McGregor *et al.* (2015)
[907] McGregor *et al.* (2014); Hamer (2019)

Tasmanian *Biosecurity Act 2019*

1. All users of the Project Area have a general biosecurity duty and a shared responsibility under the Act.
2. All users must prevent a breach of the containment principles of the Act.

General hygiene

In conjunction with direct weed control, various site hygiene measures must be put in place as complementary methods of weed containment. The following prescriptions must be followed by all contractors on site during construction and follow-up weed control operations.

Throughout the Project Areas contractors are required to adhere to best practice guidelines:

- *Keeping it clean - A Tasmanian field hygiene manual to prevent the spread of freshwater pests and pathogens*[908]
- *Weed and Disease Planning and Hygiene Guidelines - Preventing the spread of weeds and diseases in Tasmania*[909]
- *Tasmanian Washdown Guidelines for Weed and Disease Control. Machinery, Vehicles & Equipment*[910]
- *Wetlands and Waterways Works Manual*[911]

Earthworks associated with clearance and soil disturbance present a risk of spreading weeds, both onsite and offsite. The following prescriptions must be followed by all contractors on site during construction and when doing any mechanical follow-up treatments.

Weed control

In general, control of weeds before and following construction works will minimise the risk of their spread and the timely control of any new weeds brought into the site.

Primary control

Primary control must focus on the treatment of all plants and infested patches within the Project Area. Treatment involves mechanical removal and/ or targeted spraying. For audit and compliance purposes, control details must be recorded in a weed management record (**Appendix R**).

Follow-up control

Follow up control must then largely be focussed on seedlings germinating from the soil seed bank. This includes a maintenance treatment (manual and/or herbicide) of weed seedlings every six months following primary treatment and ideally in spring and autumn following rain when the plants are actively growing. Follow up treatment is required across the entire Project Area.

Weed disposal

All woody material and groundcover vegetation comprising WoNS and/or declared weeds must be taken to a nearby waste transfer station for disposal in the general waste (not green waste). Any flowering and/ or seed bearing or fruiting declared weeds located within the development footprint must be separately double bagged and disposed to general waste[912].

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908 Allen and Gartenstein (2010)
909 Department of Primary Industries, Parks, Water & Environment (2015)
910 Department of Primary Industries, Parks, Water & Environment (2004)
911 Department of Primary Industries, Parks, Water & Environment (2003b)
912 Refer to Section 3 for details of weeds present and/or the online NRE weed resources available at: https://nre.tas.gov.au/invasive-species/weeds.

Herbicides

Only registered herbicides and those listed under an off-label permit issued by the Australian Pesticide and Veterinary Medicines Authority (APVMA) (Permit PER84775) for control of environmental weeds are legally allowed to be used in the control of weeds in Tasmania.

Selective herbicides, with active ingredients such as metsulfuron-methyl, triclopyr, picloram and aminopyralid, are preferable for the control of woody plants, particularly where grassy species are also present, as these herbicides only affect woody plants. Selective herbicides are likely to produce better control results on woody weeds.

Broad spectrum herbicides, with active ingredients such as glyphosate will potentially result in more off target damage as they will affect all plants. In some cases, for example on weedy grasses, they are preferred as they are non-residual. For control sites that are highly sensitive due to their proximity to waterways, control may be restricted to glyphosate products that are registered for use near waterways. Where woody weeds occur along creek lines and in sensitive remnant native vegetation, the cut and paint technique can be used. This technique minimises the risk of off-target damage to surrounding plants.

A qualified Bushcare contractor or weed control operator who holds a current NRE Commercial Operators Licence and NRE Certificate of Competency will know the correct herbicides and rates and will have the appropriate qualifications to legally apply them. By law they must record herbicide usage (see **Appendix R**). This also provides an audit trail to demonstrate compliance works were undertaken prior to civil construction and for the following two years defects liability period (or as specified).

The NRE weed website can also provide advice[913]. Up to date information should always be sought as products and recommendations can change regularly.

Soil movement

In order to reduce the likelihood of any weed seeds being moved off site, soil movement must be kept to a minimum during any construction, digging, or trenching activities.

- Excavated soil from weed infested areas must remain as close as practicable to the spot from where it was removed and deep buried nearby under 500 mm of clean fill. It must not be stored in weed free areas;
- Following construction activities, soil must be returned to as close as practicable to the area it was removed from; and
- Soil known to contain weed seed must not be removed from the site unless approval is obtained from the State government under the *Biosecurity Act 2019* or associated *Biosecurity Regulations 2022*.

Clean machinery

Any earthmoving machinery and vehicles used in operational areas that contain weeds will potentially accumulate seeds and contaminated soil. In addition, dirty vehicles and machinery entering a site have the potential to introduce new weeds and pathogens to the area. Consequently, a further critical measure to prevent weed spread is that of vehicle and machinery hygiene.

- The minimum standard for machinery cleanliness entering a site is that no weed seeds or propagules and no clods of dirt or loose soil are present after wash-down and that the machine is completely dry prior to coming on site. Check that wheel arches, cab, air cleaner and engine bay (including radiators), as well as buckets and tracks and track frames are free of any seeds or clods of dirt. If the vehicle or machinery does not meet the minimum standard of cleanliness,

[913] NRE online weed resources are available at: https://nre.tas.gov.au/invasive-species/weeds

the supervisor must direct that it be further cleaned before another inspection and prior to entering the site.

- All vehicles and earthmoving machinery entering any works, including any staging or laydown areas, must be inspected and shown to be clean prior to entering the area.
- Any wash-downs must follow the procedures detailed in the *Tasmanian Weed and Disease Planning and Hygiene Guidelines*[914]. The wash-down site(s) must be located in accordance with these guidelines and include a well-drained hard surface.
- Wash-down sites will be confirmed in consultation with the relevant parties prior to the start of works period. Once selected these sites must be shown on the relevant soil and water plan(s).
- Wash-down checklists must be completed for each wash-down (checklists for various machinery are provided in **Appendix R**), for both entry to and exit from the site.
- Following wash-down completion prior to leaving the site, the site supervisor/manager (or equivalent personnel) must inspect vehicles and machinery for cleanliness. If the machinery meets the standards of cleanliness outlined in the guidelines, the supervisor can authorise its exit and record the wash-down in a ledger (**Appendix R**).
- All vehicles and earthmoving machinery (e.g., dozers, excavators, loaders, etc.) must be cleaned (washed down) before leaving any contaminated area and especially at the end of all works and prior to moving away from the Project Area.

Contract specifications

All of the hygiene requirements in this section must be specified within the contract conditions of any contractors conducting earthworks on site. They must be included in the CEMP where appropriate.

4.4.5.2 Introduced fauna

Increase in cat activity would likely be isolated to areas where additional edge habitat has been created through the removal of forest. Habitat management to increase structural complexity, such as reducing grazing or managing fire, has been shown to have long-term reduction on cat presence in both natural and production ecosystems[915]. Mitigation of any increase in cat activity could be achieved through the immediate revegetation of cleared areas with vegetation of equal or greater structural complexity to provide refuge for potentially impacted species (in accordance with a rehabilitation plan as detailed in **Section 4.1.1**).

The introduction of dogs from project related staff or contractors must prohibited to minimise the chances of negative interactions with native fauna in the Project Area.

[914] Department of Primary Industries, Parks, Water & Environment (2015)
[915] Dorph *et al.* (2024)

4.5 Summary of Proposed Mitigation Measures

Table 42 provides a summary of the prescribed mitigation measures for RFAI 6(a-k). Further detailed with be provided within the CEMP and OEMP.

Table 42: Summary of proposed mitigation measures and assessment of effectiveness

Avoidance / Mitigation Measure	Description	Applicable MNES	Responsible Party	Location	Timing	Assessment of Effectiveness	Further Information
Avoidance	Avoidance to the extent possible of protected matters, achieved through realignment, reduction of the design corridor, and exclusion areas.	All MNES	Tasmanian Irrigation	Entire Project Area	Design & Assessment Phase	**Very high** Avoidance is a direct measure of mitigation and thus comes with high confidence in effectiveness.	-
Exclusion Zones	Demarcation of exclusion zones around identified natural values across the Survey Area. This must be clearly defined in the CEMP, and on the ground. Distances may vary depending on the values being protected.	Black gum/Brookers gum forest, all flora MNES, swift parrot, blue-winged parrot, Tasmanian masked owl, CNBC, green and gold frog	Tasmanian Irrigation Civil Contractor	Entire Project Area	Construction Phase	**Very high** The implementation of exclusion zones is a frequently used method to minimise impacts to threatened values. Avoidance is a direct measure of mitigation and thus comes with high confidence in effectiveness.	**Section 4.1.2.1** **Section 4.2.2** **Section 4.3.1** **SWISA CEMP**
Vegetation Rehabilitation	A revegetation plan in accordance with the DCCEEW *Environmental Management Plan Guidelines*[916] must be included as a condition within the CEMP and be implemented throughout the construction phase to restore temporary disturbance to native vegetation. Rehabilitation must occur within 30 days of the completion of works.	Tasmanian devil, spotted-tail quoll, eastern quoll, eastern barred bandicoot, blue-winged parrot	Tasmanian Irrigation Civil Contractor	Entire Project Area	Construction Phase	**Very high** Revegetation of native and agricultural habitats within 30 days of the completion of given works will ensure the provision of foraging and denning habitat for the applicable MNES will be restored in a timely manner and that limits any disturbance to listed species. This measure comes with a high confidence in its effectiveness, and based on published literature, may provide additional benefit to some MNES.	**Section 4.1.1** **SWISA CEMP**
Construction Ramps	Installation of ramps within open trenches to allow for fauna species to escape in the event of being trapped.	All ground mammals, green and gold frog	Civil Contractor	Entire Project Area	Construction Phase	**Very high** The installation of escape ramps within open trenches allows for trapped fauna to escape on their own. In the event that an animal remains trapped prior to the recommencement of works, and animal handler will be responsible for ensuring the safe removal of the animal. This measure will ensure that no animals are harmed due to being trapped within an open trench.	**SWISA CEMP**
Pre-clearance Orchid Surveys	A pre-clearance check during the optimal flowering period (late August to November, noting that flowering times can be variable across the state[917]) by a suitably qualified ecologist for this species is required prior to construction. This check must cover a 50 m buffer of the Construction Corridor to capture any plants that may be at inadvertent risk from construction activities. In the event that this species is recorded during pre-clearance surveys, alternative avenues to avoid impacts must be explored. If it is deemed that impacts cannot be avoided, reconsideration of the potential for significant residual impacts is required, and an	*Caladenia caudata*, *Caladenia tonellii*	Civil Contractor	Within 50 m of Construction Corridor in areas of native forest vegetation	*C. caudata* - August to November *C. tonellii* - late October to early December	**Very high** While the effectiveness of the pre-clearance checks are difficult to define, the process is designed in such a manner that the potential for direct impacts to individuals is removed through a thorough search program.	**Section 4.2.2.1** **Section 4.2.2.2** **SWISA CEMP**

[916] Department of Climate Change, Energy, the Environment & Water (2024b)
[917] Threatened Species & Marine Section (2014); Wapstra (2018)

Avoidance / Mitigation Measure	Description	Applicable MNES	Responsible Party	Location	Timing	Assessment of Effectiveness	Further Information
	application for a permit to take under the TSP Act must be submitted to NRE for consideration.						
Pre-clearance Check & Den Discovery Protocol	Prior to the commencement of the construction, the civil contractor must implement the pre-clearance check and den discovery protocol as detailed in **Appendix G**. This protocol will require approvals under the Tasmanian *Nature Conservation Act 2002* should dens be required to be decommissioned. The application of this protocol must: a) Be conducted within two weeks of the commencement of any vegetation clearance and must be applied to a 50 m buffer of the works area. b) If dens are located, they must be subject to a den monitoring assessment as detailed in Section B of the protocol. c) Comply with the reporting and regulation components of Section C of the protocol.	Tasmanian devil, spotted-tail quoll, eastern quoll	Tasmanian Irrigation Civil Contractor	Entire Project Area	Construction Phase	**Very high** The application of this protocol is consistent with the management advice given in the *Survey Guidelines and Management Advice for Development Proposals that may impact on the Tasmanian Devil* [918]. These guidelines were developed in 2015 with the input from several experts in the management and ecology of Tasmanian dasyurids. While the effectiveness of the pre-clearance checks are difficult to define, the process is designed in such a manner that the potential for direct impacts to individuals is removed through a thorough search and monitoring program.	**Section 4.3.1.1** **Appendix G** **SWISA CEMP**
Roadkill Mitigation Strategy	During the construction phase, the civil contractor must comply with roadkill mitigation measures as detailed in **Appendix H**. Roadkill mitigation measures include: a) Reduction of speed across all project roads for project vehicles. b) Centralising transport of key infrastructure to core roads. c) Restricting use of roads outside of daytime hours as much as is practicable. d) Project vehicles will be fitted with a basic, high-frequency animal repellent device. e) Specific mitigation for special purpose vehicles, including travel convoys, escort vehicles, and further speed reduction.	Tasmanian devil, spotted-tail quoll, eastern quoll	Tasmanian Irrigation Civil Contractor	Entire Project Area	Construction Phase	**Very high** The application of the roadkill mitigation strategy is consistent with the management advice given in the *Survey Guidelines and Management Advice for Development Proposals that may impact on the Tasmanian Devil*[919]. These guidelines were developed in 2015 and revised in 2023 with the input from several experts in the management and ecology of Tasmanian dasyurids. The strategies proposed in this roadkill mitigation plan are somewhat tested, with reduction of driver speed likely to be an effective in reducing overall collision numbers[920], and limiting vehicles from night-time use is also likely to reduce collision risk as the majority of species likely to be at risk from collision are crepuscular or nocturnal[921] The effectiveness of high-frequency animal repellent devices is challenging to assess, with trials of virtual fencing yielding mixed results but areas in which it has been effective consistent with the current project area[922].	**Section 4.3.1** **Appendix H** **SWISA CEMP**
Habitat Tree Management Protocol	The civil contractor must avoid the removal of potential habitat trees to the extent that is possible. Trees that	Tasmanian masked owl, swift parrot, blue-winged parrot	Civil Contractor	Protocol Application Area	Construction Phase	**Very high** The protocol considers the Australian Standard AS4970-2009 Protection of Trees on Development	**Section 4.3.1.3** **Section 4.3.1.4** **Section 4.3.1.9**

[918] Environment Strategic Business Unit (2023)
[919] Environment Strategic Business Unit (2023)
[920] Hobday & Minstrell (2008); Hobday (2010)
[921] Lester (2015); Hobday & Minstrell (2008)
[922] Fox *et al.* (2019); Magnus *et al.* (2004)

Avoidance / Mitigation Measure	Description	Applicable MNES	Responsible Party	Location	Timing	Assessment of Effectiveness	Further Information
	are identified as unavoidable impacts will be subject to a habitat tree management protocol (**Appendix I**). If a tree is confirmed/likely to be a nesting breeding tree, it will be excluded from clearance. A 150 m exclusion zone where no works will occur must be applied until fledging has completed (up to 18 weeks), breeding has failed, or additional evidence is available to refute the suspected breeding evidence. A monitoring program will be required to inform this process and will need to be determined by the ecologist as to what is most suitable for the particular nesting tree. Alignment deviation works can commence within this buffer area upon determination of absence from the ecologist					Sites and thus can be relied on to have captured all potential trees at risk of indirect or direct impacts. The method includes a multi-faceted survey method for determining use and occupancy at the time of proposed clearance and given the survey techniques include direct observation there is effectively no chance occupation of a hollow could be overlooked. The method relies on a permit from the State regulators, thus providing scope for their further input and conditions of permit approval. The protocol specifies avoidance of works occupied hollows (no clearance) for a period of time until nesting has commenced, after which works can occur within the specified radius (but the tree will be retained). With these measures in place, we are confident the method can be effective in mitigation impacts to the masked owl, swift parrot, and blue-winged parrot.	**Appendix I** **SWISA CEMP**
Burrowing Crayfish Salvage & Relocation Protocol	Designs have been modified to reduce potential impacts to CNBC by realigning the pipeline to avoid known burrowing crayfish locations. The priority is to avoid known burrows through micro siting of the pipeline alignment during construction, although some habitat impacts may be unavoidable. Where avoidance is not possible, these burrowing crayfish sites will be excavated during the trenching process. The following Burrowing Crayfish Habitat Management, Salvage and Relocation Protocol for SWISA has been based on this precedent to minimise impacts to habitat and ensure best possible survival of impacted crayfish.	CNBC	Civil Contractor	Protocol Application Area	Construction Phase	**Very high** A standard operating procedure for the salvage and relocation of CNBC has been established previously and undertaken successfully[923]. Similar protocols have been undertaken as part of other TI schemes, as well as a number of EPBC Act approved projects in the Devonport Region. This protocol has been developed in conjunction with a leading expert in burrowing crayfish ecology and comes with a high level of confidence in achieving its intended purpose.	**Section 4.3.1.7** **Appendix M** **SWISA CEMP**
Green and Gold Frog Direct Impact & Habitat Management Protocol	The civil contractor must apply the green and gold frog protocol as detailed in **Appendix Q** of this document.	Green and gold frog	Civil Contractor	Protocol Application Area	Construction Phase	**Very high** This protocol has been developed in accordance with the approved advice published in the Department of State Growth (2015) *Green and Gold Frog (Litoria raniformis) Management Guidelines* and thus can reliably meet the direct impact mitigation and habitat management aims of the project. Dynamic monitoring and auditing will occur to ensure key objectives are being met.	**Section 4.3.1.8** **Appendix Q** **SWISA CEMP**
Breeding Season Exclusions	Species-specific breeding zone exclusions to reduce the risk of direct impact and interruption of breeding activity.	Tasmanian devil, spotted-tail quoll, Tasmanian masked owl, swift parrot, blue-winged parrot	Tasmanian Irrigation Civil Contractor	Entire Project Area	Construction Phase	**Very high** By eliminating works around potential nesting and denning sites during the breeding season for these species, the potential disruption to breeding activity is entirely avoided.	**Section 4.3.1** **SWISA CEMP**

[923] Richardson (2024) – **Appendix L**

Avoidance / Mitigation Measure	Description	Applicable MNES	Responsible Party	Location	Timing	Assessment of Effectiveness	Further Information
Eagle Management Constraint Period	The civil contractor will not conduct any works within 500 m direct distance and/or 1,000 m line-of-sight of an active eagle nest during the breeding season (defined as the beginning of July to the end of January, unless advice surrounding shortened or lengthened breeding season is provided by the Forest Practices Authority).	Tasmanian wedge-tailed eagle	Tasmanian Irrigation Civil Contractor	Applicable to nests within 500 m direct distance and/or 1,000 m line-of-sight from construction areas.	Construction Phase February – June (inclusive) designated as the period outside of the breeding season, other than following seasons in which breeding extends into February (which gets identified annually around November by the FPA and NRE).	**Very high** By eliminating works around active eagle nests during the breeding season, all potential impacts relating to the disruption of nesting activities will be avoided. This is consistent with the prescriptions of the Forest Practices Authority breeding season guidelines, which have been in operation within Tasmania for over 20 years, and are supported by NRE, with the same management prescriptions published on the threatened species profile for this species[924].	**Section 4.3.1.5** **SWISA CEMP**
Aerial Nest Search	Tasmanian Irrigation must engage with a suitably qualified eagle specialist to undertake periodic aerial nest search/es outside of the eagle breeding season to detect any new nests within 1,250 m of the Construction Corridor – noting that any new nests will be subject to the same avoidance principles and seasonal constraints.	Tasmanian wedge-tailed eagle	Tasmanian Irrigation	All areas within 1,250 m of the Construction Corridor during construction. All areas within 1,250 m of the operational area during operation.	Every 2 years for the duration of the construction and operational phase. February – June (inclusive) designated as the period outside of the breeding season, other than following seasons in which breeding extends into February.	**Very high** Aerial nest searches (current for a maximum of 2 years) are a survey method developed by the Forest Practices Authority to document nest locations to aid management of disturbance to eagles in a dynamic landscape. These search methods are supported by NRE[925] and the EPA[926] and can be taken to have a high likelihood of success.	**Section 4.3.1.5** **SWISA CEMP** **SWISA OEMP**
Using annual eagle nest activity assessment to inform seasonal constraints around active nest sites	Survey conducted during the eagle breeding season to establish the activity status of known eagle nests within 500 m direct distance and/or 1,000 m line-of-sight of parts of the project area in which works may be required/desired during the eagle breeding season. Nests must be assumed to be active from the commencement of the season until a nest activity assessment proves otherwise. Works can be undertaken around inactive nests with no risk of disturbance. If a nest is active, no construction will occur (within 500 m or 1,000 m line of sight) for the remainder of the breeding season unless emergency principles must apply.	Tasmanian wedge-tailed eagle	Tasmanian Irrigation Assessments conducted by the Forest Practices Authority or suitably qualified eagle specialists	Applicable to nests within 500 m direct distance and/or 1,000 m line-of-sight from construction areas.	Annually (for duration of construction) during breeding season, July – January (inclusive) (extended into February in late years). As required (for scheduled maintenance).	**Very high** Eagle nest activity assessments and associated constraints according to these principles (applicable to a single season only) are a mitigation method developed by the Forest Practices Authority to manage disturbance to eagles in a dynamic landscape. These search methods are supported by NRE[927] and can be considered to have a high likelihood of success.	**Section 4.3.1.5** **SWISA CEMP** **SWISA OEMP**
Future planning	Forward planning of scheduled routine maintenance to occur outside of the eagle breeding season.	Tasmanian wedge-tailed eagle	Tasmanian Irrigation	Applicable to nests within 500 m direct distance and/or 1,000 m line-of-sight from construction and operational areas.	February – June (inclusive) designated as the period outside of the breeding season, other than following seasons in	**Very high** Seasonal avoidance of routine maintenance around eagle nests (in conjunction with regular nest searches to identify new nest locations) will be effective at preventing nests from being disturbed by maintenance activities. As a contingency, the emergency works	**Section 4.3.1.5** **SWISA CEMP** **SWISA OEMP**

924 Threatened Species Section (2023b)
925 Threatened Species Section (2023b)
926 Environment Protection Authority (2023)
927 Threatened Species Section (2023a)

Avoidance / Mitigation Measure	Description	Applicable MNES	Responsible Party	Location	Timing	Assessment of Effectiveness	Further Information
					which breeding extends into February.	mitigation measure can apply around active (or not definitively inactive) nests.	
Exceptional Circumstances	Maintenance within 500 m or 1,000 m line-of-sight of an active nest within the eagle management constraint period may be a potential impact pathway as breeding disruption. The primary need for mitigation is in relation to the risk of disrupting a breeding event during maintenance works around an active nest within a given breeding season. In order to minimise the risk of disturbing an active nest, the following constraints are required: • Planned maintenance within 500 m of any active eagle nest must not be conducted during the eagle management constraint period. • In the event that unplanned repair work or maintenance must be undertaken during eagle management constraint period (unless the repair work is urgently required to avert serious threat to life, property or the environment), the following measures are required: i) Unless a nest activity assessment has been undertaken for all nests within 1,250 m of the location, assume that all known nests are active eagle nests; ii) Ensure that, before entering the works area, all workers are aware of the location of all active eagle nests; iii) Ensure that no person or vehicle enters any area within 200 m of an active eagle nest; iv) Ensure that no person looks directly towards an active eagle nest while they are within 1,000 m of an active eagle nest; v) Ensure that, unless not visible from any active eagle nest, no heavy vehicles and no more than 2 light vehicles enter any area within 1,000 m of an active eagle nest, and that in any seven-day period, no vehicle enters within 1,000 m of an active eagle nest more than twice; vi) Ensure that no heavy vehicles, and no more than 2 light vehicles, enter any area within 500 m of an active eagle nest in any seven-day period, or enters within 500 m of an active eagle nest more than twice; vii) Ensure that, in any seven-day period, unless not visible from any active eagle nest, no vehicle remains within 1,000 m of an active eagle nest any	Tasmanian wedge-tailed eagle	Tasmanian Irrigation Civil Contractor	Applicable to nests within 500 m direct distance and/or 1,000 m line-of-sight from operational areas.	N/A	**Very high** Limited interaction with nests during the breeding season may be necessary in the event of an emergency, however with these measures in place (consistent with those used within the forestry industry[928]), potential nest disturbance due to emergency works can confidently be mitigated.	**Section 4.3.1.5** **SWISA CEMP** **SWISA OEMP**

[928] Forest Practices Authority (2023)

Avoidance / Mitigation Measure	Description	Applicable MNES	Responsible Party	Location	Timing	Assessment of Effectiveness	Further Information
	longer than 30 minutes and that regardless of visibility, no vehicle remains within 500 m of an active eagle nest any longer than 30 minutes, unless a suitably qualified eagle specialist has provided prior written agreement to the use of vehicles for longer than 30 minutes, specifying the required safeguards and mitigation measures and justification that harm will not result from the presence of the vehicles for longer than 30 minutes; viii) If safety requirements allow, instruct workers to not wear hi-visibility clothing while in the allowed proximity to an active eagle nest; ix) Ensure that no vehicle is parked within sight of an active eagle nest; and x) Ensure workers always remain within 5 m of one another (to the degree possible) and no work breaks are conducted while within 500 m of an active eagle nest. • In the event that ii) to x) are not achievable, and/or one or more eagles are noted on or around a nest during works (or the nest is already known or assumed to be active when the exceptional circumstances have been triggered), NRE as the State regulator must be notified immediately and a nest-specific management plan prepared by the proponent to the satisfaction of the regulator, with further mitigation measures to be implemented to the degree practicable on a case-by-case basis. These measures may include: o If possible/deemed necessary, the works to cease immediately – until the nesting season is finished and/or the nest is deemed inactive; and o If the nature of the works is such that they cannot cease, suitably qualified ecologist/s must be present to observe and monitor the eagle(s) for signs of distress and disruption of breeding activity and advise the contractors accordingly of periods when work can occur.						
Weed & Hygiene Management Controls	A project specific weed and hygiene management plan that is embedded within the CEMP and OEMP to put measures in place to prevent the introduction and to minimise the spread of weeds and pathogens across the Project Area.	Black gum/Brookers gum forest, all flora MNES, Blue-winged parrot CNBC	Tasmanian Irrigation Civil Contractor Individual Irrigator	Entire Project Area	Construction & Operational Phase	**Very high** The application of project specific weed and hygiene management plans is a frequently used mechanism to meet the legislative requirements of the Tasmanian *Biosecurity Act 2019* and can with confidence by relied on to prevent the spread of pathogens and weeds across the Project Area.	**Section 4.4.5** **Appendix R** **SWISA CEMP** **SWISA OEMP**

Avoidance / Mitigation Measure	Description	Applicable MNES	Responsible Party	Location	Timing	Assessment of Effectiveness	Further Information
Construction Environment Management Plan	A project specific CEMP will compile scheme-specific construction measures to ensure adequate protection of MNES.	All MNES	Tasmanian Irrigation Civil Contractor	Entire Project Area		**Very high** The CEMP is a document that will be legally enforceable as a component of the approval conditions for SWISA.	**SWISA CEMP**
Operational Environment Management Plan	A project specific OEMP will develop scheme-specific operational measures to ensure adequate protection of MNES.	All MNES	Tasmanian Irrigation	All SWISA properties	Operational Phase	**Very high** The OEMP is a document that will be legally enforceable as a component of the approval conditions for SWISA.	**SWISA OEMP**
Farm WAP	A Farm Water Access Plan is required for all properties that NMIS water is applied to. Farm WAPs will be prepared by a prequalified consultant and will be prepared in accordance with the State approved soil, water, and biodiversity modules of the Farm WAP program. The irrigator is responsible for: • Having a Farm WAP in place; • Ensuring TI water is only applied to land where a current Farm WAP is in place; • Informing TI of any changes to practices, so TI can assist with the updating and approval of a revised Farm WAP prior to those changed practices being implemented; • Applying the water in accordance with the Farm WAP requirements including ensuring that the volume of water applied matches the land capability and crop water usage volumes; • Complying with the management actions and monitoring schedules prescribed in the Farm WAP; and • Keeping records of irrigation, chemical and fertiliser use in compliance with Tasmanian regulations. Farm WAPs must be audited in accordance with the conditions under the Tasmanian *Water Management Act 1999*.	All MNES	Tasmanian Irrigation	All SWISA properties	Operational Phase	**Very high** The Farm Water Access Plan has been developed by Tasmanian Irrigation as a further measure to mitigate against impacts to natural values and processes. The Farm WAP process has been applied to over 15 irrigation schemes in Tasmania with numerous threatened flora populations protected under the process. Farm WAPs are a condition of Federal and State Government approval for all Tasmanian Irrigation built schemes.	**Section 1.3.2.3** **SWISA OEMP**

4.6 Residual Impacts to MNES

Table 43 provides a summary of the impacts to MNES[929] and an assessment of significant residual impacts.

Table 43: Summary of residual impacts to MNES

MNES	Impact Without Mitigation	Impact With Mitigation	Significant Residual Impact[930]	Further Information
Tasmanian forests and woodlands dominated by black gum or Brookers gum	No occurrences within the Construction Corridor Potential for impacts to buffer areas due to introduction of weeds Potential for unregulated clearance and degradation from agricultural activities Altered hydrology and water quality Potential for hybridisation with non-native eucalypts	Weed and pathogen control measures in place to prevent indirect impacts Operational measures in place to prevent unregulated clearance and to restrict agricultural activities within buffer areas Controls to prevent eucalypt hybridisation	No	**Section 4.1.2.1**
Tasmanian white gum wet forest	No occurrences within the Construction Corridor Potential for unregulated clearance and degradation from agricultural activities Altered hydrology and water quality Potential for hybridisation with non-native eucalypts	Weed and pathogen control measures in place to prevent indirect impacts Operational measures in place to prevent unregulated clearance and to restrict agricultural activities within buffer areas Controls to prevent eucalypt hybridisation	No	**Section 4.1.2.2**
Caladenia caudata	No occurrences within the Construction Corridor Potential for weed and pathogen invasion of viable habitat Potential for unregulated clearance and degradation from agricultural activities	Pre-clearance checks and exclusion areas to prevent direct impact Weed and pathogen control measures in place to prevent indirect impacts No unregulated clearance of habitat to occur within the Operational Area	No	**Section 4.2.2.1**

[929] Excluding the Australian grayling which is addressed in a separate study
[930] Assessed in accordance with the Significant Impact Guidelines 1.1.

MNES	Impact Without Mitigation	Impact With Mitigation	Significant Residual Impact[930]	Further Information
Caladenia tonellii	No occurrences within the Construction Corridor Potential for direct and indirect impact in the vicinity of the Construction Corridor Potential for weed and pathogen invasion of viable habitat Potential for unregulated clearance and degradation from agricultural activities	Pre-clearance checks and exclusion areas to prevent direct impact Weed and pathogen control measures in place to prevent indirect impacts No unregulated clearance of habitat to occur within the Operational Area	No	**Section 4.2.2.2**
Cassinia rugata	No occurrences within the Construction Corridor Potential for weed and pathogen invasion of viable habitat Potential for habitat loss due to conversion of land for agriculture	Weed and pathogen control measures in place to prevent indirect impacts No unregulated clearance of habitat to occur within the Operational Area	No	**Section 4.2.2.3**
Eastern quoll	Not recorded within the Project Area Impact to 8.46 ha of optimal denning habitat Potential direct impact to den sites. Potential for increased carrying capacity for introduced predators Entrapment in construction trenching Potential for roadkill impacts	Permanent loss of 0.06 of optimal denning habitat Impact to 8.46 ha of optimal habitat to be rehabilitated post-construction Temporary disturbance to foraging habitat throughout the Construction Corridor, to be rehabilitated post-construction, also reducing risk of increases in feral cat populations No direct impact to dens or individuals though the application of a Pre-clearance Check and Den Discovery Protocol Construction methods in place to prevent entrapment in trenching Roadkill risk minimised through roadkill mitigation measures	No	**Section 4.3.1.1**
Spotted-tail quoll	Confirmed as present within the Survey Area Impact to 8.46 ha of optimal denning habitat	Permanent loss of 0.06 of optimal denning habitat	**TBD**	**Section 4.3.1.1**

MNES	Impact Without Mitigation	Impact With Mitigation	Significant Residual Impact[930]	Further Information
	Potential direct impact to den sites Potential noise impacts and breeding disturbance Potential for increased carrying capacity for introduced predators Entrapment in construction trenching Potential for roadkill impacts	Impact to 8.46 ha of optimal habitat to be rehabilitated post-construction Temporary disturbance to foraging habitat throughout the Construction Corridor, to be rehabilitated post-construction, also reducing risk of increases in feral cat populations No direct impact to dens or individuals though the application of a Pre-clearance Check and Den Discovery Protocol Potential for noise disturbance to impact breeding activity Construction methods in place to prevent entrapment in trenching Roadkill risk minimised through roadkill mitigation measures		
Tasmanian devil	Confirmed as present within the Survey Area, including multiple den sites, one of which was a maternal den at the time of survey Impact to 8.46 ha of optimal denning habitat Potential direct impact to den sites Potential noise impacts and breeding disturbance Entrapment in construction trenching Potential for roadkill impacts	Permanent loss of 0.06 of optimal denning habitat Impact to 8.46 ha of optimal habitat to be rehabilitated post-construction Temporary disturbance to foraging habitat throughout the Construction Corridor, to be rehabilitated post-construction No direct impact to dens or individuals though the application of a Pre-clearance Check and Den Discovery Protocol Potential for noise disturbance to impact breeding activity Construction methods in place to prevent entrapment in trenching Roadkill risk minimised through roadkill mitigation measures	**TBD**	**Section 4.3.1.1**
Eastern barred bandicoot	Potential for loss of habitat through vegetation clearance Potential for increased carrying capacity for introduced predators	Temporary disturbance to foraging habitat throughout the Construction Corridor, to be rehabilitated post-construction	No	**Section 4.3.1.2**

MNES	Impact Without Mitigation	Impact With Mitigation	Significant Residual Impact[930]	Further Information
	Entrapment in construction trenching Potential for roadkill impacts	Construction methods in place to prevent entrapment in trenching Roadkill risk minimised through roadkill mitigation measures		
Swift parrot	Direct habitat loss of potential nesting and foraging trees	Application of a Habitat Tree Management and Impact Mitigation Protocol to ensure nesting and foraging trees are not impacted Exclusion zones to protect trees that are to be retained	No	**Section 4.3.1.3**
Tasmanian masked owl	Direct habitat loss of potential nesting trees Potential for roadkill impacts	Application of a Habitat Tree Management and Impact Mitigation Protocol to ensure nesting and foraging trees are not impacted Exclusion zones to protect trees that are to be retained Roadkill risk minimised through roadkill mitigation measures	No	**Section 4.3.1.4**
Tasmanian wedge-tailed eagle	Potential breeding/ nest disturbance Potential for roadkill impacts	Eagle nest management constraint period to ensure no impact to breeding eagles Provisions for ongoing and emergency maintenance to ensure any potential disruption to breeding/nesting activity is adequately managed in accordance with relevant guidelines Roadkill risk minimised through roadkill mitigation measures	No	**Section 4.3.1.5**
Central north burrowing crayfish	Potential for destruction of habitat, individuals and colonies through excavation, compaction, and alteration of water regimes Potential for weed invasion of viable habitat Potential for impacts through application of pesticides and fertilisers Changes in the water table through construction of dams and similar processes	Avoidance of key habitat areas through the use of horizontal directional drilling Construction impacts mitigated through the application of a CNBC Salvage and Relocation Protocol Exclusion zones to protect habitat areas during construction Weed and pathogen control measures in place to prevent indirect impacts	No	**Section 4.3.1.6**

MNES	Impact Without Mitigation	Impact With Mitigation	Significant Residual Impact[930]	Further Information
		Operational measures to prevent compaction and trampling of habitat		
Green and gold frog	Direct construction impact to individuals and habitat areas Introduction/spread of chytrid fungus Altered hydrology Habitat degradation through agricultural activities, including stock trampling, application of chemicals and fertilisers, and increased pollution and sediment loads	Avoidance of key habitat areas through the use of horizontal directional drilling Construction impacts mitigated through the application of a Green and Gold Frog Direct Impact and Habitat Management Protocol Exclusion zones to protect habitat areas during construction Weed and pathogen control measures in place to prevent indirect impacts Application of operational mitigations to ensure protection of habitat, including regulation of water levels, protection from grazing, removal of vegetation, fertiliser and chemical restrictions, and exclusion of heavy machinery Ongoing monitoring to ensure the success of mitigation measures	No	**Section 4.3.1.7**
Blue-winged parrot	Direct habitat loss of potential nesting trees Temporary disturbance to potential foraging habitat	Application of a Habitat Tree Management and Impact Mitigation Protocol to ensure nesting and foraging trees are not impacted Exclusion zones to protect trees that are to be retained Temporary disturbance to foraging habitat throughout the Construction Corridor, to be rehabilitated post-construction	No	**Section 4.3.1.8**

5 HERITAGE

5.1 EUROPEAN HERITAGE

Cultural Heritage Management Australia (CHMA) was engaged by TI to undertake the historic heritage assessment for the SWISA. The field survey was undertaken over a 3-week period in May 2023. The field survey assessed 101 km of the proposed pipeline alignment with a nominated width of the pipeline corridor being 15 m. The field work involved covering a series of two survey transects at an average width of 10 m to then be inspected by an archaeologist. Additionally, the field team walked a series of survey transects around the existing Great Bend pump station and the footprint for the new balance tank located on Saggers Hill. The results of the survey suggest the following:

- No listed Tasmanian Heritage Register (THR) sites are located within or in the immediate surrounds of the project area. Previous investigations undertaken by CHMA (2009 and 2010) for the original SWIS pipeline easement also did not identify any THR listed historic sites or features.
- One property at Northdown (CT144681/1) is listed on the *Latrobe Interim Planning Scheme 2013* (now operating under the *Tasmanian Planning Scheme*), where it is listed within the Local Historic Heritage Code. A 150 m section of the SWISA pipeline easement traverses along the western boundaries of this property. The historic heritage assessment confirmed this section of pipeline easement avoids all built structures on the property. The installation of the pipeline will have no adverse effects on the heritage values of the property and satisfies the performance criteria outlined in Section C6 of the *Tasmanian Planning Scheme*.

Further details of the historic heritage assessment for the proposed action are detailed in the Historic Heritage Assessment Report (**Attachment G**).

5.2 INDIGENOUS HERITAGE

Cultural Heritage Management Australia and Aboriginal Heritage Officer (AHO) Vernon Graham were engaged by TI to undertake the Aboriginal heritage assessment for the SWISA. The assessment involved a field survey conducted over 3 weeks in May 2023 and coincided with the historic heritage assessment of the pipeline easements.

5.2.1 Registered aboriginal sites in the vicinity of the study area

A search of the Aboriginal Heritage Register (AHR) revealed that 59 registered aboriginal sites are situated within an approximate 3 km radius of the SWISA corridor.

Of these 59 registered aboriginal sites, there are five (5) registered sites that are situated within the SWISA pipeline easement. Four of these sites (AH10942, AH10943, AH10944 and AH11037) were recorded by CHMA (2009 and 2010) as part of the assessment of the original SWIS pipeline easement. As previously noted, Aboriginal Heritage Tasmania (AHT) has advised that a permit had been previously issued for these sites (Permit 1011/4). The other registered Aboriginal site (AH6130) was potentially recorded by Dunnett (1994). No permit has been issued for this site.

In addition, there are another four (4) registered Aboriginal sites that are situated within a 150 m radius of the SWISA pipeline easement. Two of these sites (AH10940, AH10941) were recorded by CHMA (2009) as part of the assessment of the original SWIS pipeline easement. AHT has advised that a permit had been previously issued for these two sites (Permit 1011/4). No permit has been issued for the other two sites (AH6129 and AH6890).

5.2.2 Results of field survey

No aboriginal heritage sites, suspected features, or specific areas of elevated archaeological potential were identified during the field survey assessment of the SWISA project footprint. The field survey assessment confirmed that there are no rock shelter features that occur within or in the immediate vicinity of the project footprint. The field survey was also able to confirm that there were no stone resources detected within the project footprint that would be suitable for stone artefact manufacturing. It is considered that there is very little potential for quarry/procurement sites to be present, given the nature of the underlying geology.

The assessments management recommendations in regard to the AHR search results and to minimise the impact of the proposed SWISA project on aboriginal cultural heritage values are shown in Table 44.

Further details of the historic heritage assessment for the proposed action are detailed in the Aboriginal Heritage Assessment Report (**Attachment G**).

Table 44: Management recommendations for sites and areas identified in the Aboriginal Heritage Assessment Report

Sites and Areas	Management Recommendations
AH10942 AH10943 AH10944 AH11037	These four aboriginal sites are confirmed as having been situated within the SWISA pipeline corridors. A permit has been previously issued to impact sites (Permit 1011/4). No artefacts were identified at any of these four site areas during current survey assessment. These sites are confirmed as being located in an areas where the original SWIS pipeline installation work carried out and the sites appear to have been destroyed it is advised that there are no further requirements for these four sites.
AH6130	The grid reference provided for this site places it within the pipeline easement. An extensive search was undertaken in this area, but no evidence of the site could be found. Site was recorded over 30 years ago, before the use of handheld GPS devices, and the grid reference is likely to be somewhat inaccurate. Because of the lack of descriptive information, it is impossible to verify the exact location of this site and whether site is in the pipeline corridor. Seek advice from AHT regarding permit requirements for this site.
AH10940 AH10941 AH6129 AH6890	The four registered aboriginal sites are confirmed as being situated outside of the project footprint. These sites are not under any threat of direct impact from this project. However, as a precautionary measure the sites must be plotted onto the project plannings maps, and it noted that the sites are to be avoided.
General Recommendations	If previously undetected Aboriginal heritage sites or objects are located during the course of construction works, the processes outlined in the Unanticipated Discovery Plan must be followed. Any design changes not covered by this assessment to be the focus of a separate assessment and addendum report. Copies of this report must be submitted to AHT for review and comment.

6 LAND TENURE

The majority (79.10 %) of the Project Area is private freehold land, and a further 9.25 % is permanent timber production zone land. Only very small components of the Project Area are within reserves or under other government jurisdictions. A summary of land tenure classes within the Construction Corridor and Survey Area is provided in Table 45.

Table 45: Extent of tenure classes within the Survey Area. All areas are in hectares

Tenure Class	Area Within Construction Corridor (% of Class Extent in Project Area)	Area Within Survey Area (% of Class Extent in Project Area)	Area Within Project Area	Key Locations
Authority Freehold	-	0.60 (0.14 %)	421.09	TasNetworks substation (Mill Rd)
Casement	17.01 (1.20 %)	97.71 (6.91 %)	1,412.96	Road easements across Project Area
Conservation Area	1.98 (0.38 %)	6.75 (1.30 %)	509.93	Warrawee Conservation Area
Inland Water	0.01 (0.03 %)	0.57 (1.12 %)	50.50	Mersey River
Permanent Timber Production Zone Land	0.01 (0.0003 %)	9.95 (0.28 %)	3,603.97	Old Deloraine Rd / Bonneys Creek
Private Freehold	303.92 (0.98 %)	1,225.15 (3.96 %)	29,375.41	Across Project Area
Public Reserve	0.04 (0.01 %)	0.90 (0.21 %)	428.72	Sassafras Primary School, Frankford Road (Harford)
Total	**322.96**	**1,341.62 (exc. Construction Corridor)**	**39,068.31**	

Additional tenure classes within the Project Area, but outside of the Construction Corridor and Survey Area include:

- Authority Crown;
- Commonwealth;
- Conservation Covenant;
- Future Potential Production Forest (Crown);
- Local Government;
- Local Government Act Reserve;
- National Park;
- Nature Reserve;
- Private Sanctuary;
- State Reserve;
- Tasmanian Irrigation; and
- TasWater.

6.1 Tasmanian Reserve Estate

The Project Area contains numerous parcels that are reserved either under the Tasmanian NC Act, local government, private reserves, conservation covenants, or as Permanent Timber Production Zone Land under the Tasmanian *Forest Management Act 2013*. A summary of reserves located within the Project Area is shown in Table 46 and parcels are mapped in Figure 38.

Reserves of note within the Project Area include the Warrawee Conservation Area, Pardoe-Northdown Conservation Area, Port Sorell Conservation Area, Narawntapu National Park, Rubicon Sanctuary (Tasmanian Land Conservancy), Henry Somerset Orchid Reserve, and the Hawley Nature Reserve. No Ramsar wetlands are located within the Project Area

Impacting and NC Act reserve areas will require reserve activity assessments (RAA) and/or consideration of the requirements of a conservation management plan and any equivalent vegetation management agreements.

The only reserve area that will be impacted by the construction and operation of SWISA is the Warrawee Conservation Area. The Tasmanian PWS has been consulted regarding this aspect and the RAA process has commenced.

Table 46: Extent of reserve classes within the Survey Area. All areas are in hectares

Reserve Class	Area Within Construction Corridor (% of Class Extent in Project Area)	Area Within Survey Area (% of Class Extent in Project Area)	Area Within Project Area	Key Locations
Conservation Area	1.98 (0.38 %)	6.75 (1.31 %)	515.19	Warrawee Conservation Area
Informal Reserve on Permanent Timber Production Zone Land or STT managed land	-	1.00 (0.33 %)	298.31	Old Deloraine Rd / Bonneys Creek
Informal Reserve on other public land	-	0.27 (0.11 %)	240.00	Frankford Road (Harford)
Other Private Reserve	0.86 (0.55 %)	1.53 (0.98 %)	153.05	Bonney's Creek, Great Bend
Total	**322.96**	**1,341.62 (exc. Construction Corridor)**	**39,068.31**	

Additional reserve classes present in the Project Area include:

- Conservation Covenant (NCA);
- Future Potential Production Forest;
- National Park;
- Nature Reserve;
- Private Sanctuary; and
- State Reserve.

6.2 Commonwealth Lands

Twenty-four Commonwealth land titles are present within the broader region. Twenty of these titles are all attributed to Telstra exchanges in small regional centres, and four are attributed to Defence sites associated with the Devonport Training Depot. The construction and operation of SWISA will have no direct or indirect impacts to these titles.

7 GEOCONSERVATION SITES

The NRE *Guidelines for Natural Values Surveys*[931] requires that a desktop assessment must be undertaken to determine if any geoconservation sites occur within 1 km of the Project Area. This is achieved through a review of sites listed on the Tasmanian Geoconservation Database. If sites are present, and are at risk of impacts, further assessment by a suitable qualified specialist may be required.

Geoconservation sites are Tasmanian geological, geomorphological (landform), and pedological (soil) sites, features, areas, and systems considered to be of significant conservation, scientific or heritage value.

Five geoconservation sites listed on the Tasmanian Geoconservation database are present within in the Project Area (Figure 39), however no sites are within 3.3 km of the Construction Corridor and will not be impacted by the construction and operation of the SWISA, thus no further surveys are required for this aspect.

The geoconservation sites within the Project Area include:

- Caroline Creek glacial deposits (3.3 km southwest of Great Bend);
- Griffith Point dolerite (4.9 km north of Woodbury Lane)
- Mersey Bluff pseudo petroglyphs (3.6 km northwest of the Pardoe Downs extension); and
- North East Arm shell bed, and North East Arm structure (4.3 km northeast of Woodbury Lane).

8 WILDERNESS QUALITY

The wilderness quality layer is a coverage that represents the level of naturalness and remoteness based on the proximity of physical intrusions and infrastructure. In the Tasmanian Regional Forests Agreement, the quality of wilderness was determined to range between 0 – 20. To qualify as "High Quality Wilderness" an area must be larger than 8,000 hectares and have a National Wilderness Inventory (NWI) rating of 12 or larger[932].

The Wilderness Quality Index for Tasmania (derived from the NWI and using the same values) indicates that the entire Project Area does not register as having any wilderness values at all (Figure 40). This is largely a result of fragmented landscapes, with silvicultural and agricultural activities contributing to the overall degradation of wilderness quality in the region, as well as urban and rural residential areas scattered throughout the Project Area. Small areas of low-quality wilderness values are present within 5 km of the Project Area, most notably along the eastern side of the Rubicon River (NWI ratings between 0 and 8).

With these NWI ratings in mind, there are no sections of the Project Area that qualify as 'High Quality Wilderness' as defined by Lesslie and Maslen (1995). The construction of SWISA will not alter the existing wilderness quality values within and around the Project Area.

The nearest area of High Quality Wilderness occurs in the Walls of Jerusalem National Park, which is >40 km south of the Project Area.

9 CONSERVATION OF FRESHWATER ECOSYSTEM VALUES

The Conservation of Freshwater Ecosystem Values (CFEV) program involved an assessment of the conservation management priorities of all freshwater ecosystems throughout the state. The scope of the audit included an assessment of rivers (including riparian vegetation), wetlands, lakes and waterbodies, saltmarshes, estuaries, karst systems and groundwater-dependent ecosystem values. An Integrated Conservation Value (ICV) for each ecosystem spatial unit was assigned based upon its distinctiveness or 'Special Values, such as threatened flora and fauna species, important bird sites etc.

[931] Department of Primary Industries, Parks, Water & Environment (2019)
[932] Lesslie & Maslen (1995)

The ICV is classified as low, medium, high, or very high. Figure 41 illustrates the ICV for each freshwater ecosystem within the SWISA area and a summary of key features is detailed in Table 47.

Table 47: Conservation of Freshwater Ecosystem Values within the SWISA Project Area

CFEV Integrated Conservation Value	CFEV Saltmarshes, & Wetlands in Project Area	CFEV Estuaries & Waterbodies in Project Area	CFEV Rivers in Project Area	CFEV Karst in GSEIS District
Very High	Bakers Point, Mersey Estuary, Pardoe Creek	-	Caroline Creek, Greens Creek, Mersey River, Pardoe Creek, Rubicon River, and numerous drains	-
High	Ballahoo Island, Rabbit Island, Northeast Arm	Port Sorell, Mersey River	Greens Creek, Latrobe Creek, Mersey River, Rubicon River, and numerous drains and minor tributaries	Port Sorell karst
Medium	Deans Point, Grass Island, Pardoe Creek/Beach, Westford Creek	-	Paramatta Creek, Rubicon River, and numerous drains and minor tributaries	-
Low	Ballahoo Creek, Northdown, and numerous farm dams	-	Bishton Creek, Bonney's Creek, Cockers Creek, Figure of Eight Creek, and numerous drains and minor tributaries	Kimberley & Railton karst

10 ACID SULFATE SOILS

Across the entire SWISA Project Area, the potential for exposure of acid sulfate soil is considered to be low to very low risk (Figure 42). Areas of high coastal acid sulfate soils occur in the Mersey and Port Sorell estuaries, as well as along the Pardoe and Northland Beach region, however there is no risk to these area from the construction and operation of the SWISA.

All other areas of low to very low risk acid sulfate soil sites.

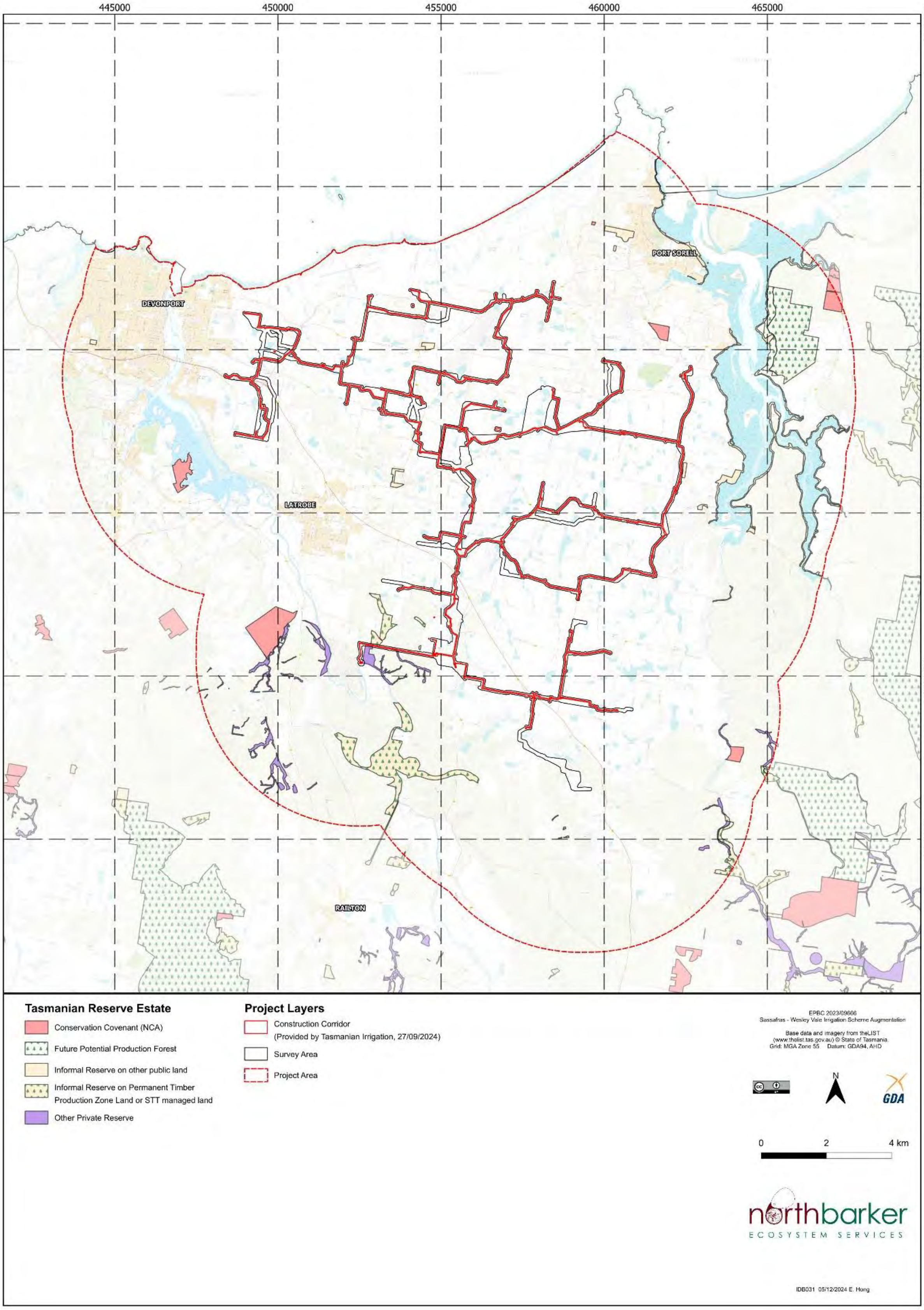

Figure 38: Distribution of reserves across the Project Area

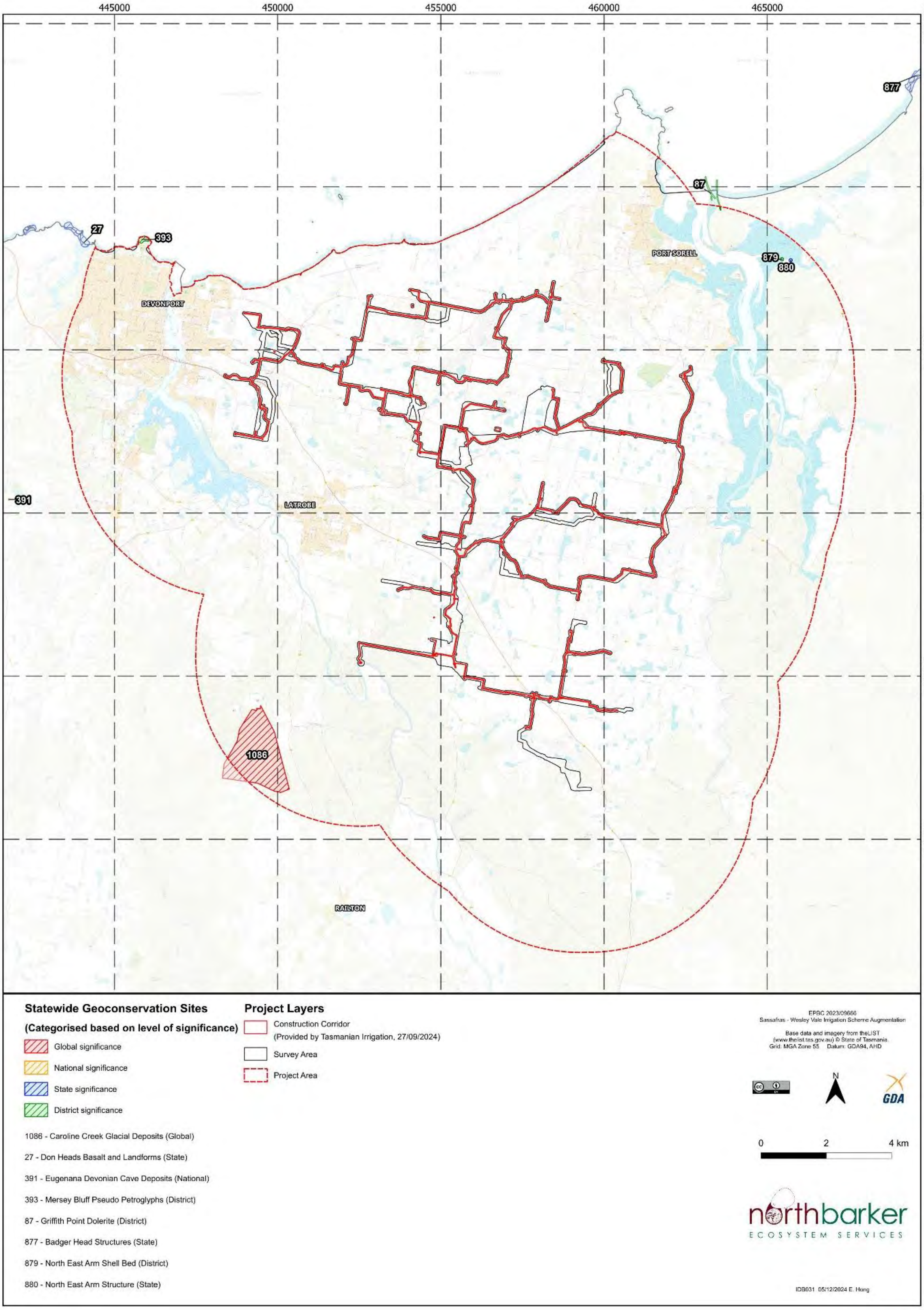

Figure 39: Distribution of geoconservation sites across the Project Area

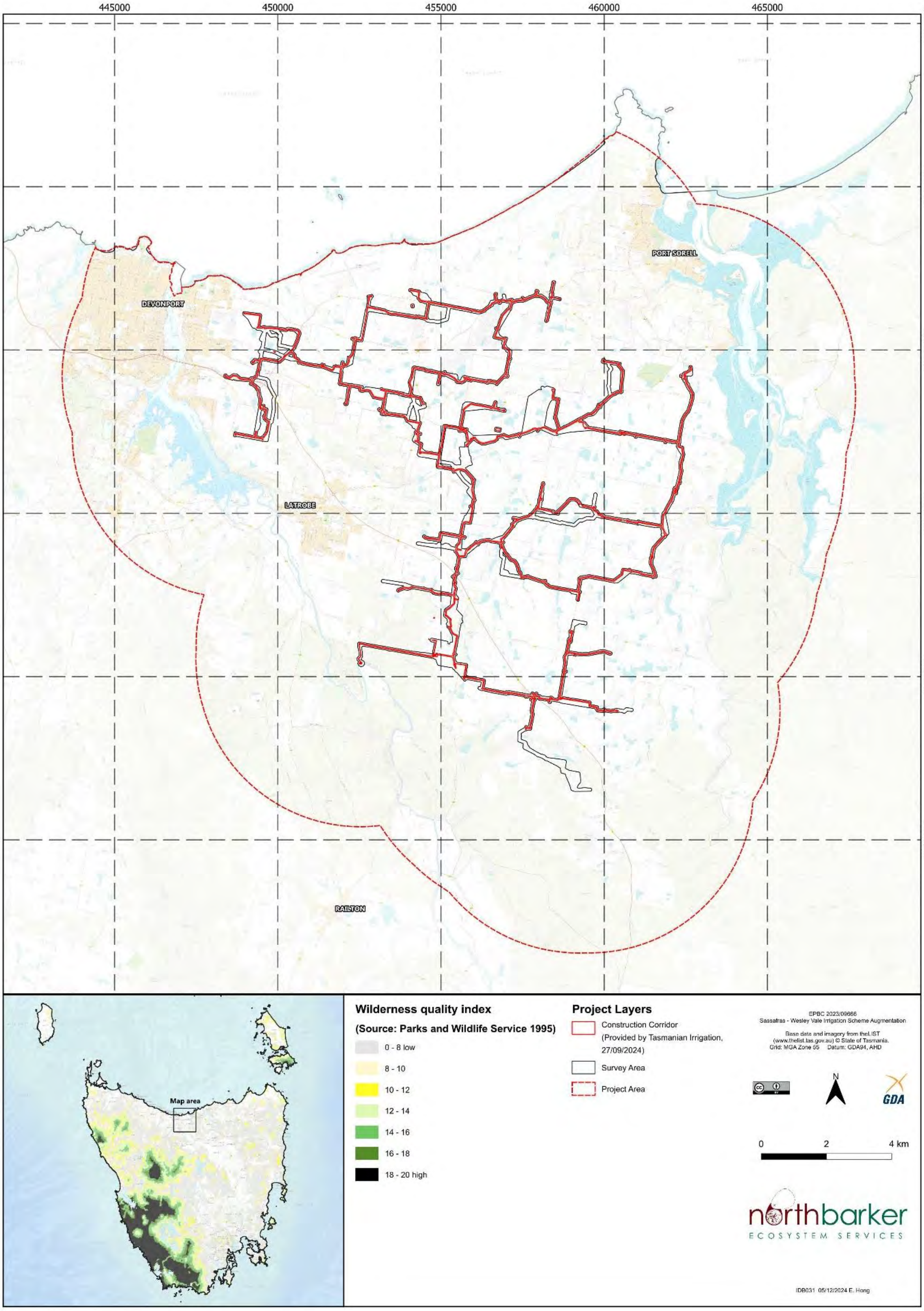

Figure 40: Wilderness quality index in relation to the Project Area

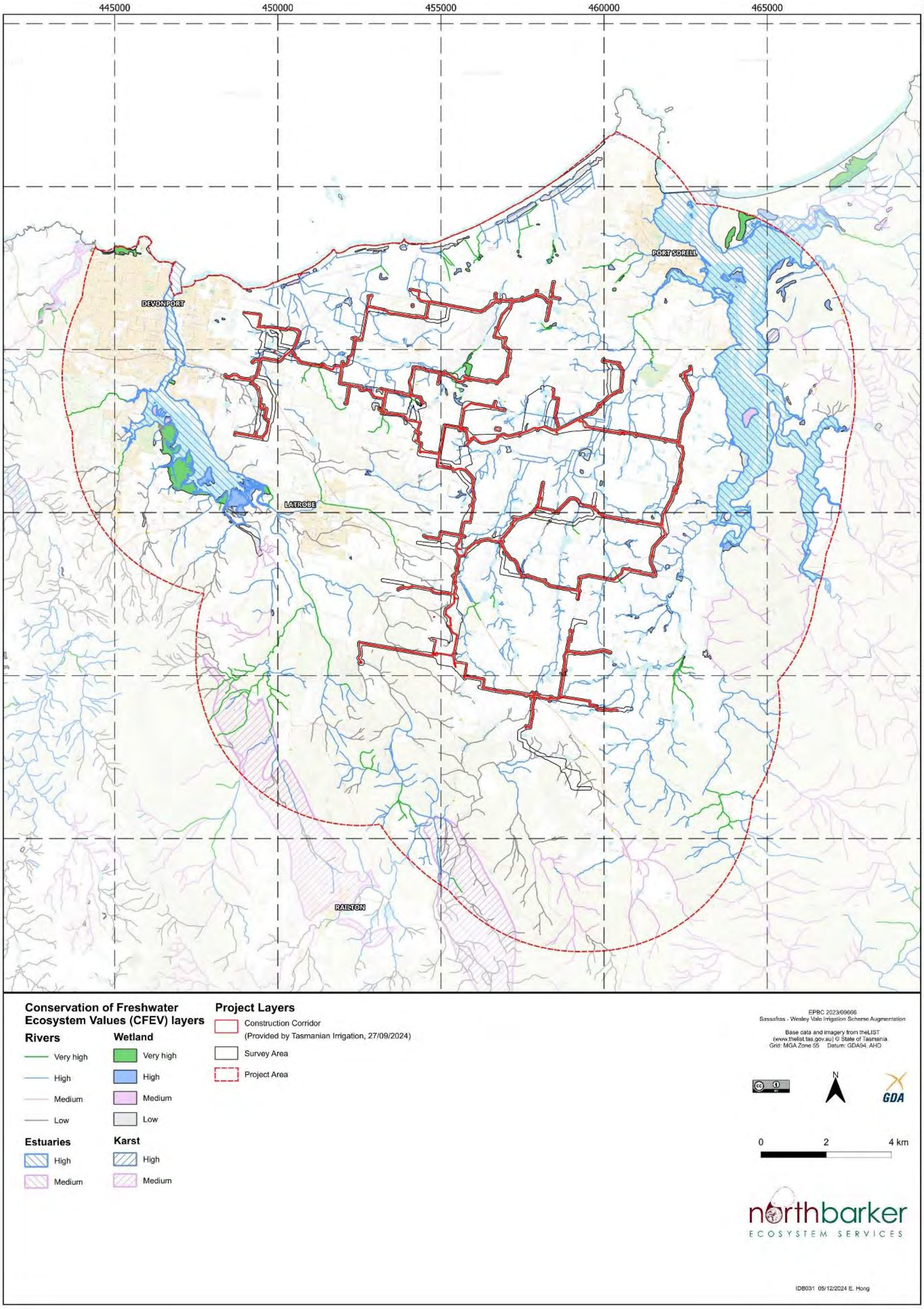

Figure 41: Conservation of Freshwater Ecosystem Values across the Project Area

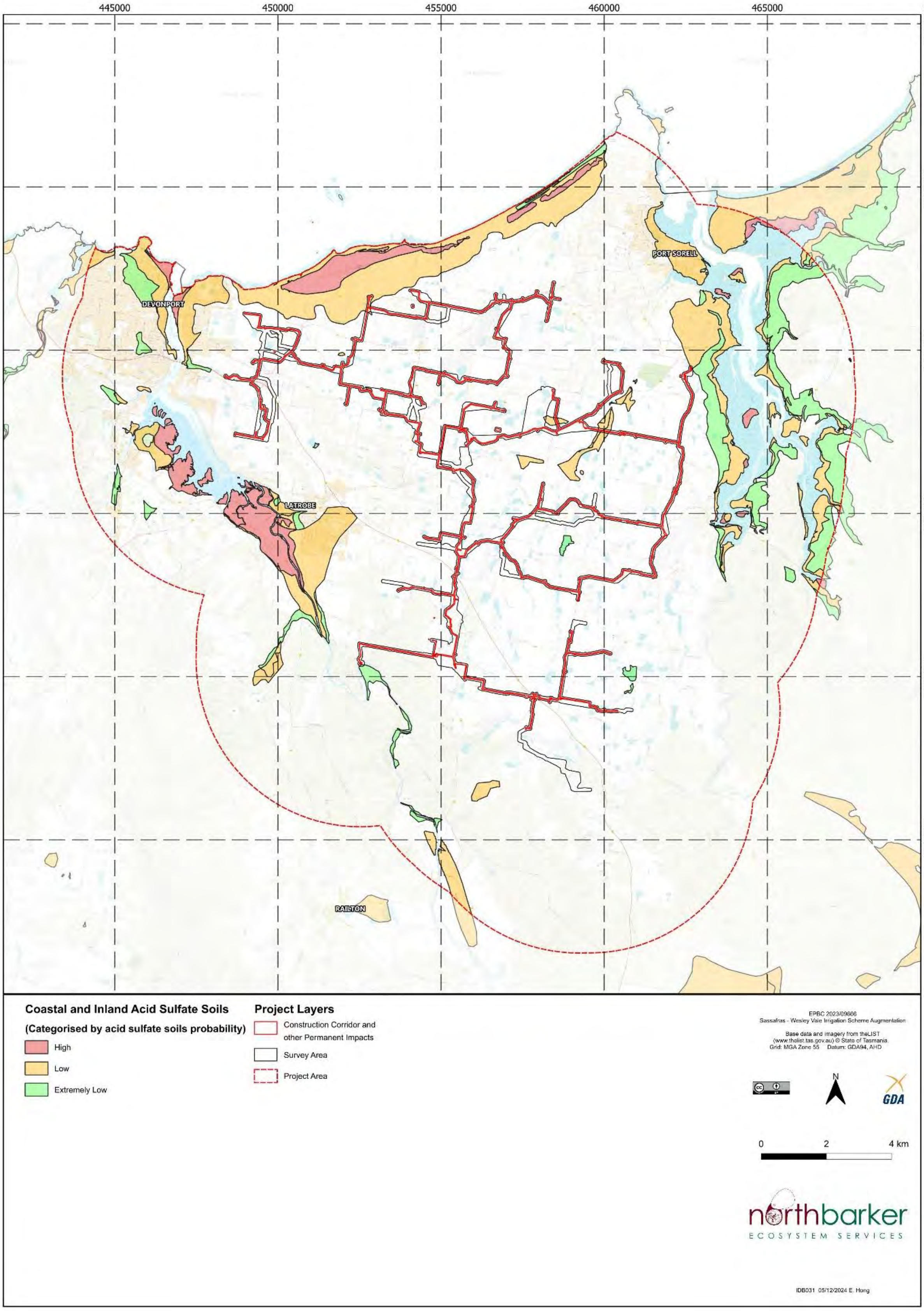

Figure 42: Acid sulfate soil risk classes across the Project Area

11 LEGISLATIVE IMPLICATIONS

11.1 COMMONWEALTH *ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999*

The project has been referred to the Minister for potential significant impacts to several MNES (see **Section 4**).

The project has been assessed as a controlled action, with a request for additional information requested by DCCEEW on 12/02/2024. The project will be assessed through the submission of preliminary documentation.

11.2 TASMANIAN *THREATENED SPECIES PROTECTION ACT 1995*

Under the TSP Act, a person cannot knowingly without a permit 'take' a listed species. With the definition of 'take' encompassing actions that kill, injure, catch, damage, destroy and/or collect threatened species or vegetation elements that support threatened species, e.g. nests and dens.

A permit to take threatened species will be required for where the project cannot directly avoid occurrences of threatened flora or fauna listed under the TSP Act, and/or is likely to impact individuals of threatened flora or fauna.

Based on the current construction corridor, a permit to take is likely to be required for:

- *Persicaria decipiens* – slender waterpepper
- *Engaeus granulatus* – central north burrowing crayfish (relocation only)
- *Litoria raniformis* – green and gold frog (relocation only)

Pre-clearance surveys may determine permits are required for additional threatened flora and fauna species.

11.3 TASMANIAN *NATURE CONSERVATION ACT 2002*

Protection of communities listed under the NC Act is administered through the Tasmanian *Land Use Planning and Approvals Act 1993* (LUPA Act) or under the *Forest Practices Code 2015* in areas where Forest Practices Plans apply. In this case consideration will be via LUPAA and the local planning scheme provisions and a Forest Practices Plan is not required.

If preclearance checks of mature trees, dens, or burrows that require clearing was in use by a species listed under Schedule 1, 5 or 8 of the Tasmanian *Nature Conservation (Wildlife) Regulations 2021*, then a permit to take a product of wildlife would be required for removal of the nest. Permits to take are administered under the NC Act.

Based on the current construction corridor, a permit to take is likely to be required for:

- Burrowing crayfish burrows destruction
- Den / burrow decommission
- Mature tree hollow decommission

11.4 TASMANIAN *BIOSECURITY ACT 2019*

11.4.1 General biosecurity duty

Under the Tasmanian *Biosecurity Act 2019*, a general biosecurity duty operates as a statutory "duty of care". This means that a person (which includes all levels of government, individuals, and private corporate entities) has to take all reasonable and practical measures to prevent, eliminate, or minimise biosecurity risks including weeds. The general biosecurity duty supports the principles of shared responsibility.

11.4.2 Weeds of national significance

Weeds of National Significance (WoNS) are those weed species which have been listed under the *Australian Weed Strategy 2017-2027*. These nationally recognised weeds have significant environmental and economic impact at a national scale[933]. All WoNS are declared weeds in Tasmania. Management of WoNS may be supported by nationally funded strategies and programmes. It is expected that State and regional weed management planning will pay particular attention to the management of WoNS. Their presence, however, does not confer any additional requirement on landowners beyond State weed legislation.

11.4.3 Declared weeds

The Tasmanian *Biosecurity Act 2019* and associated *Biosecurity Regulations 2022* include a list of declared weeds. Statutory weed management plans exist for the majority of listed species. These include a classification of each weed at the municipal level and provide direction as to their management intent.

Class A municipalities for a particular weed are those that are yet to be detected or are limited to localised infestations that are deemed to be eradicable. Therefore, the objective is the eradication of infestations.

Class B municipalities are those which host moderate or large and widespread infestations of the declared weed that are not deemed eradicable because the feasibility of effective management is low at this time. Therefore, the objective is containment of infestations. This includes preventing spread of the declared weed from the municipality or into properties currently free of the weed or which have developed or are implementing a locally integrated weed management plan for that species. As well there is a requirement to prevent spread of the weeds to properties containing sites for significant flora, fauna, and vegetation communities.

Class A species within the Project Area include:

- *Hypericum perforatum* subsp. *veronense*
- *Ilex aquifolium* (no current statutory management plan, thus is treated as Class A)
- *Ulex europaeus* (Devonport City Council only)

Class B species within the Project Area include:

- *Carduus tenuiflorus*
- *Cytisus scoparius*
- *Erica lusitanica*
- *Foeniculum vulgare*
- *Genista monspessulana*
- *Lycium ferocissimum*
- *Rubus fruticosus*
- *Salix X fragilis* var. *fragilis*
- *Senecio jacobaea*
- *Ulex europaeus* (Latrobe Council only)

11.5 TASMANIAN *LAND USE PLANNING AND APPROVALS ACT 1993*

The LUPA Act states that 'in determining an application for a permit, a planning authority must (amongst other things) seek out the objectives set out in Schedule 1[934].

Schedule 1 includes 'The objectives of the Resource Management and Planning System of Tasmania' which are (amongst other things):

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[933] Invasive Plants & Animals Committee (2016)

[934] Section 51(2)(b) – Part 4 Enforcement of Planning Control – Division 2 Development Control (*LUPA Act 1993*)

> 'To promote sustainable development of natural and physical resources and the maintenance of ecological processes and genetic diversity'.

Sustainable development includes 'avoiding, remedying or mitigating any adverse effects of activities on the environment'[935].

11.6 TASMANIAN PLANNING SCHEME

In consideration of the requirements of LUPA Act, each municipal area incorporates development standards codes under the appropriate planning scheme. The majority of the proposed route is located within the Latrobe Council Area, less than 2 km of the alignment is within the Devonport Council Area. Latrobe Council both of which operate under the Tasmanian Planning Scheme.

11.6.1 Zoning

As the pipeline route largely passes through agricultural land, the dominant zone in the region is Rural and Agriculture. Smaller areas of general industrial, recreation, village zone are scattered throughout the project area. Neither the rural, agriculture, recreation, village, or general industrial zones have any specifications in relation to the protection of natural values, so the project will not conflict with zone purpose statements (in relation to natural values). The Warrawee Conservation Area is subject to the Environmental Management Zone; however, it is not addressed in this report as it will satisfy the permit requirements through the RAA process.

11.6.2 Code Overlays

Eight code overlays apply to the Project Area, with only one the Natural Assets Code containing provision for the protection of natural values. This code overlay covers waterways and areas of priority vegetation. The waterway and coastal protection area overlay covers a buffer of waterways throughout the Project Area, with width of the buffer varying depending on the class of the waterway. Priority vegetation overlays are largely confined to areas of mature forest and are mostly concentrated to areas around the Warrawee Conservation Area, Moriarty Road, and Northdown.

11.6.3 Assessment of development standards for buildings and works

It is understood that all planning requirements for the development applications to both the Devonport and Latrobe councils are being addressed by Pitt & Sherry in a separate document, thus this report does not address any development standards pertaining to natural values for this project.

12 CONCLUSION

This assessment of impacts of the proposed Sassafras - Wesley Vale Irrigation Scheme Augmentation has determined that with the rigourous mitigation strategies and environmental protection requirements developed by NBES and TI, the construction and operation of the SWISA **will not** have a significant impact on any MNES listed under the EPBC Act .

A number of permits will be required under various State legislation to conduct impact mitigation protocols and to remove one threatened flora species that the construction of the SWISA will impact.

Management and mitigation measures for construction and operation will be clearly detailed within a CEMP and OEMP, which will be submitted for approval alongside Preliminary Documentation.

This report satisfies the requirements Department of Natural Resources and Environment *Guidelines for Natural Values Surveys – Terrestrial Development Proposals*[936], and adequately addreses all relevant MNES in order to satisfy the DCCEEW RFAI that was issued on the 12/02/2024.

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[935] Page 56 – *LUPA Act 1993*

[936] Department of Primary Industries, Parks, Water & Environment (2019)

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APPENDIX A – DEFINITIONS OF CONSERVATION VALUES OF FLORA AND FAUNA SPECIES

SPECIES OF NATIONAL SIGNIFICANCE

Listed in Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

The EPBC Act has six categories of threat status for species:

1. **Extinct -** If at a particular there is no reasonable doubt that the last member of the species has died
2. **Extinct in the wild -** If it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or If it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form
3. **Critically endangered** - If at a particular time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria
4. **Endangered** - If it is not critically endangered; and it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria
5. **Vulnerable** - If at a particular time it is not critically endangered or endangered; and it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
6. **Conservation dependent -** If, at that time, the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years

SPECIES OF STATE SIGNIFICANCE

Listed in Tasmanian *Threatened Species Protection Act 1995*

Threatened flora and fauna species in Tasmania are listed in Schedules 3 (extinct or endangered), 4 (vulnerable) or 5 (rare). These three categories are defined in Section 15 of the Act.

1. **Extinct** - If no occurrence of the taxon in the wild can be confirmed during the past 50 years
2. **Endangered -** If it is in danger of extinction because long-term survival is unlikely while the factors causing it to be endangered continue operating.
3. **Vulnerable** - If it is likely to become an endangered taxon while the factors causing it to be vulnerable continue operating.
4. **Rare** - If it has a small population in Tasmania that is not endangered or vulnerable but is at risk."

Species that have been nominated and approved by the Scientific Advisory Committee for listing in the Act

SPECIES OF REGIONAL OR GENERAL SIGNIFICANCE

The following definitions are from three publications: Flora Advisory Committee 1994, Vertebrate Advisory Committee 1994, Invertebrate Advisory Committee 1994

Flora only - Species listed as rare but not necessarily 'at risk' (**r3**)

Fauna only – Species requiring monitoring (**m**)

Both – Species of unknown risk status (**k**) in Tasmania, or thought to be uncommon within region, or a species having a declining range or populations within the area.

Species considered to be outside its normal range or of an unusual form as determined and justified in the body of the report.

Species identified in regional studies as being of conservation significance that are not listed in current legislation

Species that have been recognised but have not been formally described in a published journal that are thought to significant as determined and justified in the body of the report.

Plant species that are not known to be reserved. To be so it must be known to exist in at least one secure Reserve. Secure reserves include reserves and parks requiring the approval of both Houses of Parliament for their revocation. They include National Parks, Aboriginal Sites, Historic Sites, Nature Reserves, State Reserves, Game Reserves, Forest Reserves, Wellington Park, and insecure reserves in the World Heritage Area which is protected by international agreement under the World Heritage Convention.

APPENDIX B – LEGISLATIVE IMPLICATIONS OF THREATENED SPECIES

Tasmanian State Legislation Affecting Threatened Species

Tasmanian *Threatened Species Protection Act 1995*

Threatened flora and fauna species in Tasmania are listed in Schedules 3 (endangered) and 4 (vulnerable) of the Tasmanian *Threatened Species Protection Act 1995*. Rare species that are considered to be 'at risk' are listed in Schedule 5 of the Act. These three categories are defined in Section 15 of the Act.

1. "An extant taxon of native flora or fauna may be listed as **endangered** if it is in danger of extinction because long-term survival is unlikely while the factors causing it to be endangered continue operating.
2. A taxon of native flora or fauna may be listed as **vulnerable** if it is likely to become an endangered taxon while the factors causing it to be vulnerable continue operating.
3. A taxon of native flora or fauna may be listed as **rare** if it has a small population in Tasmania that is not endangered or vulnerable but is at risk."

The Act provides mechanisms for protecting these species from threatening processes the implementation of 'recovery plans', 'threat abatement plans', 'land management plans', public authority agreements', and 'interim protection orders'.

Section 51 (a) of the TSP Act states that: "A person must not knowingly, without a permit – take, trade in, keep or process any listed flora or fauna". The Act defines 'take' as including: "kill, injure, catch, damage, destroy and collect. A land manager is therefore required to obtain a permit from the Tasmanian Department of Natural Resources and Environment to carry out activity that may adversely affect any of the species listed in the Act.

Commonwealth of Australia Legislation Affecting Threatened Species

Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

The EPBC Act establishes a process for assessing actions that are likely to have impacts to *Matters of National Environmental Significance.* Such impacts include World Heritage Areas, RAMSAR Wetland sites of international importance, migratory species protected under international agreements, nuclear actions, the Commonwealth marine environment and **nationally threatened species and communities.**

Threatened species are defined in several categories:

1. Extinct

- If at a particular there is no reasonable doubt that the last member of the species has died

2. Extinct in the wild

- If it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or
- If it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form

3. Critically endangered

- If at a particular time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria

4. Endangered

- If it is not critically endangered; and it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria

5. Vulnerable

- If at a particular time it is not critically endangered or endangered; and it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

6. Conservation dependent

- If, at that time, the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years

An action that is likely to affect species that are listed in any of the above categories may require ministerial approval unless the Commonwealth Environment Minister has granted an exemption. The Act establishes a **referral process** to Environment Australia to determine whether an action requires a formal **approval** and thus would be required to proceed through the **assessment and approval process**.

A referral must provide sufficient information to allow the Minister to make a decision. The Minister is then required to make a decision within 20 business days of the referral. The Minister may decide an approval is not necessary if the action is taken in a specified manner. The action may not require approval but may require a **permit** if undertaken on Commonwealth land. If an approval is required, then an **environmental assessment** must be carried out. In such instances the environmental assessment approach will be determined by the Minister and may vary from preliminary documentation to a full public inquiry depending on the scale and complexity of the impact.

APPENDIX C – VASCULAR PLANT SPECIES LIST

Status codes:

ORIGIN	NATIONAL SCHEDULE	STATE SCHEDULE
i - introduced	EPBC Act 1999	TSP Act 1995
d - declared weed WM Act	CR - critically endangered	e - endangered
en - endemic to Tasmania	EN - endangered	v - vulnerable
t - within Australia, occurs only in Tas.	VU - vulnerable	r - rare

Name	Common name	Status
DICOTYLEDONAE		
APOCYNACEAE		
Vinca major	blue periwinkle	i
AQUIFOLIACEAE		
Ilex aquifolium	holly	d
ASTERACEAE		
Bedfordia salicina	tasmanian blanketleaf	en
Cassinia aculeata subsp. aculeata	dollybush	
Centipeda elatinoides	spreading sneezeweed	
Cirsium vulgare	spear thistle	i
Hypochaeris radicata	rough catsear	i
Olearia floribunda	flowery daisybush	
Senecio jacobaea	ragwort	d
Senecio linearifolius var. linearifolius	common fireweed groundsel	
Senecio minimus	shrubby fireweed	
Sonchus oleraceus	common sowthistle	i
CAMPANULACEAE		
Lobelia anceps	angled lobelia	
Wahlenbergia sp.	bluebell	
CARYOPHYLLACEAE		
Stellaria sp.	chickweed	i
CASUARINACEAE		
Allocasuarina littoralis	black sheoak	
CONVOLVULACEAE		
Dichondra repens	kidneyweed	
ERICACEAE		
Acrotriche serrulata	ants delight	
Epacris impressa	common heath	
Epacris sp.	heath	
Erica lusitanica	spanish heath	d
EUPHORBIACEAE		
Euphorbia lathyris	caper spurge	i
FABACEAE		
Acacia dealbata subsp. dealbata	silver wattle	

Acacia melanoxylon	blackwood	
Acacia mucronata	variable sallow wattle	
Acacia myrtifolia	redstem wattle	
Acacia stricta	hop wattle	
Acacia terminalis	sunshine wattle	
Acacia verticillata	prickly moses	
Aotus ericoides	golden pea	
Bossiaea cinerea	showy bossiaea	
Daviesia ulicifolia subsp. ulicifolia	yellow spiky bitterpea	
Dillwynia glaberrima	smooth parrotpea	
Genista monspessulana	canary broom	d
Indigofera australis subsp. australis	native indigo	
Lotus sp.	trefoil	i
Lotus uliginosus	greater birdsfoot-trefoil	i
Psoralea pinnata	blue butterflybush	i
Pultenaea daphnoides	heartleaf bushpea	
Pultenaea gunnii	golden bushpea	
Pultenaea gunnii subsp. gunnii	golden bushpea	
Pultenaea juniperina	prickly beauty	
Ulex europaeus	gorse	d
GENTIANACEAE		
Centaurium erythraea	common centaury	i
GERANIACEAE		
Geranium potentilloides var. potentilloides	mountain cranesbill	
Geranium sp.	native geranium	
Pelargonium sp.	stork's-bill	
GOODENIACEAE		
Goodenia lanata	trailing native-primrose	
Goodenia ovata	hop native-primrose	
HALORAGACEAE		
Gonocarpus sp.	raspwort	
Gonocarpus teucrioides	forest raspwort	
LAMIACEAE		
Prunella vulgaris	selfheal	i
LAURACEAE		
Cassytha pubescens	downy dodderlaurel	
Cassytha sp.	dodder-laurel	
LYTHRACEAE		
Lythrum hyssopifolia	small loosestrife	
MENYANTHACEAE		
Ornduffia reniformis	running marsh flower	
MYRTACEAE		
Eucalyptus amygdalina	black peppermint	en
Eucalyptus globulus subsp. globulus	tasmanian blue gum	
Eucalyptus obliqua	stringybark	

Eucalyptus ovata var. ovata	black gum	
Eucalyptus viminalis subsp. viminalis	white gum	
Leptospermum scoparium	common tea-tree	
Melaleuca ericifolia	coast paperbark	
Melaleuca squarrosa	scented paperbark	
ONAGRACEAE		
Epilobium sp.	willowherb	
OXALIDACEAE		
Oxalis sp.	woodsorrel	
PITTOSPORACEAE		
Billardiera heterophylla	bluebell creeper	i
Billardiera longiflora	purple appleberry	en
Billardiera mutabilis	green appleberry	
Bursaria spinosa subsp. spinosa	prickly box	
Pittosporum undulatum	sweet pittosporum	i
POLYGALACEAE		
Comesperma volubile	blue lovecreeper	
POLYGONACEAE		
Acetosella vulgaris	sheep sorrel	i
Persicaria decipiens	slender waterpepper	v
Persicaria lapathifolia	pale knotweed	i
Persicaria prostrata	creeping waterpepper	
Polygonum aviculare	creeping wireweed	i
Rumex brownii	slender dock	
PORTULACACEAE		
Montia australasica	white purslane	
PRIMULACEAE		
Lysimachia arvensis	scarlet pimpernel	i
PROTEACEAE		
Lomatia tinctoria	guitarplant	en
RANUNCULACEAE		
Clematis aristata	mountain clematis	
Clematis sp.	clematis	
Ranunculus repens	creeping buttercup	i
RHAMNACEAE		
Pomaderris apetala	common dogwood	
ROSACEAE		
Acaena novae-zelandiae	common buzzy	
Crataegus monogyna	hawthorn	i
Rosa rubiginosa	sweet briar	i
Rubus fruticosus	blackberry	d
Rubus parvifolius	native raspberry	
RUBIACEAE		

Coprosma quadrifida	native currant	
RUTACEAE		
Zieria arborescens	stinkwood	
SANTALACEAE		
Exocarpos cupressiformis	common native-cherry	
Leptomeria drupacea	erect currantbush	
SOLANACEAE		
Lycium ferocissimum	african boxthorn	d
STACKHOUSIACEAE		
Stackhousia monogyna	forest candles	
STYLIDIACEAE		
Stylidium armeria subsp. armeria	broadleaf triggerplant	
THYMELAEACEAE		
Pimelea humilis	dwarf riceflower	
VIOLACEAE		
Viola hederacea	ivyleaf violet	
WINTERACEAE		
Tasmannia lanceolata	mountain pepper	
GYMNOSPERMAE		
PINACEAE		
Pinus radiata	radiata pine	i
MONOCOTYLEDONAE		
AGAPANTHACEAE		
Agapanthus praecox subsp. orientalis	agapanthus	i
ALISMATACEAE		
Alisma lanceolatum	narrowleaf water plaintain	i
Alisma plantago-aquatica	water plantain	i
ARACEAE		
Zantedeschia aethiopica	arum lily	i
ASPARAGACEAE		
Lomandra longifolia	sagg	
CYPERACEAE		
Carex appressa	tall sedge	
Carex fascicularis	tassel sedge	
Carex inversa	knob sedge	
Cyperus eragrostis	drain flatsedge	i
Eleocharis acuta	common spikesedge	
Eleocharis sphacelata	tall spikesedge	
Gahnia grandis	cutting grass	
Isolepis cernua	nodding clubsedge	
Isolepis inundata	swamp clubsedge	

Isolepis producta	nutty clubsedge	
Lepidosperma concavum	sand swordsedge	
Lepidosperma elatius	tall swordsedge	
Lepidosperma laterale	variable swordsedge	
Lepidosperma longitudinale	spreading swordsedge	
Machaerina tetragona	square twigsedge	
Schoenus apogon	common bogsedge	
HEMEROCALLIDACEAE		
Dianella tasmanica	forest flaxlily	
IRIDACEAE		
Crocosmia Xcrocosmiiflora	montbretia	i
Diplarrena moraea	white flag-iris	
Patersonia fragilis	short purpleflag	
Watsonia meriana var. bulbillifera	bulbil watsonia	i
JUNCACEAE		
Juncus capitatus	capitate rush	i
Juncus filicaulis	thread rush	
Juncus holoschoenus	jointleaf rush	
Juncus pallidus	pale rush	
Juncus planifolius	broadleaf rush	
Juncus procerus	tall rush	
Juncus sarophorus	broom rush	
Juncus sp.	Rush	
Juncus subsecundus	finger rush	
JUNCAGINACEAE		
Cycnogeton procerum	greater waterribbons	
ORCHIDACEAE		
Caladenia carnea	pink fingers	
Caladenia tonellii	robust fingers	CR e
Calochilus platychila	purple beard-orchid	
Chiloglottis reflexa	autumn bird-orchid	
Dipodium roseum	rosy hyacinth-orchid	
Thelymitra ixioides	spotted sun-orchid	
Thelymitra pauciflora	slender sun-orchid	
POACEAE		
Agrostis capillaris	brown top bent grass	i
Anthoxanthum odoratum	sweet vernalgrass	i
Arrhenatherum elatius var. bulbosum	bulbous oatgrass	i
Austrostipa rudis subsp. australis	southern speargrass	
Austrostipa sp.	speargrass	
Bromus catharticus	prairie grass	i
Dactylis glomerata	cocksfoot	i
Distichlis distichophylla	australian saltgrass	
Glyceria maxima	reed sweetgrass	i
Holcus lanatus	yorkshire fog	i
Microlaena stipoides	weeping grass	
Paspalum dilatatum	paspalum	i

Poa labillardierei	silver tussockgrass	
Poa tenera	scrambling tussockgrass	
TYPHACEAE		
Typha latifolia	great reedmace	i
Typha sp.		

PTERIDOPHYTA

ASPIDIACEAE		
Polystichum proliferum	mother shieldfern	
ASPLENIACEAE		
Asplenium flabellifolium	necklace fern	
BLECHNACEAE		
Blechnum minus	soft waterfern	
Blechnum nudum	fishbone waterfern	
Blechnum wattsii	hard waterfern	
DENNSTAEDTIACEAE		
Histiopteris incisa	batswing fern	
Pteridium esculentum subsp. esculentum	bracken	
DICKSONIACEAE		
Calochlaena dubia	rainbow fern	
Dicksonia antarctica	soft treefern	
GLEICHENIACEAE		
Gleichenia microphylla	scrambling coralfern	
LINDSAEACEAE		
Lindsaea linearis	screw fern	

APPENDIX D – VEGETATION COMMUNITY SPECIES COMPOSITION

Site: 1 FAC - Improved pasture with native tree canopy

Grid Reference:	456779E, 5434159N
Accuracy:	GPS (within 10 metres)
Recorder:	Aleida Williams
Date of Survey:	14 Feb 2023
Trees:	*Eucalyptus viminalis subsp. viminalis*
Tall Shrubs:	*Acacia verticillata, Bursaria spinosa subsp. spinosa, Melaleuca ericifolia, Pomaderris apetala*
Shrubs:	*Coprosma quadrifida*
Herbs:	*Senecio linearifolius var. linearifolius*
Graminoids:	*Carex appressa, Juncus procerus, Typha sp.*
Ferns:	*Pteridium esculentum subsp. esculentum*
Weeds:	*Arrhenatherum elatius var. bulbosum, Bromus catharticus, Cirsium vulgare, Dactylis glomerata, Euphorbia lathyris, Vinca major*

Site: 2 DOB - *Eucalyptus obliqua* dry forest

Grid Reference:	460248E, 5434801N
Accuracy:	GPS (within 10 metres)
Recorder:	Aleida Williams
Date of Survey:	14 Feb 2023
Trees:	*Acacia melanoxylon, Eucalyptus obliqua*
Tall Shrubs:	*Bedfordia salicina, Exocarpos cupressiformis, Pultenaea daphnoides*
Shrubs:	*Cassinia aculeata subsp. aculeata, Pultenaea juniperina*
Herbs:	*Gonocarpus teucrioides, Wahlenbergia sp.*
Graminoids:	*Lepidosperma longitudinale, Lomandra longifolia*
Weeds:	*Cirsium vulgare, Crataegus monogyna, Holcus lanatus, Lysimachia arvensis, Rubus fruticosus*

Site: 3 DOV - *Eucalyptus ovata* forest and woodland

Grid Reference:	[redacted]
Accuracy:	GPS (within 10 metres)
Recorder:	Aleida Williams
Date of Survey:	15 Feb 2023
Trees:	*Acacia melanoxylon, Eucalyptus ovata var. ovata*
Tall Shrubs:	*Acacia verticillata, Melaleuca ericifolia*
Shrubs:	*Coprosma quadrifida, Rubus parvifolius, Tasmannia lanceolata*
Herbs:	*Acaena novae-zelandiae, Geranium potentilloides var. potentilloides, Gonocarpus teucrioides, Lobelia anceps, Lythrum hyssopifolia, Rumex brownii, Senecio minimus*
Graminoids:	*Eleocharis acuta, Isolepis cernua, Isolepis producta, Juncus holoschoenus, Juncus procerus, Lepidosperma longitudinale*
Weeds:	*Centaurium erythraea, Cirsium vulgare, Crocosmia Xcrocosmiiflora, Dactylis glomerata, Lotus uliginosus, Lysimachia arvensis, Prunella vulgaris, Sonchus oleraceus*

Site: 4 NME - *Melaleuca ericifolia* swamp forest

Grid Reference: 458143E, 5438817N
Accuracy: GPS (within 10 metres)
Recorder: Aleida Williams
Date of Survey: 15 Feb 2023
Trees: *Acacia melanoxylon*
Tall Shrubs: *Melaleuca ericifolia*
Shrubs: *Coprosma quadrifida*
Herbs: *Acaena novae-zelandiae*
Graminoids: *Carex appressa, Gahnia grandis*
Ferns: *Dicksonia antarctica, Histiopteris incisa*
Weeds: *Rubus fruticosus*

Site: 5 DOV - *Eucalyptus ovata* forest and woodland

Grid Reference: [redacted]
Accuracy: GPS (within 10 metres)
Recorder: Aleida Williams
Date of Survey: 15 Feb 2023
Trees: *Acacia melanoxylon, Eucalyptus globulus subsp. globulus, Eucalyptus ovata var. ovata*
Tall Shrubs: *Acacia verticillata, Bedfordia salicina, Melaleuca squarrosa, Zieria arborescens*
Graminoids: *Gahnia grandis, Lomandra longifolia*
Ferns: *Blechnum nudum, Blechnum wattsii, Gleichenia microphylla, Pteridium esculentum subsp. esculentum*
Climbers: *Clematis aristata*

Site: 6 DOV - *Eucalyptus ovata* forest and woodland

Grid Reference: [redacted]
Accuracy: GPS (within 10 metres)
Recorder: Aleida Williams
Date of Survey: 16 Feb 2023
Trees: *Acacia melanoxylon, Eucalyptus obliqua, Eucalyptus ovata var. ovata, Eucalyptus viminalis subsp. viminalis*
Tall Shrubs: *Bursaria spinosa subsp. spinosa*
Herbs: *Acaena novae-zelandiae*
Graminoids: *Carex appressa, Juncus sarophorus, Lepidosperma longitudinale*
Ferns: *Polystichum proliferum, Pteridium esculentum subsp. esculentum*
Weeds: *Agrostis capillaris, Arrhenatherum elatius var. bulbosum, Dactylis glomerata, Holcus lanatus, Senecio jacobaea*

Site: 7 DSC - *Eucalyptus amygdalina - E. obliqua* damp sclerophyll forest

Grid Reference: 458029E, 5427533N
Accuracy: GPS (within 10 metres)
Recorder: Aleida Williams
Date of Survey: 16 Feb 2023
Trees: *Acacia melanoxylon, Eucalyptus obliqua, Eucalyptus ovata var. ovata, Eucalyptus viminalis subsp. viminalis*
Tall Shrubs: *Bursaria spinosa subsp. spinosa, Pomaderris apetala*
Graminoids: *Carex appressa, Gahnia grandis, Lomandra longifolia*
Grasses: *Poa labillardierei*
Ferns: *Blechnum nudum, Pteridium esculentum subsp. esculentum*
Weeds: *Anthoxanthum odoratum, Cirsium vulgare, Crataegus monogyna, Holcus lanatus, Ilex aquifolium, Rubus fruticosus*

Site: 8 DOB - *Eucalyptus obliqua* dry forest

Grid Reference:	452508E, 5430872N
Accuracy:	GPS (within 10 metres)
Recorder:	Aleida Williams
Date of Survey:	16 Feb 2023
Trees:	*Acacia melanoxylon, Eucalyptus amygdalina, Eucalyptus obliqua*
Tall Shrubs:	*Acacia dealbata subsp. dealbata, Allocasuarina littoralis, Bursaria spinosa subsp. spinosa, Exocarpos cupressiformis, Pomaderris apetala*
Shrubs:	*Acacia stricta, Acacia terminalis, Epacris impressa, Goodenia ovata, Pultenaea gunnii subsp. gunnii*
Herbs:	*Chiloglottis reflexa, Dipodium roseum, Gonocarpus teucrioides*
Graminoids:	*Gahnia grandis, Lepidosperma concavum, Patersonia fragilis*
Ferns:	*Pteridium esculentum subsp. esculentum*
Climbers:	*Billardiera mutabilis*

Site: 9 DSC - *Eucalyptus amygdalina - E. obliqua* damp sclerophyll forest

Grid Reference:	450487E, 5439712N
Accuracy:	GPS (within 10 metres)
Recorder:	Aleida Williams
Date of Survey:	17 Feb 2023
Trees:	*Eucalyptus obliqua, Eucalyptus ovata var. ovata*
Tall Shrubs:	*Acacia verticillata, Melaleuca ericifolia*
Shrubs:	*Rubus parvifolius*
Herbs:	*Acaena novae-zelandiae, Oxalis sp.*
Graminoids:	*Juncus filicaulis, Lepidosperma longitudinale*
Grasses:	*Poa tenera*
Weeds:	*Centaurium erythraea, Rubus fruticosus*

Site: 10 DOB - *Eucalyptus obliqua* dry forest

Grid Reference:	454275E, 5437949N
Accuracy:	GPS (within 10 metres)
Recorder:	Aleida Williams
Date of Survey:	17 Feb 2023
Trees:	*Acacia melanoxylon, Eucalyptus obliqua*
Tall Shrubs:	*Acacia verticillata, Exocarpos cupressiformis, Melaleuca ericifolia*
Shrubs:	*Acacia terminalis, Epacris impressa, Lomatia tinctoria, Pultenaea gunnii, Pultenaea juniperina*
Low Shrubs:	*Acacia myrtifolia, Acrotriche serrulata*
Herbs:	*Dianella tasmanica*
Graminoids:	*Lomandra longifolia*
Ferns:	*Pteridium esculentum subsp. esculentum*
Climbers:	*Billardiera mutabilis, Cassytha pubescens, Clematis aristata*
Weeds:	*Billardiera heterophylla, Centaurium erythraea, Cirsium vulgare, Holcus lanatus, Paspalum dilatatum, Psoralea pinnata, Rubus fruticosus*

Site: 11 DAM - *Eucalyptus amygdalina* forest on mudstone

Grid Reference: 454281E, 5432718N
Accuracy: GPS (within 10 metres)
Recorder: Aleida Williams
Date of Survey: 17 Feb 2023

Trees: *Eucalyptus amygdalina*
Tall Shrubs: *Allocasuarina littoralis, Exocarpos cupressiformis*
Graminoids: *Lepidosperma concavum, Lomandra longifolia*
Ferns: *Pteridium esculentum subsp. esculentum*

Site: 12 DAC - *Eucalyptus amygdalina* coastal forest and woodland

Grid Reference: 462708E, 5438722N
Accuracy: GPS (within 10 metres)
Recorder: Hayley Kingsley
Date of Survey: 15 Feb 2023

Trees: *Eucalyptus amygdalina, Eucalyptus ovata var. ovata*
Tall Shrubs: *Acacia dealbata subsp. dealbata*
Shrubs: *Bossiaea cinerea*
Graminoids: *Juncus pallidus, Juncus procerus*
Ferns: *Pteridium esculentum subsp. esculentum*
Weeds: *Acetosella vulgaris, Erica lusitanica, Genista monspessulana, Holcus lanatus, Hypochaeris radicata, Polygonum aviculare, Rubus fruticosus*

Site: 13 DOV - *Eucalyptus ovata* forest and woodland

Grid Reference: [redacted]
Accuracy: GPS (within 10 metres)
Recorder: Hayley Kingsley
Date of Survey: 15 Feb 2023

Trees: *Acacia melanoxylon, Eucalyptus amygdalina, Eucalyptus ovata var. ovata*
Tall Shrubs: *Melaleuca ericifolia*
Graminoids: *Gahnia grandis, Juncus sp., Lomandra longifolia*
Ferns: *Pteridium esculentum subsp. esculentum*
Weeds: *Acetosella vulgaris, Crataegus monogyna, Hypochaeris radicata, Polygonum aviculare, Rubus fruticosus, Ulex europaeus*

Site: 14 DAC - *Eucalyptus amygdalina* coastal forest and woodland

Grid Reference: 462382E, 5436194N
Accuracy: GPS (within 10 metres)
Recorder: Hayley Kingsley
Date of Survey: 15 Feb 2023

Trees: *Eucalyptus amygdalina*
Tall Shrubs: *Acacia dealbata subsp. dealbata, Bedfordia salicina, Exocarpos cupressiformis, Leptospermum scoparium*
Shrubs: *Cassinia aculeata subsp. aculeata, Epacris sp.*
Herbs: *Gonocarpus sp.*
Graminoids: *Lepidosperma longitudinale, Lomandra longifolia*
Ferns: *Pteridium esculentum subsp. esculentum*
Weeds: *Acetosella vulgaris, Agapanthus praecox subsp. orientalis, Cirsium vulgare, Dactylis glomerata, Holcus lanatus, Hypochaeris radicata, Pinus radiata, Ulex europaeus, Zantedeschia aethiopica*

Site: 15 DOB - *Eucalyptus obliqua* dry forest

Grid Reference:	460522E, 5434840N
Accuracy:	GPS (within 10 metres)
Recorder:	Hayley Kingsley
Date of Survey:	17 Feb 2023
Trees:	*Acacia melanoxylon, Eucalyptus amygdalina, Eucalyptus obliqua, Eucalyptus viminalis subsp. viminalis*
Tall Shrubs:	*Acacia dealbata subsp. dealbata, Bedfordia salicina, Exocarpos cupressiformis, Melaleuca ericifolia, Melaleuca squarrosa, Pomaderris apetala*
Shrubs:	*Cassinia aculeata subsp. aculeata, Dillwynia glaberrima*
Herbs:	*Dianella tasmanica, Gonocarpus teucrioides*
Graminoids:	*Gahnia grandis, Juncus pallidus, Juncus procerus*
Grasses:	*Austrostipa sp.*
Ferns:	*Pteridium esculentum subsp. esculentum*
Climbers:	*Cassytha sp.*
Weeds:	*Anthoxanthum odoratum, Cirsium vulgare, Crataegus monogyna, Cyperus eragrostis, Holcus lanatus, Lotus uliginosus, Lysimachia arvensis, Paspalum dilatatum, Polygonum aviculare, Rubus fruticosus, Ulex europaeus, Vinca major*

Site: 16 DOV - *Eucalyptus ovata* forest and woodland

Grid Reference:	[redacted]
Accuracy:	GPS (within 10 metres)
Recorder:	Hayley Kingsley
Date of Survey:	15 Feb 2023
Trees:	*Acacia melanoxylon, Eucalyptus obliqua, Eucalyptus ovata var. ovata*
Tall Shrubs:	*Melaleuca ericifolia*
Graminoids:	*Juncus pallidus*
Ferns:	*Dicksonia antarctica*
Weeds:	*Cirsium vulgare, Crataegus monogyna, Cyperus eragrostis, Dactylis glomerata, Rubus fruticosus*

Site: 17 FAC - Improved pasture with native tree canopy

Grid Reference:	459216E, 5426535N
Accuracy:	GPS (within 10 metres)
Recorder:	Hayley Kingsley
Date of Survey:	16 Feb 2023
Trees:	*Acacia melanoxylon, Eucalyptus obliqua, Eucalyptus viminalis subsp. viminalis*
Tall Shrubs:	*Acacia dealbata subsp. dealbata, Exocarpos cupressiformis*
Shrubs:	*Coprosma quadrifida*
Graminoids:	*Carex appressa, Gahnia grandis*
Ferns:	*Polystichum proliferum, Pteridium esculentum subsp. esculentum*
Weeds:	*Dactylis glomerata, Holcus lanatus, Rubus fruticosus*

Site: 18 DSC - *Eucalyptus amygdalina* - *E. obliqua* damp sclerophyll forest

Grid Reference:	458918E, 5426935N
Accuracy:	GPS (within 10 metres)
Recorder:	Hayley Kingsley
Date of Survey:	16 Feb 2023
Trees:	*Acacia melanoxylon, Eucalyptus obliqua, Eucalyptus ovata var. ovata, Eucalyptus viminalis subsp. viminalis*
Tall Shrubs:	*Acacia verticillata, Melaleuca ericifolia, Pomaderris apetala*
Shrubs:	*Cassinia aculeata subsp. aculeata*
Graminoids:	*Lomandra longifolia*
Ferns:	*Blechnum wattsii, Pteridium esculentum subsp. esculentum*
Weeds:	*Cirsium vulgare, Holcus lanatus, Rubus fruticosus*

Site: 19 DSC - *Eucalyptus amygdalina* - *E. obliqua* damp sclerophyll forest

Grid Reference:	458748E, 5427138N
Accuracy:	GPS (within 10 metres)
Recorder:	Hayley Kingsley
Date of Survey:	16 Feb 2023
Trees:	*Acacia melanoxylon, Eucalyptus obliqua, Eucalyptus ovata var. ovata, Eucalyptus viminalis subsp. viminalis*
Tall Shrubs:	*Bursaria spinosa subsp. spinosa, Exocarpos cupressiformis, Melaleuca ericifolia, Pomaderris apetala*
Shrubs:	*Coprosma quadrifida*
Herbs:	*Geranium sp., Gonocarpus sp., Goodenia lanata, Oxalis sp.*
Graminoids:	*Carex appressa, Gahnia grandis, Lepidosperma laterale*
Grasses:	*Microlaena stipoides*
Ferns:	*Blechnum wattsii, Polystichum proliferum, Pteridium esculentum subsp.*
Climbers:	*Clematis sp.*
Weeds:	*Stellaria sp.*

Site: 20 DSC - *Eucalyptus amygdalina* - *E. obliqua* damp sclerophyll forest

Grid Reference:	449617E, 5440428N
Accuracy:	GPS (within 10 metres)
Recorder:	Hayley Kingsley
Date of Survey:	17 Feb 2023
Trees:	*Eucalyptus amygdalina, Eucalyptus obliqua, Eucalyptus ovata var. ovata, Eucalyptus viminalis subsp. viminalis*
Tall Shrubs:	*Exocarpos cupressiformis, Melaleuca ericifolia, Pomaderris apetala*
Shrubs:	*Coprosma quadrifida*
Herbs:	*Acaena novae-zelandiae, Gonocarpus teucrioides, Oxalis sp.*
Graminoids:	*Carex appressa, Juncus pallidus, Lepidosperma laterale, Lomandra longifolia*
Grasses:	*Microlaena stipoides*
Ferns:	*Blechnum wattsii, Dicksonia antarctica, Pteridium esculentum subsp. esculentum*
Climbers:	*Comesperma volubile*
Weeds:	*Cirsium vulgare, Crataegus monogyna, Dactylis glomerata, Holcus lanatus, Ilex aquifolium, Lycium ferocissimum, Pittosporum undulatum, Ulex europaeus*

Site: 21 DAM - *Eucalyptus amygdalina* forest on mudstone

Grid Reference:	449908E, 5439977N
Accuracy:	GPS (within 10 metres)
Recorder:	Hayley Kingsley
Date of Survey:	17 Feb 2023
Trees:	*Eucalyptus amygdalina, Eucalyptus obliqua, Eucalyptus ovata var. ovata*
Tall Shrubs:	*Exocarpos cupressiformis, Melaleuca ericifolia*
Herbs:	*Acaena novae-zelandiae, Oxalis sp., Viola hederacea*
Graminoids:	*Lepidosperma laterale, Lomandra longifolia*
Ferns:	*Pteridium esculentum subsp. esculentum*
Weeds:	*Cirsium vulgare, Erica lusitanica, Lotus sp., Ulex europaeus, Watsonia meriana var. bulbillifera*

Site: 22 DSC - *Eucalyptus amygdalina* - *E. obliqua* damp sclerophyll forest

Grid Reference:	454273E, 5432697N
Accuracy:	GPS (within 10 metres)
Recorder:	Hayley Kingsley
Date of Survey:	17 Feb 2023
Trees:	*Acacia melanoxylon, Eucalyptus amygdalina, Eucalyptus ovata var. ovata*
Tall Shrubs:	*Acacia mucronata, Exocarpos cupressiformis, Melaleuca ericifolia*
Shrubs:	*Coprosma quadrifida*
Herbs:	*Geranium sp.*
Graminoids:	*Gahnia grandis, Lepidosperma laterale, Lomandra longifolia*
Grasses:	*Microlaena stipoides*
Ferns:	*Pteridium esculentum subsp. esculentum*
Climbers:	*Billardiera longiflora, Cassytha sp., Comesperma volubile*
Weeds:	*Ulex europaeus*

Site: 23 ASF - Freshwater aquatic sedgeland and rushland

Grid Reference:	458020E, 5438104N
Accuracy:	within 5 kilometre
Recorder:	Aleida Williams
Date of Survey:	17 Feb 2023
Herbs:	*Centipeda elatinoides, Ornduffia reniformis, Persicaria decipiens, Persicaria prostrata*
Graminoids:	*Carex fascicularis, Cycnogeton procerum, Eleocharis acuta, Eleocharis sphacelata, Juncus procerus, Juncus sp.*
Weeds:	*Alisma lanceolatum, Alisma plantago-aquatica, Cyperus eragrostis, Glyceria maxima, Persicaria lapathifolia, Typha latifolia*

Site: 24 WOB - *Eucalyptus obliqua* forest with broad-leaf shrubs

Grid Reference:	452542E, 5430636N
Accuracy:	GPS (within 10 metres)
Recorder:	Aleida Williams
Date of Survey:	12 Mar 2023
Trees:	*Acacia melanoxylon, Eucalyptus obliqua*
Tall Shrubs:	*Acacia dealbata subsp. dealbata, Exocarpos cupressiformis, Pomaderris apetala*
Shrubs:	*Coprosma quadrifida*
Graminoids:	*Gahnia grandis, Lepidosperma longitudinale, Lomandra longifolia*
Ferns:	*Polystichum proliferum, Pteridium esculentum subsp. esculentum*

Site: 25 DOB - *Eucalyptus obliqua* dry forest

Grid Reference:	455297E, 5431528N
Accuracy:	GPS (within 10 metres)
Recorder:	Aleida Williams
Date of Survey:	16 May 2023
Trees:	*Eucalyptus obliqua, Eucalyptus viminalis subsp. viminalis*
Tall Shrubs:	*Exocarpos cupressiformis, Pultenaea daphnoides*
Shrubs:	*Acacia stricta, Epacris impressa, Leptomeria drupacea*
Graminoids:	*Lomandra longifolia*
Ferns:	*Pteridium esculentum subsp. esculentum*

Site: 26 DOB - *Eucalyptus obliqua* dry forest

Grid Reference:	455245E, 5431687N
Accuracy:	GPS (within 10 metres)
Recorder:	Aleida Williams
Date of Survey:	16 May 2023
Trees:	*Eucalyptus obliqua*
Tall Shrubs:	*Exocarpos cupressiformis, Melaleuca ericifolia*
Shrubs:	*Pultenaea juniperina*
Graminoids:	*Gahnia grandis, Lepidosperma longitudinale, Lomandra longifolia*
Ferns:	*Pteridium esculentum subsp. esculentum*

Site: 27 WOL - *Eucalyptus obliqua* forest over *Leptospermum*

Grid Reference:	455786E, 5430281N
Accuracy:	GPS (within 10 metres)
Recorder:	Aleida Williams
Date of Survey:	16 May 2023
Trees:	*Acacia melanoxylon, Eucalyptus obliqua*
Tall Shrubs:	*Acacia verticillata, Melaleuca ericifolia, Melaleuca squarrosa*
Shrubs:	*Cassinia aculeata subsp. aculeata, Goodenia ovata*
Herbs:	*Acaena novae-zelandiae, Epilobium sp.*
Graminoids:	*Carex appressa, Juncus pallidus, Juncus sarophorus, Lepidosperma*
Grasses:	*Distichlis distichophylla*
Ferns:	*Blechnum nudum, Blechnum wattsii, Pteridium esculentum subsp. esculentum*
Weeds:	*Ranunculus repens, Rubus fruticosus*

Site: 28 DOV - *Eucalyptus ovata* forest and woodland

Grid Reference:	[redacted]
Accuracy:	GPS (within 10 metres)
Recorder:	Aleida Williams
Date of Survey:	16 May 2023
Trees:	*Eucalyptus obliqua, Eucalyptus ovata var. ovata, Eucalyptus viminalis subsp. viminalis*
Tall Shrubs:	*Acacia verticillata, Melaleuca ericifolia*
Shrubs:	*Pultenaea juniperina*
Graminoids:	*Carex appressa, Juncus pallidus, Juncus sarophorus, Lepidosperma longitudinale, Lomandra longifolia*
Weeds:	*Cirsium vulgare, Rubus fruticosus*

Site: 29 NAF - *Acacia melanoxylon* swamp forest

Grid Reference:	454331E, 5438298N
Accuracy:	GPS (within 10 metres)
Recorder:	Aleida Williams
Date of Survey:	17 May 2023
Trees:	*Acacia melanoxylon*
Tall Shrubs:	*Melaleuca squarrosa*
Graminoids:	*Carex appressa, Juncus sarophorus, Machaerina tetragona*
Ferns:	*Blechnum minus, Blechnum nudum, Blechnum wattsii, Dicksonia antarctica, Histiopteris incisa, Pteridium esculentum subsp. esculentum*
Weeds:	*Rubus fruticosus*

Site: 30 DOV - *Eucalyptus ovata* forest and woodland

Grid Reference:	[redacted]
Accuracy:	GPS (within 10 metres)
Recorder:	Aleida Williams
Date of Survey:	17 May 2023
Trees:	*Eucalyptus ovata var. ovata*
Tall Shrubs:	*Melaleuca ericifolia*
Graminoids:	*Juncus procerus, Juncus sarophorus, Lepidosperma longitudinale, Lomandra longifolia*
Weeds:	*Dactylis glomerata, Rosa rubiginosa, Rubus fruticosus*

Site: 31 DOB - *Eucalyptus obliqua* dry forest

Grid Reference:	450021E, 5440526N
Accuracy:	GPS (within 10 metres)
Recorder:	Aleida Williams
Date of Survey:	17 May 2023
Trees:	*Eucalyptus amygdalina, Eucalyptus obliqua, Eucalyptus viminalis subsp. viminalis*
Tall Shrubs:	*Acacia verticillata, Bursaria spinosa subsp. spinosa, Exocarpos cupressiformis, Pultenaea daphnoides*
Shrubs:	*Coprosma quadrifida, Daviesia ulicifolia subsp. ulicifolia, Pultenaea juniperina, Rubus parvifolius*
Low Shrubs:	*Aotus ericoides, Indigofera australis subsp. australis, Pimelea humilis*
Herbs:	*Acaena novae-zelandiae, Dichondra repens, Gonocarpus teucrioides, Oxalis sp., Pelargonium sp.*
Ferns:	*Pteridium esculentum subsp. esculentum*
Climbers:	*Billardiera mutabilis*
Weeds:	*Pelargonium sp., Ulex europaeus*

Site: 32 DOV - *Eucalyptus ovata* forest and woodland

Grid Reference:	[redacted]
Accuracy:	within 100 metres
Recorder:	Aleida Williams
Date of Survey:	6 Dec 2023
Trees:	*Eucalyptus ovata var. ovata*
Tall Shrubs:	*Acacia verticillata, Bursaria spinosa subsp. spinosa, Melaleuca ericifolia*
Shrubs:	*Olearia floribunda*
Herbs:	*Acaena novae-zelandiae*
Graminoids:	*Carex appressa, Carex inversa, Diplarrena moraea, Gahnia grandis, Isolepis inundata, Juncus filicaulis, Juncus pallidus, Juncus planifolius, Juncus procerus, Juncus subsecundus, Lepidosperma longitudinale, Lomandra longifolia, Schoenus apogon*
Grasses:	*Austrostipa rudis subsp. australis*
Climbers:	*Clematis aristata*
Weeds:	*Juncus capitatus*

Site: 33 MISC - Incidental Observations

Grid Reference:	E, N
Accuracy:	within 5 kilometre
Recorder:	Aleida Williams
Date of Survey:	31 Dec 2023
Herbs:	*Caladenia carnea, Caladenia tonellii, Calochilus platychila, Montia australasica, Stackhousia monogyna, Stylidium armeria subsp. armeria, Thelymitra ixioides, Thelymitra pauciflora*
Graminoids:	*Lepidosperma elatius*
Ferns:	*Asplenium flabellifolium, Calochlaena dubia, Lindsaea linearis*

APPENDIX E – THREATENED FLORA WITHIN PROJECT AREA[937]

Species	Status EPBC Act	Status TSP Act	Records Within Project Area	Habitat[938]	Likelihood of Occurrence / Impact	Commentary
Acacia ulicifolia juniper wattle	-	Rare	5	*Acacia ulicifolia* is found in sandy coastal heaths and open heathy forest and woodland in the north and east of Tasmania. Populations are often sparsely distributed, and most sites are near-coastal, but it can occasionally extend inland (up to 30 km).	**None**	There is marginal habitat available for this species in DAC vegetation in the northeast of the Survey Area, however this is a distinctive species and is unlikely to have been overlooked during field surveys. There is no likelihood that this species will be impacted by the proposed construction and operation of the SWISA.
Amphibromus neesii southern swampgrass	-	Rare	20	*Amphibromus neesii* is found in damp ground around marshes, lagoons, river flats, pools and streams.	**Very Low**	This species is only known from swampy vegetation within the Rubicon Sanctuary. Although there may be some suitable habitat within the the Survey Area, it was not detected during field surveys, and if present, it is likely to be in very low numbers and may be subject to additional pressures from agricultural use. The proposed construction and operation of the SWISA presents a very low risk to this species.
Caladenia pallida rosy spider-orchid	Critically Endangered	Endangered	1	Appears to be restricted to lowland areas with an annual rainfall less than 1,000 mm. In recent years it has been recorded only from dry *Eucalyptus amygdalina* forest in the northern Midlands at Epping Forest and in the central north at Railton. However, it was once more widespread and may have occupied more diverse habitats.	**None**	A single occurrence is known from the Henry Somerset Orchid Reserve. Habitat is marginal for this species, and surveys within suitable habitat were conducted within the optimal flowering period for this species, and it is unlikely to have been overlooked or confused with another species. There is no likelihood that this species will be impacted by the proposed construction and operation of the SWISA.
Caladenia patersonii Paterson's spider-orchid	-	Vulnerable	1	Favours coastal and near-coastal areas in northern Tasmania, growing in low shrubby heathland and	**None**	Known from a single location in the Rubicon Hills, with very low location accuracy, and recorded in 1972.

[937] Natural Values Atlas data – as at 11 of September 2024
[938] Threatened Species Section (2024a). Species habitat descriptions sourced from relevant threatened species management profiles, note sheets, and listing statements.

Species	Status EPBC Act	Status TSP Act	Records Within Project Area	Habitat[938]	Likelihood of Occurrence / Impact	Commentary
				heathy forest/woodland in moist to well-drained sandy and clay loam.		There is no habitat suitable for this species within the Survey Area, and thus there is no likelihood that this species will be impacted by the proposed construction and operation of the SWISA.
Callitriche sonderi matted waterstarwort	-	Rare	2	*Callitriche sonderi* generally occurs on river flood plains or other places subject to periodic inundation and in Tasmania is only known from the Sea Elephant River on King Island.	**None**	Recorded at two sites on the Mersey River in 2024 in an area of high silt and gravels. There is no habitat suitable for this species within the Survey Area, and thus there is no likelihood that this species will be impacted by the proposed construction and operation of the SWISA.
Calystegia soldanella sea bindweed	-	Rare	1	*Calystegia soldanella* is recorded from coastal sands, mainly in the north-east of the State (but it is now also known from the north-east coast of King Island). It has also been found growing in granite soils and grazed coastal grasslands.	**None**	There is no habitat suitable for this species within the Survey Area, and thus there is no likelihood that this species will be impacted by the proposed construction and operation of the SWISA.
Carex longebrachiata drooping sedge	-	Rare	1	*Carex longebrachiata* grows along riverbanks, in rough grassland and pastures, in damp drainage depressions and on moist slopes amongst forest, often dominated by *Eucalyptus viminalis, E. ovata* or *E. rodwayi.*	**None**	Although there may be some suitable habitat within the the Survey Area, it was not detected during field surveys, and if present, it is likely to be in very low numbers and may be subject to additional pressures from agricultural use. *Carex* is very distinctive at the genus level, and it is unlikely to have been overlooked. There is no likelihood that this species will be impacted by the proposed construction and operation of the SWISA.
Cyrtostylis robusta large gnat-orchid	-	Rare	26	*Cyrtostylis robusta* is known from coastal or near-coastal sites in forest and heathland on well-drained soils. There is sometimes a strong correlation with *Allocasuarina verticillata* on coastal dolerite cliffs.	**None**	There is no habitat suitable for this species within the Survey Area, and thus there is no likelihood that this species will be impacted by the proposed construction and operation of the SWISA.
Desmodium gunnii southern ticktrefoil	-	Vulnerable	3	Occurs in the north and sub-coastal areas of the north-east, with outlying sites at Woolnorth. It grows	**None**	Known from three sites scatted across the Project Area, with no observations made since 1998.

Species	Status EPBC Act	Status TSP Act	Records Within Project Area	Habitat[938]	Likelihood of Occurrence / Impact	Commentary
				mostly in damp sclerophyll forest and woodland, usually on fertile sites.		This species is distinctive and can be identified from leaf morphology at any time of the year. It is also susceptible to grazing, so it is highly unlikely to occur in modified and stock-grazed woodland patches. It is highly unlikely to have been overlooked during field surveys, thus there is no likelihood that this species will be impacted by the proposed construction and operation of the SWISA.
Epacris exserta South Esk heath	Endangered (Pending)	Endangered	1	Occurs along the lower reaches of the South Esk, North Esk and Supply Rivers. It is a strictly riparian species that grows in areas subject to periodic inundation, mainly on alluvium amongst dolerite boulders within dense riparian scrub, and occasionally in open rocky sites. It has been recorded at 10–310 m above sea level.	**None**	There is no habitat suitable for this species within the Survey Area or Construction Corridor. This is also a distinctive species that can be detected at any time of the year, and it is not likely to have been overlooked, thus there is no likelihood that this species will be impacted by the proposed construction and operation of the SWISA.
Euphrasia scabra yellow eyebright	-	Endangered	1	Occurs in moist herb/sedge communities in grassy leads in marshes and in drier open grassy areas at the headwaters of creeks. Its habitat is associated with gaps created by grazing, flooding, or other disturbance. It has been recorded from scattered sites throughout lowland areas of Tasmania, including the north-west coast, central north, Midlands, Eastern Tiers and around Hobart. However, it is considered to be extinct from many of these sites, and populations are low and transient in areas (Eastern Tiers and Hobart) with the greatest probability of still supporting the species.	**None**	The only occurrence of this species in the Project Area was recorded in 1932 and has very low position accuracy. Given the highly modified nature of the Project Area, habitat availability for this species is very limited. *Euphrasia* is distinctive at the genus level and is not likely to have been overlooked, thus there is no likelihood that this species will be impacted by the proposed construction and operation of the SWISA.
Hackelia latifolia forest houndstongue	-	Rare	10	*Hackelia latifolia* is known from four widely separated locations in the State's north, including King Island. Its recorded habitat in Tasmania includes damp eucalypt forest along creek lines and rivers, and *Melaleuca ericifolia* swamp forest.	**None**	Although there is some habitat suitable for this species within the Survey Area and Construction Corridor, this is also a distinctive species that can be detected at any time of the year, and it is not likely to have been overlooked, thus there is no chance of it occurring or being impacted by the proposal.

Species	Status EPBC Act	Status TSP Act	Records Within Project Area	Habitat[938]	Likelihood of Occurrence / Impact	Commentary
Hovea tasmanica rockfield purplepea	-	Rare	2	*Hovea tasmanica* is usually found on dry, rocky ridges or slopes (mostly dolerite) in forest and riverine scrub. This medium to tall, spindly, erect shrub can be detected at any time of the year and can be identified by vegetative characters including form and colour of leaves.	**None**	There is no habitat suitable for this species within the Survey Area or Construction Corridor. This is also a distinctive species that can be detected at any time of the year, and it is not likely to have been overlooked, thus there is no chance of it occurring or being impacted by the proposed construction and operation of the SWISA.
Isolepis stellata star clubsedge	-	Rare	70	*Isolepis stellata* has been recorded from near-coastal areas in the State's north and east, and also in the Northern Midlands near Conara. Habitat includes the margins of sedgy wetlands, wet soaks and seasonally inundated heathy sedgelands; the altitude of recorded sites in Tasmania ranges from close to sea level to elevations of 240 m above sea level.	**None**	There is no habitat suitable for this species within the Survey Area or Construction Corridor. This is also a distinctive species that can be detected at any time of the year, and it is not likely to have been overlooked, thus there is no chance of it occurring or being impacted by the proposed construction and operation of the SWISA.
Lepidosperma viscidum sticky swordsedge	-	Rare	6	*Lepidosperma viscidum* occurs in a range of heathland to heathy/shrubby woodland habitats often dominated by species of *Allocasuarina* on a range of substrates.	**None**	Suitable habitat for this species is sparse throughout the Survey Area. This genus is very distinctive, and the species has distinctive diagnostic traits that are not likely to have been overlooked, thus, there is no chance that this species occurs within the Construction Corridor, thus there is no chance of it occurring or being impacted by the proposed construction and operation of the SWISA.
Leucopogon affinis lanceleaf beardheath	-	Rare	91	*Leucopogon affinis* occurs in a broad range of habitats including tall scrub, mainly on stabilised dune sands and hinterlands, lagoon margins, and gullies and riverbanks in wet eucalypt forest, probably restricted to the Bass Strait islands. Observations near Devonport and Latrobe require confirmation.	**None**	There is no habitat suitable for this species within the Survey Area or Construction Corridor. This is also a distinctive species that can be detected at any time of the year, and it is not likely to have been overlooked, thus there is no chance of it occurring or being impacted by the proposed construction and operation of the SWISA.
Limonium australe var. *australe* yellow sea lavender	-	Rare	135	*Limonium australe* var. *australe* occurs in succulent or graminoid saltmarsh close to the high-water mark, typically near small brackish streams.	**None**	There is no habitat suitable for this species within the Survey Area or Construction Corridor, thus there is no chance of it occurring or being impacted by the proposed construction and operation of the SWISA.

Species	Status EPBC Act	Status TSP Act	Records Within Project Area	Habitat[938]	Likelihood of Occurrence / Impact	Commentary
Lycopus australis Australian gypsywort	-	Endangered	30	Occurs in moist, shaded places including disturbed areas within *Melaleuca ericifolia* swamp forest, *Phragmites australis* reed beds, and rocky (dolerite) riverbeds fringed by riparian scrub.	**None**	Although there is marginal habitat within stands of Melaleuca ericifolia forests, this species is distinctive and is unlikely to have been overlooked, thus there is no chance of it occurring or being impacted by the proposed construction and operation of the SWISA.
Mentha australis river mint	-	Endangered	47	Known from riparian habitats along the lower reaches of the South Esk River, Lake Trevallyn and the Rubicon River, where it occurs along the rocky (dolerite) margins of rivers and lakes.	**None**	There is no habitat suitable for this species within the Survey Area or Construction Corridor, thus there is no chance of it occurring or being impacted by the proposed construction and operation of the SWISA.
Muehlenbeckia axillaris matted lignum	-	Rare	1	*Muehlenbeckia axillaris* is predominantly found in moist gravely or rocky places on the Central Plateau, extending out to the west, north-west and lower reaches of the South Esk River.	**None**	There is no habitat suitable for this species within the Survey Area or Construction Corridor, thus there is no chance of it occurring or being impacted by the proposed construction and operation of the SWISA.
Paraprasophyllum limnetes marsh leek-orchid	Critically Endangered	Endangered	61	Known only from one site near Port Sorell, where it occurs in the ecotone between low-lying marshy heath/sedgeland dominated by rushes and sedges with scattered patches of *Lomandra longifolia* and *Themeda triandra*, and coastal *Eucalyptus amygdalina* woodland with a heathy/grassy understorey.	**None**	This species is known only from a single population at the Rubicon Sanctuary. Due to the highly modified landscape in the broader region, it is unlikely that this species occurs elsewhere outside its current range. Suitable habitat for this species is absent from the Survey Area, thus it has no chance of occurring. The Rubicon Sanctuary is reserved under a conservation covenant and is not at risk of impacts due to the construction and operation of the SWISA.
Paraprasophyllum pulchellum pretty leek-orchid	Critically Endangered	Endangered	327	Known from widely scattered coastal and near-coastal sites in the north, north-west and south-east of the State. It occurs in dense low sedgy heath with pockets of *Melaleuca* or *Leptospermum* on poorly to moderately drained sandy or peaty loam.	**None**	Known only from the far northwest coast of Tasmania, and an isolated subpopulation in the Rubicon Sanctuary. Due to the highly modified landscape in the broader region, it is unlikely that this species occurs elsewhere within the Project Area. Suitable habitat for this species is absent from the Survey Area and it is not likely to be present, thus there is no chance of it

Species	Status EPBC Act	Status TSP Act	Records Within Project Area	Habitat[938]	Likelihood of Occurrence / Impact	Commentary
						occurring or being impacted by the proposed construction and operation of the SWISA.
Paraprasophyllum robustum robust leek-orchid	Critically Endangered	Endangered	3	Known only from one small site in grassy and shrubby *Eucalyptus amygdalina* forest on well-drained brown loam derived from basalt. The species has a much wider historical distribution.	**None**	Within the Project Area, this species is only known from Dooley's Hill near Latrobe, where it has been observed by two well regarded orchid specialists, the most recent being observed in 2008. There is no habitat suitable for this species within the Survey Area or Construction Corridor, thus there is no chance of it occurring or being impacted by the proposed construction and operation of the SWISA.
Parietaria debilis shade pellitory	-	Rare	1	*Parietaria debilis* occurs around muttonbird rookeries, on cliffs/rocks in the salt spray zone, in moist shaded areas in dune scrubs, and under rock overhangs in forested gullies.	**None**	There is no habitat suitable for this species within the Survey Area or Construction Corridor, thus there is no chance of it occurring or being impacted by the proposed construction and operation of the SWISA.
Phyllangium divergens wiry mitrewort	-	Vulnerable	1	Occurs in a wide variety of near-coastal habitats on a range of substrates, a common feature usually being bare ground (e.g. tracks) and rock exposures (e.g. outcrops, coastal cliffs).	**None**	Known from a single site near Shearwater, recorded in 1990. There is no habitat suitable for this species within the Survey Area or Construction Corridor, thus there is no chance of it occurring or being impacted by the proposed construction and operation of the SWISA.
Phylloglossum drummondii pygmy clubmoss	-	Rare	2	*Phylloglossum drummondii* occurs in wet peaty soils where there is little competition from other plants.	**None**	Known only from the Hawley Nature Reserve, last recorded in 1990. This species requires open space, and benefits from frequent fires to reduce competition from other plants. The forest patches within the Survey Area are not subject to frequent fire regimes that this species require, and it is also distinctive and unlikely to have been overlooked if present, thus there is no chance of it occurring. There is no likelihood that this species will be impacted by the proposed construction and operation of the SWISA.

Species	Status EPBC Act	Status TSP Act	Records Within Project Area	Habitat[938]	Likelihood of Occurrence / Impact	Commentary
Pomaderris intermedia lemon dogwood	-	Rare	26	*Pomaderris intermedia* occurs in heathland and heathy woodland on eastern Bass Strait islands but extends to mainly dry sclerophyll forest on mainland Tasmania, most often associated with rock outcrops (dolerite), riparian areas and open forest.	**None**	There is sparsely distributed suitable habitat for this species within the Survey Area or Construction Corridor; however, this is also a distinctive species that can be detected at any time of the year, and it is not likely to have been overlooked, thus there is no chance of it occurring or being impacted by the proposed construction and operation of the SWISA.
Pterostylis squamata ruddy greenhood	-	Vulnerable	1	Occurs in heathy and grassy open eucalypt forest, woodland, and heathland on well-drained sandy and clay loams.	**None**	There is no habitat suitable for this species within the Survey Area or Construction Corridor, thus there is no chance of it occurring or being impacted by the proposed construction and operation of the SWISA.
Pterostylis ziegeleri grassland greenhood	Vulnerable	Vulnerable	1	Restricted to the east and north of Tasmania. In coastal areas, the species occurs on the slopes of low stabilised sand dunes and in grassy dune swales, while in the Midlands it grows in native grassland or grassy woodland on well-drained clay loams derived from basalt.	**None**	There is no habitat suitable for this species within the Survey Area or Construction Corridor, thus there is no chance of it occurring or being impacted by the proposed construction and operation of the SWISA.
Ruppia megacarpa largefruit seatassel	-	Rare	1	*Ruppia megacarpa* occurs in estuaries and lagoons along the east and south-east coasts, and brackish lagoons in the Midlands; there is also an historic record from the Tamar estuary in the States' north.	**None**	There is no habitat suitable for this species within the Survey Area or Construction Corridor, thus there is no chance of it occurring or being impacted by the proposed construction and operation of the SWISA.
Senecio squarrosus leafy fireweed	-	Rare	28	*Senecio squarrosus* occurs in a wide variety of habitats. One form occurs predominantly in lowland damp tussock grasslands. The more widespread and common form occurs mainly in dry forests (often grassy) but extends to wet forests and other vegetation types.	**None**	This species is relatively abundant through dry forests in the north, and southeast of Tasmania. It is thought to recruit after disturbance from fire. Within the Project Area, it is only known from the Rubicon Sanctuary. At the genus level, *Senecio* is distinctive and is unlikely to have been overlooked in areas where suitable habitat may occur. There is no likelihood that this species will be impacted by the proposed construction and operation of the SWISA.

Species	Status EPBC Act	Status TSP Act	Records Within Project Area	Habitat[938]	Likelihood of Occurrence / Impact	Commentary
Spyridium obcordatum creeping dustymiller	Vulnerable	Vulnerable	19	Restricted to the central north coast. In hills to the east of the Dazzler Range near Beaconsfield, it primarily occurs amongst serpentine outcrops in dry open forest or woodland dominated by *Eucalyptus amygdalina.* In coastal areas from Greens Beach to Hawley Beach at Port Sorell, it occurs on sandstone and dolerite in *Allocasuarina verticillata* woodland and *Allocasuarina monilifera* – *Leptospermum scoparium* heath. The species is often associated with outcropping rocks, exposed rock plates and rocky ground. It occurs at altitudes less than 180 m above sea level. It is most abundant in disturbed areas as it can proliferate from soil-stored seed after disturbance.	**None**	There is no habitat suitable for this species within the Survey Area or Construction Corridor, thus there is no chance of it occurring or being impacted by the proposed construction and operation of the SWISA.
Spyridium parvifolium var. *molle* soft dustymiller	-	Rare	1	*Spyridium parvifolium* var. *molle* is endemic to Tasmania, occurring in a range of habitats including riparian, rocky slopes, open woodland and heath. This species is only found in the north-east and the Furneaux group.	**None**	There is no habitat suitable for this species within the Survey Area or Construction Corridor, thus there is no chance of it occurring or being impacted by the proposed construction and operation of the SWISA.
Spyridium parvifolium var. *parvifolium* coast dustymiller	-	Rare	17	*Spyridium parvifolium* var. *parvifolium* mainly occurs in near-coastal areas in northern Tasmania. It occurs in a range of vegetation types, mainly shrubby dry sclerophyll forests and woodlands. It can proliferate from soil-stored seed after disturbance.	**None**	Within the Project Area, this species is recorded in relatively high abundance along the Rubicon River. At the genus level, *Spyridium* is distinctive and is unlikely to have been overlooked in areas where suitable habitat may occur. There is no likelihood that this species will be impacted by the proposed construction and operation of the SWISA.
Tetratheca ciliata northern pinkbells	-	Rare	1	*Tetratheca ciliata* occurs from near-coastal areas in the State's north at elevations below 70 m, ranging from Rocky Cape in the west to Tomahawk / Boobyalla in the east, and an outlying site near Liffey about 60 km inland and 320 m above sea level. It has been recorded from heathlands and heathy	**None**	A single observation from near Port Sorell with very low spatial accuracy and unknown observation date is recorded. This is prolific after fire, however it distinctive and can be detected at any time of year. No occurrences were observed during field surveys, and it is unlikely to have been overlooked.

Species	Status EPBC Act	Status TSP Act	Records Within Project Area	Habitat[938]	Likelihood of Occurrence / Impact	Commentary
				woodlands on sandy well-drained soils, the woodland dominated by *Eucalyptus amygdalina.*		There is no likelihood that this species will be impacted by the proposed construction and operation of the SWISA.
Thelymitra holmesii bluestar sun-orchid	-	Rare	188	*Thelymitra holmesii* occurs in moist areas of grassland, heathy open forest and heathland in water-retentive soils such as clay loam and peaty loam, in soaks, beside streams and around swamp margins, usually below about 200 m above sea level.	**None**	Within the Project Area, most records of this species occur within the Rubicon Sanctuary, with one additional occurrence known from Native Plains Road. Given the modified landscape, this species is unlikely to occur outside of the known populations. No *Thelymitra* species were recorded during field surveys, and although the flowering window for this genus is short, post-flowering material can persist much longer. Suitable habitat for this species is largely absent from the Survey Area. There is no likelihood that this species will be impacted by the proposed construction and operation of the SWISA.
Thelymitra mucida plum sun-orchid	-	Endangered	28	Occurs in moist to wet depressions, swamp margins and other low-lying sites in coastal and near-coastal heathland, heathy forest and shrubland in dark sandy or peaty soils, usually below about 50 m above sea level.	**None**	Within the Project Area, this species only occurs within the Rubicon Sanctuary. Given the modified landscape, this species is unlikely to occur outside of the known populations. No *Thelymitra* species were recorded during field surveys, and although the flowering window for this genus is short, post-flowering material can persist much longer. Suitable habitat for this species is largely absent from the Survey Area. There is no likelihood that this species will be impacted by the proposed construction and operation of the SWISA.

APPENDIX F – CLARIFICATION OF POPULATION DISTRIBUTION OF *CALADENIA TONELLII* (ECOTAS 2023)

FILE NOTE: Mark Wapstra (ECOtas) to Richard White (NBES)

18 May 2023

Richard White enquired about the extent of targeted threatened flora surveys undertaken by ECOtas in the Devil Road area, specifically in relation to *Caladenia tonellii* (but note this is also relevant to *Caladenia caudata*).

ECOtas was engaged by TI to assess for threatened flora during the peak flowering species. Our report was clear that our timing in spring 2022 was appropriate. The primary focus of our surveys was the then nominal 100 m wide survey corridor based on the existing pipeline between the pump station on the Mersey River and the reservoir at the top of the hill (and then along the track to the east, plus some other miscellaneous areas). This area was searched and findings on *Caladenia tonellii* presented. All data has been entered into the NVA.

As part of those assessments, initial discussions on the potential impacts to *Caladenia tonellii* were had, which resulted in the possibility of the new pipeline running along Devil Road and then east up the hill. This was prior to the on-ground surveys (i.e. we discussed "just in case" scenarios to ensure that surveys did not miss the critical window should changes be made). As such, our surveys also covered this route (specifically the areas indicated in the map provided via text), although we did not survey wet forest (as unsuitable habitat). Note that I also searched either side of the road between Devil Road and the reservoir.

The records in the NVA attributed to Mark Wapstra from the last 2 years appropriately show what I believe to be the distribution of *Caladenia tonellii* in this area. Note caveats in my report and also in NVA records regarding taxonomy and identification. ECOtas will continue monitoring this population (and undertaking miscellaneous/opportunistic extension surveys) as part of our engagement by Forico Pty Limited (landowner). If novel sites of threatened flora are detected that may be impacted by the irrigation pipeline, I will ensure you and TI are advised direct (and data will be entered into NVA).

Mark Wapstra

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APPENDIX G – PRE-CLEARANCE CHECK AND DEN DISCOVERY PROTOCOL

SCOPE

This natural values assessment undertaken for the Sassafras – Wesley Vale Irrigation Scheme Augmentation detected suitable denning habitat nearby the project Construction Corridor suitable for Tasmanian devils and spotted-tail quolls, species listed under both the Tasmanian *Threatened Species Protection Act 1995* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

The *Pre-clearance Check and Den Discovery Protocol* has been developed to mitigate potential impacts to devils and quolls the during construction phase. This protocol is required to be implemented across the entire Construction Corridor and associated buffer area, as well as any associated works areas that will require ground disturbance.

With these protocol measures in place, potential for direct impacts (loss of animals) or indirect impacts (disruption of breeding) to devils and quolls will be minimised.

Timeframes

Application of this protocol (**Sections A** through **D**) will be undertaken at least two weeks prior to any vegetation clearance and/or ground-breaking works in a designated works area. Approval to clear in a designated area (**Section C**) will be valid for up to eight weeks from completion of the protocol. The protocol measures must be in place for the entire construction.

Responsible Parties

The protocol will be overseen by suitably qualified ecologists (the Ecologist) and Tasmanian Irrigation. Clauses within the protocol will be conducted by the Ecologist with minor components able to be undertaken by the contractor. Some oversight and control of hold-points will be required by either regulators or the proponent and in that case linked to contract requirements for the contractor. Responsible personnel for each task within the protocol are set out in the *Pre-clearance Check and Den Discovery Protocol: Ground Survey Methods* document.

Protocol Application Area

This Protocol Application Area covers the Construction Corridor impact area and a 50 m buffer of the Construction Corridor for the entirety of the Project Area (**Figures G1-6**).

Permit Requirements

Approval to decommission any den (inactive: **Section A(vii)** or active: **Section B**) will require a permit to take products of wildlife, issued under the *Nature Conservation Act 2002* by the Tasmanian Department of Natural Resources and Environment.

Definitions

Suitably qualified ecologist – a consultancy or individual who has relevant professional qualifications, permits, and ethics approval, and at least 3 years of work experience writing and implementing management plans for the relevant protected matter; has implemented and reported on management plans for the habitat of the particular protected matter; can demonstrate the efficacy of those management plans, and in the event of ineffective measures, can demonstrate and implement corrective actions and solutions to achieve the desired outcomes; and can give authoritative assessment and advice on offset management to improve the habitat quality of the protected matter using relevant protocols, standards, methods and/or literature. Additionally, the ecologist must have experience in the identification of fauna and fauna dens for all species listed within the protocol.

Den site - Soil burrows/holes in the substrate with an appropriate entrance hole, clusters of boulders with cavities, dense clumps of vegetation with visible animal use, rock outcrops, and dry hollow logs.

Optimal/Suboptimal/Unsuitable denning habitat – General suitability of an area based on likelihood of containing suitable den sites, as outlined in Table 14 of the natural values assessment.

CHECKLIST

- ☐ Identify parties responsible for protocol application in the area of proposed works.
- ☐ Conduct walkover of Protocol Application Area at least two weeks prior to any vegetation clearance and/or ground-breaking works in a particular area (**Section A**).
- ☐ Investigate potential den sites to determine likelihood of usage.
- ☐ Establish 50 m exclusion zones around any den with activity or potential for activity.
- ☐ Decommission any dens in the Construction Corridor deemed to be inactive.
- ☐ Conduct a den monitoring assessment on any potentially active dens (**Section B**).
- ☐ Where a maternal den or continuously occupied den is identified, retain exclusion zone and continue monitoring until the absence of natal activity is confirmed.
- ☐ Where a den is occupied by a non-maternal devil or quoll, or another species:
    - o Within the Construction Corridor – Confirm vacancy (with or without gate) and decommission;
    - o Potential to intersect with the Construction Corridor – Install one-way gate and confirm vacancy;
    - o Outside of the Construction Corridor – No further action.
- ☐ Lift exclusion zones where applicable.
- ☐ Seek approval for clearance.

PRE-CLEARANCE CHECK AND DEN DISCOVERY PROTOCOL

A- Pre-clearance check for potential dens

(i) At least two weeks prior to any vegetation clearance and/or ground-breaking works in a particular area, a walkover of the Protocol Application Area must be undertaken to systematically search for potential dens. Conditions of the pre-clearance search are as follows:

a. In areas of optimal and sub-optimal denning habitat, pre-clearance searches must be undertaken by the Ecologist.

b. In areas of highly modified and agricultural land (unsuitable denning habitat), pre-clearance searches can be undertaken by the contractor under guidance and training by the Ecologist and will be independently audited for assurance and verification purposes. Any potential den site recorded in modified and agricultural land by the contractor must be clearly marked on the ground and **Sections A(ii) and A(iii)** must then be conducted by the Ecologist

(ii) Any potential den sites[939] will be investigated and recorded by the Ecologist. Potential dens are mostly soil burrows/holes in the substrate with an appropriate entrance hole, but also include

[939] As devils and quolls are known to opportunistically occupy burrows dug by other species (principally wombats), the protocol manages any burrow as potential habitat for a listed threatened species.

clusters of boulders with cavities, dense clumps of vegetation with visible animal use, rock outcrops, abandoned mine shafts, and dry hollow logs.

(iii) The general quality of each potential den will be inspected in relation to factors such as soil warmth (sunlight), proneness to inundation, landscape position, *etc.* Factors including spider webs, delicate fungi, wear marks, hairs, scats, and footprints at potential den entrances will be noted as potential indicators of activity (or non-activity). The Ecologist will use this information to determine the likelihood of usage and the need for further assessment.

(iv) **Section B**, the 'den monitoring assessment', will be applied to any potential den where:

a. The Ecologist concludes has evidence of use by a devil or quoll;

b. The occupying species that cannot be determined;

c. Any den that is considered to be highly suitable for devil or quoll occupation but does not have definitive evidence of being vacant at the time of assessment.

(v) An exclusion zone of a 50 m radius must be established around any potential den that warrants application of **Section B** and will remain in place until the requirements of **Section B** are completed.

(vi) Vegetation clearance and/or ground-breaking works cannot commence in the exclusion zone until that den or burrow is confirmed vacant and the exclusion zone can be lifted as per **Section C**.

(vii) Any potential den within the Construction Corridor impact area that the Ecologist advises is not being used (*i.e.* definitively inactive and vacant) can be decommissioned under a permit to destroy a product of wildlife under the NC Act.

(viii) If a potential den that is not within the Construction Corridor impact area that the Ecologist advises is not being used (*i.e.* definitively inactive and vacant), it should not be decommissioned, and **Section C** will apply.

(ix) If no potential dens are found that require application of **Section B**, the application of the protocol can proceed to **Section C**.

B- Den monitoring assessment

(i) Any den deemed by the Ecologist to be possibly occupied by a devil or quoll, a den monitoring assessment must be undertaken as follows:

a. At least two infra-red motion sensor cameras will be installed at each entrance of each burrow. Camera settings will be - sensitivity: high; capture method: video; capture length > 20 sec; capture delay interval: 0 seconds.

b. Cameras must remain in place for at least 7 nights.

(ii) Footage will be inspected to identify captures[940], with the following possible outcomes (with input from the Ecologist if devils or quolls are captured):

a. If a pouch-laden devil or quoll, an imp (young devil), or a kitten (young quoll) is recorded using a den, or if an individual devil or quoll displaying natal characteristics is recorded

[940] If this is done in the field, outcomes a, b, c or d may apply immediately. If memory cards are collected for desktop analysis, cards (and batteries if necessary) will be replaced, and camera(s) will remain in place for continued monitoring until action can be informed by the footage. In other words, monitoring will always continue up until the point of decommissioning, which will only be undertaken when an assessment of all footage up until that time has established the den is vacant at the time. A one-way gate may be used in any of the different outcomes to facilitate vacancy (only if the 7 nights of footage has sufficiently informed the action).

using a den for two or more nights, then the den will be treated as a likely maternal den and **Section B(iii)** will apply.

b. If any devil or quoll is using a den regularly (*i.e.* almost every night) **Section B(iii)** will apply

c. If a den is found to be in regular use degree by a species other than a devil or quoll **Section B(iv)** or **Section B(v)** will apply.

d. If a den is found to be in opportunistic use only by any species (*i.e.* not occupied for several consecutive nights; in which scenario there are usually several different animals and species frequenting the potential den) **Section B(iv)** or **Section B(v)** will apply.

e. If a potential den is within the Construction Corridor and is found to be inactive (no evidence of use), it can be decommissioned, and **Section C** will apply.

f. If a potential den is **not** within the Construction Corridor and it is found to be inactive, it should **not** be decommissioned, and **Section C** will apply.

(iii) Where the Ecologist deems the den likely to be an active maternal devil or quoll den, a 50 m exclusion zone must remain in place and monitoring will continue until the Ecologist determines there is no current natal activity:

a. Continued monitoring definitively establishes that the den is not consistently occupied by a breeding female (e.g. pouch-laden females may visit multiple dens before dropping their young in one location, and some females may be observed showing natal characteristics [such as lactating and scent marking] around dens in which they have not dropped their young) – **Section B(iv)** or **Section B(v)** will apply

b. Continued monitoring establishes the occupying devil or quoll is not a breeding female – **Section B(iv)** or **Section B(v)** will apply

c. The den is no longer necessary for the rearing of young and it is confirmed that the mother and young have discontinued use of the den – **Section B(iv)** or **Section B(v)** will apply

(iv) Where the den is within the Construction Corridor, and the Ecologist establishes the den is active but not a maternal devil or quoll den:

a. Camera footage from the night and morning immediately prior to the inspection will be used to determine occupancy at that time.

b. If the potential den is conclusively vacant at the time of inspection, it will be decommissioned at that time.

c. If an animal is within the burrow at that time, either a one-way gate will be installed to aid eviction, or the burrow will be revisited the following day and occupancy re-determined based on the footage from the previous night and morning.

d. Monitoring of the potential den (with or without a gate) will continue until a time when it is conclusively vacant at the time of inspection and can be decommissioned.

(v) Where the den is outside of the Construction Corridor, and the Ecologist establishes the den is active but not a maternal devil or quoll den:

a. If there is potential for the burrow/den to extend below ground into the Construction Corridor impact area, a one-way gate will be installed, and monitoring must continue until a time when it is conclusively vacant, and **Section C** will apply.

b. If there is no potential for the den to intersect with the Construction Corridor impact area, no action will be taken, and **Section C** will apply.

C- Reporting and regulation

(i) If **Section B** does not apply, the contractor can advise the proponent (or regulator) of the area searched and seek approved clearance (release of hold point) within the designated area.

(ii) If **Section B** applies, the area approved for clearance will be conditional upon the maintenance of exclusion zones around active dens or dens still under assessment. Once the monitoring requirements of **Section B** are completed and dens have been decommissioned, the contractor can request exclusion zones are lifted and un-conditional clearance granted for the designated area.

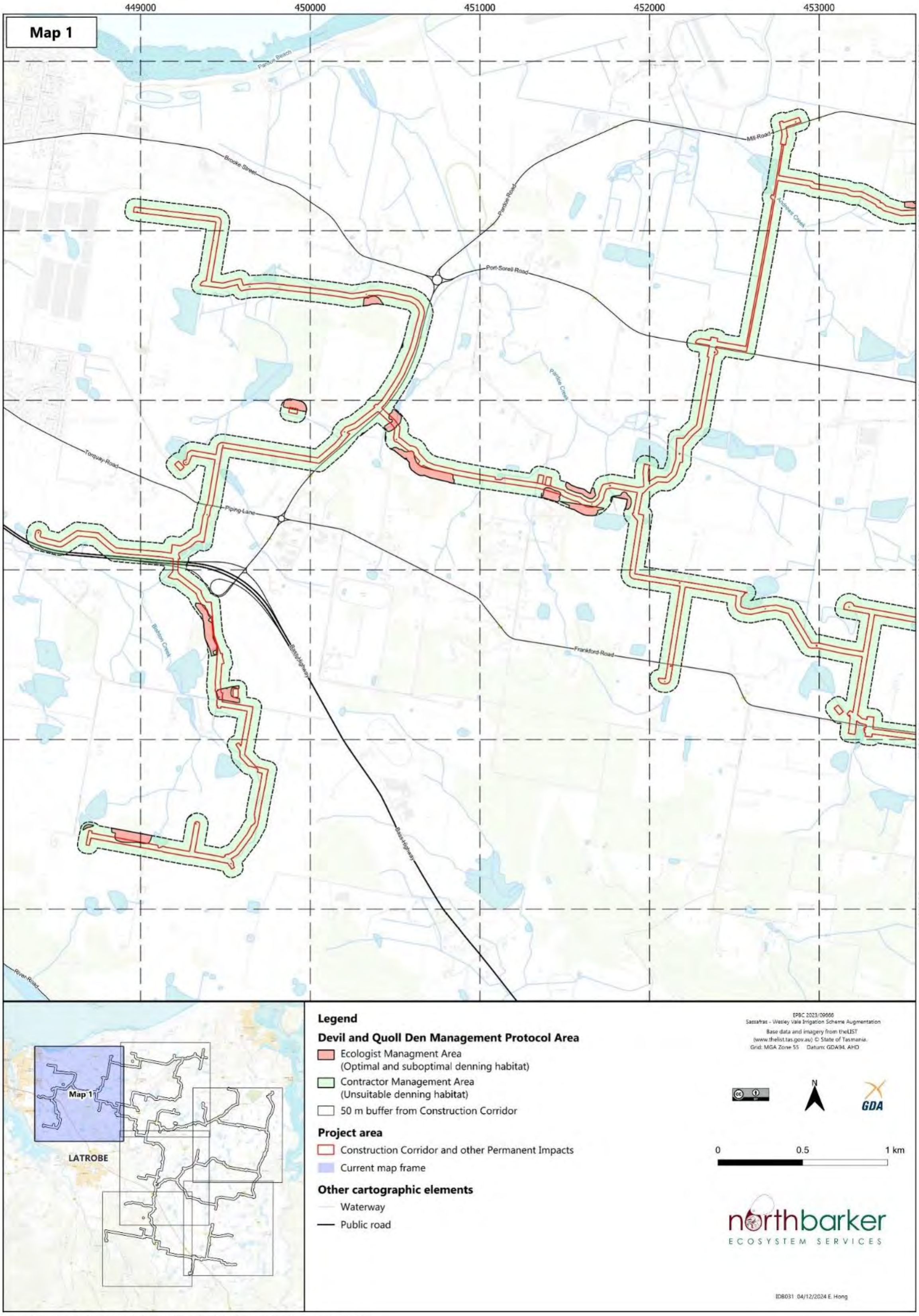
(iii) Approval to clear in a designated area is only valid for up to 8 weeks, after which time a new den check and assessment (**Sections A** and **B**) is required unless an extension to this window is approved by the proponent and regulator (noting an extension may be considered sufficiently low risk in some scenarios, as informed by **Section A** and **B** results).

(iv) If the works area is divided into coupes, the process must be repeated until surveying of the entire footprint is complete.

D- Unanticipated discoveries

Notwithstanding **Section C (i)** and **(ii)**, should a previously unidentified or unanticipated discovery of a potential den be found by the contractor (or other parties) during works, an assessment as per **Section A** must be undertaken, and, if necessary, the den monitoring assessment as per **Section B** adopted.

Pre-clearance Check and Den Discovery Protocol Application Area



The mapping has been undertaken using a hand held GPS and subjective interpretation. Consequently it should be considered indicative only.

Figure G1: Pre-clearance check and den discovery protocol application area

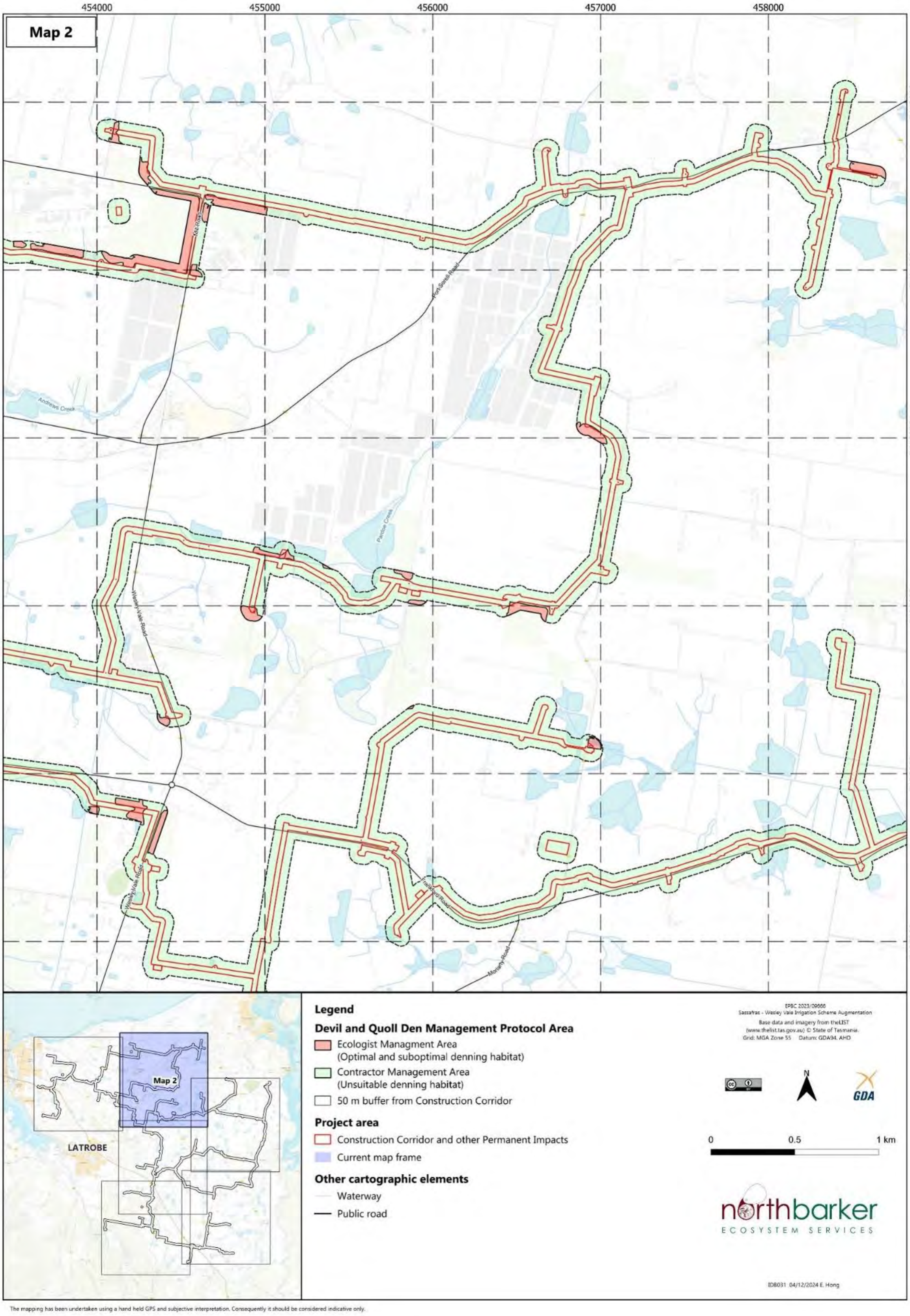


Figure G2: Pre-clearance check and den discovery protocol application area

northbarker
ECOSYSTEM SERVICES

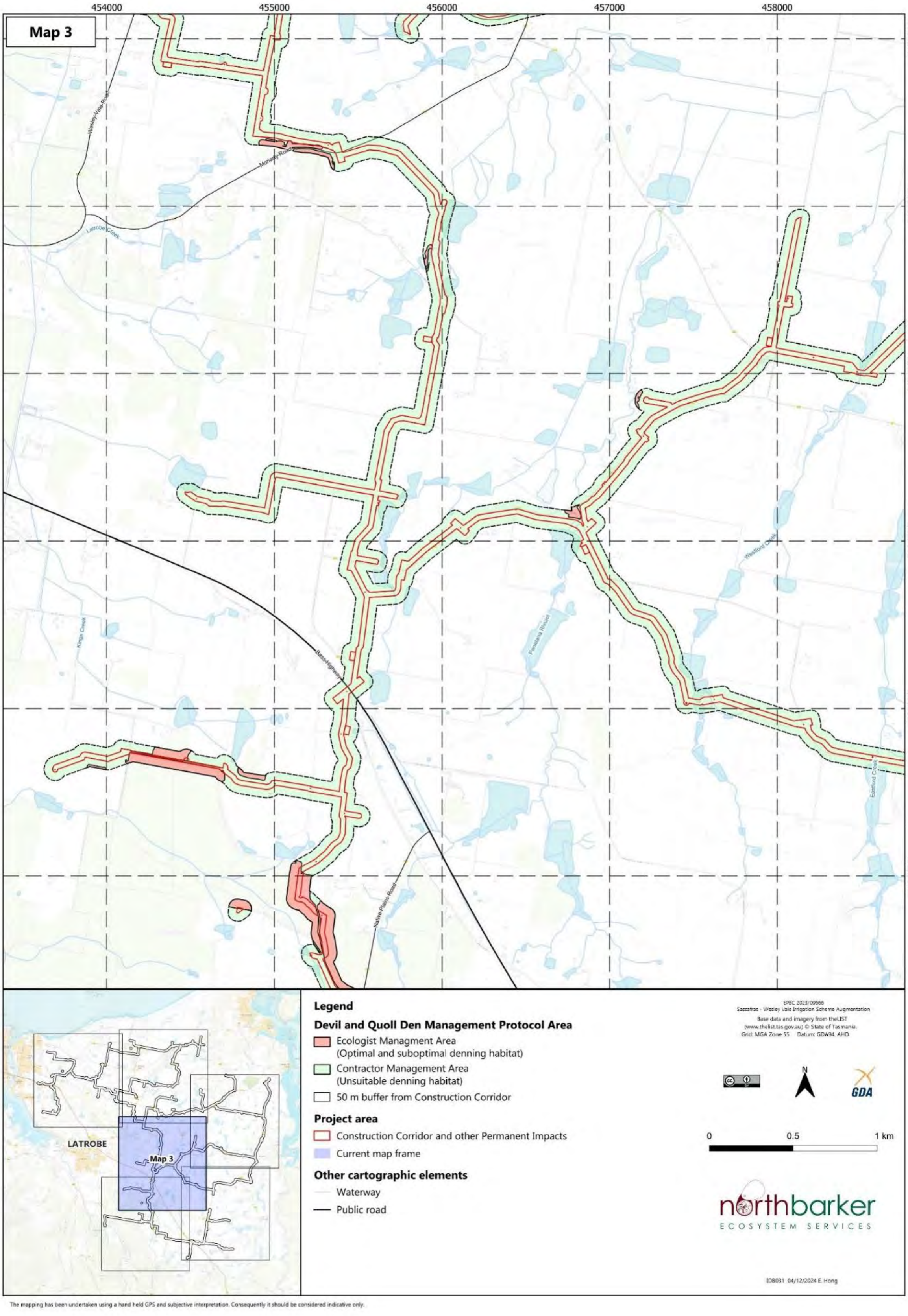
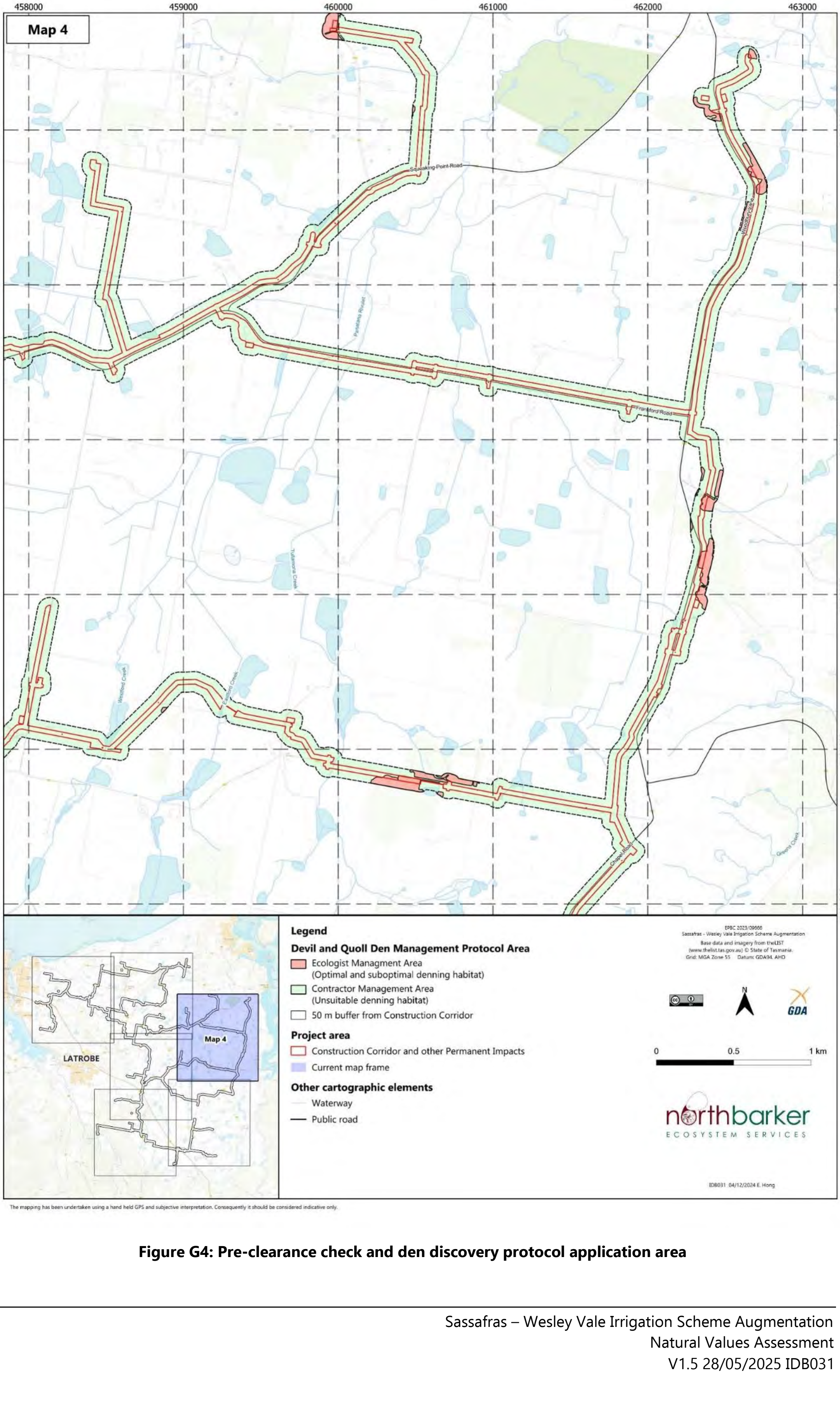


Figure G3: Pre-clearance check and den discovery protocol application area



The mapping has been undertaken using a hand held GPS and subjective interpretation. Consequently it should be considered indicative only.

Figure G4: Pre-clearance check and den discovery protocol application area

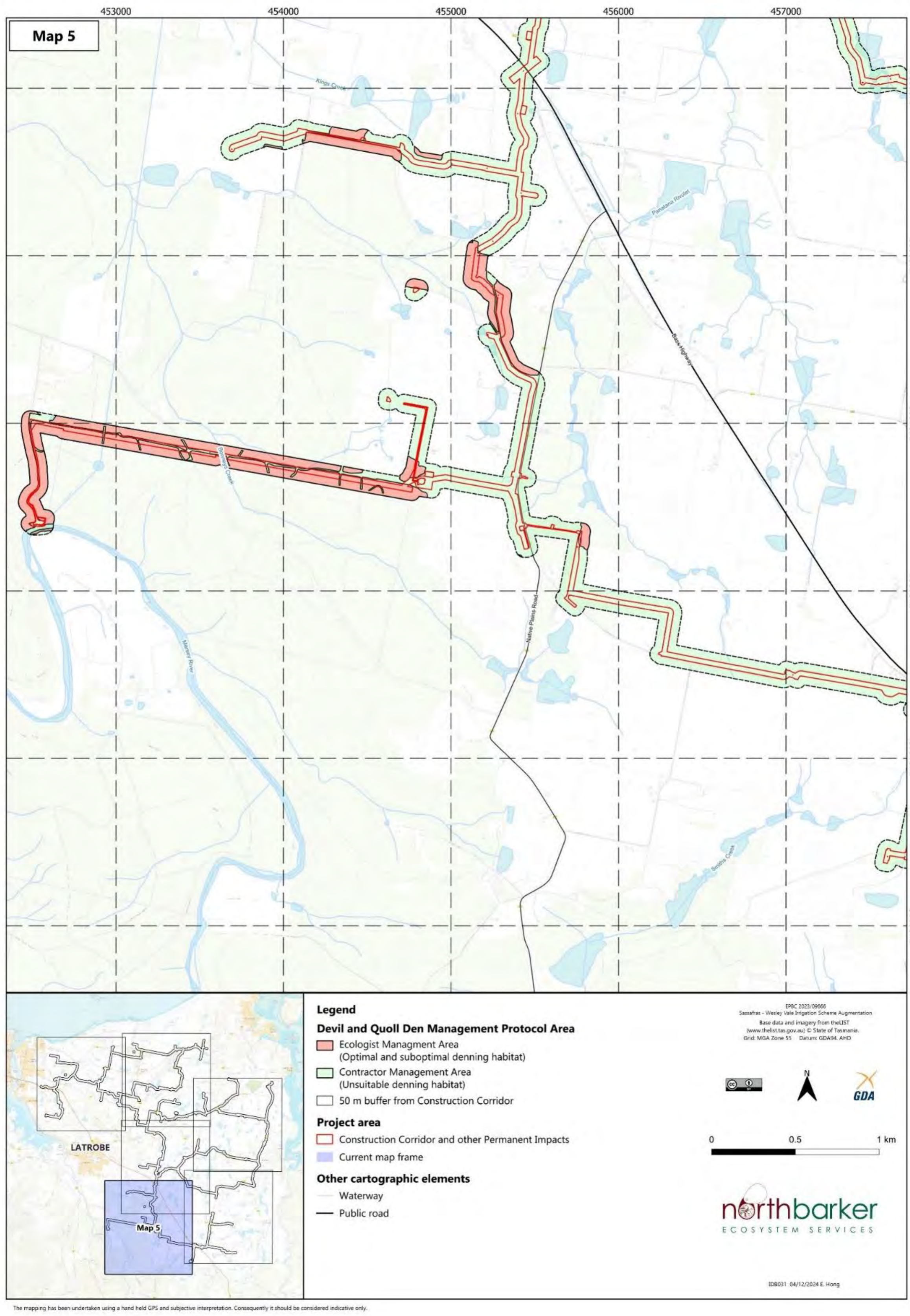


Figure G5: Pre-clearance check and den discovery protocol application area

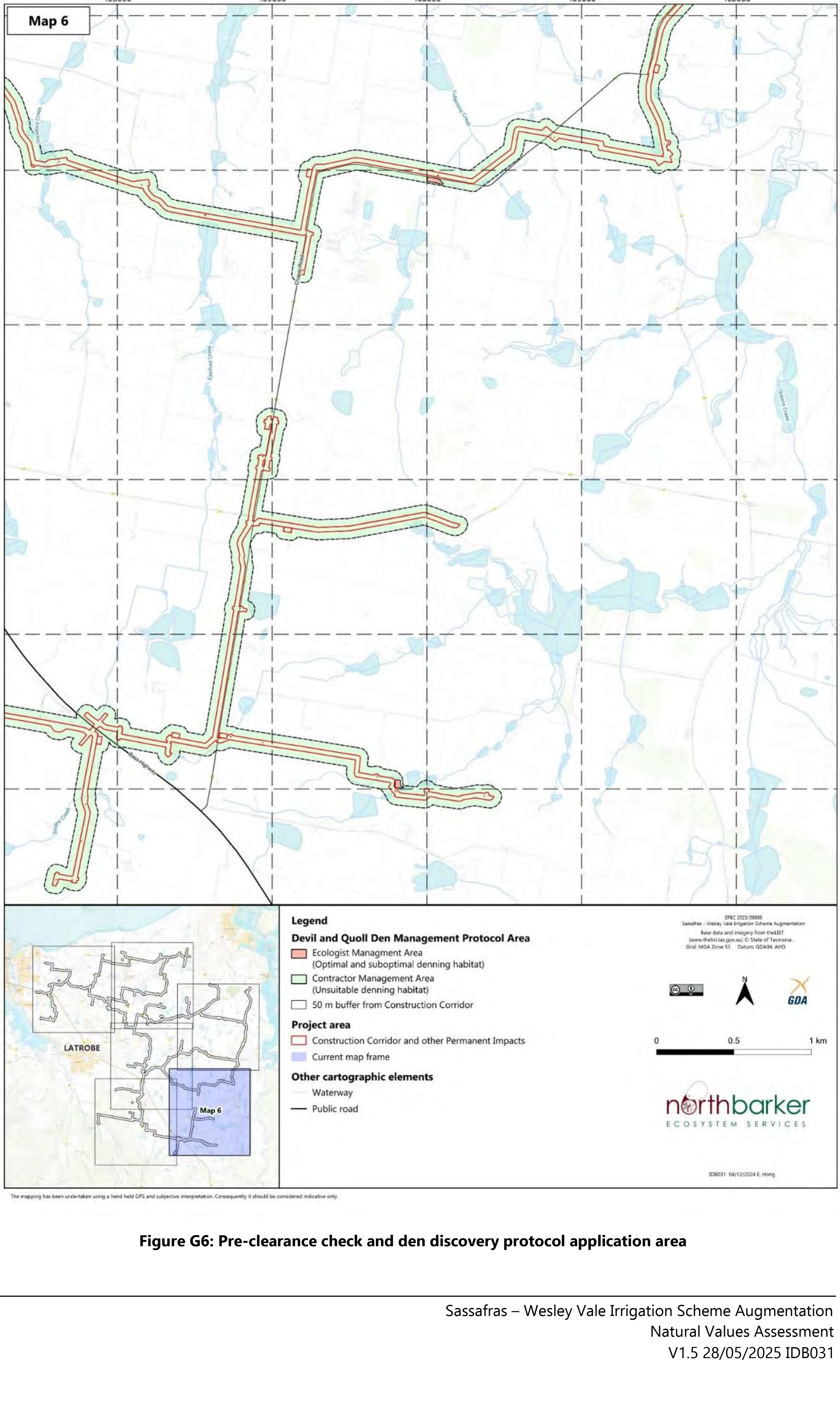
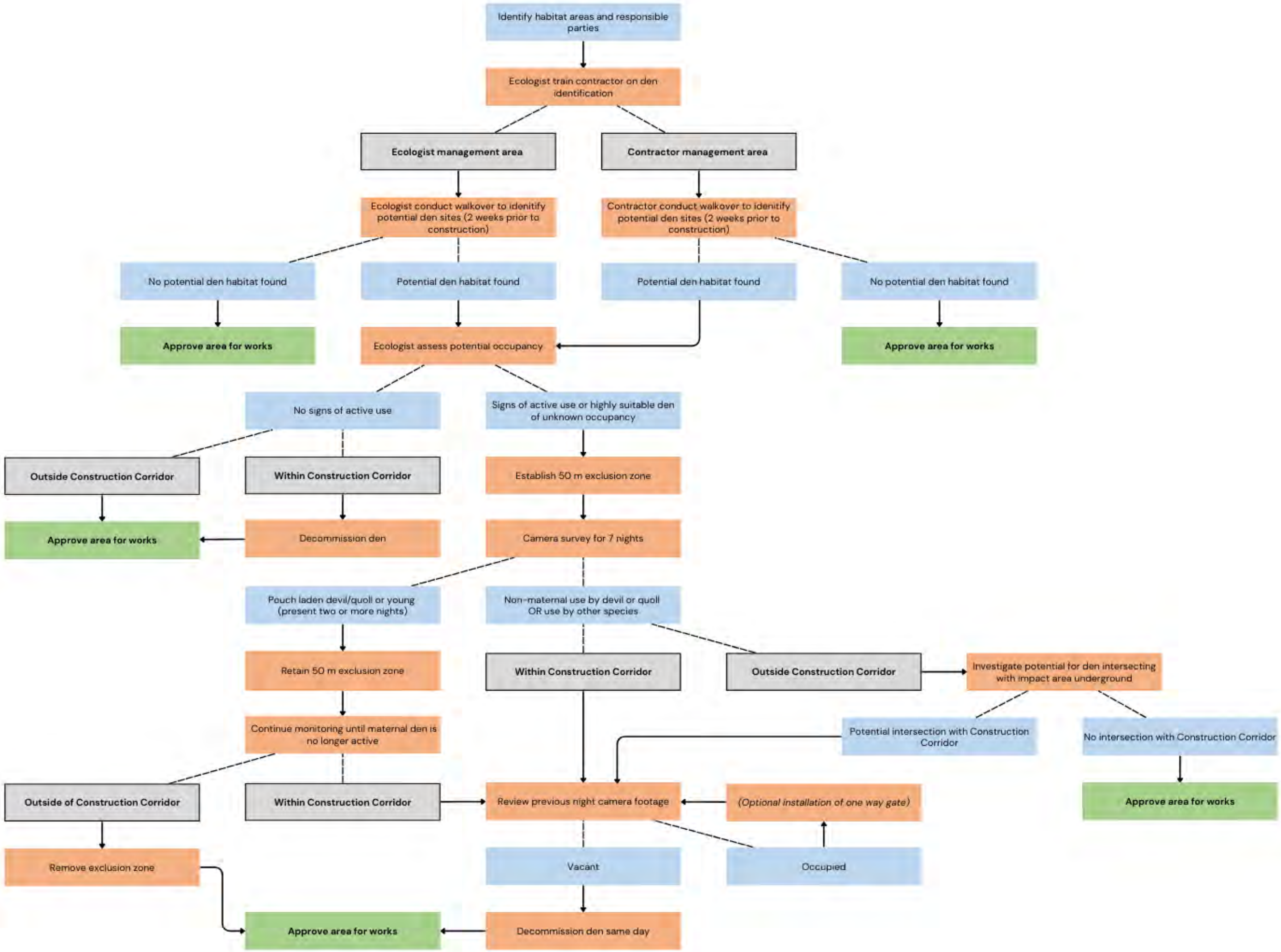


Figure G6: Pre-clearance check and den discovery protocol application area

Flowchart of Protocol Operations



APPENDIX H – ROADKILL MITIGATION STRATEGY

Scope

This natural values assessment undertaken for the Sassafras – Wesley Vale Irrigation Scheme Augmentation detected activity of Tasmanian devils and spotted-tail quolls within the project Construction Corridor, species listed under both the Tasmanian *Threatened Species Protection Act 1995* and the federal *Environment Protection and Biodiversity Conservation Act 1999.*

This *Roadkill Mitigation Strategy* has been developed to mitigate increased roadkill risk during the construction phase of the SWISA project. This strategy is applicable where Tasmanian devil or quoll roadkill mortalities are expected to increase by more than 10 % (as determined by a traffic impact assessment and a roadkill assessment). This strategy is required to be implemented at the initiation of the project construction phase, and the civil contractor must comply with all roadkill mitigation measures, including monitoring and managing compliance.

Protocols outlined in the strategy have been adapted from the '*Survey guidelines and management advice for development proposals that may impact on the Tasmanian Devil 2015*' (the Survey Guidelines[941]), which outlines a process for assessing the potential impacts of developments requiring road usage on Tasmanian devils. This process focuses on identifying and mitigating impacts on devils, but the mitigation measures are also suitable for reducing road mortalities for other native fauna, including quolls.

With these mitigation measures in place, project-specific roadkill mortalities can be minimised, with regular monitoring and periodic data review in place to trigger contingency measures if needed.

<u>Timeframes</u>

Application of the strategy protocols is required for the duration of the construction phase of the project.

<u>Responsible Parties</u>

The protocol clauses are to be implemented and enforced by the civil contractor. The protocol will be overseen by Tasmanian Irrigation, with independent review undertaken by an ecologist. Some oversight will be required by regulators in the form of wildlife collision reporting and, in that case, linked to contract requirements for the contractor. The protocol will apply (where relevant) to all project related vehicles operating within or travelling to the Project Area during the construction phase.

<u>Definitions</u>

Project Area - The Project Area is defined as a 5 km buffer of the proposed pipeline alignment (as supplied 15/07/2024).

Project related vehicles - All Tasmanian Irrigation, civil contractor and sub-contractor vehicles operating within or travelling to the Project Area during the construction phase.

Night-time hours – The period between one hour before dusk and one hour after dawn.

Daylight hours – The period between one hour after dawn and one hour before dusk.

[941] Environment Strategic Business Unit (2023)

Checklist

- ☐ Inform all vehicle operators of relevant management areas, protocol restrictions, roadkill removal and reporting requirements (**Section A**).
- ☐ Install road speed signs on local roads and private land indicating daytime and nighttime speed limits and restrictions for project related traffic (**Section B**).
- ☐ Install advisory fauna warning signs in "High Risk" road sections (**Section C**).
- ☐ Limit heavy vehicle traffic to daylight hours or implement **Section D(ii)** protocols where applicable in special circumstances (**Section D**).
- ☐ Record all wildlife vehicle collisions involving project vehicles (**Section E**).
- ☐ Monitor all internal roads within the current works or commute routes daily for roadkill (noting when, where and species of any roadkill) and, where safe to do so, move carcasses from the road immediately upon location (**Section F**).
- ☐ Report all wildlife hit by project vehicles to TI, and to NRE through the Roadkill Reporter app (**Section G**).
- ☐ Submit roadkill data for independent review at least every six months (**Section G**).
- ☐ Monitor and enforce compliance of speed limits, heavy vehicle restrictions and reporting/removal of roadkill (**Sections A-G**).

Roadkill Mitigation Strategy

A- Application of the protocol

(i) The protocol applies to all operators of project-related vehicles, including Tasmanian Irrigation, civil contractor and sub-contractor vehicles operating within or travelling to the Project Area during the construction phase.

(ii) It is a requirement of the contractor to define the variation in the night-time period in relation to the various requirements on a week-by-week basis as part of their construction environment management practices.

B- Speed restrictions - Local roads and private land

(i) Road speed limits for project vehicles must be set at a maximum of 80 km/h during daylight hours and at 60 km/h during night-time on all local roads and private land within the Project Area, excepting:

a. Where the speed limits may be less than these amounts under existing conditions; or

b. Under temporary conditions applied for other road traffic management.

(ii) In addition, in areas identified as high devil and quoll activity, including those within the Warrawee Conservation Area, project vehicles are prohibited during night-time hours unless for emergency works. In the event of emergency works, vehicles must be limited to 20 km/h on private roads, and 40 km/h on public roads.

(iii) Speed limits must be advertised using semi-permanent project specific signage and enforced under contract requirements.

(iv) Advisory speed recommendations of 60 km/h during night-time hours must be in place for project vehicles travelling in or commuting to the Project Area using State roads identified as High Risk within the Traffic Impact Assessment (**Attachment F**) excepting:

a. Vehicles travelling on the Bass Highway, Frankford Road, and Port Sorell Road. All vehicles travelling on these roads must adhere to any night-time advisory signage.

C- Additional signage

(i) Advisory warning signage (Slow Down Dusk to Dawn) must be installed in areas identified as high devil and quoll activity areas, including those within the Warrawee Conservation Area.

D- Heavy vehicles

(i) Heavy rigid vehicles or larger must be limited to daylight hours unless special circumstances apply.

(ii) Special circumstances may require transport outside of daylight hours only in accordance with the conditions defined in the following subclauses:

a. Special purpose heavy vehicles moving large plant and equipment may operate outside the above times when it is a road traffic requirement to minimise impact on other traffic, and/or comply with any other road authority permits – in such cases these vehicles must have a lead escort vehicle and be limited to a maximum speed of 60 km/h whilst on project roads.

b. In the event that general cartage heavy vehicles are prevented from operating during daylight hours, such as due to weather events, these vehicles must be limited to a maximum speed of 60 km/h during night-times on all project roads (unless exempt under **Section B(iv)(a)**) – in such cases, these vehicles must travel in a convoy of a minimum of 2 vehicles, with convoys to be separated by at least 15 minutes – by travelling in a convoy, the frequency of individual heavy vehicles will be reduced, thus reducing roadkill opportunities.

E- Wildlife vehicle collisions

(i) No animals are to be deliberately killed with vehicles.

(ii) Project vehicles must be fitted with a basic, high-frequency animal repellent device (which emits an ultra-sonic sound wave at speeds above 50 km/h). The installation and operation of these devices will be audited periodically as part of the contractors CEMP requirements (to be linked to contract commitments).

(iii) Wildlife hit by project vehicles must be recorded, including details of when, where, and species if identifiable.

(iv) All carcasses must be removed from the road surface immediately upon location (where safe to do so) to limit likelihood of predators being attracted to the carcass. Carcasses must be moved a minimum of 20 m from the edge of the road verge.

(v) If any injured wildlife is found, WIRES Wildlife Rescue (1300 094 737) must be contacted immediately, and arrangements made for transferring injured wildlife to specialist carers at an animal hospital, vet, or refuge. If rehabilitation is not possible, animals are to be dealt with humanely in accordance with the *Best Practice Guidelines for Wildlife Rehabilitation*[942] set out by NRE.

F- Roadkill monitoring

(i) All internal roads within the current works or commute routes must be monitored daily for roadkill.

(ii) The same must apply to selected arterial roads that will be subject to increased use as project staff commute to the site from places of accommodation.

[942] Department of Primary Industries, Parks, Water, and Environment (2021)

(iii) Documentation must be completed recording all inspections along with noting when, where and species of any roadkill.

(iv) All carcasses must be removed from the road surface immediately upon location (where safe to do so) to limit likelihood of predators being attracted to the carcass.

(v) Roadkill must be noted either as a project vehicle collision or if it is found incidentally (and not already reported) assumed to be the result of collision from a non-project vehicle.

G- Reporting

(i) Wildlife hit by project vehicles must be reported to TI along with the monthly report.

(ii) Wildlife hit by project vehicles must also be reported to NRE through the Roadkill Reporter app.

(iii) Collision data must be periodically independently reviewed at a minimum of every 6 months, with scope to assess collision rates and determine if site access measures require reassessment and further mitigation implemented where applicable.

(iv) All roadkill data must be submitted to NRE and the DCCEEW at the conclusion of the construction period.

APPENDIX I – HABITAT (HOLLOW-BEARING) TREE MANAGEMENT PROTOCOL

SCOPE

This natural values assessment for the Sassafras – Wesley Vale Irrigation Scheme Augmentation (SWISA) identifiedlarge trees/stags with potential to contain habitat suitable for nesting/roosting fauna and additional areas of potential habitat outside the Construction Corridor. This roosting/nesting fauna includes the Tasmanian masked owl *(Tyto novaehollandiae subsp. castanops),* swift parrot *(Lathamus discolor)*, and blue-winged parrot *(Neophema chrysostoma).*

Whilst the direct risk to the masked owl, swift parrot and blue-winged parrot is low on account of the small number of trees within the Construction Corridor relative to available trees in the area, coupled with the relatively low likelihood of the species being present in those particular trees, the NVA recommended the following:

- Avoid impacts to as many of the identified potential habitat trees as possible;
- Any potential habitat trees that cannot be avoided by the Construction Corridor must be subject to a habitat tree management protocol, to ensure no impact on masked owl, swift parrot or blue-winged parrot nests; and
- Any potential habitat trees within 150 m of the Construction Corridor must be subject to a habitat tree management protocol, to ensure no impact on actively breeding masked owls..

During the construction phase of the action, the civil contractor must comply with habitat tree management measures as detailed in this document, including monitoring and managing compliance.

Timeframes

The protocol must be initiated in the spring (September – November) prior to any tree clearance in a designated works area. All passive survey work (**Sections C** through **F**) must be completed in the spring/summer directly preceding clearance.

Hollow-bearing tree decommissioning and clearance (**Sections G** and **H**) must be undertaken (to the extent possible) between April 1st and July 31st (for the swift parrot and blue-winged parrot) or March 1st and July 31st (for the masked owl) as per **Sections B(ii)** and **B(iii)**.

Responsible parties

The protocol clauses (other than the vegetation clearance itself) are to be carried out by a suitably qualified ecologist. The protocol will be overseen by a suitably qualified ecologist and Tasmanian Irrigation, with minor components able to be undertaken by the contractor. Some oversight and control of hold-points will be required by either regulators or the proponent and in that case linked to contract requirements for the contractor. Responsible personnel for each task within the protocol are set out in the document.

Protocol Area

This Protocol Application Area covers any trees with potential habitat values for masked owls, swift parrots and blue-winged parrots within the Construction Corridor and trees with potential habitat values for masked owls within a 150 m buffer area (**Figures I1-5**). This area encompasses any trees directly within the Construction Corridor, any trees with a Tree Protection Zone (TPZ) intersecting the Construction Corridor with incursion >10 %, and any trees with nesting potential that may require implementation of an exclusion buffer during active breeding.

<u>Permit requirements</u>

Application of this protocol (**Sections G** and **I**) will require approval to take products of wildlife protected under the Tasmanian *Nature Conservation (Wildlife) Regulations 2021* and will require regulatory oversight for release of hold points for clearance. Any conditions within the associated permit/s must be adhered to and may supersede clauses in the protocol.

<u>Definitions</u>

Suitably qualified ecologist – A consultancy or individual who has relevant professional qualifications, permits, and ethics approval, and at least 3 years of work experience writing and implementing management plans for the relevant protected matter; has implemented and reported on management plans for the habitat of the particular protected matter; can demonstrate the efficacy of those management plans, and in the event of ineffective measures, can demonstrate and implement corrective actions and solutions to achieve the desired outcomes; and can give authoritative assessment and advice on offset management to improve the habitat quality of the protected matter using relevant protocols, standards, methods and/or literature. Additionally, the ecologist must have experience in the identification of fauna and fauna nests for all species listed within the protocol.

Suitably qualified bioacoustics analyst – An ecologist with experience in bioacoustics collection and analysis and specific familiarity with the species listed within the protocol and other threatened species likely to be present.

Suitably qualified wildlife carer – A person who has received wildlife rescue and rehabilitation training through a certified training agent (i.e. WIRES or Bonorong Wildlife Sanctuary).

Suitable qualified arborist – a consultancy or individual who has relevant professional qualifications (Certificate IV in Arboriculture), and at least 3 years of work experience assessing and providing arboricultural advice in the development landscape.

Tree Protection Zone (TPZ) – Exclusion area around a tree that is protected when nearby works are being undertaken to protect the root zones tree. The TPZ is calculated as 12x the DBH of the tree.

CHECKLIST

- ☐ TI to communicate location of potential habitat trees and the provisions of the habitat tree management protocol to the Contractor (**Section A-**).
- ☐ Ecologist to identify and reassess all hollow-bearing potential habitat trees at risk of impacts within the Protocol Application Area (**Section C-**).
- ☐ Contractor and a qualified arborist to undertake retention viability assessment where applicable (**Section C-**).
- ☐ Contractor to mark exclusion zones and associated buffers where trees are to be retained (**Section C-**).
- ☐ Where works are to be undertaken within 150 m of hollow bearing trees, Ecologist to undertake pre-clearance surveys (**Sections D-** through **F-**):
    - o Passive acoustic monitoring (PAM) in spring AND summer in areas of potential masked owl habitat;
    - o Visual surveys in spring AND summer for swift parrot and blue-winged parrot habitat;
    - o Visual surveys in spring OR summer for masked owl habitat.
- ☐ Ecologist to conduct active hollow assessment and decommissioning outside of breeding season as per **Section B-(iii)** and **B-(iv)** (**Section G-**).

- ☐ Contractor to exclude clearance of trees with evidence of nesting from swift parrots, blue-winged parrots or masked owls and mark relevant exclusion zones (TPZ) (**Section I**).
- ☐ Where breeding is active, Contractor to mark additional buffer exclusion zones (150 m) and exclude all work until vacancy is confirmed (**Section I**).
- ☐ In the case where decommissioning is not possible, Ecologist to undertake visual assessment for up to 5 days prior to clearance to confirm vacancy (**Section H**).
- ☐ Contractor to clear trees within approved period where vacancy is confirmed, and no exclusion zones apply (**Section H**).
- ☐ Contractor to assess all hollows post felling (**Section H**).

HOLLOW-BEARING TREE MANAGEMENT PROTOCOL

A- Application of the protocol

(i) The protocol must be applied to any potential habitat tree (hollow-bearing likelihood) identified by the NVA field assessment within the Protocol Application Area - **Figures I1-5**.

(ii) The protocol must also be applied to areas of all forest habitat within the Protocol Application Area (as per TASVEG 4.0) that have not been surveyed previously (i.e. outside of the Survey Area) - **Figures I1-5**.

(iii) The protocol may additionally apply to any tree with a hollow suspected/confirmed during later investigations (such as observed during works) within the Protocol Application Area.

(iv) All contractors must be aware of the location of potential habitat trees and the provisions of the habitat tree management protocol.

B- Timing of works

(i) The protocol must be initiated in the spring (September – November) prior to any tree clearance in a designated works area. All passive survey work (**Sections C-**through **F-**) must be completed in the spring/summer directly preceding clearance.

(ii) Additional surveys to identify new potential trees within mature habitat can be conducted at any time prior to this or be conducted concurrently with habitat value reassessments **Section C-(ii)**.

(iii) Hollow-bearing tree decommissioning and clearance (**Sections G-** and **H-**) with particular reference to trees with suitability for the masked owl must be undertaken between March 1st and July 31st, to reduce the likelihood of nesting activity at the time of clearance[943].

(iv) Hollow-bearing tree decommissioning and clearance (**Sections G-** and **H-**) with particular reference to trees with suitability for the swift parrot and blue-winged parrot, must be undertaken between April 1st and July 31st, to reduce the likelihood of nesting activity at the time of clearance[944].

(v) For those trees in which **Section H** applies, clearance must be undertaken within the working day on which approval is given, or the processes within that section repeated.

[943] Noting that for masked owls breeding is possible year 'round (including an observation of chicks in May), but largely seasonal (October to November for most egg-laying) (Threatened Species Scientific Committee, 2010)

[944] Noting that for swift parrots breeding season varies between years, depending on food availability (Department of Climate Change, Energy, the Environment and Water 2024)

C- Pre-clearance procedure

(i) Identify all hollow-bearing potential habitat trees at risk of impact within the Protocol Application Area as per **Sections A-(i), A-(ii)** or **A-(iii)**.

(ii) All hollow-bearing potential habitat trees will be reassessed by the Ecologist for habitat values. This will account for any changes to habitat values since initial habitat assessments.

a. Where habitat values for masked owls, swift parrots or blue-winged parrots are present, **Section C-(iii) – (v)** apply.

b. Where no habitat values are present the protocol does not apply.

(iii) For those trees identified as per **Section C-(ii)a** the Contractor is to undertake retention viability assessment with the guidance of an arborist and/or ecologist.

(iv) Those that can viably be retained must be marked as exclusion zones by the Contractor including an associated buffer as a tree protection zone[945] - the remainder of the protocol will not apply.

(v) For those that cannot be retained:

a. Where habitat values for masked owl are present **Section D-** will apply

b. Where habitat values for swift parrots or blue-winged parrots are present **Section E-** will apply

D- Hollow-bearing tree management – Masked owl passive acoustic monitoring

(i) For trees determined to contain masked owl habitat values in **Section C-(ii)**, the Ecologist will set up a passive acoustic monitoring (PAM) device near the tree site

(ii) The PAM can be applied to any hollow bearing trees within a 200 m radius of the device and must adhere to the following survey requirements:

a. Monitoring must be conducted over two separate deployments – once in spring and once in summer. Each deployment must run for a minimum of three weeks.

b. Detection range of PAM devices must be accounted for in the survey design period.

c. PAM devices must record for the duration of the night to determine presence/absence of masked owls.

d. Analysis of PAM data must be analysed by a qualified bioacoustics analyst.

(iii) If no masked owl activity is recorded by the PAM, **Section E-** will apply

(iv) If PAM detects masked owls within the patch, **Section F-** applies.

E- Hollow-bearing tree management – passive inspection/s for swift parrots and blue-winged parrots

(i) For trees with swift parrot or blue-winged parrot habitat values, passive visual inspections are required to determine occupancy and/or breeding activity.

(ii) Visual observation must be undertaken by the Ecologist within 2 hours of dawn or 1 hour before dusk for minimum 1 hour, repeated over 5 consecutive days in spring preceding the proposed removal of trees.

(iii) Where swift parrots or blue-winged parrots are not identified, a second visual observation must be undertaken by an ecologist within 2 hours post-dawn or 1 hour before dusk for minimum 1 hour, repeated over 5 consecutive days in the following summer.

[945] As per AS 4970-2009

(iv) If swift parrot or blue-winged parrot activity is recorded during these surveys, the Ecologist will make an assessment on the likelihood of breeding activity from the observations:

a. If breeding is suspected, **Section I-** will apply.

(v) In all other cases (other species or no fauna observed), **Section G-** will apply.

F- Hollow-bearing tree management – passive inspection/s for masked owl

(i) For trees with masked owl habitat values, passive visual inspections are required to determine occupancy and/or breeding activity

(ii) The Ecologist must undertake a dusk observation (minimum 1 hour), followed by a dawn observation (minimum 1 hour) the next day, and repeat these surveys over the course of 5 consecutive evenings/mornings.

(iii) If masked owl activity is recorded during this survey, the Ecologist will make an assessment on the likelihood of breeding activity from the observations:

a. If breeding is suspected, **Section I-** will apply.

b. If the use is suspected to be non-breeding, **Section G-** will apply.

(iv) In all other cases (other species or no fauna observed), **Section G-** will apply.

G- Hollow-bearing tree management – active inspection/s and decommissioning

(i) Each tree/hollow must be assessed for direct hollow observation options (*i.e.* mechanisms to allow a suitably trained ecologist to access the hollows for direct close-up observation) – options may include (but are not limited to) use of a cherry picker or similar, rope climbing, ladders:

a. If a tree can safely/adequately be assessed with such methods, **Sections G-(ii) – (v)** apply.

b. If a tree cannot safely be assessed with such methods, **Section H-** applies.

(ii) Upon accessing the tree, the Ecologist must inspect (to the degree possible) all hollows for viability and occupation of vertebrate fauna:

a. Inviable hollows can be ignored.

b. Viable hollows[946] are to be investigated for current evidence of vertebrate fauna occupation as per **Section G-(iii).**

c. Hollows that can't be safely inspected must be subject to requirements of **Section H-**.

(iii) If a hollow contains current evidence of being in use for nesting, the Ecologist must conclude if the nest (and nest contents) is that of a masked owl, swift parrot, blue-winged parrot or any other species covered by a permit to take protected wildlife and/or products of wildlife:

a. If the nest/nest contents are that of a masked owl, swift parrot or blue-winged parrot **Section I-** applies.

b. If the nest/nest contents are from a protected species (as per the schedules of the *Nature Conservation (Wildlife) Regulations 2021*) other than masked owl, swift parrot or blue-winged parrot, a permit to take products of wildlife under these regulations is required.

[946] Hollows suitable for the Tasmanian masked owl typically have a minimum entrance of 15 cm diameter, and an internal hollow depth of ≥55 cm (David James, pers comm).

c. If the nest/nest contents are from a species other than masked owl, swift parrot or blue-winged parrot and they are covered by a permit (or do not require a permit), they may be taken (as per the conditions of the permit where applicable).

d. If the nest/nest contents are from a protected species (as per the schedules of the *Nature Conservation (Wildlife) Regulations 2021*) other than masked owl, swift parrot or blue-winged parrot and not a species covered by a permit, they should be estimated for time required until fledging and treated as an exclusion zone (as per **Section I-**) until nesting is completed and the hollow vacated – after which time **Sections (v)** and **G-(vi)** can apply.

(iv) If a hollow contains no current evidence of nesting but occupants are roosting/sheltering inside, the individual/s can be encouraged to leave the hollow or observed until they leave of their own accord (which could require dusk/dawn observation).

(v) Once the absence of current nesting and occupation has been confirmed, a vacant hollow may be decommissioned/blocked-up by the Ecologist by covering entrances with corflute (or equivalent material). Where hollow occupancy is inconclusive, a one-way flap device must be installed in place of corflute to allow any wildlife to escape the hollow.

(vi) Once all viable hollows in a tree are decommissioned as per this method, the tree can be approved for clearance by the Ecologist. The clearance timeframe is not critical once hollows are decommissioned as long as it is cleared before July 31st of the same year.

H- Hollow-bearing tree management – Confirmation of vacancy and clearance

(i) For trees cannot safely be accessed and decommissioned as per **Section F-(i)**, vacancy must be confirmed by the Ecologist before clearance:

a. Where tree observation surveys record occupation from a species other than masked owl, swift parrot or blue-winged parrot or suspected non-breeding use by a masked owl, swift parrot or blue-winged parrot (e.g. temporary roosting), the surveys will continue in evenings/mornings until a day occurs where all hollows in a tree under observation are considered to be vacant and the tree will be cleared on that day.

b. Where 5 consecutive evenings/mornings are surveyed and the hollow/s are still occupied, the tree should be banged on with hand-mallets until the occupant/s vacate (if this does not work the regulator will need to be engaged to advise on acceptable methods to vacate the occupants).

(ii) Once all viable hollows in a tree are determined by the Ecologist to be vacant, the tree can be approved for clearance and must be cleared within the day approved. If not cleared within this timeframe, a dusk/dawn survey must be repeated, and the steps of **Section H-(i)** repeated if occupancy is detected.

(iii) All trees identified as containing hollows must be inspected by the Ecologist post-felling as a measure to confirm the ecologist's determination and to evaluate the accuracy of the protocol. This should be conducted by a suitably qualified wildlife carer in the event that an animal is injured during the tree felling process.

(iv) Any wildlife-related incidents must be reported by TI to the Conservation Assessment Branch of the Department of Natural Resources and Environment within 30 days of the incident.

I- Hollow-bearing tree management – masked owl, swift parrot or blue-winged parrot nesting

(i) If past or current nesting of masked owl, swift parrot or blue-winged parrots is confirmed by the Ecologist, the tree must be excluded from clearance, a **permanent** TPZ exclusion zone must be applied and marked as exclusion zones on civil contracts, and exclusion fencing erected by the Contractor.

(ii) If current breeding activity of masked owl is likely/confirmed:

a. A temporary 150 m buffer exclusion zone where no works will occur must be applied until fledging has been determined to be complete by a suitably qualified ecologist, breeding has failed, or additional evidence is available to refute the suspected breeding evidence.

b. Exclusion fencing must be erected by the Contractor.

c. A monitoring program will be required to inform this process and will need to be determined by the ecologist as to what is most suitable for the particular nesting tree.

(iii) Once the requirements of **Section I-(ii)** are completed and absence has been confirmed by the Ecologist, realignment works can commence within this buffer area (outside of the permanent TPZ exclusion zone).

HOLLOW-BEARING TREE MANAGEMENT PROTOCOL APPLICATION AREA

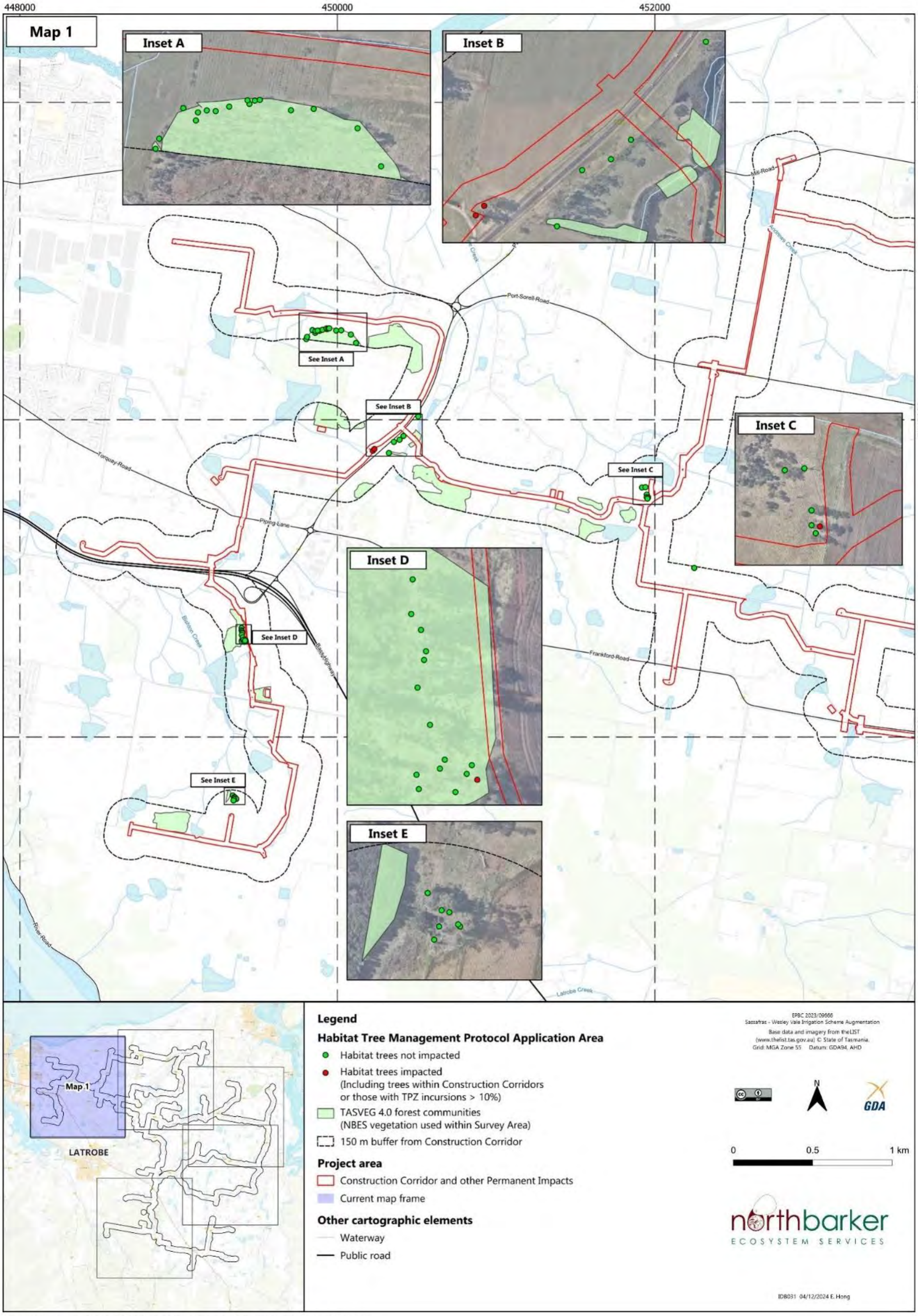
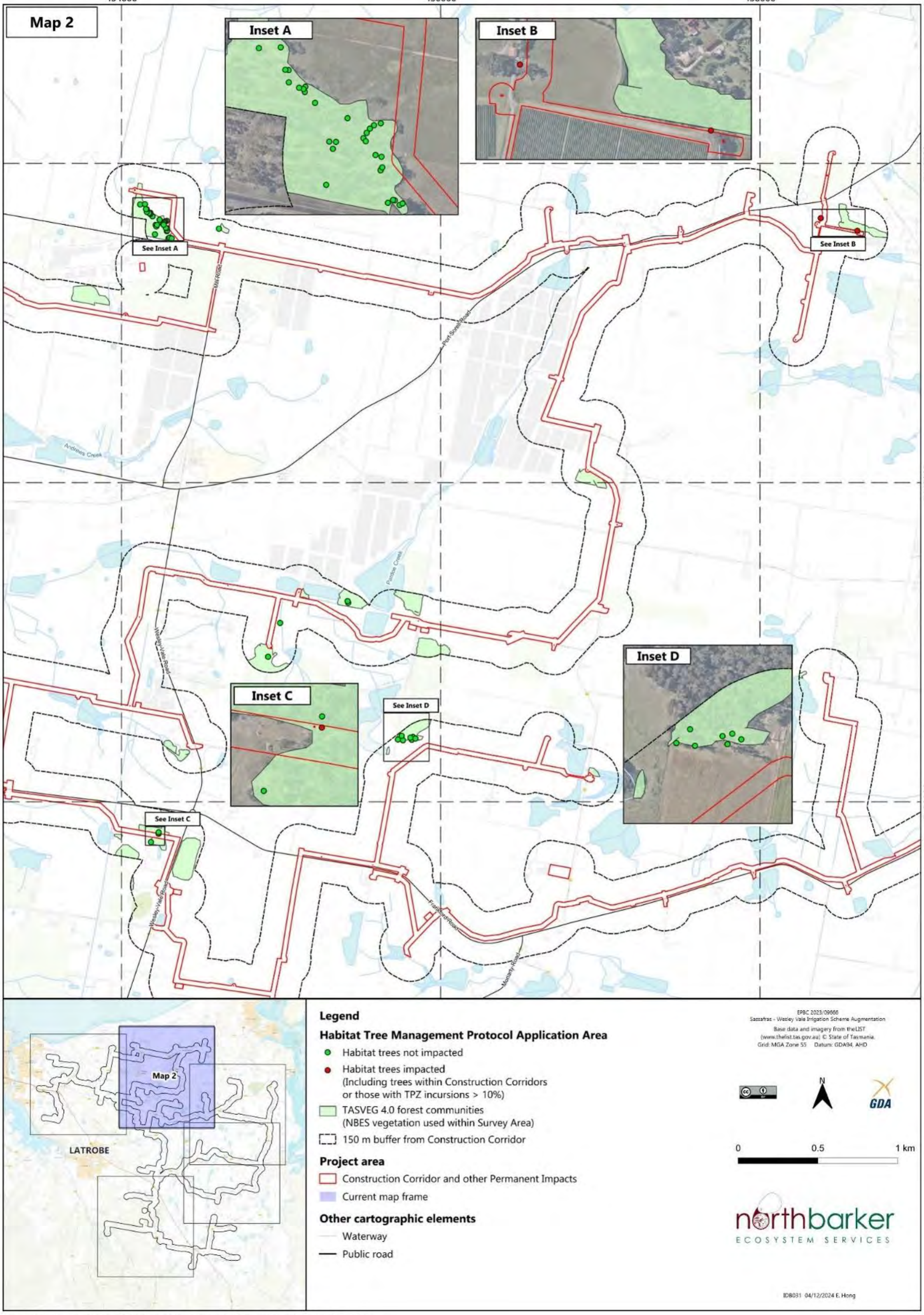
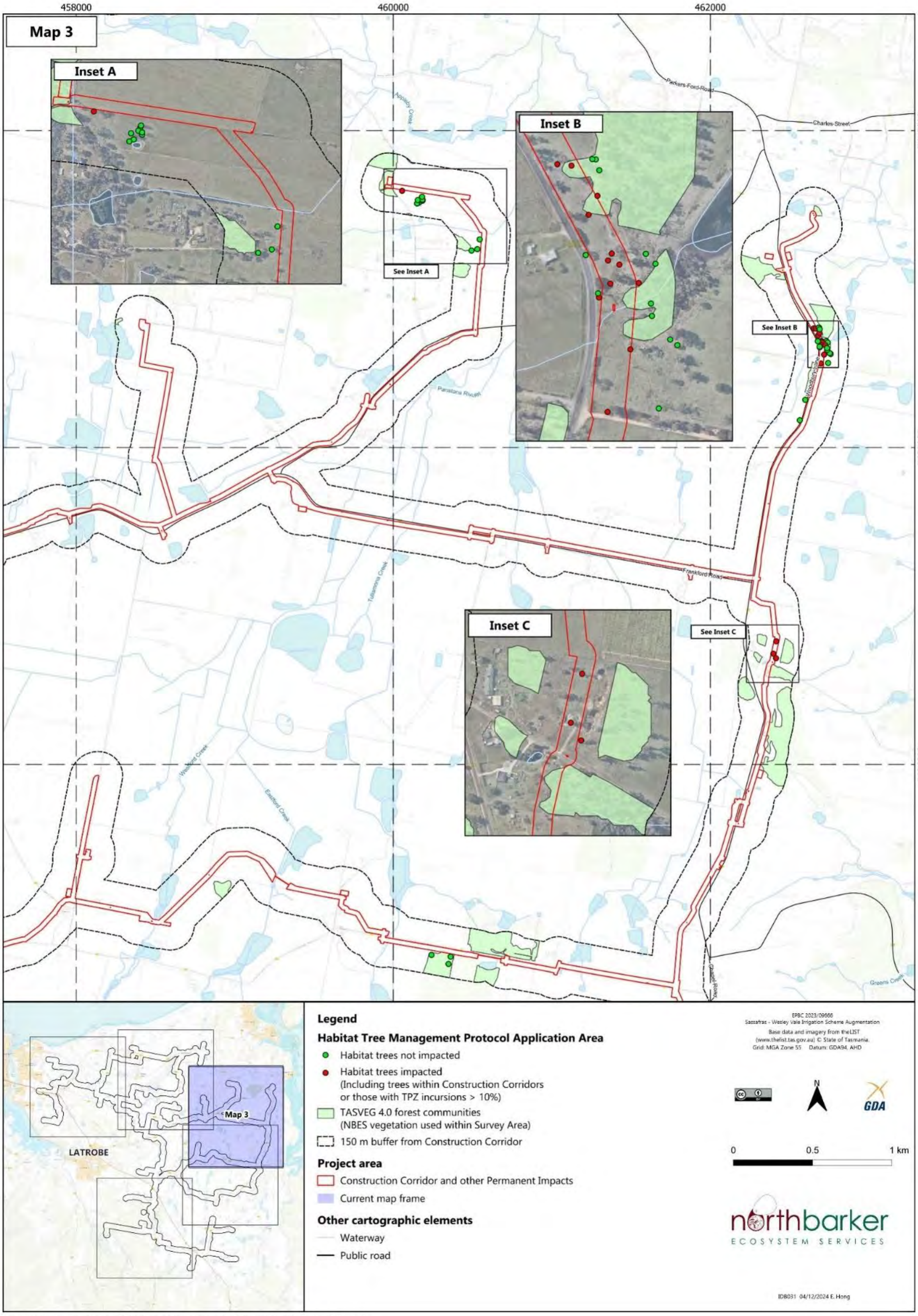


Figure I1: Hollow-bearing tree management protocol application area



The mapping has been undertaken using a hand held GPS and subjective interpretation. Consequently it should be considered indicative only.

Figure I2: Hollow-bearing tree management protocol application area



The mapping has been undertaken using a hand held GPS and subjective interpretation. Consequently it should be considered indicative only.

Figure I3: Hollow-bearing tree management protocol application area

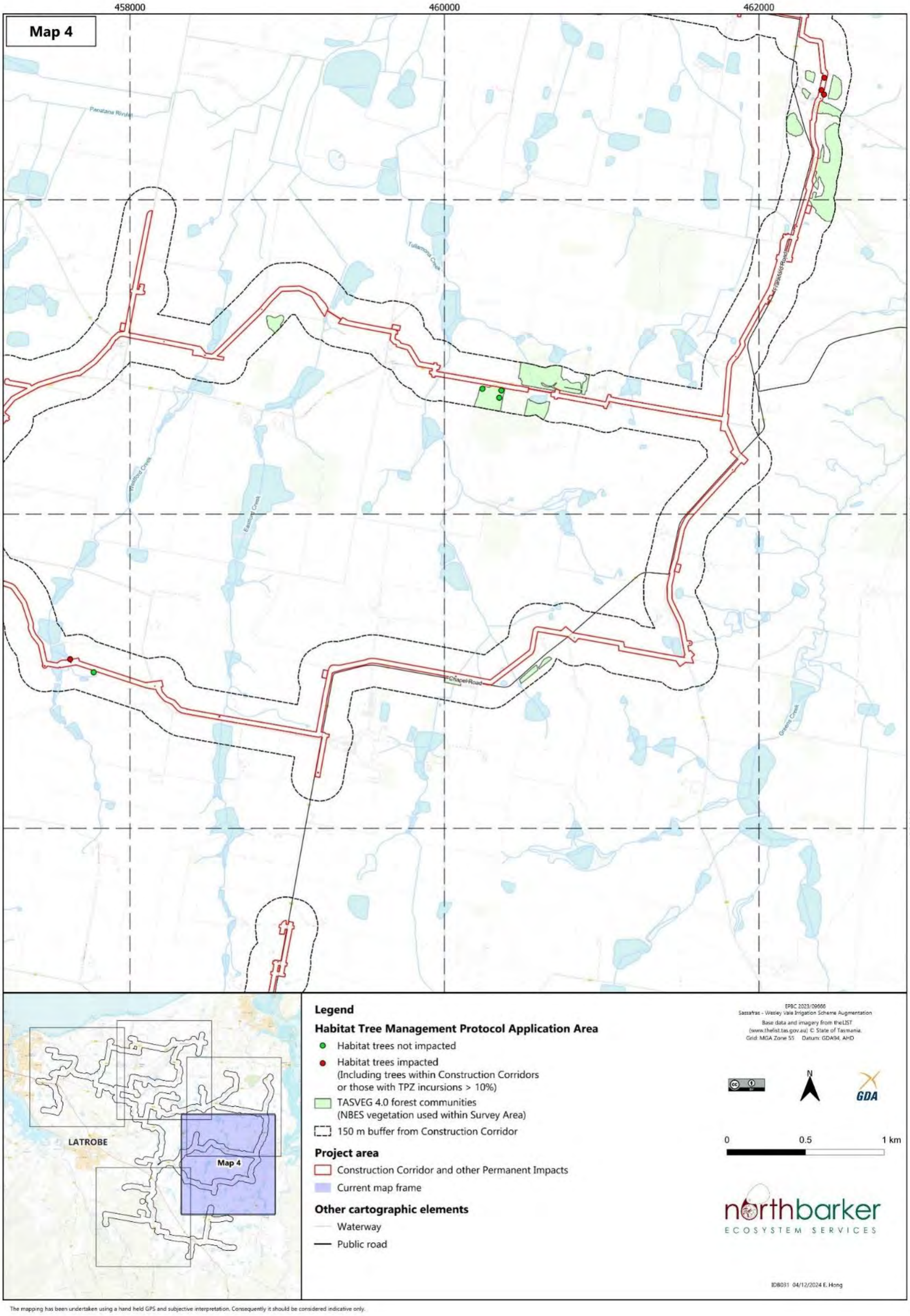


Figure I4: Hollow-bearing tree management protocol application area

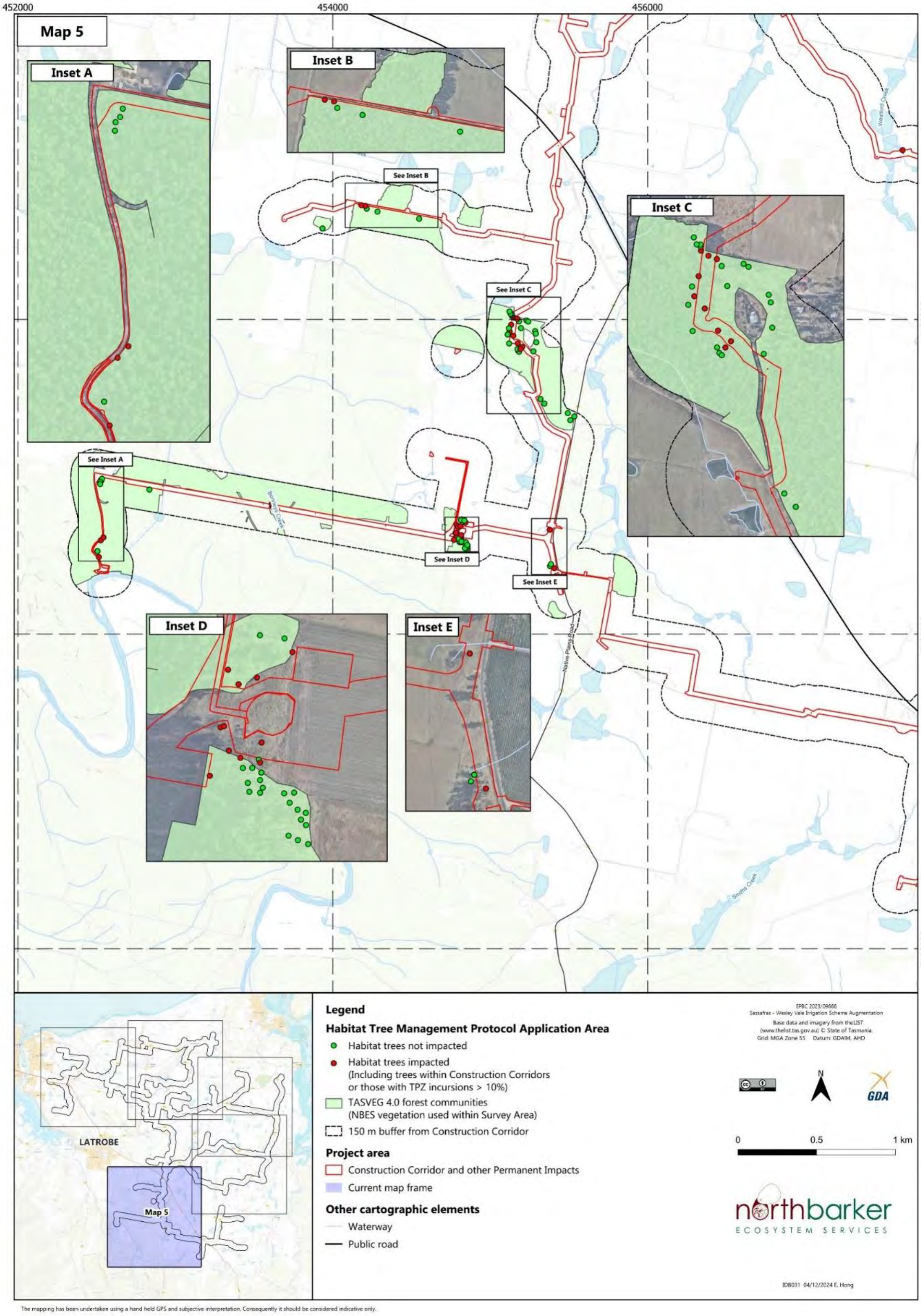
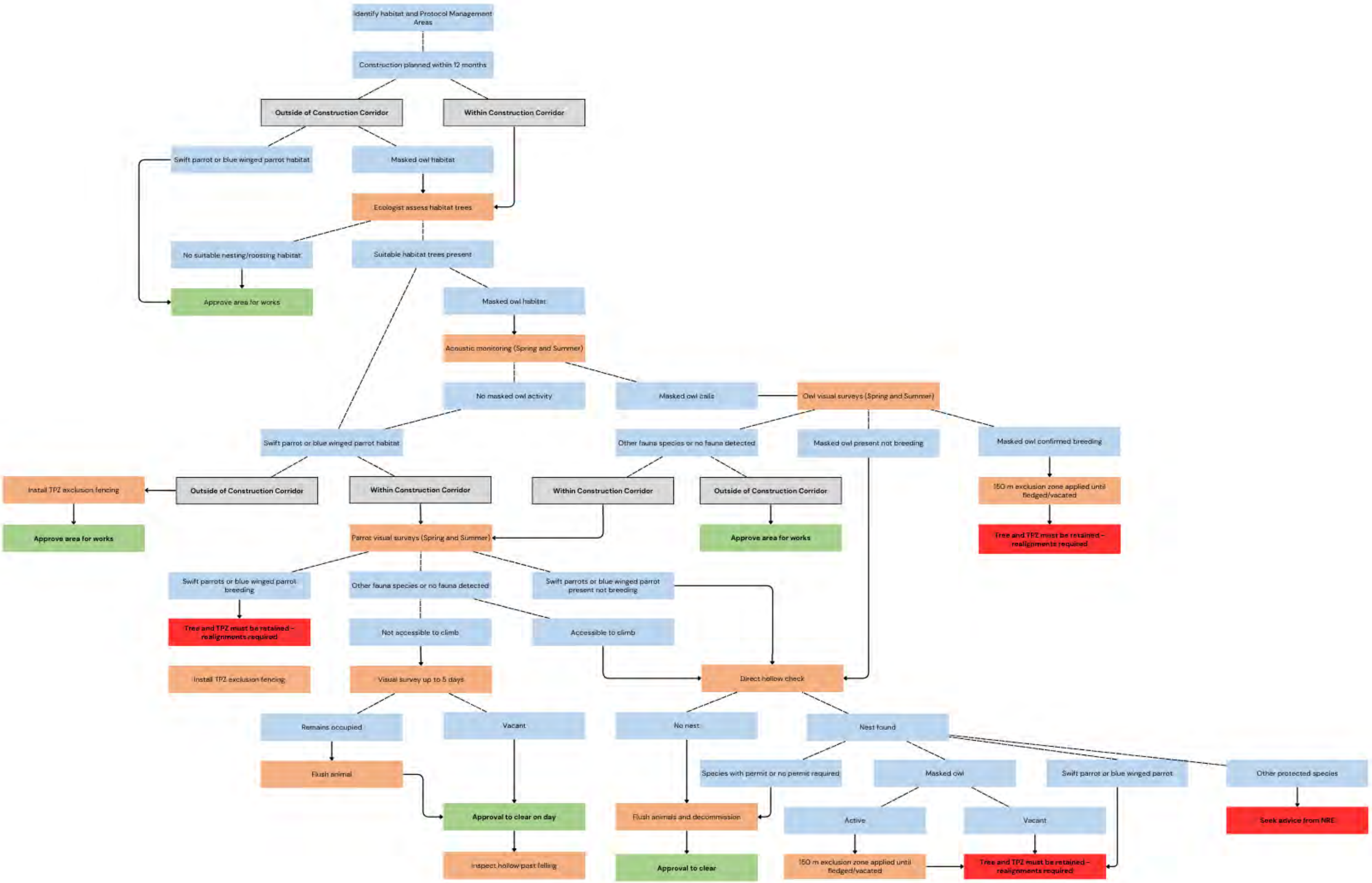


Figure I5: Hollow-bearing tree management protocol application area

Flowchart of Protocol Operations



APPENDIX J – EAGLE NEST VIEWSHED MODELLING

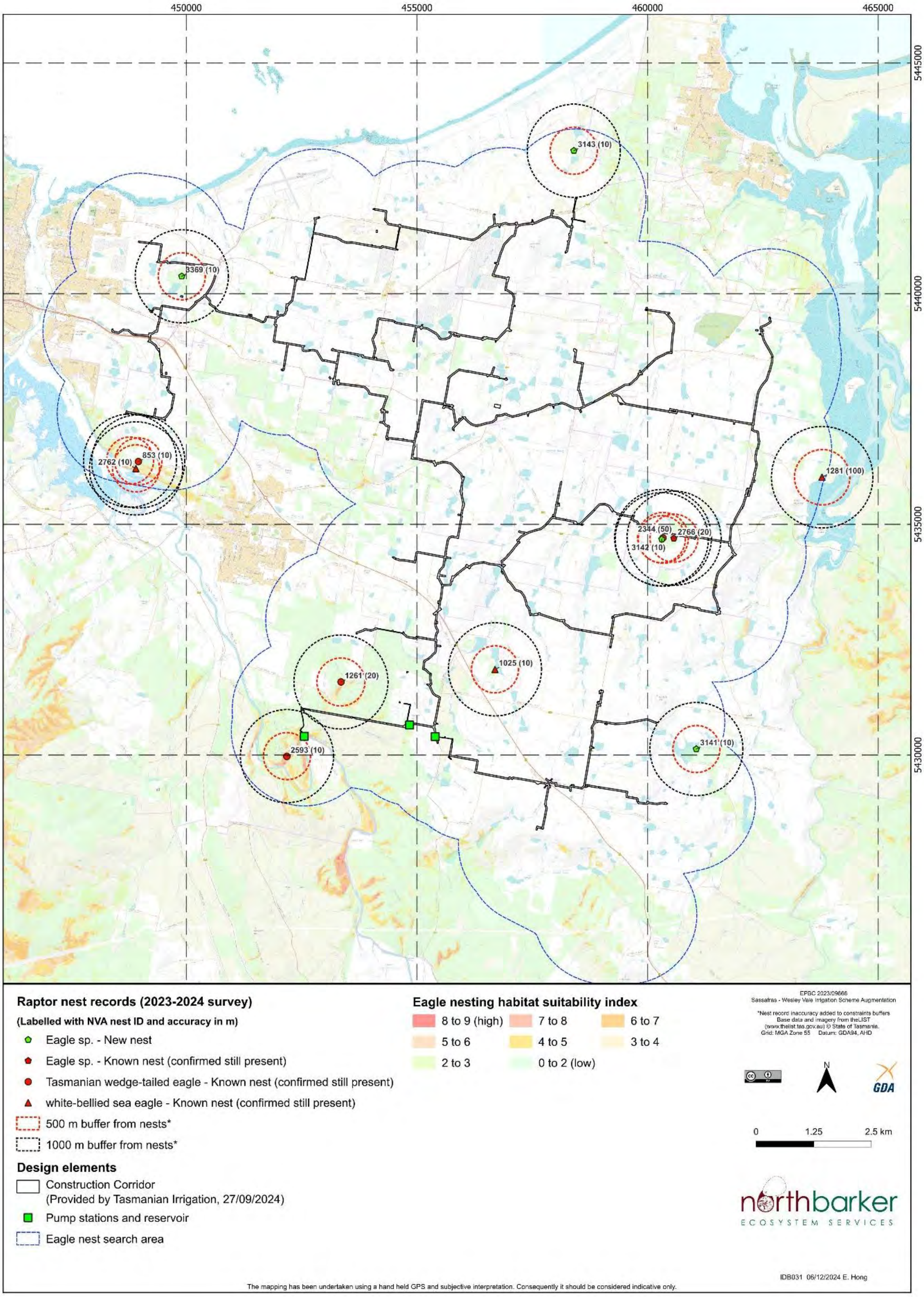


Figure J1: Overview of eagle nest locations

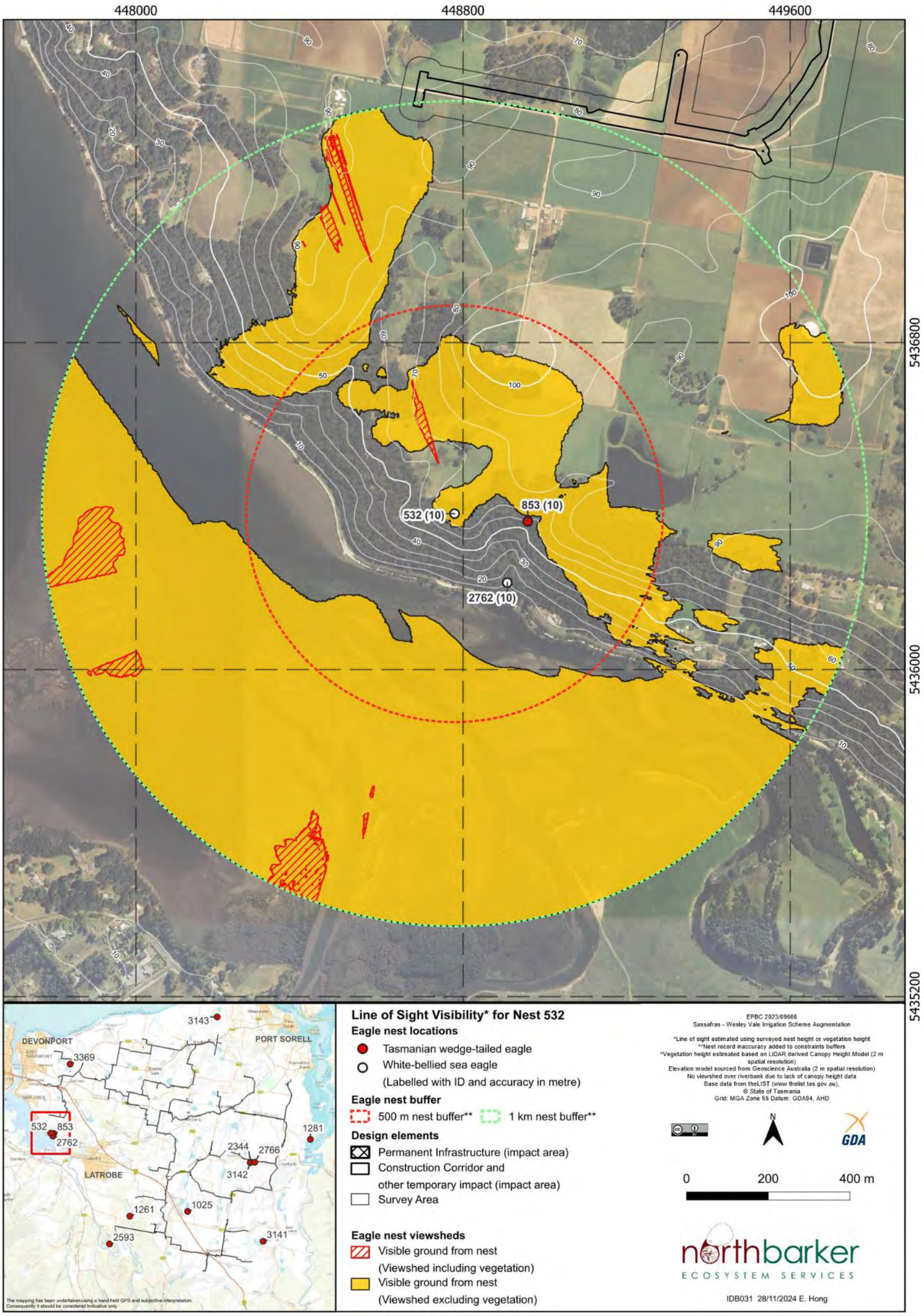


Figure J2: Nest viewshed modelling for Nest ID: 532

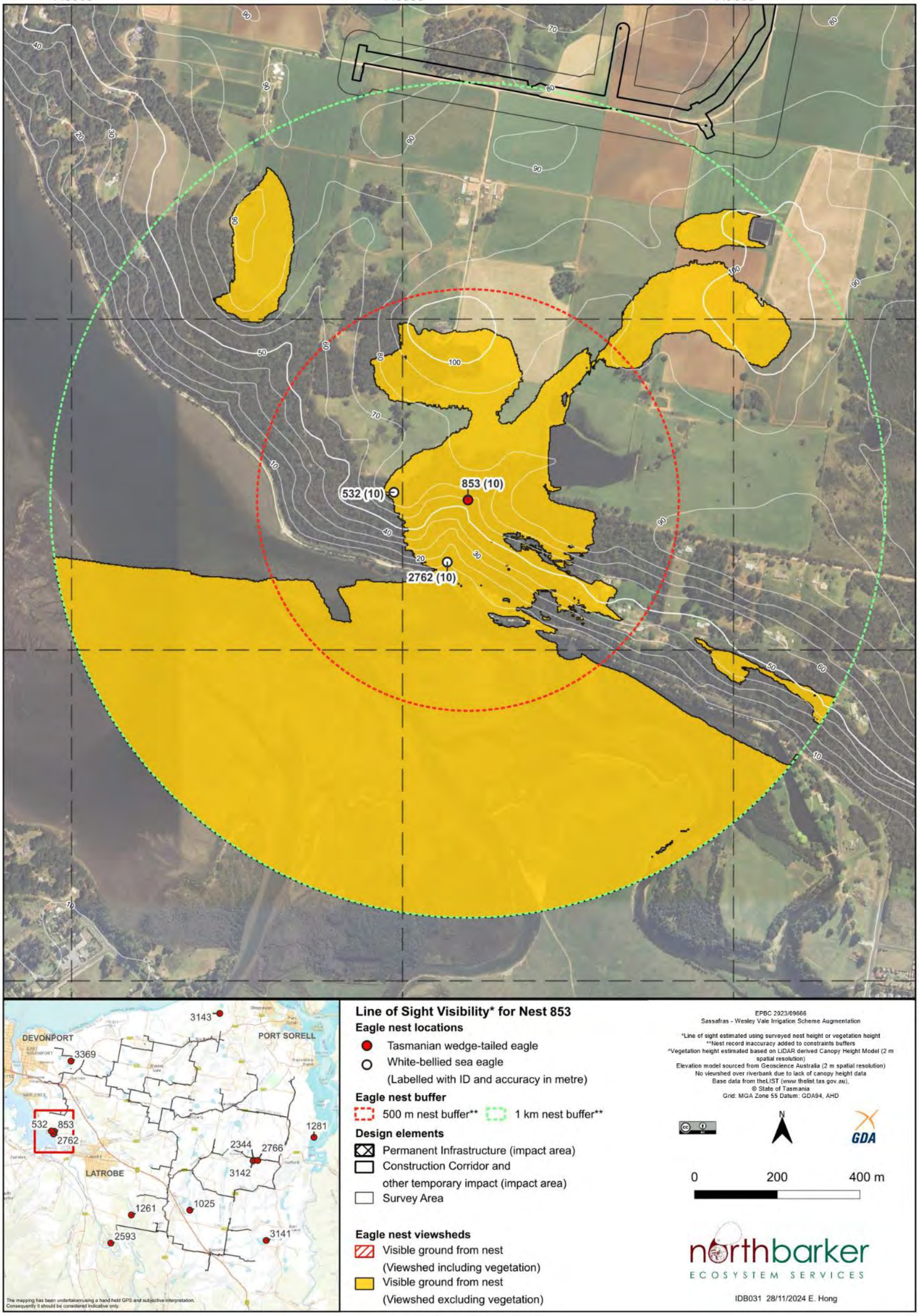


Figure J3: Nest viewshed modelling for Nest ID: 853

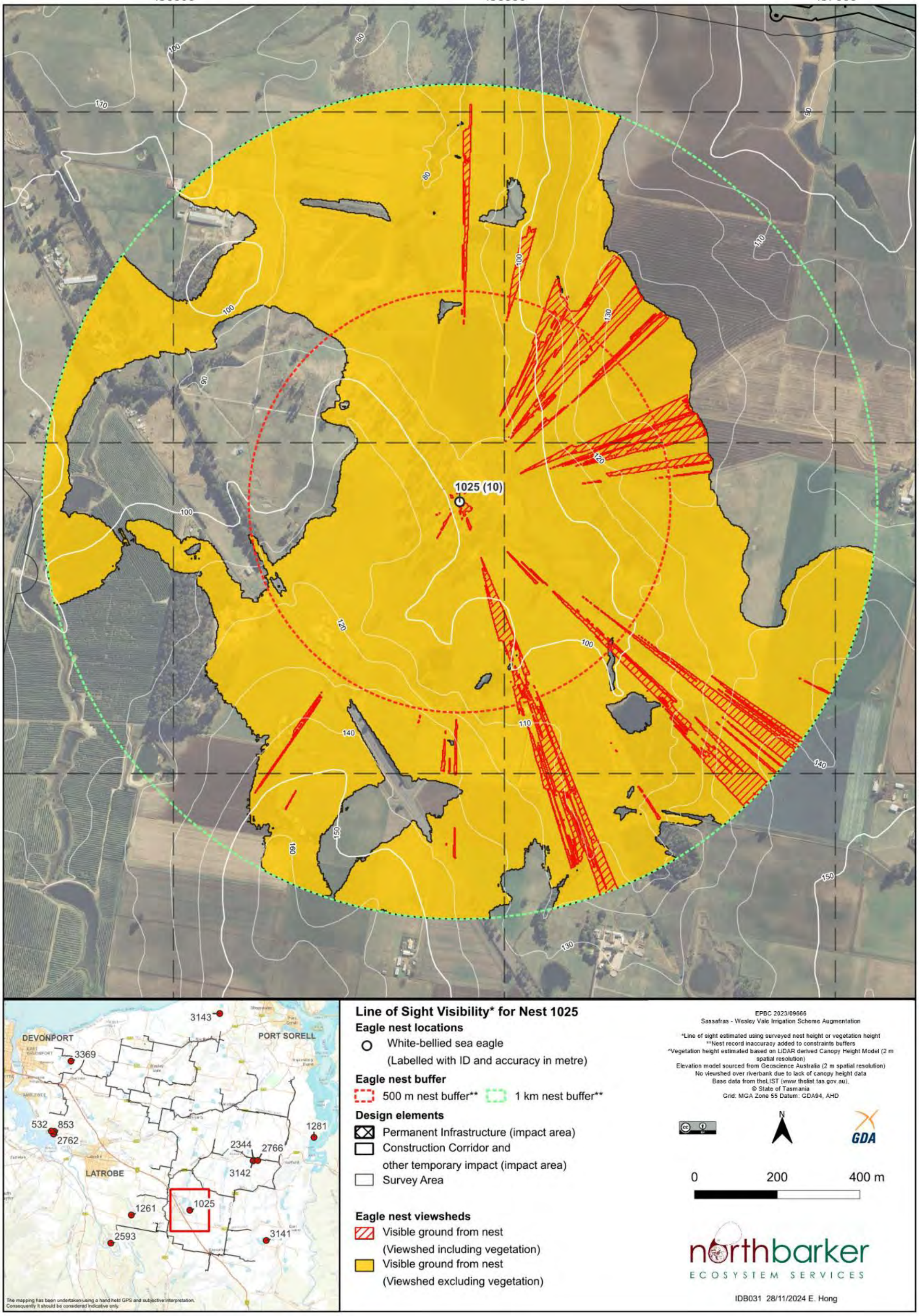


Figure J4: Nest viewshed modelling for Nest ID: 1025

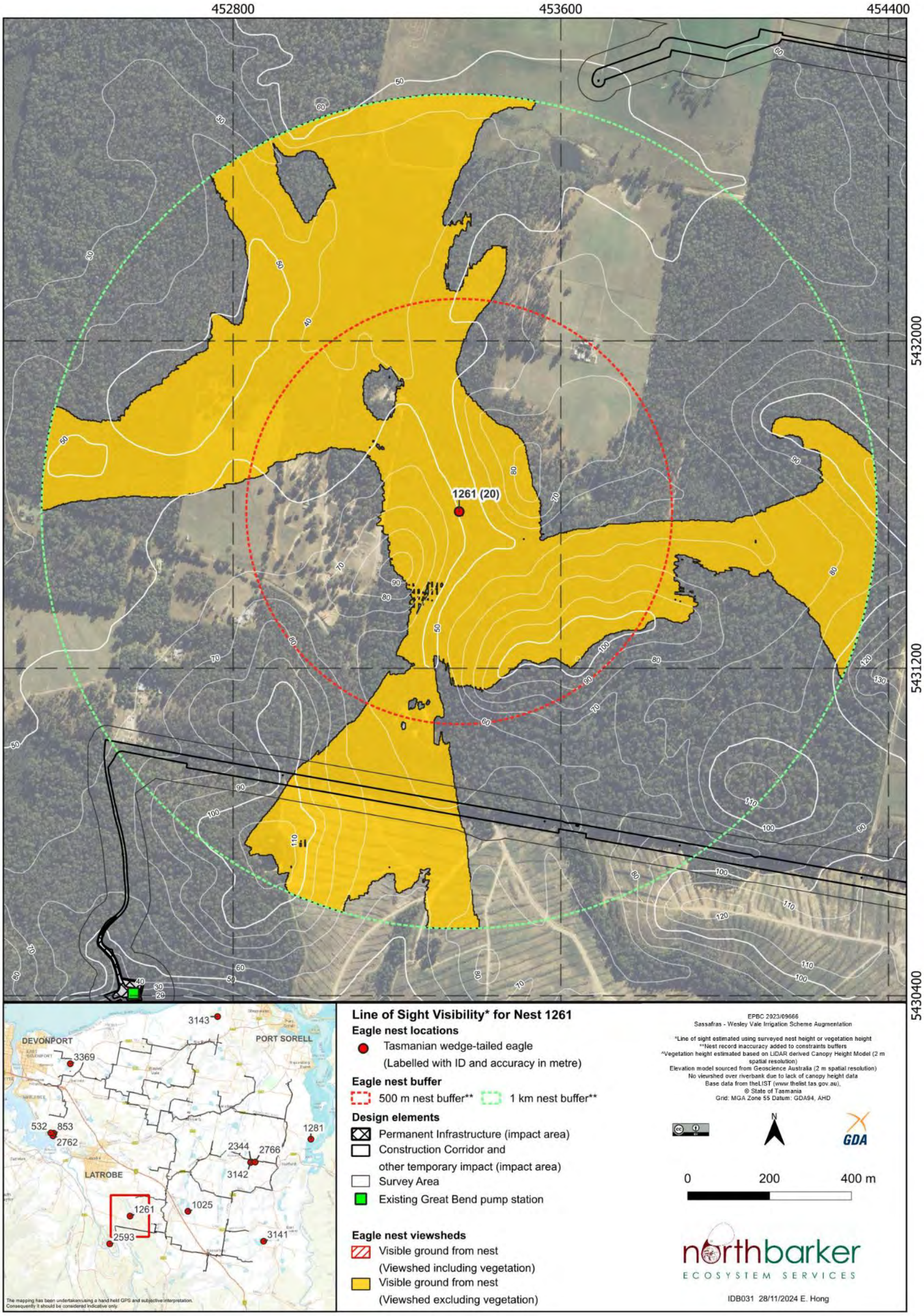


Figure J5: Nest viewshed modelling for Nest ID: 1261

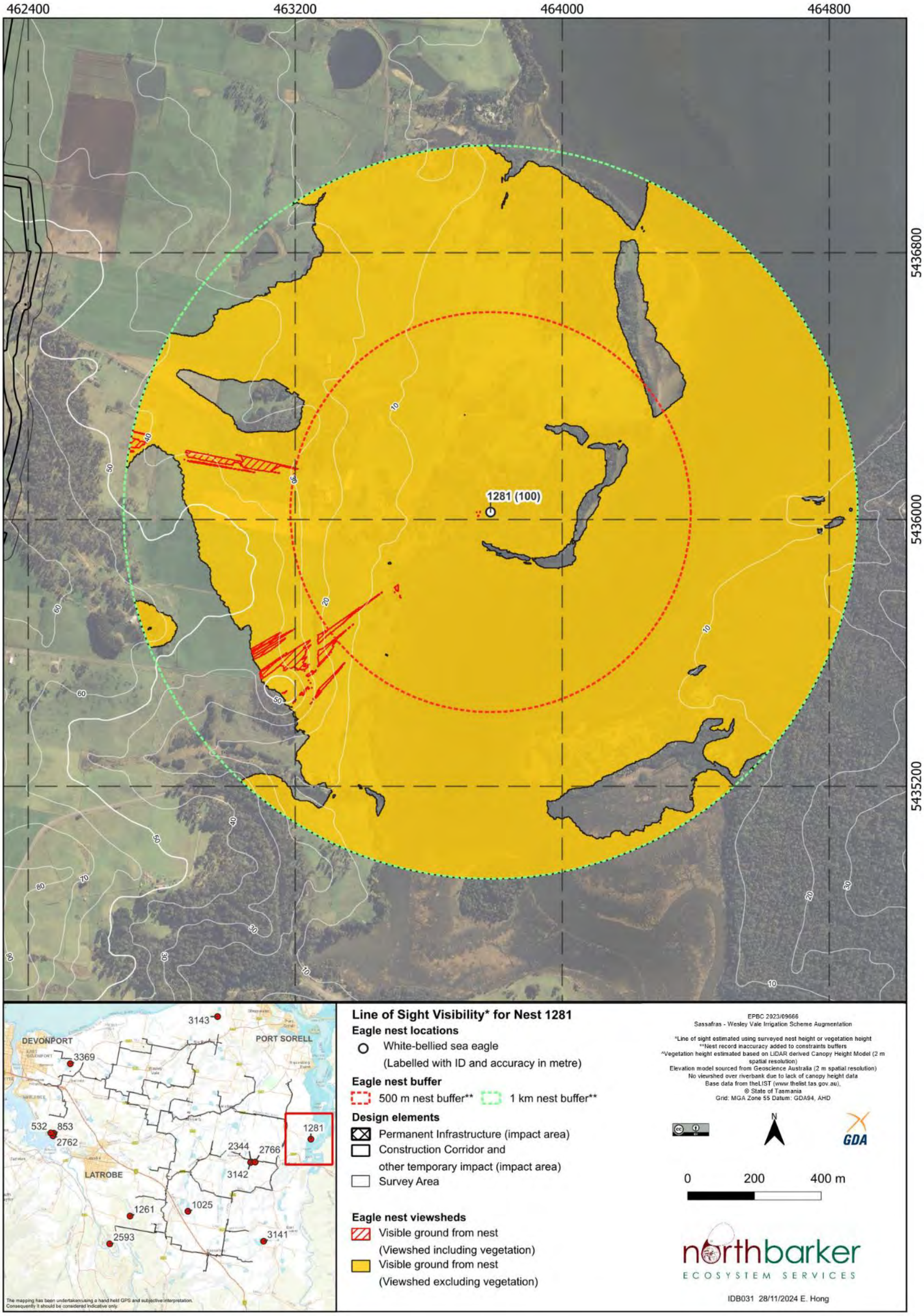


Figure J6: Nest viewshed modelling for Nest ID: 1281

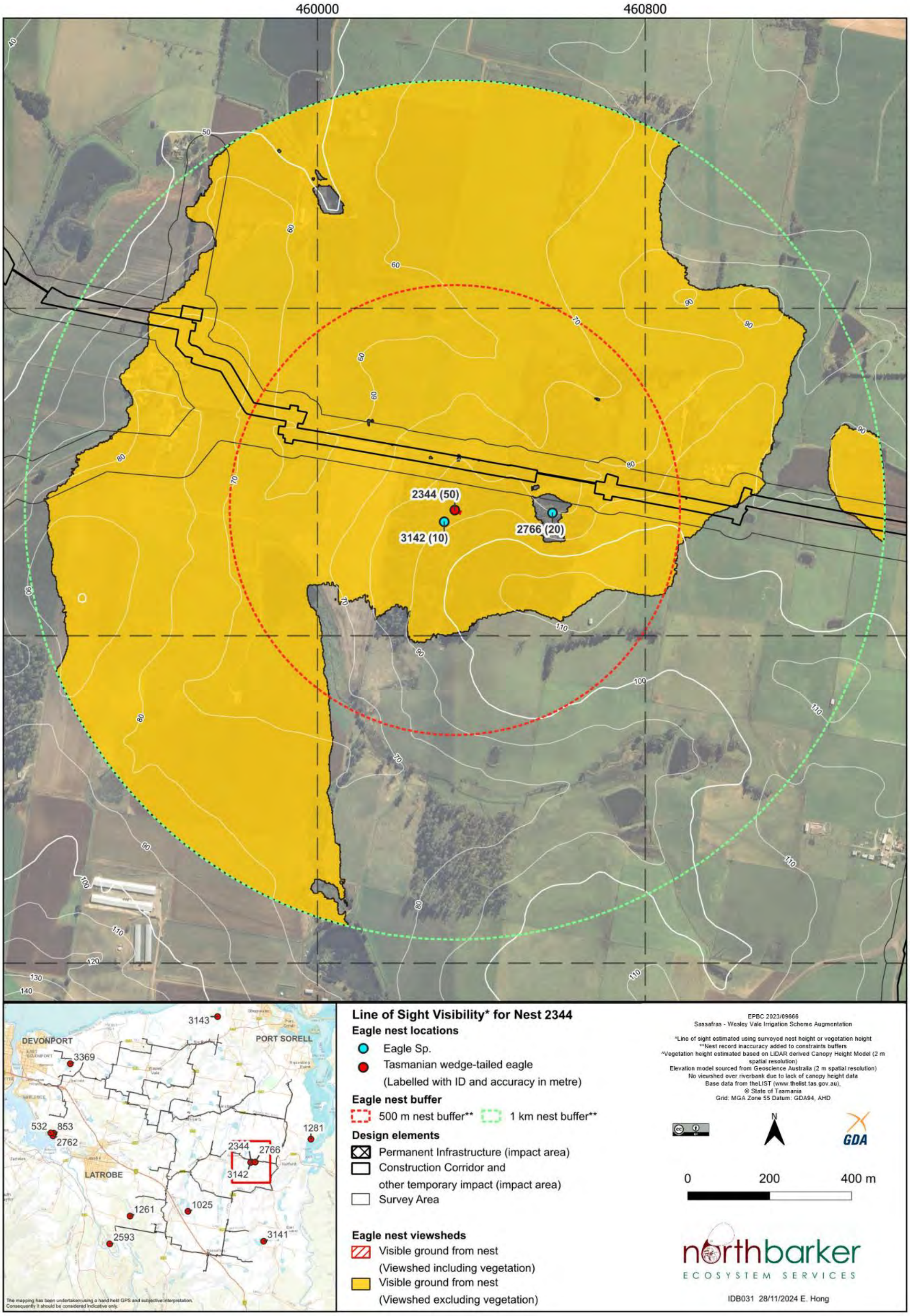


Figure J7: Nest viewshed modelling for Nest ID: 2344

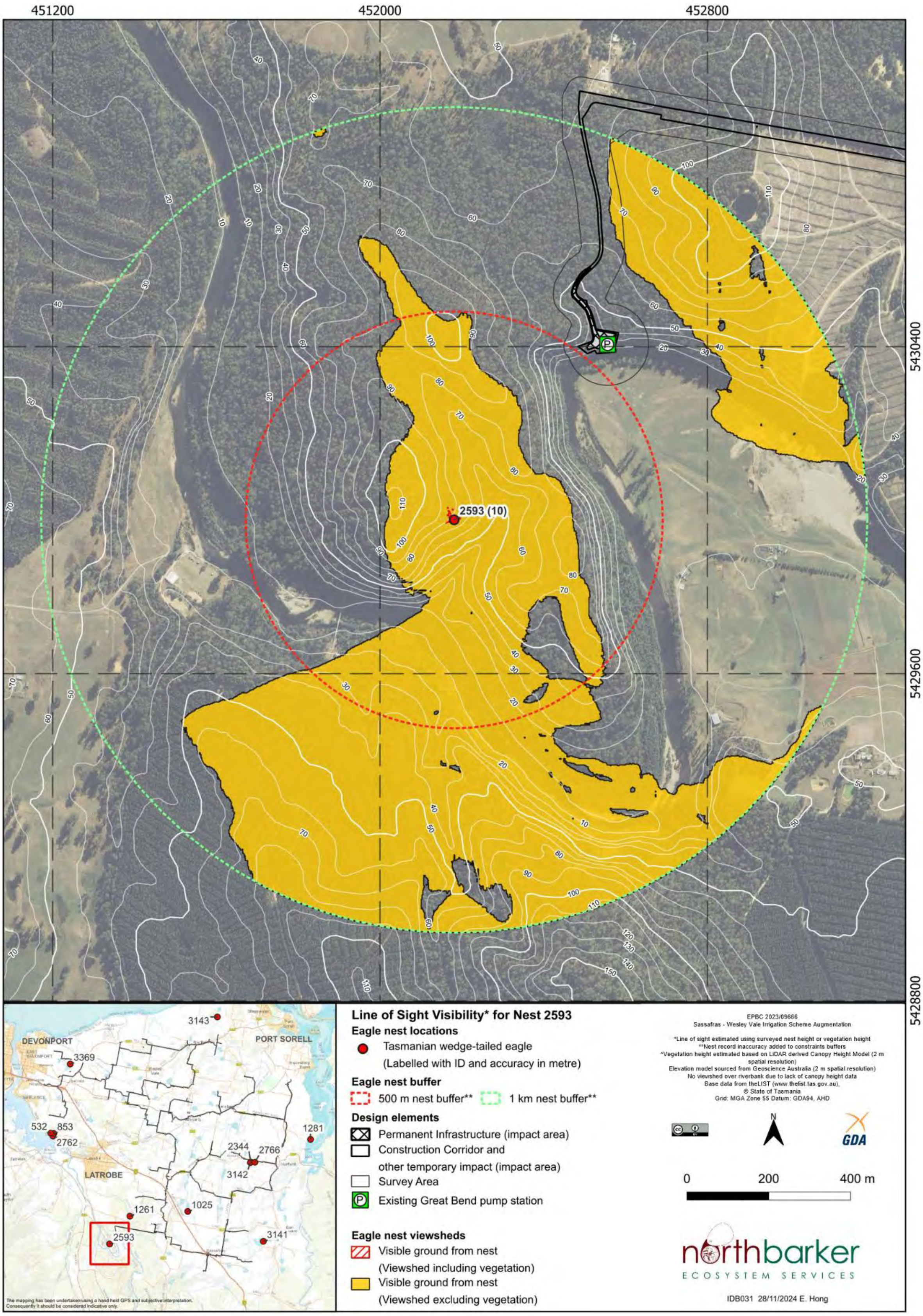


Figure J8: Nest viewshed modelling for Nest ID: 2593

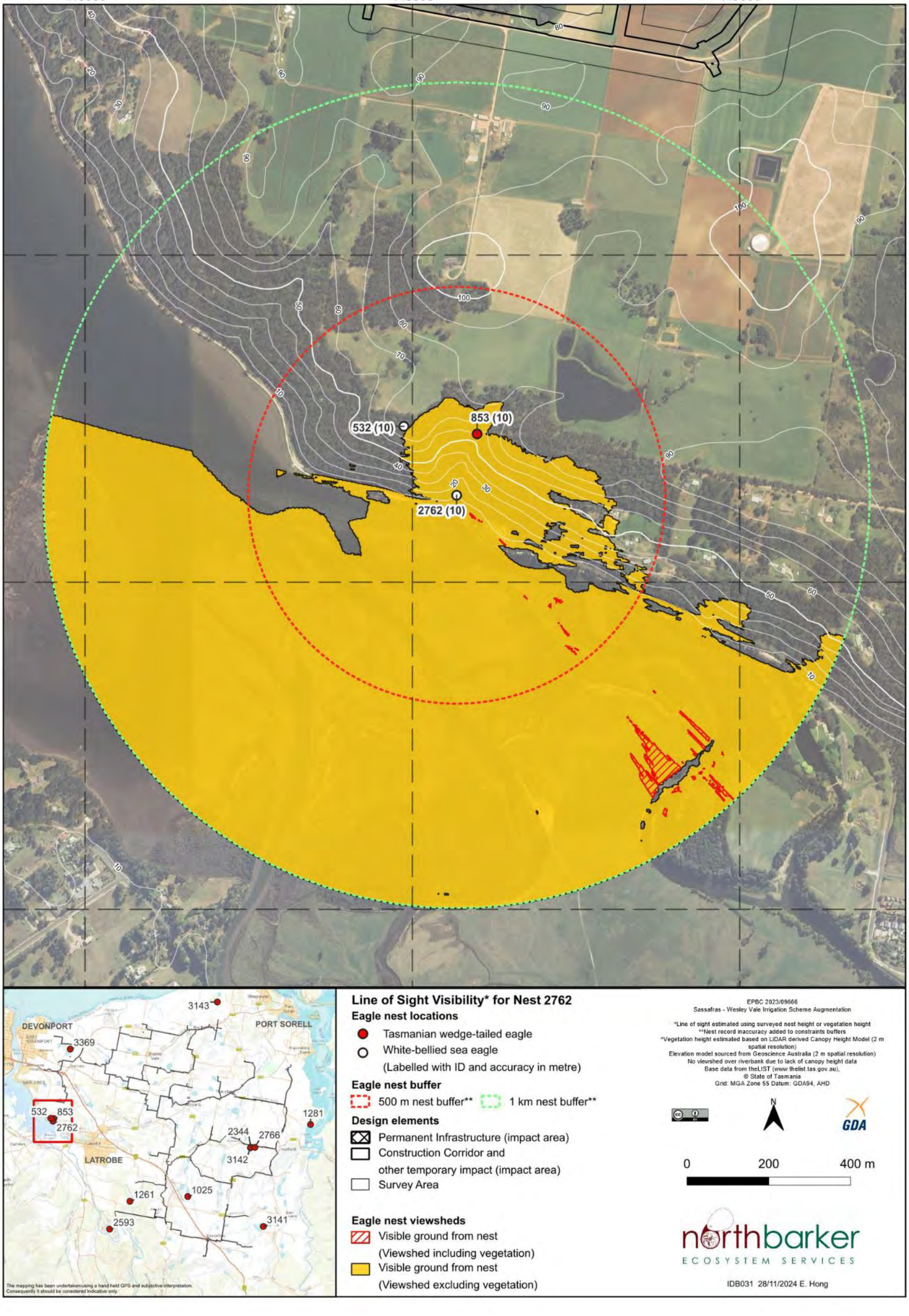


Figure J9: Nest viewshed modelling for Nest ID: 2762

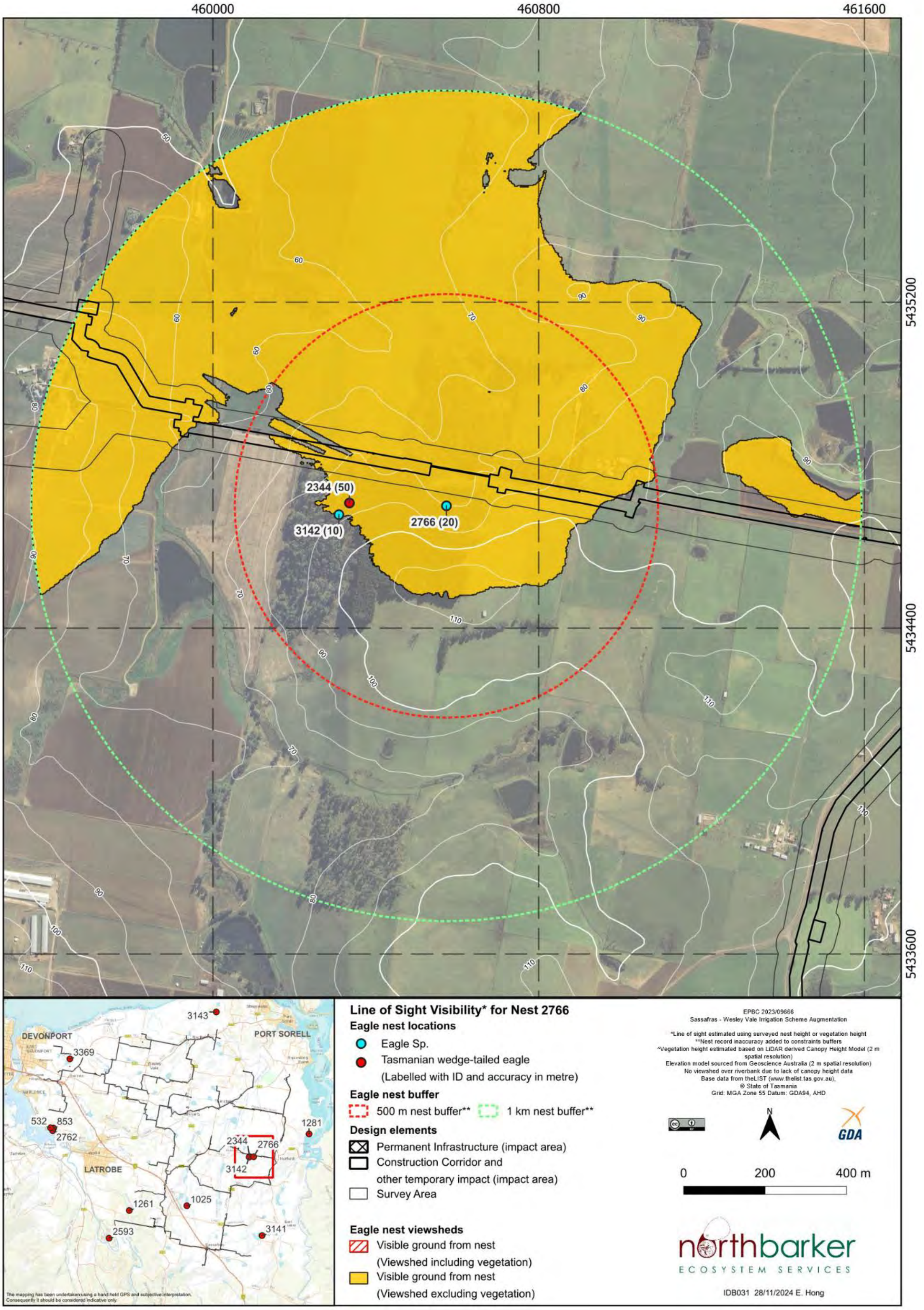


Figure J10: Nest viewshed modelling for Nest ID: 2766

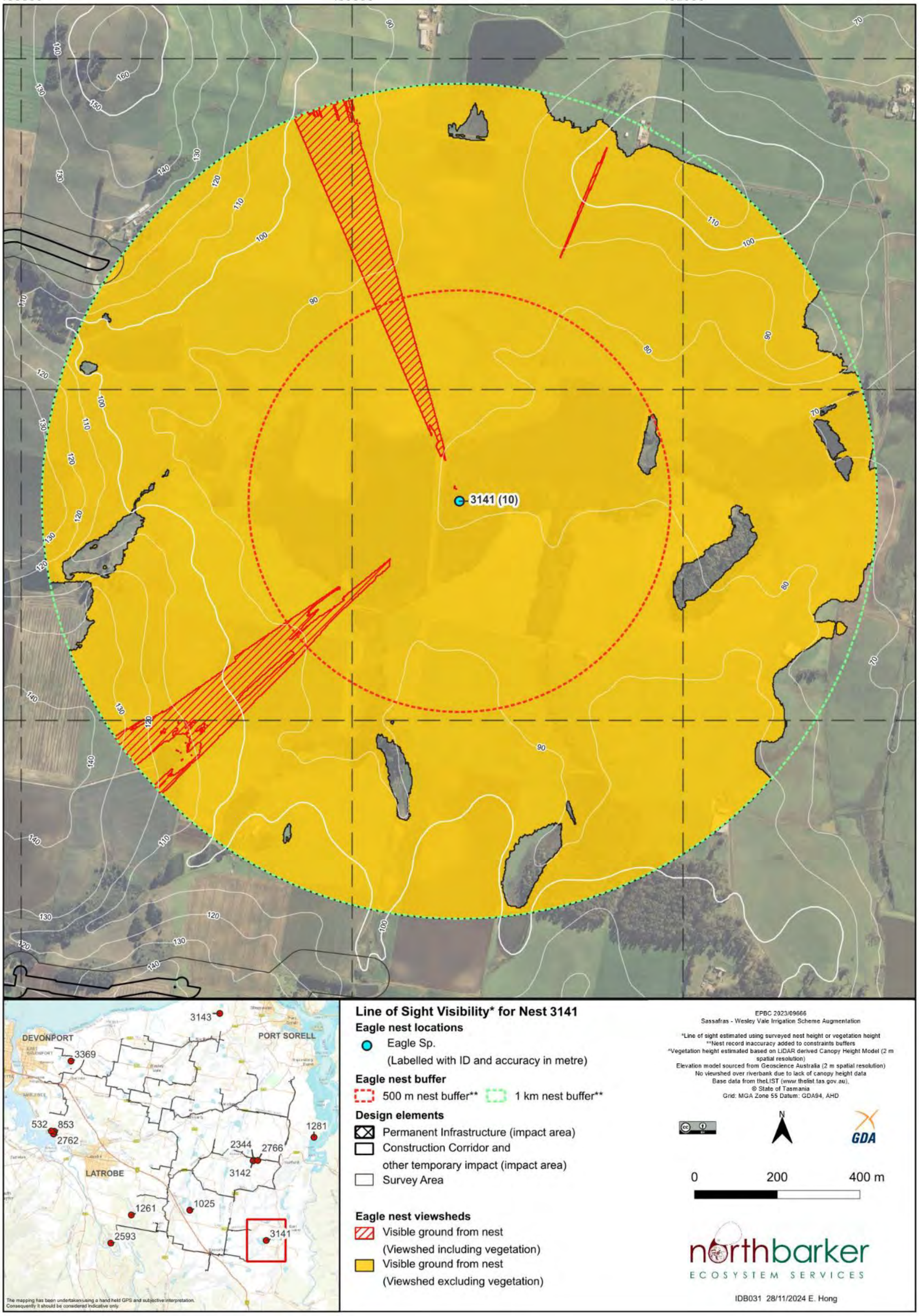


Figure J11: Nest viewshed modelling for Nest ID: 3141

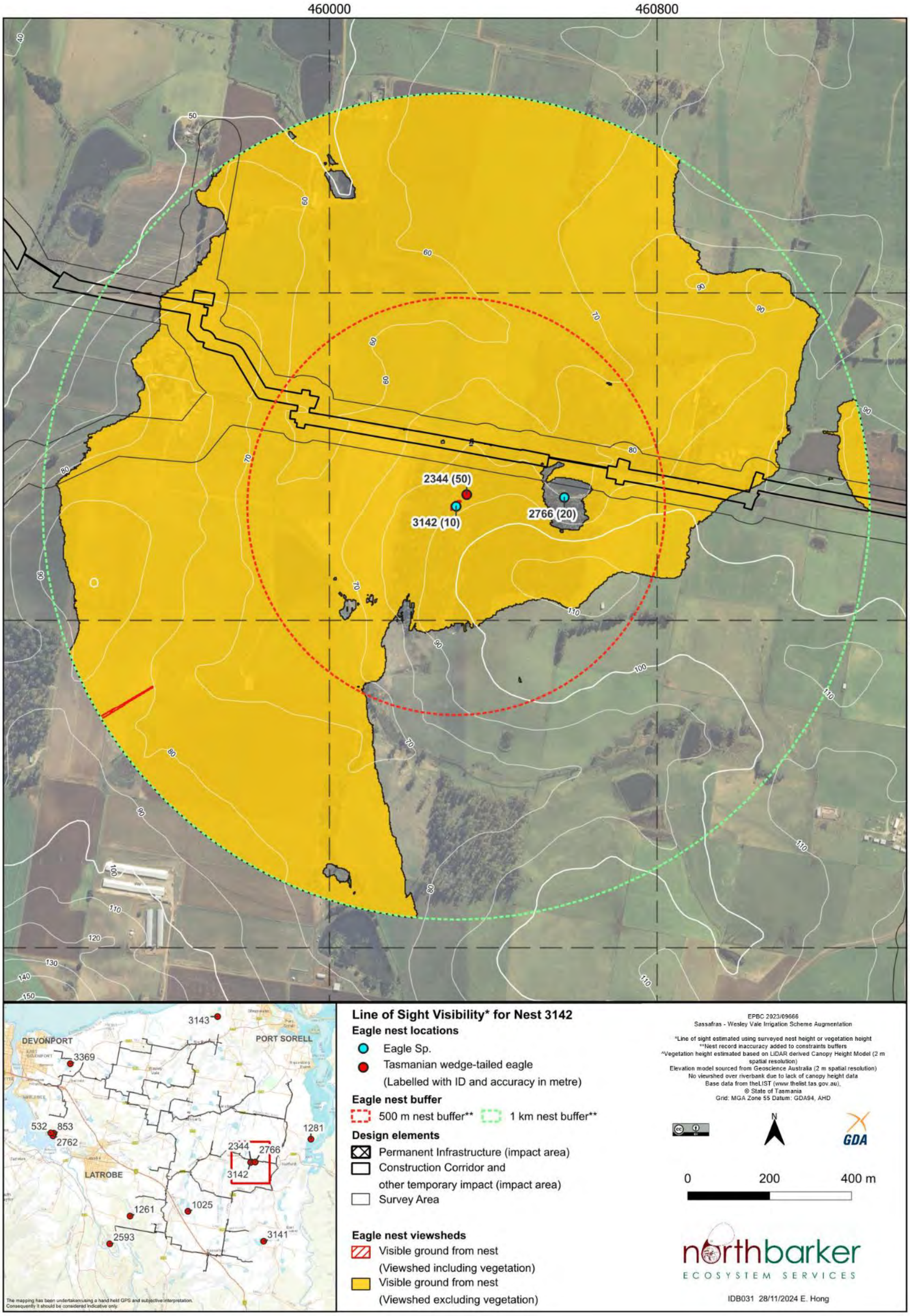


Figure J12: Nest viewshed modelling for Nest ID: 3142

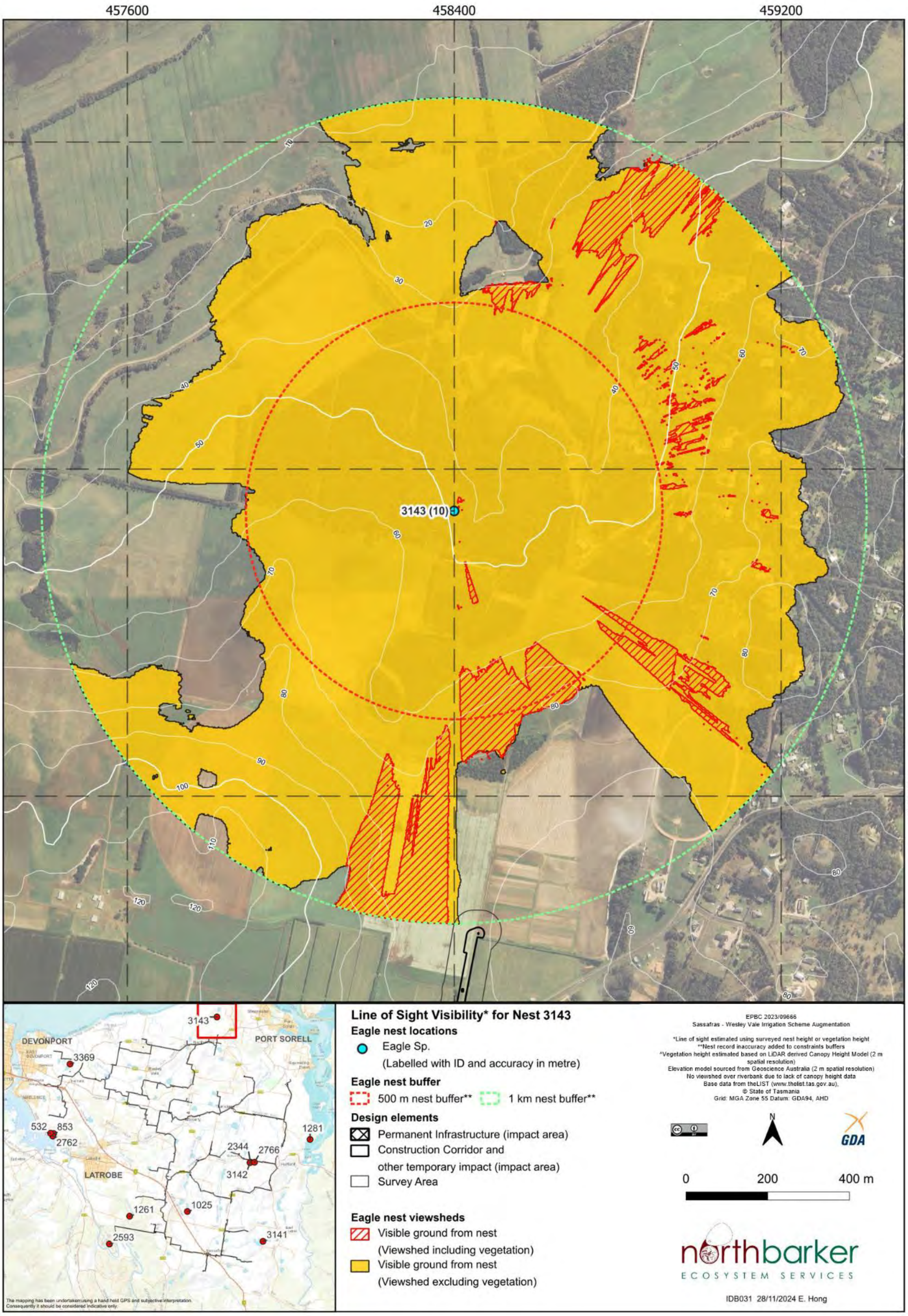


Figure J13: Nest viewshed modelling for Nest ID: 3143

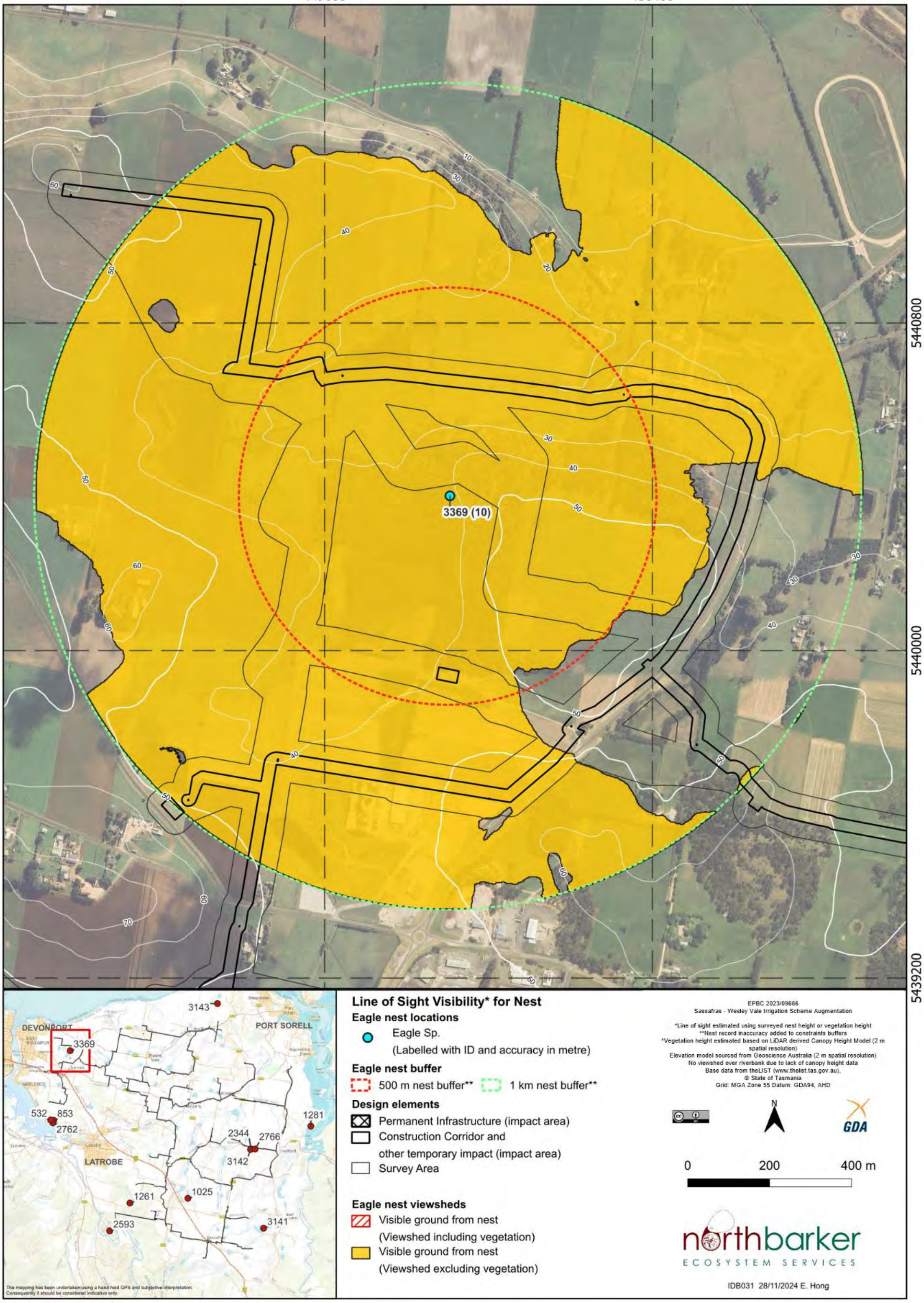


Figure J14: Nest viewshed modelling for Nest ID: 3369

APPENDIX K – RAPTOR NEST LOCATION FORMS

Raptor Nest Location Form

Nest number and name (Office use only):

New eagle nest: 3141

SPECIES: Eagle sp.

OBSERVER:

Erin Harris, Aleida Williams, Adam Hardy

North Barker Ecosystem Services 313 Macquarie Street, Hobart.

(03) 6231 9788

DATE OF THIS REPORT:	**WHEN WAS THE NEST FOUND?**
29 May 2023	9 February 2023

HOW WAS THE NEST FOUND? eg. during pre-logging search, during forestry operation, etc.

During aerial eagle nest search of selected area.

HAD THE AREA BEEN PREVIOUSLY SEARCHED? give detail

Previous search history of area unknown.

LOCATION OF NEST:

300 m north of Perry's Road, Sassafras- approximately 10 km SE of Latrobe.

FPP number: NA **Coupe number**: NA

Grid Coordinates: 461056 E / 5430131 N **Mapsheet:** ? **Datum:** GDA

GPSed? Yes **Accuracy (m):** 10 m

NEST SITUATION: was it in a tree (species?), on a cliff, or on the ground?

The nest is approximately 28 m off the ground within a 35 m tall *E. obliqua*. This nest has a slight bowl and is bleached underneath.

HISTORY OF NEST USE: known breeding attempts? results?

Unknown.

NEST DISTURBANCE: forestry, recreation, roading, building, etc.?

The nest is located within a remnant patch of native vegetative adjacent to a dam, there are agricultural activities approximately 180 m north of the nest.

WHAT WAS SEEN? eggs, birds, droppings, nest material, prey, etc.?

A moderate sized nest within a remnant patch of native vegetation by a dam. The nest has a slight bowl and is bleached underneath. No bird activity was observed.

Nest 3141 – 300 m North of Perrys Road, Sassafras

Raptor Nest Location Form

Nest number and name (Office use only):

Nest: 3142

SPECIES: Eagle sp.

OBSERVER:

Erin Harris, Aleida Williams, Adam Hardy

North Barker Ecosystem Services 313 Macquarie Street, Hobart.

(03) 6231 9788

DATE OF THIS REPORT:	**WHEN WAS THE NEST FOUND?**
30 May 2023	9 February 2023

HOW WAS THE NEST FOUND? eg. during pre-logging search, during forestry operation, etc.

During aerial eagle nest search of selected area.

HAD THE AREA BEEN PREVIOUSLY SEARCHED? give detail

Previous search history of area unknown.

LOCATION OF NEST:

170 m south of Oppenheim Road, Moriarty- approximately 8 km E of Latrobe.

FPP number: NA **Coupe number**: NA

Grid Coordinates: 460309 E / 5434678 N **Mapsheet:** ? **Datum:** GDA

GPSed? Yes **Accuracy (m):** 10 m

NEST SITUATION: was it in a tree (species?), on a cliff, or on the ground?

Nest located approximately 16 m up in a 21 m tall *E. obliqua* tree. Remnant forest patch within an agricultural landscape.

HISTORY OF NEST USE: known breeding attempts? results?

Unknown.

NEST DISTURBANCE: forestry, recreation, roading, building, etc.?

Agriculture.

WHAT WAS SEEN? eggs, birds, droppings, nest material, prey, etc.?

Medium sized bleached nest with loose sticks on one side where sloping has occurred. No bird activity was observed.

Nest 3142 – 170 m south of Oppenheims Road, Moriarty

Raptor Nest Location Form

Nest number and name (Office use only):

New eagle nest: 3143

SPECIES: Eagle sp.	
OBSERVER: Erin Harris, Aleida Williams, Adam Hardy North Barker Ecosystem Services 313 Macquarie Street, Hobart. (03) 6231 9788	
DATE OF THIS REPORT: 30 May 2023	**WHEN WAS THE NEST FOUND?** 9 February 2023
HOW WAS THE NEST FOUND? eg. during pre-logging search, during forestry operation, etc. During aerial eagle nest search of selected area.	
HAD THE AREA BEEN PREVIOUSLY SEARCHED? give detail Previous search history of area unknown.	
LOCATION OF NEST: 800 m W of Summerhill Drive, Port Sorell. **FPP number**: NA **Coupe number**: NA **Grid Coordinates:** 458402 E / 5443100 N **Mapsheet:** ? **Datum:** GDA **GPSed?** Yes **Accuracy (m):** 10 m	
NEST SITUATION: was it in a tree (species?), on a cliff, or on the ground? Nest located in an *E. viminalis* tree within 100 m of pasture edge.	
HISTORY OF NEST USE: known breeding attempts? results? Unknown.	
NEST DISTURBANCE: forestry, recreation, roading, building, etc.? Agriculture and residential.	
WHAT WAS SEEN? eggs, birds, droppings, nest material, prey, etc.? A large robust nest in an *E. viminalis* tree. No bird activity was observed.	

Nest 3143 – 800 m W of Summerhill Drive, Port Sorell

northbarker
ECOSYSTEM SERVICES

Raptor Nest Location Form

Nest number and name (Office use only):

Eagle nest number: 2593

SPECIES: Wedge-tailed eagle

OBSERVER:

Erin Harris, Aleida Williams, Adam Hardy

North Barker Ecosystem Services 313 Macquarie Street, Hobart.

(03) 6231 9788

DATE OF THIS REPORT:	**WHEN WAS THE NEST FOUND?**
30 May 2023	9 February 2023

HOW WAS THE NEST FOUND? eg. during pre-logging search, during forestry operation, etc.

During aerial eagle nest search of selected area.

HAD THE AREA BEEN PREVIOUSLY SEARCHED? give detail

Yes this nest has been previously observed in 2019.

LOCATION OF NEST:

Approximately 550 m south-west of the Mersey River Great Bend Pump Station, Latrobe.

FPP number: NA **Coupe number**: NA

Grid Coordinates: 452178 E / 5429970 N **Mapsheet:** ? **Datum:** GDA

GPSed? Yes **Accuracy (m):** 10 m

NEST SITUATION: was it in a tree (species?), on a cliff, or on the ground?

Nest located in an *E. obliqua* tree approximately 27 m up a 35 m tree.

HISTORY OF NEST USE: known breeding attempts? results?

Nest activity has previously been observed in 2019.

NEST DISTURBANCE: forestry, recreation, roading, building, etc.?

Agriculture and residential.

WHAT WAS SEEN? eggs, birds, droppings, nest material, prey, etc.?

The nest was obscured by dense canopy and appeared to have a slight bowl in it with brown leaves and sticks. The nest appeared to be in prime condition. No bird activity was observed.

Nest 2593 – 550 m SW of Mersey River Great Bend Pump Station

Raptor Nest Location Form

Nest number and name (Office use only):

Eagle nest number: 1261

SPECIES: Wedge-tailed eagle

OBSERVER:

Erin Harris, Aleida Williams, Adam Hardy

North Barker Ecosystem Services 313 Macquarie Street, Hobart.

(03) 6231 9788

DATE OF THIS REPORT:	**WHEN WAS THE NEST FOUND?**
30 May 2023	9 February 2023

HOW WAS THE NEST FOUND? eg. during pre-logging search, during forestry operation, etc.

During aerial eagle nest search of selected area.

HAD THE AREA BEEN PREVIOUSLY SEARCHED? give detail

Yes this nest has been surveyed on numerous occasions since first being discovered in 2003.

LOCATION OF NEST:

Adjacent to Bonney's Creek approximately 550 m north of Old Deloraine Road, Latrobe.

FPP number: NA **Coupe number**: NA

Grid Coordinates: 453353 E / 5431584 N **Mapsheet:** ? **Datum:** GDA

GPSed? Yes **Accuracy (m):** 20 m

NEST SITUATION: was it in a tree (species?), on a cliff, or on the ground?

Nest located in an *E. obliqua* approximately 29 m up a 35 m high tree. The nest is large and slighty sloping with a lot of loose sticks underneath and a small amount of algal leeching.

HISTORY OF NEST USE: known breeding attempts? results?

Several verified nest activity records since 2001.

NEST DISTURBANCE: forestry, recreation, roading, building, etc.?

Forestry.

WHAT WAS SEEN? eggs, birds, droppings, nest material, prey, etc.?

Whitewash was observed on the branches adjacent to the nest. This nest is heading towards being derelict if its structure keeps deteriorating. No bird activity was observed.

Nest 1261 – Bonney's Creek, Latrobe

northbarker
ECOSYSTEM SERVICES

Raptor Nest Location Form

Nest number and name (Office use only):

Eagle nest number: 1025

SPECIES: White-bellied sea eagle

OBSERVER:

Erin Harris, Aleida Williams, Adam Hardy

North Barker Ecosystem Services 313 Macquarie Street, Hobart.

(03) 6231 9788

DATE OF THIS REPORT:	WHEN WAS THE NEST FOUND?
30 May 2023	9 February 2023

HOW WAS THE NEST FOUND? eg. during pre-logging search, during forestry operation, etc.

During aerial eagle nest search of selected area.

HAD THE AREA BEEN PREVIOUSLY SEARCHED? give detail

Yes this this nest was previously observed in 2001.

LOCATION OF NEST:

Approximately 450 m NE of the Bass Highway, Sassafras

FPP number: NA **Coupe number**: NA

Grid Coordinates: 456692 E / 5431854 N **Mapsheet:** ? **Datum:** GDA

GPSed? Yes **Accuracy (m):** 20 m

NEST SITUATION: was it in a tree (species?), on a cliff, or on the ground?

This nest is in a 31 m height exposed dead stag roughly 28 m high. The nest is bleached with a slight bowl and is in a viable condition.

HISTORY OF NEST USE: known breeding attempts? results?

This nest was first observed in 2001, no other history of nest use is known.

NEST DISTURBANCE: forestry, recreation, roading, building, etc.?

Forestry.

WHAT WAS SEEN? eggs, birds, droppings, nest material, prey, etc.?

Nearby nest #1024 could not be identified. No bird activity was observed.

Nest 1025 – 450 m N of Bass Highway, Sassafras

northbarker
ECOSYSTEM SERVICES

Raptor Nest Location Form

Nest number and name (Office use only):

Eagle nest number: 2766

SPECIES: Eagle sp.

OBSERVER:

Erin Harris, Aleida Williams, Adam Hardy

North Barker Ecosystem Services 313 Macquarie Street, Hobart.

(03) 6231 9788

DATE OF THIS REPORT:	**WHEN WAS THE NEST FOUND?**
30 May 2023	9 February 2023

HOW WAS THE NEST FOUND? eg. during pre-logging search, during forestry operation, etc.

During aerial eagle nest search of selected area.

HAD THE AREA BEEN PREVIOUSLY SEARCHED? give detail

Yes, this nest was first observed in 2020.

LOCATION OF NEST:

Oppenheims Road, Approximately 1.5 km WNW of Harford.

FPP number: NA **Coupe number**: NA

Grid Coordinates: 460570 E / 5434697 N **Mapsheet:** ? **Datum:** GDA

GPSed? Yes **Accuracy (m):** 20 m

NEST SITUATION: was it in a tree (species?), on a cliff, or on the ground?

This nest is approximately 15 m up a 20 m tall *E. Obliqua*. The nest has a flat top with brown leaves. Nest is in prime condition.

HISTORY OF NEST USE: known breeding attempts? results?

This nest was first observed in 2020, no other history of nest use is known.

NEST DISTURBANCE: forestry, recreation, roading, building, etc.?

Agriculture.

WHAT WAS SEEN? eggs, birds, droppings, nest material, prey, etc.?

Whitewash observed on branches adjacent to nest. No bird activity was observed.

Nest 2766 – 1.5 km WNW of Harford

Raptor Nest Location Form

Nest number and name (Office use only):

Eagle nest number: 3142

SPECIES: Eagle sp.

OBSERVER:

Erin Harris, Aleida Williams, Adam Hardy

North Barker Ecosystem Services 313 Macquarie Street, Hobart.

(03) 6231 9788

DATE OF THIS REPORT:	**WHEN WAS THE NEST FOUND?**
30 May 2023	9 February 2023

HOW WAS THE NEST FOUND? eg. during pre-logging search, during forestry operation, etc.

During aerial eagle nest search of selected area.

HAD THE AREA BEEN PREVIOUSLY SEARCHED? give detail

This is a new nest but was found within 50 m of nest #2344 which was first observed in 2017.

LOCATION OF NEST:

160 m south of Oppenheims Road, Approximately 1.5 km WNW of Harford.

FPP number: NA **Coupe number**: NA

Grid Coordinates: 458402 E / 5443100 N **Mapsheet:** ? **Datum:** GDA

GPSed? Yes **Accuracy (m):** 20 m

NEST SITUATION: was it in a tree (species?), on a cliff, or on the ground?

This nest is roughly 16 m up a 21 m high *E. obliqua* and is a medium sized bleached nest with loose sticks on one side where sloping has occurred.

HISTORY OF NEST USE: known breeding attempts? results?

This is a new nest; history of nest use is unknown.

NEST DISTURBANCE: forestry, recreation, roading, building, etc.?

Agriculture.

WHAT WAS SEEN? eggs, birds, droppings, nest material, prey, etc.?

No bird activity was observed.

Nest 3142 – 160 m S of Oppenheims Road, Sassafras

Raptor Nest Location Form

Nest number and name (Office use only):
Eagle nest number: 2344

SPECIES: Wedge-tailed eagle	
OBSERVER: Erin Harris, Aleida Williams, Adam Hardy North Barker Ecosystem Services 313 Macquarie Street, Hobart. (03) 6231 9788	
DATE OF THIS REPORT: 30 May 2023	**WHEN WAS THE NEST FOUND?** 9 February 2023
HOW WAS THE NEST FOUND? eg. during pre-logging search, during forestry operation, etc. During aerial eagle nest search of selected area.	
HAD THE AREA BEEN PREVIOUSLY SEARCHED? give detail Yes this nest was first observed in 2017.	
LOCATION OF NEST: Adjacent to pine plantation, approximately 120 m south of Oppenheim's Road, Sassafras. **FPP number**: NA **Coupe number**: NA **Grid Coordinates:** 460335 E / 5434707 N **Mapsheet:** ? **Datum:** GDA **GPSed?** Yes **Accuracy (m):** 50 m	
NEST SITUATION: was it in a tree (species?), on a cliff, or on the ground? This nest is approximately 14 m up a 18 m high *E.obliqua*. The nest has a slight bowl with old dry green leaves in the centre.	
HISTORY OF NEST USE: known breeding attempts? results? This nest was first observed in 2017, no other history of nest use is known.	
NEST DISTURBANCE: forestry, recreation, roading, building, etc.? Forestry.	
WHAT WAS SEEN? eggs, birds, droppings, nest material, prey, etc.? Old dry green leaves observed within centre of the nest. No bird activity was observed.	

Nest 2344 – 120 m S of Oppenheims Road, Sassafras

northbarker
ECOSYSTEM SERVICES

Raptor Nest Location Form

Nest number and name (Office use only):

Eagle nest number: 853

SPECIES: Wedge-tailed eagle

OBSERVER:

Erin Harris, Aleida Williams, Adam Hardy

North Barker Ecosystem Services 313 Macquarie Street, Hobart.

(03) 6231 9788

DATE OF THIS REPORT:	**WHEN WAS THE NEST FOUND?**
30 May 2023	9 February 2023

HOW WAS THE NEST FOUND? eg. during pre-logging search, during forestry operation, etc.

During aerial eagle nest search of selected area.

HAD THE AREA BEEN PREVIOUSLY SEARCHED? give detail

Yes this nest was first observed in 1985 and again in 2020.

LOCATION OF NEST:

200 m north of Latrobe sewage works, adjacent to Mersey River.

FPP number: NA **Coupe number**: NA

Grid Coordinates: 448960 E / 5436361 N **Mapsheet:** ? **Datum:** GDA

GPSed? Yes **Accuracy (m):** 10

NEST SITUATION: was it in a tree (species?), on a cliff, or on the ground?

This nest is approximately 18 m up a 25 m high *E. obliqua*.

HISTORY OF NEST USE: known breeding attempts? results?

This nest was observed as being occupied in 2020.

NEST DISTURBANCE: forestry, recreation, roading, building, etc.?

Agriculture.

WHAT WAS SEEN? eggs, birds, droppings, nest material, prey, etc.?

This nest has a lot of white-wash on adjacent branches and a very flat top. It was likely active during the last breeding season. Algal leeching is present under this nest. No bird activity was observed.

Nest 853 – 220 m N of Latrobe sewage works

Raptor Nest Location Form

Nest number and name (Office use only):

Eagle nest number: 2762

SPECIES: White-bellied sea eagle

OBSERVER:

Erin Harris, Aleida Williams, Adam Hardy

North Barker Ecosystem Services 313 Macquarie Street, Hobart.

(03) 6231 9788

DATE OF THIS REPORT:	**WHEN WAS THE NEST FOUND?**
30 May 2023	9 February 2023

HOW WAS THE NEST FOUND? eg. during pre-logging search, during forestry operation, etc.

During aerial eagle nest search of selected area.

HAD THE AREA BEEN PREVIOUSLY SEARCHED? give detail

Yes this nest was first observed in 2017 and has been surveyed on numerous occasions since.

LOCATION OF NEST:

Eastern shore of the Mersey River, approximately 2.5 km south of Latrobe.

FPP number: NA **Coupe number**: NA

Grid Coordinates: 448906 E / 5436210 N **Mapsheet:** ? **Datum:** GDA

GPSed? Yes **Accuracy (m):** 10 m

NEST SITUATION: was it in a tree (species?), on a cliff, or on the ground?

This nest is approximately 17 m up a 24 m high *E. obliqua* and is starting to slope significantly.

HISTORY OF NEST USE: known breeding attempts? results?

This nest has been known to be occupied on numerous occasions since being first discovered in 2017.

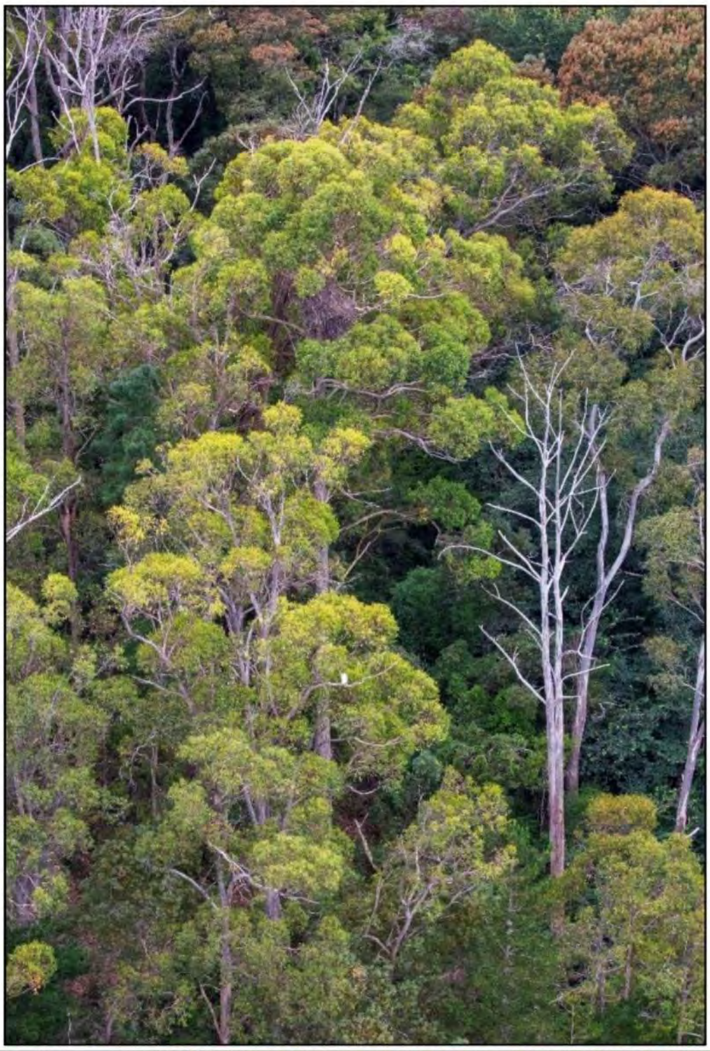
NEST DISTURBANCE: forestry, recreation, roading, building, etc.?

Agriculture.

WHAT WAS SEEN? eggs, birds, droppings, nest material, prey, etc.?

This large nest has been added to over the years and has separated into two large clumps of material. Two adult white-bellied sea eagles were perched near this nest, and it has been noted as being active this year.

Nest 2762 – Eastern shore of Mersey River, 2.5 km S of Latrobe



Raptor Nest Location Form

Nest number and name (Office use only):

Eagle nest number: 1281

SPECIES: White-bellied Sea eagle

OBSERVER:

Erin Harris, Aleida Williams, Adam Hardy

North Barker Ecosystem Services 313 Macquarie Street, Hobart.

(03) 6231 9788

DATE OF THIS REPORT:	WHEN WAS THE NEST FOUND?
30 May 2023	9 February 2023

HOW WAS THE NEST FOUND? eg. during pre-logging search, during forestry operation, etc.

During aerial eagle nest search of selected area.

HAD THE AREA BEEN PREVIOUSLY SEARCHED? give detail

Yes this nest was first observed in 2003.

LOCATION OF NEST:

Finger Point, approximately 6 km south of Port Sorell.

FPP number: NA **Coupe number**: NA

Grid Coordinates: 463782 E / 5436023 N **Mapsheet:** ? **Datum:** GDA

GPSed? Yes **Accuracy (m):** 100 m

NEST SITUATION: was it in a tree (species?), on a cliff, or on the ground?

This nest is approximately 20 m up a 24 m high *E. viminalis*.

HISTORY OF NEST USE: known breeding attempts? results?

This nest was first observed in 2003, no other history of nest use is known.

NEST DISTURBANCE: forestry, recreation, roading, building, etc.?

Agriculture.

WHAT WAS SEEN? eggs, birds, droppings, nest material, prey, etc.?

This nest is difficult to identify under dense canopy. The nest is in derelict condition and the sticks on this nest are bleached and loose on top. Sloping has started to occur. No bird activity was observed.

Nest 1281 – Finger point 6 km S of Port Sorell

Raptor Nest Location Form

Nest number and name (Office use only):

Eagle nest number: 532

SPECIES: White-bellied Sea eagle

OBSERVER:

Erin Harris, Aleida Williams, Adam Hardy

North Barker Ecosystem Services 313 Macquarie Street, Hobart.

(03) 6231 9788

DATE OF THIS REPORT:	**WHEN WAS THE NEST FOUND?**
30 May 2023	Nest could not be located

HOW WAS THE NEST FOUND? eg. during pre-logging search, during forestry operation, etc.

Nest could be located during an aerial eagle nest search of selected area.

HAD THE AREA BEEN PREVIOUSLY SEARCHED? give detail

Yes this nest was first discovered in 1985.

LOCATION OF NEST:

Approximately 2 km NW of Latrobe.

FPP number: NA **Coupe number**: NA

Grid Coordinates: 448781 E / 5436372 N **Mapsheet:** ? **Datum:** GDA

GPSed? Yes **Accuracy (m):** 10 m

NEST SITUATION: was it in a tree (species?), on a cliff, or on the ground?

Recorded in 1985 in a *E. obliqua*. Nest not found during ground search undertaken in 2020 by E. Harris.

HISTORY OF NEST USE: known breeding attempts? results?

This nest was first discovered in 1985, no other history of nest use is known.

NEST DISTURBANCE: forestry, recreation, roading, building, etc.?

Agriculture.

WHAT WAS SEEN? eggs, birds, droppings, nest material, prey, etc.?

This nest was unable to be located.

Raptor Nest Location Form

Nest number and name (Office use only):
Eagle nest number: 1024

SPECIES: White-bellied Sea eagle

OBSERVER:

Erin Harris, Aleida Williams, Adam Hardy

North Barker Ecosystem Services 313 Macquarie Street, Hobart.

(03) 6231 9788

DATE OF THIS REPORT:	WHEN WAS THE NEST FOUND?
30 May 2023	Nest could not be located

HOW WAS THE NEST FOUND? eg. during pre-logging search, during forestry operation, etc.

Nest could be located during an aerial eagle nest search of selected area.

HAD THE AREA BEEN PREVIOUSLY SEARCHED? give detail

Yes this nest was first discovered in 2001 and has been observed on multiple occasions since.

LOCATION OF NEST:

Sassafras.

FPP number: NA **Coupe number**: NA

Grid Coordinates: 456579 E / 5431949 N **Mapsheet:** ? **Datum:** GDA

GPSed? Yes **Accuracy (m):** 10 m

NEST SITUATION: was it in a tree (species?), on a cliff, or on the ground?

First recorded in 2001 in a *E. obliqua*. Nest not found during aerial search undertaken.

HISTORY OF NEST USE: known breeding attempts? results?

This nest was first discovered in 2001 with the last observation recorded in 2006. No other history of nest use is known.

NEST DISTURBANCE: forestry, recreation, roading, building, etc.?

Agriculture.

WHAT WAS SEEN? eggs, birds, droppings, nest material, prey, etc.?

This nest was unable to be located.

Raptor Nest Location Form

Nest number and name (Office use only):
Eagle nest number: 3369

SPECIES:

OBSERVER:

Aleida Williams

North Barker Ecosystem Services 313 Macquarie Street, Hobart.

(03) 6231 9788

DATE OF THIS REPORT:	WHEN WAS THE NEST FOUND?
02 September 2024	15 April 2024

HOW WAS THE NEST FOUND? eg. during pre-logging search, during forestry operation, etc.

During ground natural values survey of potential design corridor.

HAD THE AREA BEEN PREVIOUSLY SEARCHED? give detail

Unknown.

LOCATION OF NEST:

~1 km due north from Frankford Road - Port Sorell Road roundabout.

FPP number: NA **Coupe number**: NA

Grid Coordinates: 449900 E / 5440377 N **Mapsheet:** ? **Datum:** GDA

GPSed? Yes **Accuracy (m):** 100 m

NEST SITUATION: was it in a tree (species?), on a cliff, or on the ground?

In *E. obliqua* 22 m up in fork. 1-1.5 m, small sticks and bark, no big sticks, dry brown and loose, looks new

HISTORY OF NEST USE: known breeding attempts? results?

This is a new nest; history of nest use is unknown.

NEST DISTURBANCE: forestry, recreation, roading, building, etc.?

Agriculture.

WHAT WAS SEEN? eggs, birds, droppings, nest material, prey, etc.?

~1.5 m diameter, small sticks and bark, no big sticks, dry brown and loose, looks new. No bird activity was observed.

Nest 3369 – 1 km due north from Frankford Road - Port Sorell Road roundabout

FPA
FOREST PRACTICES AUTHORITY

Raptor Nest Search Form

Action	Person	Date	Result
Search of nesting habitat	Leida Williams Erin Harris Adam Hardy Person-hours: 24 Hours	9 February 2023	Three new nests found. Eight previously recorded eagle nests confirmed present. Two previously recorded eagle nests were unable to be relocated or searched for.
Follow-up search(?)	N/A Person-hours:	N/A	
Nest site added to NVA Reserve added to planning maps/GIS	NBES	07/03/2023	Three new nests to be added – nest verification data will be added to NVA

Location: Devonport- Latrobe- Sassafras- Moriarty- Port Sorell

Grid Coordinates - See Figure 1

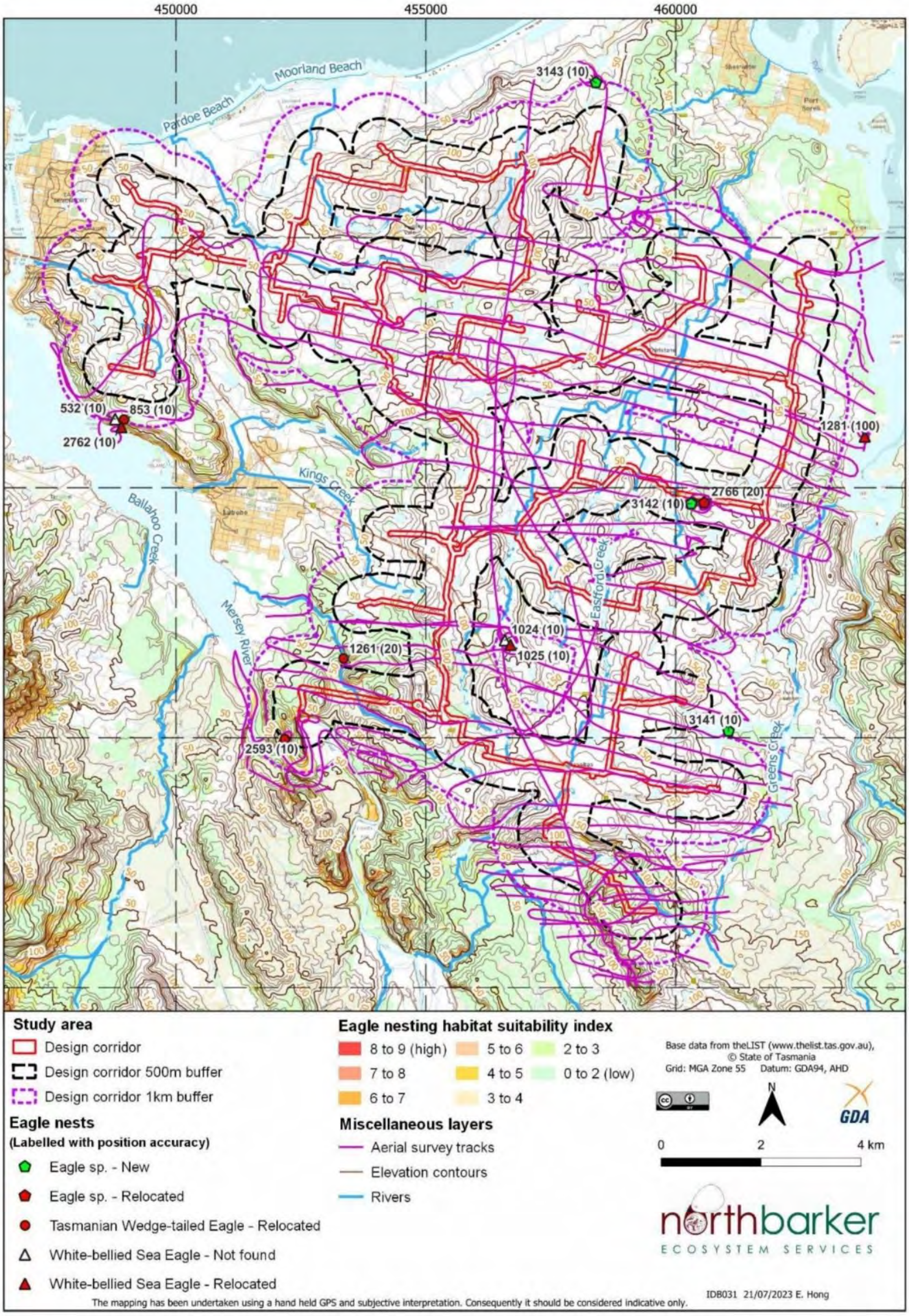


Figure 1: Eagle nesting habitat modelling, eagle nest locations, and NBES aerial eagle nest survey track log – 9 February 2023

APPENDIX L – CENTRAL NORTH BURROWING CRAYFISH ADVICE

SWISA Tranche 3
Written Advice re Central North Burrowing Crayfish (*Engaeus granulatus*)

Associate Professor Alastair MM Richardson
University Associate
Biological Sciences
Private Bag 55
Hobart TAS 7001

Background

The Central north Burrowing Crayfish, *Engaeus granulatus*, (hereafter CNBC) is one of 33 (soon to be 34, see below) species of freshwater crayfish found in Tasmania. The genus *Engaeus* includes 15 (soon 16) species, often called burrowing crayfish, all but two of which are endemic to the state. The CNBC is one of five *Engaeus* species listed in the schedules of the Tasmanian *Threatened Species Protection Act 1995* and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* where it is classified as Endangered.

Distribution & other crayfish species

The distribution of the CNBC was first described by Horwitz (1990) as part of the original description of the species, and further by Doran (2000, 2004); Richardson *et al.* (2008) used further records to model the species' likely distribution. Since then, records have accumulated in the Tasmanian Natural Values Atlas, but it should be noted that these are sometimes records of burrows alone. Because of the difficulty and undesirability of excavating burrows, especially those away from watercourses, it has been widely assumed that the CNBC occupies an exclusive core range, and thus it can be assumed that burrows within this range represent the species. However, at least four other *Engaeus* species overlap the margins of the CNBC range: *E. fossor* in the west, *E. cunicularius* along the northern coast strip, *E. nulloporius* in the south, and *E. mairener* to the east. We now know that *E. mairener*, particularly, penetrates well into the eastern half of the CNBC range.

Recent collections have revealed an undescribed species of *Engaeus* in the Latrobe area (Richardson in prep). The two localities from which this species is known are both cleared paddocks, where it digs very deep burrows, suggesting that it may have been missed in previous surveys.

It is likely that crayfish burrows in the SWIS area are mostly those of the CNBC, but the presence of *E. mairener* cannot be discounted. Where *E. mairener* has been found together with the CNBC, the former may occupy wetter conditions around water courses. The undescribed *Engaeus* sp. from the Latrobe could possibly be present, but the two sites from which it is known are outside the SWIS area and at a lower altitude. In practice, it is precautionary to assume that all burrows in the SWIS area are those of the CNBC.

CNBC Habitat

The type locality for the CNBC was described as (Horwitz 1990):

> *The type locality for E. granulatus consists of a creek approximately 2-3 m wide flowing slowly through a wet sclerophyll forest (which is dominated by Eucalyptus spp. and contains numerous ferns along the bank). This species occupies type 2 burrows in flood plains or in the bank of the creek, upstream from the mouth.*

In the process of listing the CNBC under the Commonwealth EPBC Act (Doran 2004) the habitat was described as:

> *The species occupies seeps, wetlands and stream banks.*

No critical habitat has been described for the CNBC, and there do not appear to be any habitat characteristics that are uniquely necessary for its occurrence. It naturally occurs in swamps and on the flood plains of small shallow creeks, but it also colonises and persists in artificial drains in agricultural land or along transport corridors. Like most Tasmanian burrowing crayfish it creates type 2 burrows (see Horwitz & Richardson 1986), i.e. those that derive their source of water from ground water, but it can also excavate type 1b burrows, i.e. those that are associated with surface water, with burrow entrances both below water and opening into the air on the bank.

Where more than one species of burrowing crayfish occur together they often partition the habitat on the basis of water availability. Where the CNBC co-occurs with *Engaeus mairener* the latter tends to occupy type 1b burrows at the water's edge, with the CNBC further back from the water. However, these differences may not be hard and fast, or may be too subtle to detect. Horwitz (1990) mentions finding the CNBC together with *Engaeus nulloporius* and not being able to detect any habitat difference.

Burrows distant from standing water (and often in paddocks) within the range of the CNBC are the hardest to assess since they have only rarely been excavated successfully. The burrows of the new species of *Engaeus* from around Latrobe required an excavator to reach the animals at greater than 2m depth. *E. mairener* is also capable of digging very deep burrows well away from standing water, at least in the eastern part of its range (Doran & Richardson 2007). Until eDNA methods become readily available the identity of the occupants of these deep burrows will be uncertain.

Crayfish-free habitat

The CNBC, and burrowing crayfish in general, are seriously affected by pugging of the soil by cattle (Doran 2000, 2004). Where cattle are regularly accessing waterlogged areas, such as at watering point, it is safe to assume that crayfish will not be present. While the CNBC is tolerant of non-native vegetation, such as grazed pasture or blackberry thickets, it does not seem to persist under a dense cover of tussock-forming grasses and sedges such as cocksfoot (*Dactylis glomerata*) or *Glyceria maxima* perhaps because their root mat inhibits burrowing.

Burrow depth and extent

As described above, the CNBC mostly digs type 2 burrows (Horwitz & Richardson 1986), i.e. burrows that derive their water from the water table, and so must extend down to the lowest point that the water table drops to in typical dry seasons. Thus, the depth of burrow systems at any point will depend on water table movement there. In drains and permanently wet places burrows will not be deeper than 1 metre, but in open pasture they may be more than 2m deep. Similarly, the horizontal extent of a burrow system depends on the local hydrology; in permanently wet places the burrows often ramify horizontally over 2-3 sq m, with many entrances, but where the water table can be deep the burrows are much more constrained horizontally, with perhaps 2-4 entrances within a square metre, and the burrow descending more or less vertically below that.

Colony size

The size of what appears to be a "colony" is again dependent on the local hydrology. In permanently wet places burrow systems are contiguous (we don't know whether they interconnect below ground) and will fill the available habitat. In drier sites burrow density is low and systems may be metres apart. Estimates of the density of crayfish are derived from burrow counts and assumptions about burrow occupancy. Doran & Richardson (2009) recorded burrow densities of 0.78-0.55 burrows m^{-2} for the CNBC in swampy habitat at a site on Stony Rise, Devonport. Numbers at the densest sites in the SWISA area are likely to be similar.

In considering what constitutes a "colony", the key criterion must be the opportunity for colony members to interact with each other. With no data on dispersal (see below) we can only set a speculative distance between burrows of, say, 10m. Similarly, an arbitrary figure of, say, 20 burrow entrances could be taken as a minimum colony size. But it must be stressed that these figures have no data to support them.

Dispersal

Crayfish must leave their burrows to mate, and juvenile crayfish must disperse away from the parental burrow. Circumstantial evidence (capture of females carrying eggs, or with old egg cases: Horwitz 1990) suggests a spring-summer breeding season, pehaps with spring rains providing the opportunity for males to seek out female burrows, and autumn rains allowing juveniles to disperse. But it is common to find suitable habitat for the CNBC that has no burrows, so there is obviously a limit to the distance burrowing crayfish can disperse. Dispersal along the edges of water courses is very likely, but colonisation of isolated wet patches probably happens rarely, perhaps in flood events. There are no data on the dispersal of CNBC or any other Tasmanian burrowing crayfish, but the following circumstantial observations may be helpful.

A housing subdivision at Stony Rise, Devonport included the CNBC (Doran & Richardson 2009) and the burrows were mapped during a preliminary survey. After the houses were built (sometime after 2010?) one resident used a network of irrigation sprays to extend the width of the wet gully alongside his property, about 150m upstream of the colonies mapped in the 2008 survey. A chance visit to the site in 2023 showed that the irrigated area had been extensively colonised by crayfish, presumably the CNBC. The implication is that the animals were able to colonise the new habitat 150m away in less than 10 years.

Threats and persistence
The following threats to the CNBC are presented in the EPBC Nomination Statement (Doran 2004):

1. Agricultural practices, including clearance of riparian and seepage-way vegetation, ploughing, dam construction and unrestricted stock grazing (which churns and compacts the soil making it unsuitable for *Engaeus* spp.);
2. Forestry activities, such as clearing, burning, and conversion to plantation, which impose significant mechanical disturbance on stream headwaters and seepage channels;
3. Frequent high intensity fires that have negative long-term effects on soil and vegetation;
4. Establishment of roads and associated drainage activities that impact on seep, wetland and stream-bank habitat quality (eg. through the promotion of siltation and erosion), and any other activities that degrade river bank integrity and enhance erosion;
5. Poor waste management, waterway pollution and habitat removal;
6. Inappropriate timing/application of pesticides and fertilisers;
7. Urban and rural development impacting on the surrounding environment;
8. Habitat degradation through the establishment of weeds such as gorse and blackberries in waterways and seeps;
9. The introduced crayfish *Cherax destructor*, which may pose a serious threat to native species through the spread disease and/or parasites. In some situations *C. destructor* may displace *E. granulatus* through competition for food and habitat.

Of these, 1, 4, 5, 6 and 8 are relevant here, but clearly the CNBC persists in many places within the SWIS area in the face of them. From observations with the CNBC in drains along the railway in the Spreyton area, woody weeds may be less of a problem than tussock-forming grasses (see above), and indeed may provide some protection from trampling and pugging by cattle. The report by Tas Irrigation (2018) suggests that irrigation *per se* has not affected burrow numbers.

Likely impacts
Construction (assumed to be installation of pipes in a narrow trench (depth?) with a corridor of disturbance 10-30 m wide).

If tracked vehicles are used, then only in the wettest areas will they have a serious effect on the crayfish, since with their weight spread on tracks, soil compaction will be minimal. Excavation through colonies will inevitably intersect burrows and their occupants.

Post-construction
In-filled trenches will be available for recolonisation by the crayfish. Circumstantial evidence about how often this occurs should be available around the earlier installations of piping in the SWIS area.

Operation of the irrigation scheme

Hydrological changes (raised water table, increased run off) have the potential to affect the CNBC. The earlier report (Tasmanian Irrigation 2018) suggests these effects will be minimal. They may even have a positive effect if increased run off enlarges the area of suitable habitat in drains and other poorly drained areas. Existing patches of *Juncus* rushes in paddocks which have occasional burrows now may support growing colonies of crayfish.

There may be a potential for some offsets if run off can be used to deliberately increase the area of habitat, as was successfully done for the CNBC in Miandetta, Devonport (Nelson, Undated) (see also Van Praagh 2022).

Mitigation

Construction

Suggest recognising three levels of crayfish density at crossings or in wet areas, based roughly on densities in good quality habitat recorded by Doran & Richardson (2009):

1. No burrows observed, or very low probability
2. Few burrows: 4 or less per 4x4m (i.e. no "colony")[1]
3. Dense burrows; greater than 4 per 4x4m (i.e. "colony" present)

Mitigation measures as follows:

1. None
2. Trenching spoil to be checked for crayfish; any animals found to be handled and relocated following Standard Operating Protocol. Crayfish specialist[2] not required on site.
3. Consider re-routing trench, or drilling under (to at least 2m depth). If those approaches are not feasible, crayfish specialist required on site to recover and relocate crayfish following SOP.

Post-construction

Set up monitoring program for type (3) construction sites and relocation sites as in Tasmanian Irrigation (2018).

Operation of the scheme

Monitor existing *Juncus* patches with small numbers of burrows, and possibly monitor offset sites. Fence existing colonies, any developing ones, or offset sites to prevent access by stock.

Relocation

A Standard Operating Procedure for handling and relocating excavated crayfish was devised for crayfish conservation measures during major track reinstatement by TasRail

[1] This could be converted to number of burrows per linear metre of trench to make it easier in the field
[2] I.e. someone trained in the crayfish handling protocol, with that specific task on site

in the Spreyton area (EcoTas 2020: See Appendix). Briefly, animals recovered from excavations were relocated either to burrows truncated during the deepening of trackside drains (not relevant in the SWISA context) or into 250mm diameter auger holes at least 150mm deep in suitable habitat adjacent to other burrows.

During drain deepening the spoil was examined as it was removed by excavator, but yielded few animals, probably because they retreated to the bottom of the burrow, below the reach of the excavator, when disturbed. Most salvaged animals came from the wettest sites, where the burrows were shallow, and the spoil was semi-liquid and sloppy.

Of 17 animals relocated into auger holes, just over half were alive and active (as evidenced by fresh diggings) after three months, but by six months, although the holes remained open and distinct there was no sign of digging. However, active burrows were present within 0.25m, suggesting the relocated animals had moved.

More generally, *Engaeus* species dig readily into soft substrate, and the CNBC shows a preference for soils with a higher organic content than sandy or clay soils (Hopgood-Douglas 2005), thus auger holes in soft mud adjacent to other burrows will provide the animals with an initial shelter which they may either expand to a burrow or leave and create a new burrow nearby.

Overall impact

This can be considered under the following EPBC Act headings:

Significant Impact Criteria
1. Lead to a long-term decrease in the size of a population
2. Reduce the area of occupancy of the species
3. Fragment an existing population into two or more populations
4. Adversely affect habitat critical to the survival of a species
5. Disrupt the breeding cycle of a population
6. Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
7. Result in invasive species that are harmful to the species becoming established in the species' habitat
8. Introduce disease that may cause the species to decline
9. Interfere with the recovery of the species

1) While there may be local, short-term impacts during the construction phase, the SWIS project is unlikely to lead to a long-term decrease in the CNBC population.
2) Similarly, construction may lead to short-term reduction in area of occupancy, but this is likely to be recovered.
3) Installation of pipelines across watercourses could fragment local populations but given the relatively narrow footprint (10_30 m), connectivity is likely to be re-established.

4) As noted above, there is no particular habitat type that is critical to the CNBC's survival.
5) The breeding cycle only requires access of male crayfish to females and subsequent brooding of eggs and young in the maternal burrow, so the project will not have any particular effect on the breeding cycle beyond the general short-term impact.
6) Apart from the temporary effects of construction habitat will not decline, and may in fact increase with extra water.
7) No invasive animals are likely, and the CNBC already persists in vegetation consisting mainly of introduced species.
8) No diseases of burrowing crayfish have been recorded in Tasmania.
9) The SWIS project may increase habitat and hence numbers of the CNBC, but at present there is no Recovery Plan for this species.

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Appendix

STANDARD OPERATING PROCEDURE
***ENGAEUS GRANULATUS* SALVAGE & TRANSLOCATION**
Spreyton Concrete Sleeper Replacement Program (EPBC 2012/6392)
ENVIRONMENTAL MANAGEMENT OVERVIEW

This SOP provides an overview of the environmental management objectives and guidelines for works to be addressed by contractors in salvaging *Engaeus granulatus* as part of the TasRail concrete sleeper replacement project. This SOP has been modified from the Offset Management Plan for relocating *E. granulatus* from 39 Clayton Drive, Sheffield Road (Barnes & McCoull 2012).

1.0 OBJECTIVE
To maximise the number of Central North Burrowing Crayfish (*Engaeus granulatus*) (CNBC) successfully salvaged and re-established at the Activity Site.

2.0 TARGETS

- A maximum number of CNBC (*Engaeus granulatus*) successfully salvaged at the Activity Site.
- Minimal losses of CNBC during the excavation process at the Activity Site.
- The appropriate preservation and curation of excavation-compromised CNBC for future research opportunities.

3.0 RESPONSIBILITIES

- The Contractor has a responsibility to ensure that any conditions associated with permits or approvals issued to conduct the translocation, such as the Tasmanian *Threatened Species Protection Act 1995* (TSPA) and *Nature Conservation Act 2002* (NCA), and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), are met.
- Except for when TasRail is the permit holder, TasRail has a responsibility to sight the necessary permits from the Contractor before they engage the Contractor to conduct the works.
- Only suitably qualified and experienced Contractors (authorised persons) that can lawfully perform the tasks and duties of the work will be engaged by TasRail to conduct translocation activities.

4.0 PERMITS / LICENCES
Any specific conditions contained in permits obtained under the TSPA, NCA or EPBC Act must be strictly adhered to.

5.0 SITE HYGIENE
Hand tools, gumboots, holding containers and other equipment used in the salvage of CNBC at the Activity Site must first be thoroughly washed (at least 10 minutes of soaking) in a 1% solution of F10 disinfectant.

6.0 PROCEDURE

6.1 SETUP

- Ensure all site workers are familiar with the conditions of the permits and environmental aspects of the project at the site induction.
- Establish with the excavator operator(s) the process of excavation (e.g. decide on hand signals for directions, timing of excavation and direction within each drain, direction of excavation, technique of excavation and depth to minimise injury to crayfish).
- All safety requirements must be identified and addressed, such as working close to a rail line, confined space (some of the deeper drains) and drain collapse. Measures may include the use of high-vis vests and traffic control measures.

6.2 EXCAVATION OF ANIMALS

- Hand tools cleaned in F10 disinfectant (trowel, spade, shovel, etc) will be used to recover animals from the trackside drains following initial excavation by machinery.
- Excavation is likely to take several days and will continue until all drains at the Activity Site have been excavated as per the SOP for *Engaeus granulatus* salvage.

6.3 HANDLING OF ANIMALS

- Only authorised persons (see 3.0 Responsibilities) will handle animals.
- Animals once caught will be: – examined to check that they have not been compromised by the excavation process;
- Washed free of dirt and mud from the excavation site by placing them into a container of either stream water from the site or dechlorinated potable water (tap water that has been allowed to sit in a vented container for at least 72 hours);
- Placed into their own individual storage container (which should be of sufficient size to contain the animal but limit their movement within the jar) with local stream water or dechlorinated potable water; jars must be placed on ice (in an Esky or similar cooler) in the field before return to burrows during the working day; or
- Containers with animals will kept over ice in a cooler overnight and then released the next day.
- Water within each container will be replaced regularly to ensure it is effective in washing animals.
- Compromised animals, in the opinion of a suitably qualified person, may include animals that have sustained an injury to their thorax, head or abdomen from which they are unlikely to recover or are only partially complete (e.g. have been decapitated or cut in half by the excavation process). These animals will be: – euthanased in an ice slurry for 30 minutes;
- Placed into preserving jars containing 90% ethanol; and
- Specimens will be lodged (including the appropriate collection details) with the Queen Victoria Museum for addition to the collection for future research opportunities (specimens will be lodged within 3 months of the translocation project being completed); and

- Any animals that are killed outright from the excavation will be placed into specimen jars containing 90% ethanol and lodged with the Queen Victoria Museum.

6.4 TRANSPORTATION OF ANIMALS

- Only authorised persons will transport animals from the Activity Site to their holding location overnight and back the next day.
- Animals will be transported from the Activity Site to the overnight holding site and back in their individual containers on ice within an Esky or similar cooler.

6.5 RE-INTRODUCING ANIMALS TO THE ACTIVITY SITE

- Only authorised persons will re-establish the animals at the Activity Site.
- Animals will remain in their individual containers on ice within an Esky or similar cooler until they are placed into a created auger/crow bar hole (see below).
- Animals will be relocated as close to the point of capture as possible, in one of the following ways (in decreasing order of preference): (1) in an existing, though truncated, burrow reaching the water table and at least 150 mm deep; (2) in an artificial burrow reaching the water table and at least 150 mm deep, created with a 25 mm diameter auger within the same area of habitat; or (3) in an artificial burrow reaching the water table and at least 150 mm deep, created with a 25 mm diameter auger in the nearest available habitat.
- Juvenile animals will be placed in a shallow auger/crow bar hole in a very wet area;
- Once an animal is placed in an auger/crow bar hole, a small stone or block of wood will be placed over the hole to maintain moisture and prevent animals from immediately exiting the hole;
- Selected auger/crow bar holes that have been used to re-establish an animal will be marked with a weed mat stake marked with flagging tape (blue).
- Photopoints will be set up to monitor the success of re-established animals in typical re-establishment areas (total of five (5) photopoints, one at each transect);
- A map of these typical re-establishment areas will be prepared, noting the: – occupied burrows;
- Burrows were inhabited by injured, but not compromised, animals (e. g one front claw missing); and
- Burrows occupied by gravid females (if present).

7.0 MONITORING

- Burrow numbers will be monitored using the same approach as the initial survey, i.e. assessing linear burrow density along the entire track as high density (more than 50 burrow openings per 10 metres of track), low density (fewer than 5 burrows per 10 m) or absent; and counting absolute numbers of burrows and their activity (hole, fresh diggings, chimney; see initial report) along the five 30 or 60 m transects selected in the initial survey.
- Burrow counts will be conducted one month, six months and 12 months from salvage work. Photopoint records will also be taken at these times.

8.0 RECORDS

All written records and field notes will be provided to TasRail for future reference and reporting to the Commonwealth Department of Sustainability, Environment, Water, Population & Communities (DSEWPaC) and the Policy & Conservation Assessment Branch of the Tasmanian Department of Primary Industries, Parks, Water & Environment. Written records of the salvage process will be kept by the Contractor, including:

- The date of excavation works, weather conditions, the names of persons involved in the excavation process, and: – the number of animals 'entire' salvaged and re-established;
- The number of animals that were compromised during the excavation process and subsequently euthanased and preserved;
- The date and time of notification to the Contractor of any failure to implement site specific management requirements; and
- Directions given to the Contractor by the TasRail Superintendent to fix any identified issues and the timeframe within which the Contractor should complete the remedial works.

APPENDIX M – CENTRAL NORTH BURROWING CRAYFISH SALVAGE & RELOCATION PROTOCOL

SCOPE

This natural values assessment undertaken for the Sassafras – Wesley Vale Irrigation Scheme Augmentation identified 56 potential habitat areas for the central north burrowing crayfish that intersect with the Construction Corridor.

Designs have been modified to reduce potential impacts to CNBC by realigning the pipeline to avoid known burrowing crayfish locations. The priority is to avoid known burrows through micro siting of the pipeline alignment during construction, although some habitat impacts may be unavoidable.

Where avoidance is not possible, these burrowing crayfish sites will be excavated during the trenching process. A standard operating procedure for the salvage and relocation of CNBC has been established previously and undertaken successfully[947]. The following Burrowing Crayfish Habitat Management, Salvage and Relocation Protocol for SWISA has been based on this precedent to minimise impacts to habitat and ensure best possible survival of impacted crayfish.

During the construction phase of the action, the Contractor must comply with CNBC management protocols as detailed in this document, including establishing exclusion areas, record keeping, reporting and managing compliance.

<u>Timeframes</u>

Application of the protocols is to be required for all ground works undertaken within the construction phase of the Project.

<u>Responsible parties</u>

The protocol clauses are to be carried out by suitably qualified ecologists (the Ecologist, defined below). The protocol will be overseen by the Ecologist and Tasmanian Irrigation, with minor components able to be undertaken by the Contractor. Some oversight and control of hold-points will be required by either regulators or the proponent and in that case linked to contract requirements for the Contractor. Responsible personnel for each task within the protocol are set out in the document.

<u>Protocol Area</u>

The Protocol Application Area (**Figures M1-11**) covers any potential burrowing crayfish habitat within the Construction Corridor (Relocation Management Area) and within a 20 m buffer area of the Construction Corridor (Avoidance Management Area).

<u>Permit requirements</u>

Application of this protocol will require an approved permit to take threatened species under the Tasmanian *Nature Conservation (Wildlife Regulations) 2021,* issued by the Tasmanian Department of Natural Resources and Environment and will require regulatory oversight for release of hold points for clearance. Any conditions within the associated permits must be adhered to and may supersede clauses in the protocol.

<u>Definitions</u>

Relocation Management Area – Any identified habitat within the proposed Construction Corridor.

Avoidance Management Area – Any identified habitat within a 20 m buffer area surrounding the Construction Corridor.

[947] Richardson (2024) – **Appendix L**

Suitably qualified ecologist – a consultancy or individual who has relevant professional qualifications, permits, and ethics approval, and at least 3 years of work experience writing and implementing management plans for the relevant protected matter; has implemented and reported on management plans for the habitat of the particular protected matter; can demonstrate the efficacy of those management plans, and in the event of ineffective measures, can demonstrate and implement corrective actions and solutions to achieve the desired outcomes; and can give authoritative assessment and advice on offset management to improve the habitat quality of the protected matter using relevant protocols, standards, methods and/or literature. Additionally, the Ecologist must have experience in the identification of *Engaeus granulatus* animals and habitat and must be trained in the handling *Engaeus granulatus.*

CHECKLIST

Pre-works

- ☐ Apply for a permit to take threatened species from the Tasmanian Department of Natural Resources and Environment (**Section A-**).
- ☐ TI to identify and communicate location of known potential habitat areas and the provisions of the CNBC management protocol to the Contractor (**Section A-**)
- ☐ Ecologist to conduct training for all site workers to identify burrowing crayfish habitat (**Section A-**).
- ☐ Where there are previously unsurveyed potential habitat areas within the Construction Corridor, Contractor to carefully clear vegetation (e.g. via slashing) to facilitate searching of burrows (**Section C-**).
- ☐ Ecologist to inspect all habitat areas within the Protocol Application Area for evidence of current occupation (**Section C-**).
- ☐ Contractor to mark a 5 m exclusion zone where habitat is to be retained within an Avoidance Management Area (**Section C-**).
- ☐ Contractor to confirm exclusion areas with the Ecologist prior to ground works (**Section C-**).

During works

- ☐ Immediately preceding ground works where occupied habitat is to be removed, Ecologist to initiate the Salvage and Relocation Protocols (**Section D-**) including:
  - o Collection of all burrowing crayfish within the impact area.
  - o Identification, assessment and storage of collected individuals.
- ☐ Contractor to undertake all ground works within Relocation Management Areas under supervision of the Ecologist (**Section D-**).
- ☐ Ecologist to release collected individuals into suitable habitat at or as close to the collection location on same day of collection, or hold overnight and release the following day (**Section D-**)
- ☐ Ecologist to euthanise, preserve and lodge any fatally injured individuals (**Section D-**).
- ☐ Ecologist to record locations of released animals and Contractor to install exclusion fencing (**Section D-**).
- ☐ Contractor must abide by vehicle access, water course management, unanticipated habitat discovery and vegetation removal protocols throughout the construction phase of the project (**Section E-**).

☐ Contractor to fence all habitat areas and relocation areas for post-construction management and monitoring as per provisions of the OEMP and Farm WAP (**Section F-**).

Post-works

☐ Contractor to provide written records of the excavation and salvage process to TI (**Section D-(vii)**).

☐ TI to complete any data submission requirements to NRE associated with the permit to take (**Section F-**).

BURROWING CRAYFISH HABITAT MANAGEMENT, SALVAGE AND RELOCATION PROTOCOL

A- Application of the protocol

(i) The protocol must be applied to any potential burrowing crayfish habitat area (including horizontal directional drill areas) identified by the NVA field assessment within the Protocol Application Area - **Figures M1-11**.

(ii) The protocol will additionally apply to any potential habitat area suspected/confirmed during later investigations (such as observed during works) within the Protocol Application Area.

(iii) The Contractor must be aware of the location of potential burrowing crayfish habitat and the provisions of the habitat management protocol.

(iv) All site workers must be trained by the Ecologist to be able to identify burrowing crayfish habitat elements.

(v) The protocol must be undertaken only under an approved permit to take threatened species issued by NRE under the TSP Act and will require regulatory oversight for release of hold points for clearance.

B- Timing of works

(i) Pre-construction vegetation clearance and surveys must be conducted between May and November to allow for the highest probability of chimney detection.

(ii) Surveys must be completed before any ground works, no more than 6 months prior to completion of excavation works in the area.

(iii) Excavation of known unavoidable burrow locations must be conducted between May and August inclusive (may vary depending on the season) to ensure best survival rates of animals, and to avoid excavation works within the breeding season. No excavation works will occur within habitat for this species during the breeding season (spring-summer);.

(iv) Collection of individuals must be conducted on the day of works, with individuals returned the same day or held overnight and released the following day.

C- Pre-clearance procedure

(i) Site inspections must be conducted in all areas of potential burrowing crayfish habitat by the Ecologist to identify additional crayfish burrows and confirm extent of known colonies.

(ii) Potential habitat within the Relocation Management Area will be assessed by the Contractor to determine if avoidance could be achieved through narrowing of the Construction Corridor.

(iii) Any habitat areas within the Relocation Management Area that were previously unable to be surveyed for crayfish presence are to be cleared of vegetation by the Contractor and searched for chimneys:

a. This must be conducted between May and November to allow for the highest probability of chimney detection.

b. Vegetation is to be cleared and removed in a manner that is minimally disruptive to the ground and any potential chimneys (e.g. slashing).

c. Any new colonies discovered must be subject to **Section D-**

(iv) Any potential habitat areas within the Avoidance Management Area that are unable to be surveyed for crayfish presence are to be treated as occupied and **Section C-D-(iii)** to **C-(ix)** will apply.

(v) The Construction Corridor must be clearly demarcated and narrowed to the minimum extent through any identified habitat areas.

(vi) A 5 m exclusion zone must be erected by the Contractor around all identified habitat (even in areas where horizontal directional drilling rather than excavation will occur) within the Avoidance Management Area including:

a. All identified burrowing crayfish locations.

b. All burrowing crayfish habitat patches where habitat is not being impacted.

(vii) Where a 5 m exclusion zone intersects with a Relocation Management Area, any habitat within 5 m of active work will be treated as impacted and **Section D-** will apply.

(viii) Additional exclusion zone fencing of all known potential habitat beyond the Avoidance Management Area must be erected by the Contractor prior to any breaking of ground to minimise unintended impacts from vehicles.

(ix) All exclusion zones must be checked by the Ecologist prior to ground-breaking activity. Where exclusion zones are confirmed and no habitat occurs within the Construction Corridor, the Ecologist will approve the area for works and no further action is required.

(x) All Relocation Management Areas and additional habitat identified by **Section C-(vii)** must be subject to the Salvage and Relocation protocols in **Section D-.**

D- Salvage and Relocation

(i) On the day of proposed groundworks (must be between May to November **Section B**) within known unavoidable burrowing crayfish location or unavoidable locations detected in **Section C (i**), prior to any groundbreaking the Ecologist will collect any burrowing crayfish within the area of works:

a. Crayfish will be removed where possible by digging with disinfected hand tools.

b. Upon collection in any scenario, each individual will be washed in stream water or dechlorinated water and examined to identify species and assess condition.

c. Healthy individuals will be placed into their own individual storage container (which must be of sufficient size to contain the animal but limit their movement within the jar) with local stream water or dechlorinated potable water; jars must be placed on ice (in an Esky or similar cooler) in the field.

d. Water within each container must be replaced regularly to ensure it is effective in washing animals.

e. Compromised animals, in the opinion of the Ecologist, may include animals that have sustained an injury to their thorax, head or abdomen, from which they are unlikely to recover or are only partially complete (e.g. have been decapitated or cut in half by the excavation process). These animals will be:

(1) Euthanised by the Ecologist in an ice slurry for 30 minutes;

(2) Placed into preserving jars containing 90% ethanol; and

(3) Specimens will be lodged (including the appropriate collection details) with the Queen Victoria Museum or similar institution for addition to the collection for future research opportunities (specimens will be lodged within 3 months of the translocation project being completed); and

(4) Any animals that are killed outright from the excavation will be placed into specimen jars containing 90% ethanol and lodged with the Queen Victoria Museum.

f. Animals will remain in their individual containers on ice within an Esky or similar cooler until they are released as per **Section D-(iii)** to **(vii).**

(ii) Upon completion of collection, the Ecologist will approve the area for works. The Ecologist will supervise all excavation undertaken in a Relocation Management Area:

a. The Ecologist will establish with the excavator operator the process of excavation, timing and hand signals for communication.

b. The ecologist will maintain a safe distance from machinery and collect visible burrowing crayfish from within disturbed areas as safe and practicable.

c. All excavated material with the potential to contain burrowing crayfish will be examined and all observed individuals collected.

d. Any collected individuals will be handled as per **Section D-(i).**

(iii) Collected individuals must be released on the day of collection where possible. Where individuals are not able to be released on the same day that they were collected, the jars containing the animals will be transported in their individual containers on ice within an Esky or similar cooler by the Ecologist to a refrigerator overnight and returned to the site for release the following day as per **Section D-(iv)** to **D-(vi)**.

(iv) Captured individuals will be returned to suitable habitat at, or as close as possible to the location from which they were captured, in an area where future disturbance is likely to be minimal:

a. Adults will be released by the Ecologist as follows (in decreasing order of preference):

(1) in an existing, though truncated, burrow reaching the water table and at least 150 mm deep (ideally a burrow without signs of recent digging);

(2) in an artificial burrow reaching the water table and at least 150 mm deep, created with a 25 mm diameter auger within the same area of habitat; or

(3) in an artificial burrow reaching the water table and at least 150 mm deep, created with a 25 mm diameter auger in the nearest available habitat.

b. Juveniles will be released in a shallow auger/crowbar hole in a very wet area.

c. All individuals will be placed tail first into their own burrow/hole opening.

d. A small stone or block of wood will be placed over the hole to maintain moisture and prevent individuals from immediately exiting the hole.

(v) Release locations of all individuals will be recorded by the Ecologist with a handheld GPS for post-construction monitoring.

(vi) Upon completion of works within a habitat area, the habitat area must be fenced off by the Contractor and no vehicles are to enter to prevent soil compaction.

(vii) Written records of the excavation and salvage process must be kept by the Contractor, and provided to TI including:

a. The date of excavation works, weather conditions, the names of persons involved in the excavation process.

b. The number and species of animals salvaged and re-established.

c. The number of animals that were compromised during the excavation process and subsequently euthanised and preserved.

d. The date and time of notification to the Contractor of any failure to implement site specific management requirements.

e. Directions given to the Contractor by TI to fix any identified issues and the timeframe within which the Contractor must complete the remedial works.

E- Additional Construction

(i) Vehicle traffic through habitat areas must be strictly controlled. Access to construction sites must be contained within the Construction Corridor, or on pre-existing roads and tracks. Vehicles must not be parked within potential habitat areas unless required directly for construction.

(ii) Vegetation removal must only occur to the extent necessary to complete construction.

(iii) Watercourses must not be impeded (i.e. preventing flow of water) by construction activities.

(iv) In the event of an unanticipated burrowing crayfish discovery in the Construction Corridor, all works must cease in the area and **Section D-** will apply.

(v) In the event of an unanticipated burrowing crayfish discovery within 20 m of the Construction Corridor, all works must pause in the area and **Section D-(iii)** to **C-(x)** must apply.

F- Post-construction

(i) Habitat areas must be fenced until rehabilitation is complete.

(ii) Any known, discovered, or relocation areas of burrowing crayfish must be managed, and monitored in conjunction with the landowner(s) and in accordance with the provisions of the OEMP and Farm WAP.

(iii) Data associated with the permit to take must be submitted to NRE within the timeframes specified in the permit.

Burrowing Crayfish Habitat Management, Salvage and Relocation Protocol Application Area

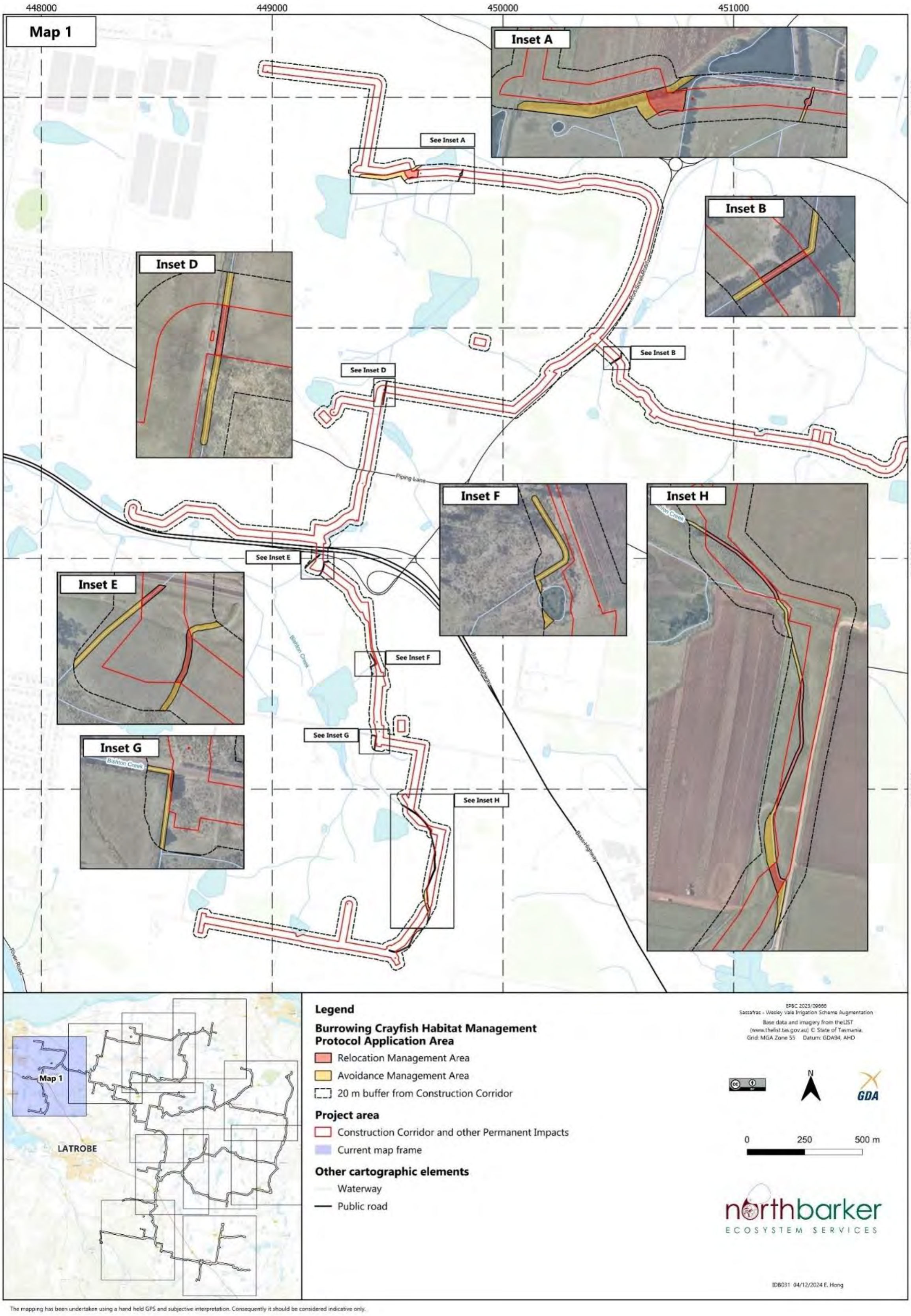
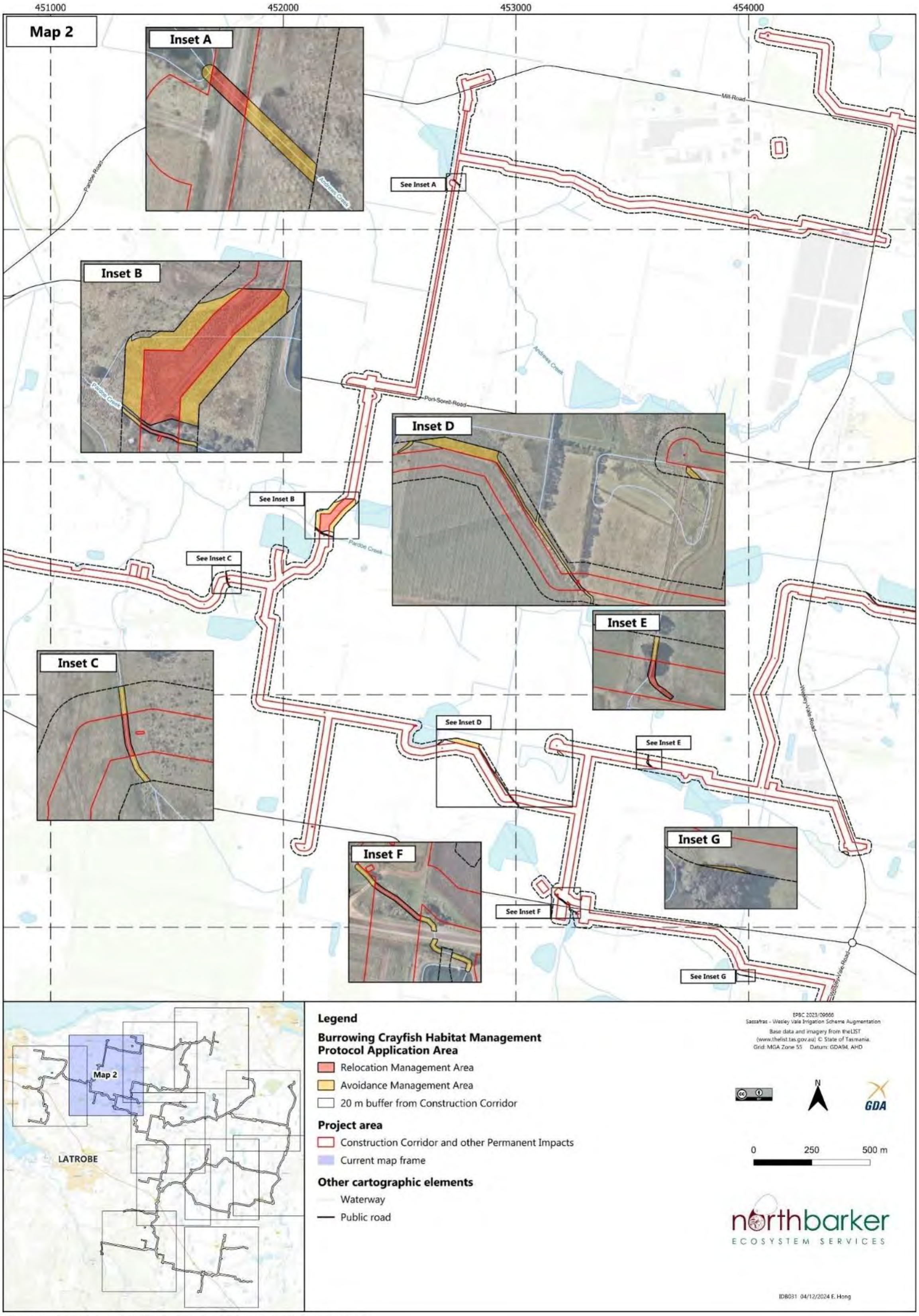
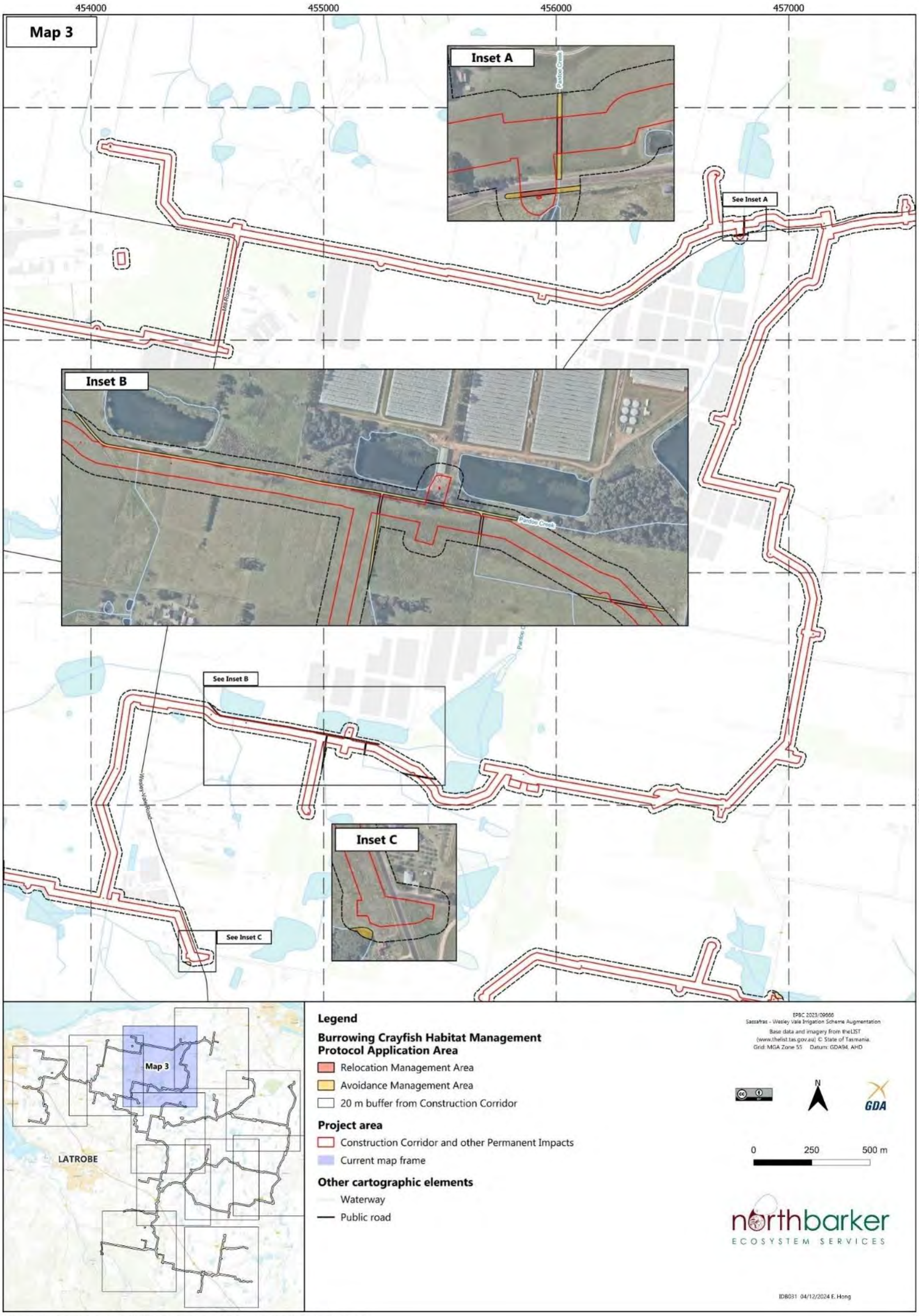


Figure M1: Burrowing crayfish habitat management, salvage and relocation protocol protocol application area



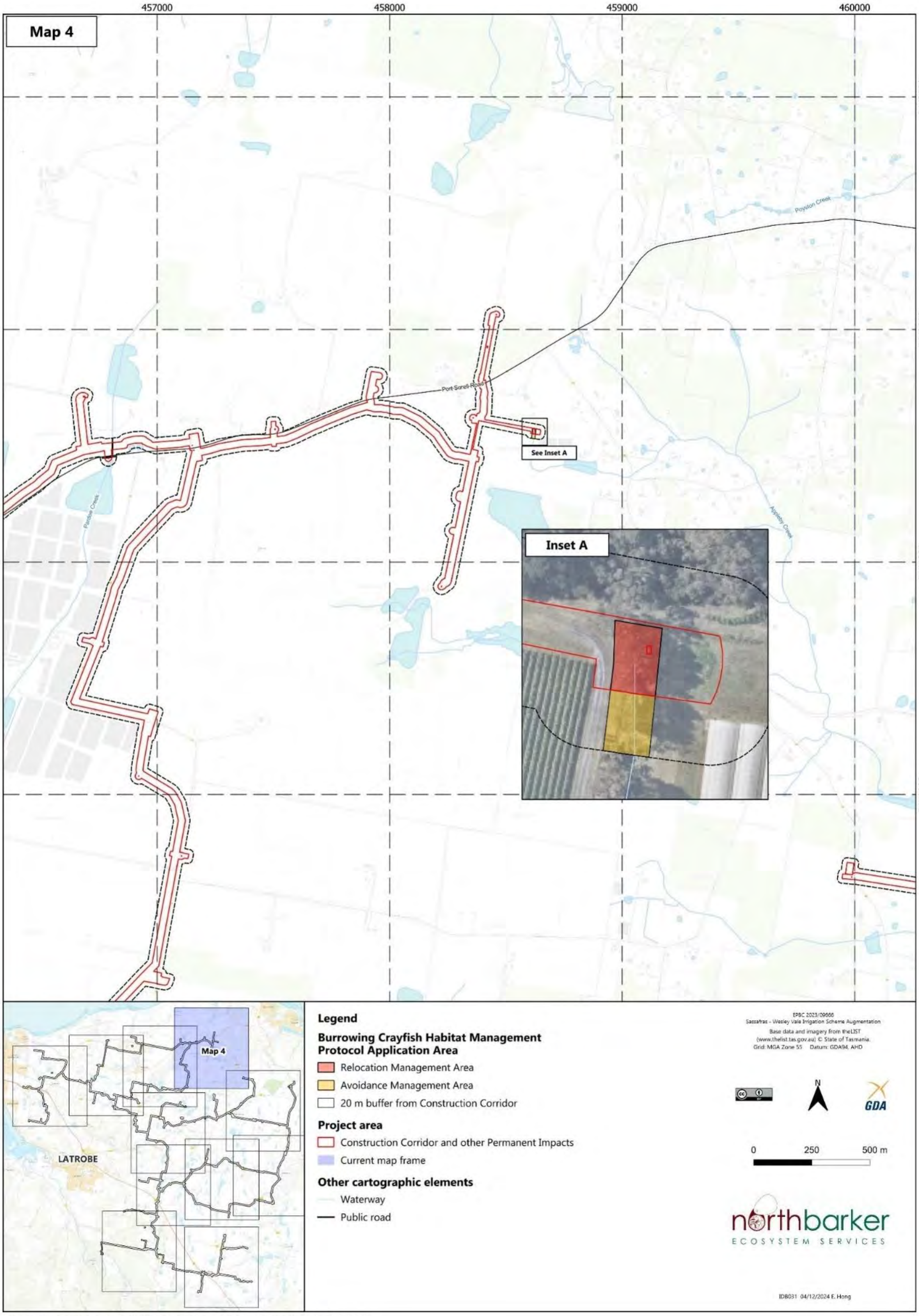
The mapping has been undertaken using a hand held GPS and subjective interpretation. Consequently it should be considered indicative only.

Figure M2: Burrowing crayfish habitat management, salvage and relocation protocol protocol application area



The mapping has been undertaken using a hand held GPS and subjective interpretation. Consequently it should be considered indicative only.

Figure M3: Burrowing crayfish habitat management, salvage and relocation protocol protocol application area



The mapping has been undertaken using a hand held GPS and subjective interpretation. Consequently it should be considered indicative only.

Figure M4: Burrowing crayfish habitat management, salvage and relocation protocol protocol application area

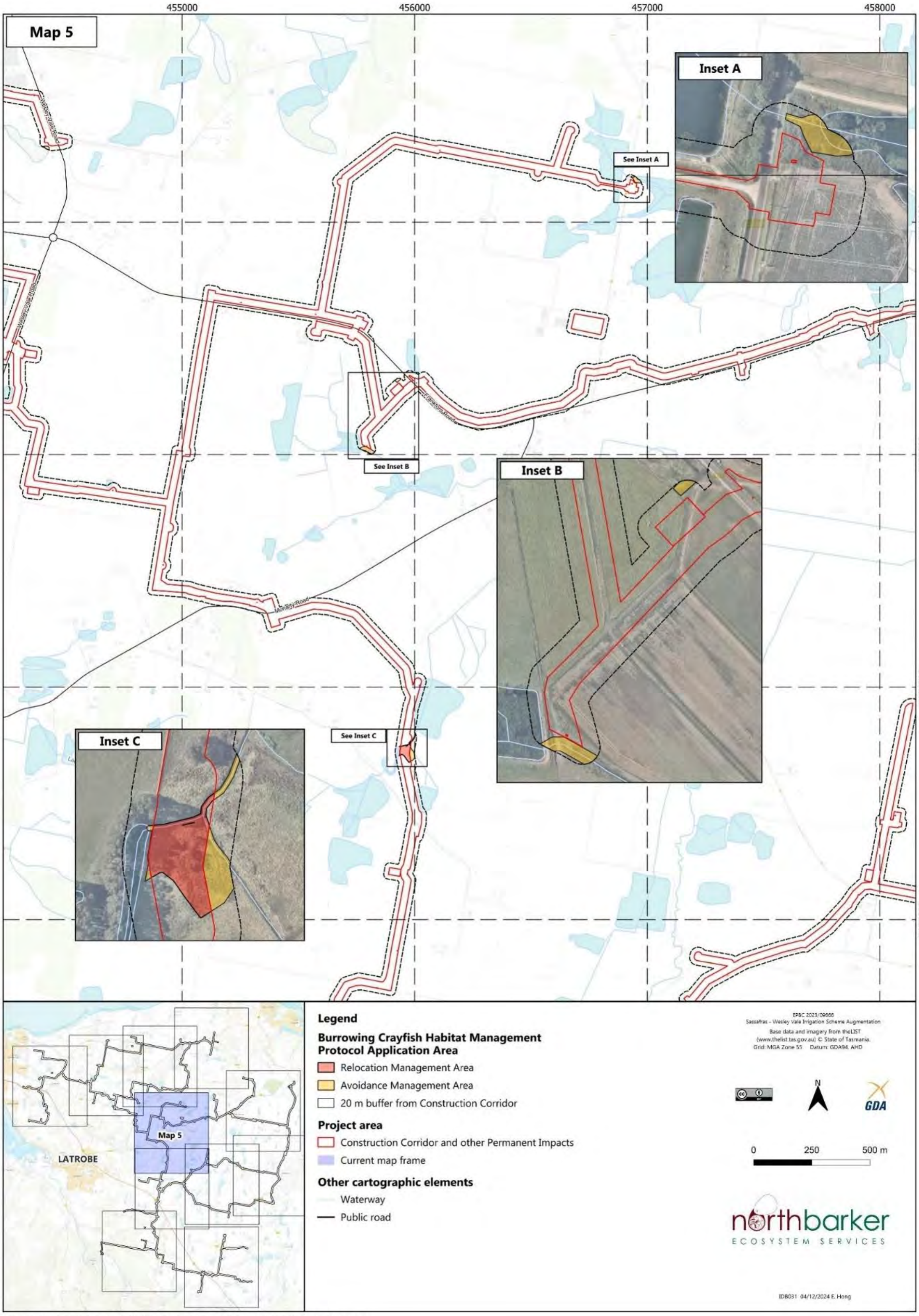


Figure M5: Burrowing crayfish habitat management, salvage and relocation protocol protocol application area

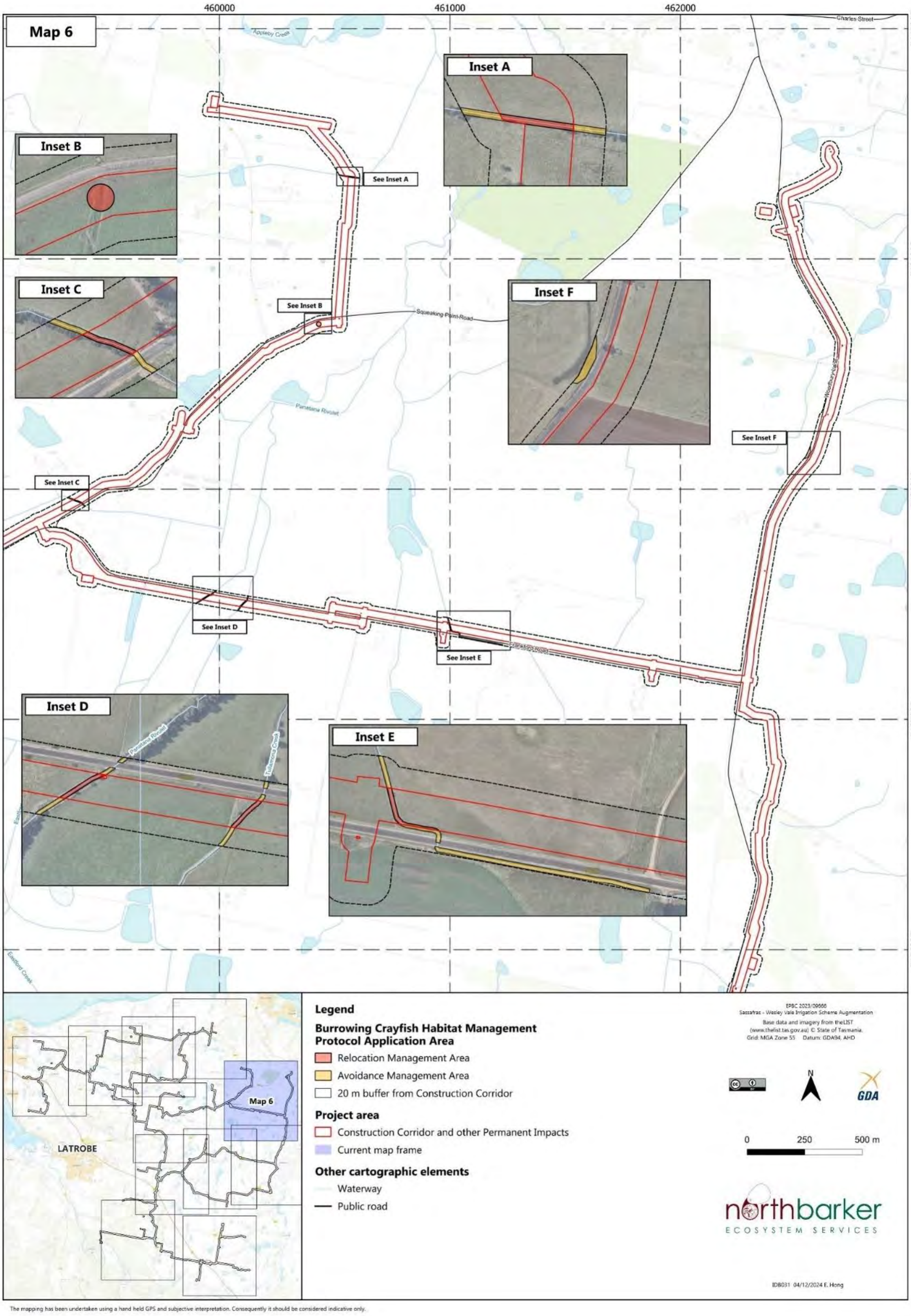


Figure M6: Burrowing crayfish habitat management, salvage and relocation protocol protocol application area

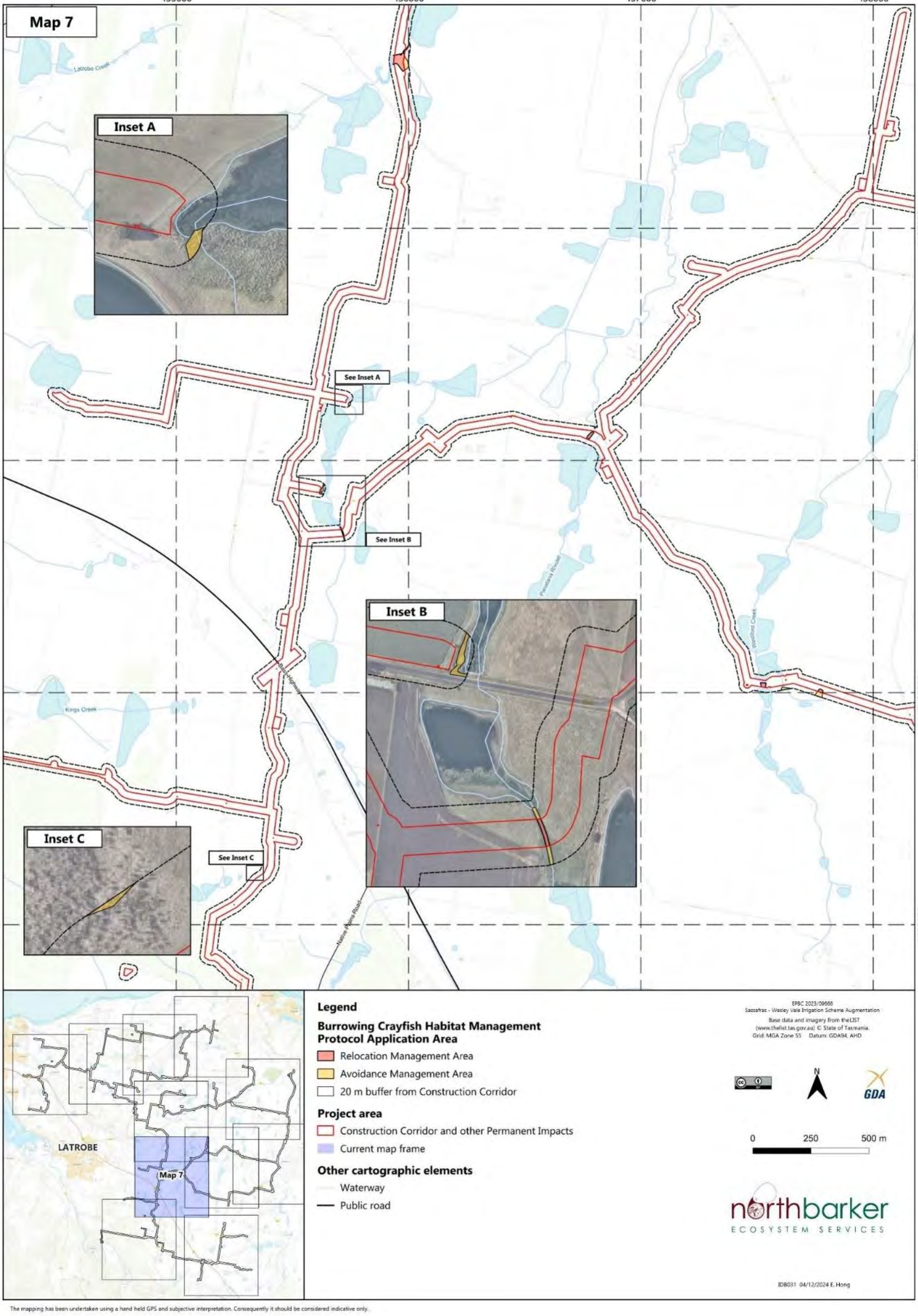


Figure M7: Burrowing crayfish habitat management, salvage and relocation protocol protocol application area

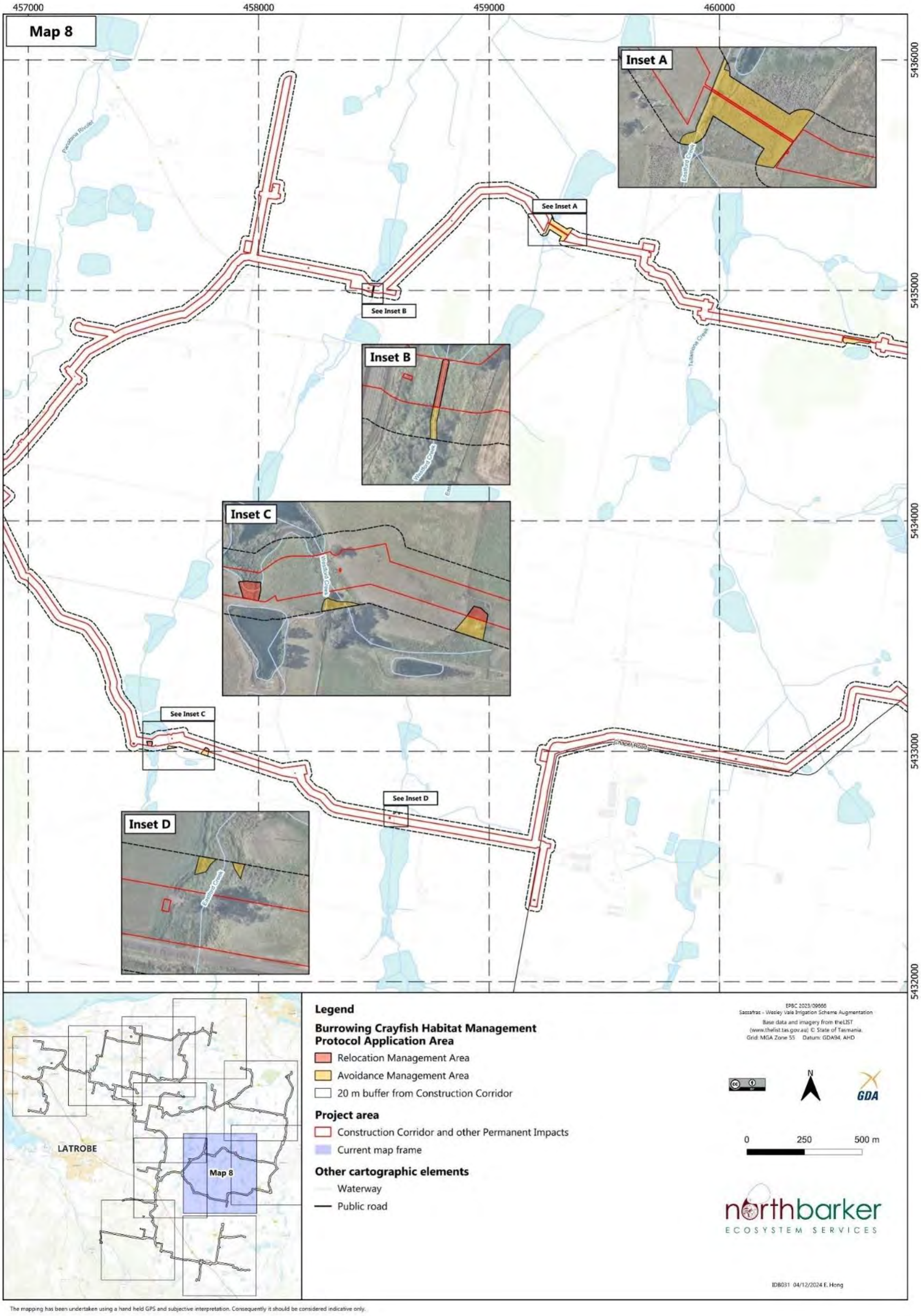
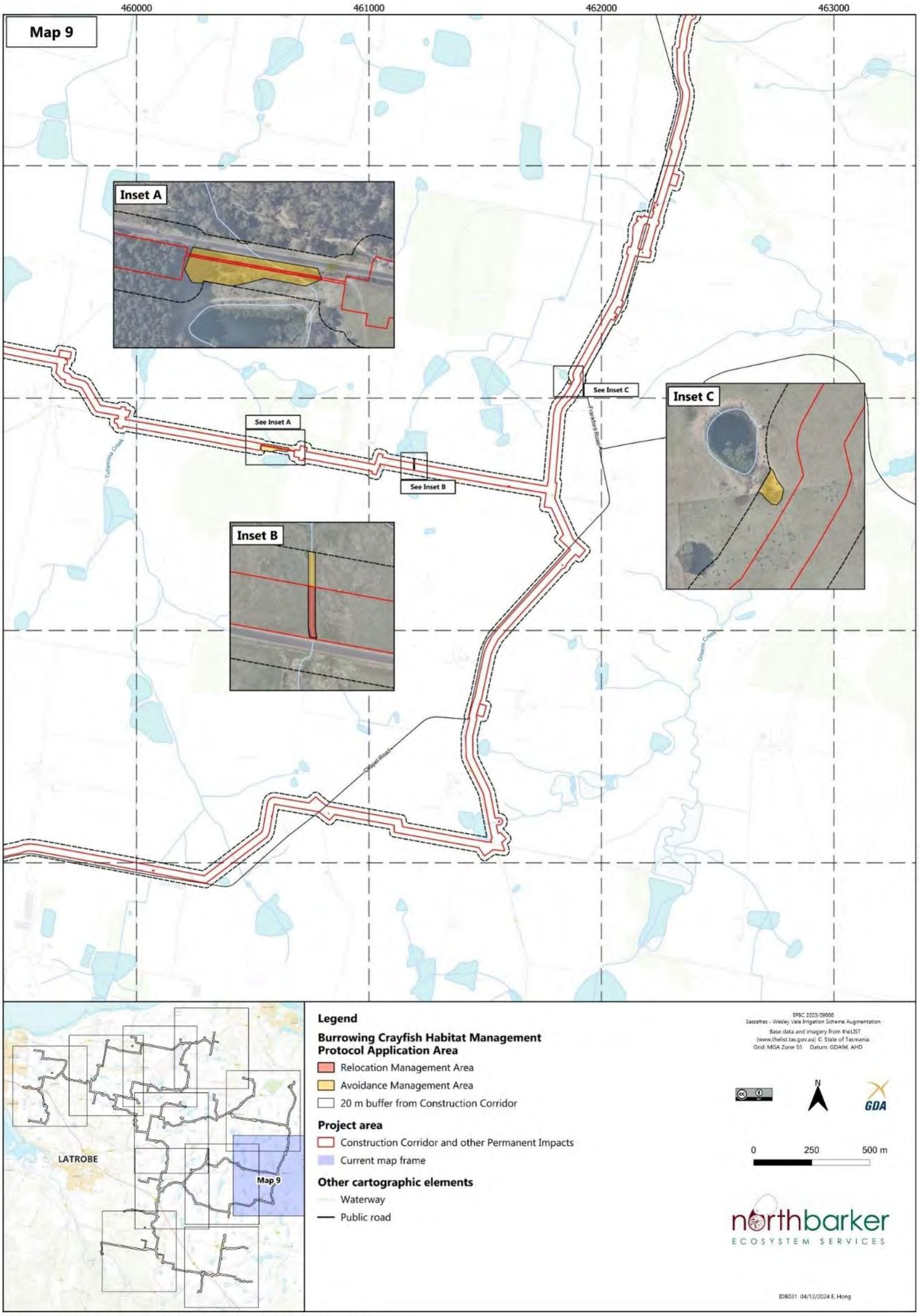


Figure M8: Burrowing crayfish habitat management, salvage and relocation protocol protocol application area



The mapping has been undertaken using a hand held GPS and subjective interpretation. Consequently it should be considered indicative only.

Figure M9: Burrowing crayfish habitat management, salvage and relocation protocol protocol application area

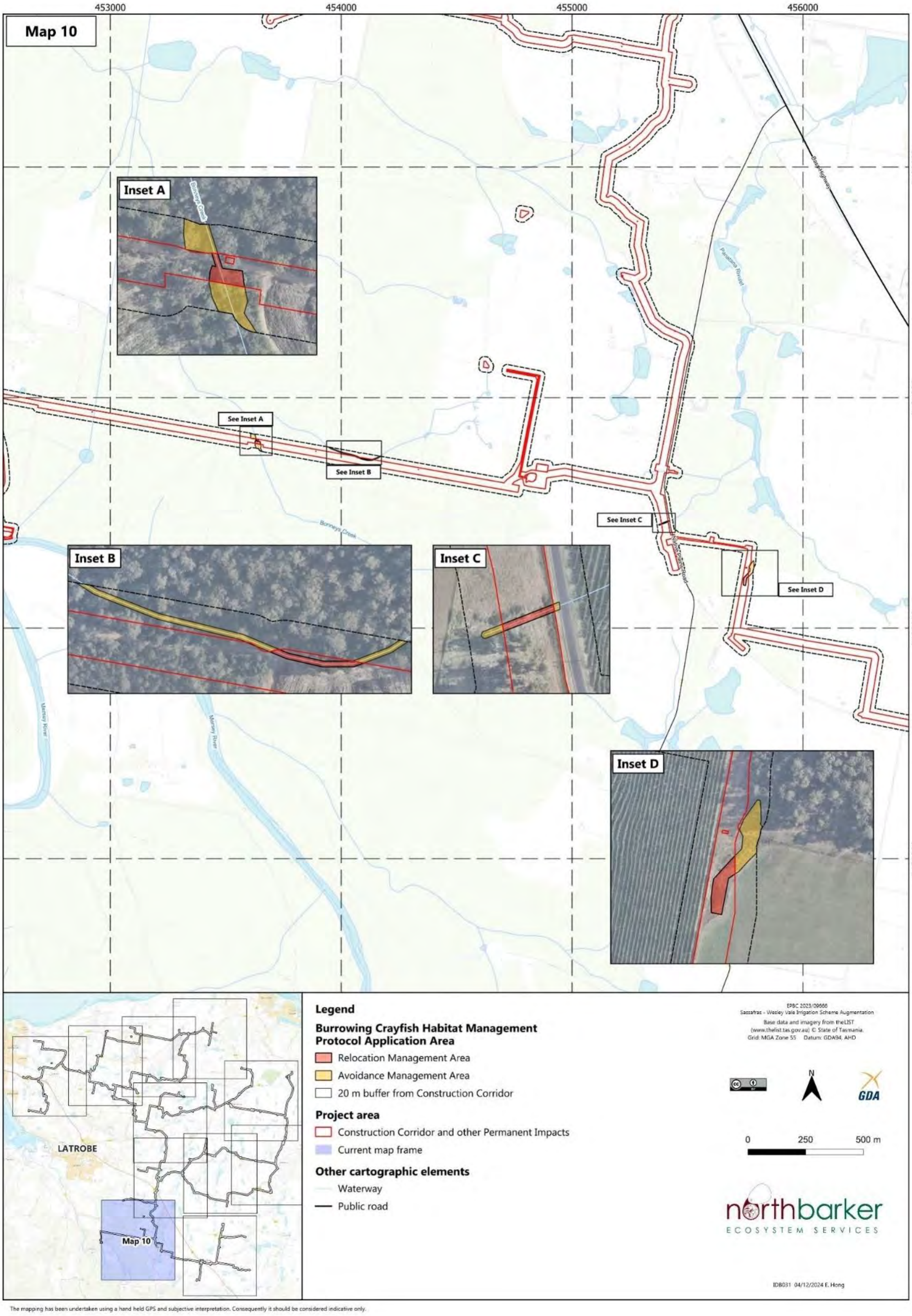
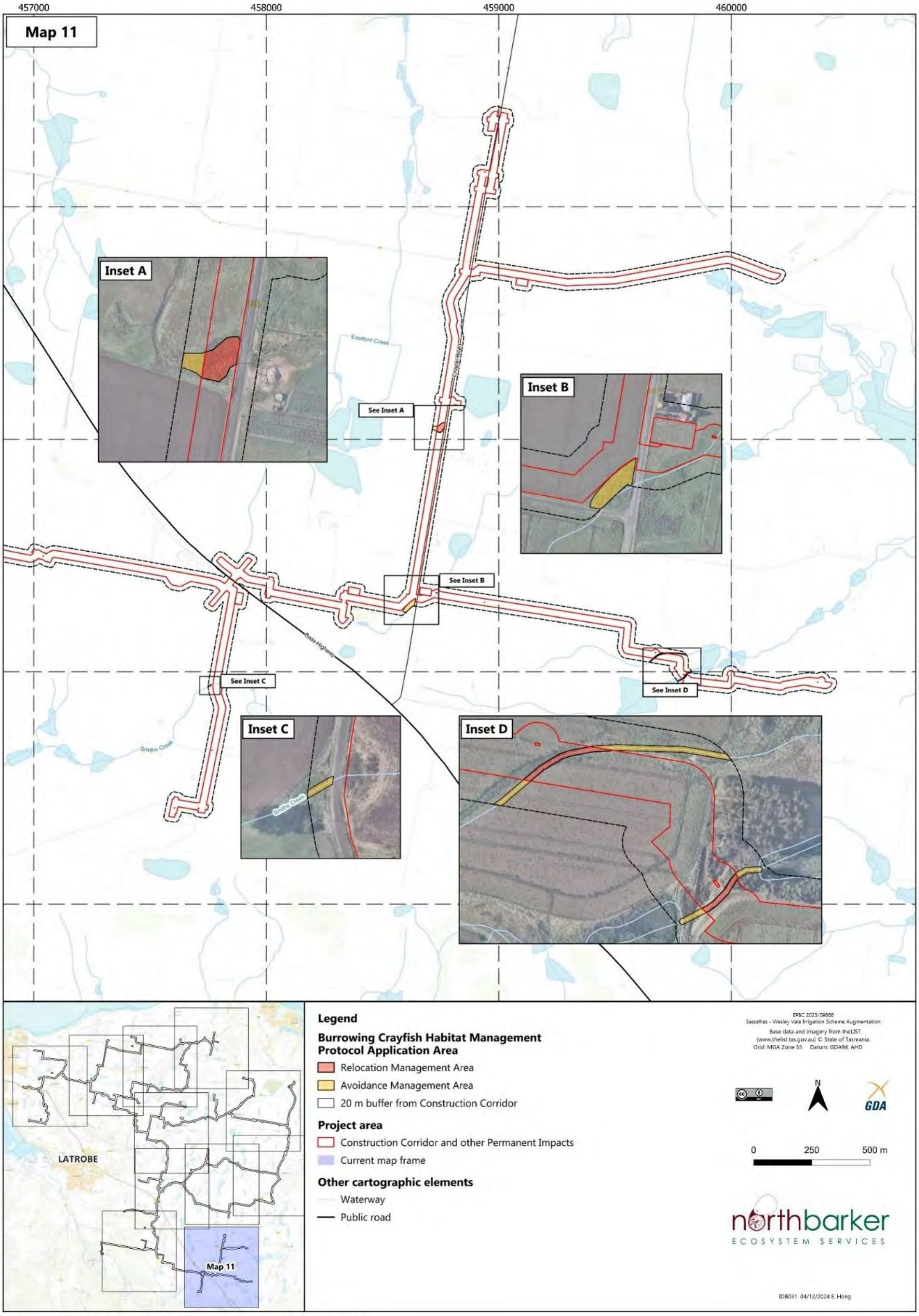


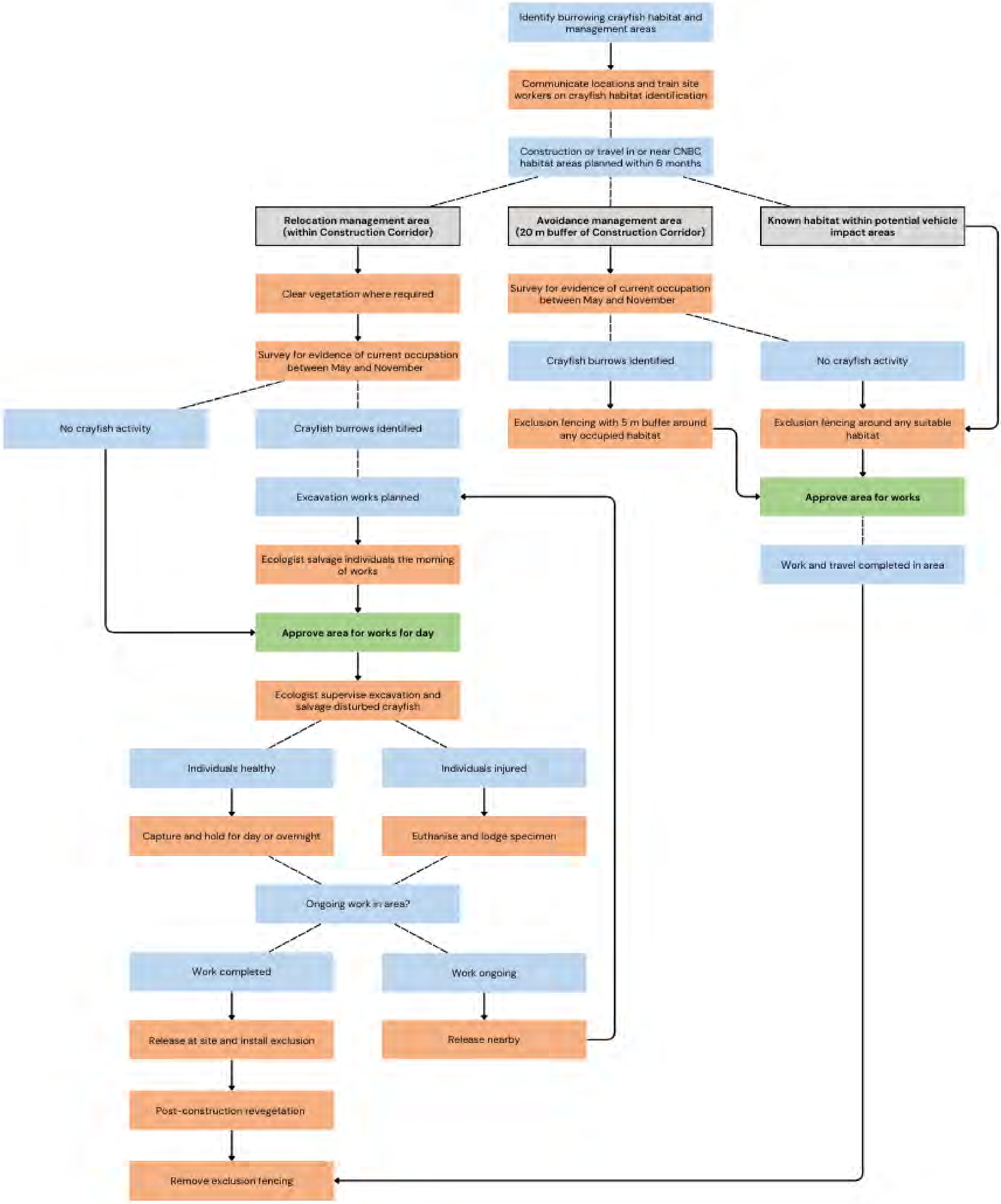
Figure M10: Burrowing crayfish habitat management, salvage and relocation protocol protocol application area



The mapping has been undertaken using a hand held GPS and subjective interpretation. Consequently it should be considered indicative only.

Figure M11: Burrowing crayfish habitat management, salvage and relocation protocol protocol application area

Flowchart of Protocol Operations



APPENDIX N – GREEN AND GOLD FROG ADVICE

8 October 2024

Dr Aleida Williams
Senior Ecologist
North Barker Ecosystem Services
313 Macquarie St,
Hobart TAS 7000

lwiliams@northbarker.com.au

Dear Leida

Re: 240788 Sassafras Growling Grass Frog Briefing Note

Scope

North Barker Ecosystem Services have engaged NGH Senior Ecologist Dr Timothy Garvey to provide a Briefing Note including ecological information and recommendations for Green and Gold Frogs (*Litoria raniformis*) (GGF) within modified agricultural landscapes. This information will act as a supplementary document to further reporting around the potential impacts of proposed alterations to existing an irrigation scheme associated with the proposed Sassafras-Wesley Vale Irrigation Scheme (SWISA) project. This project development and operations will be managed by Tasmanian Irrigation, with the development and any associated impacts to GGFs located in the Devonport and Latrobe regions of northwestern Tasmania.

This briefing note is to be read in conjunction with the Natural Values Assessment undertaken by North Barker Ecosystem Services investigating the potential impacts of project works on local GGF populations. Green and Gold Frogs were confirmed as present across the project's subject area including at waterbodies which do not meet the state guidelines for significant habitat. The below document provides supplemental context for GGF ecology, primary stressors, the potential impact of proposed works and recommended mitigation measures.

Green and Gold Frogs are currently listed at the federal level under Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 as 'vulnerable'. Within Tasmania GGF are currently recorded as 'vulnerable' within the Threatened Species Protection Act 1995 though it has been previously recommended this classification be changed to 'endangered' (Ashworth, 1998).

Ecology

Habitat

Green and Gold Frogs are associated with slow moving and still lotic and lentic waterbodies (Pyke, 2002, Heard, Roberston and Scoggie, 2006), inhabiting a wide diversity of aquatic habitats from natural wetlands, marshes, streams, swamps to anthropogenic waterbodies such as farm dams, ornamental ponds, drainage ditches and reservoirs ponds (Pyke, 2002; Heard, Robertson and Scroggie, 2004, 2006; Hamer and Organ, 2008). While primarily associated with permanent waterbodies, GGF have been frequently recorded utilising ephemeral and seasonal water sources such as inundated agricultural spaces (Wassens *et al.*, 2018) and shallow farm dams (Garvey *et al.*, 2022). The use of ephemeral water sources may provide GGF offspring habitat which is free from predators (invasive and native), and improved foraging opportunities in seasonally inundated areas (Klop-Toker *et al.*, 2018).

Green and Gold Frogs are commonly associated with the presence of abundant riparian vegetation (native and non-native). Greater vegetative complexity along watercourse provides shelter from predators and increased foraging opportunities for all stages of the GGF lifecycle (Fardell *et al.*, 2018). Despite this association, and the prescription of emergent and aquatic vegetation for significant GGF habitat in state and Commonwealth guidelines, GGF have been observed to occupy, and successfully reproduce at watercourses lacking riparian vegetation, and which have experienced significant disturbance (Garvey *et al.*, 2022). Within heavily modified agricultural landscapes GGF were found in equal abundance at farm dams with no riparian vegetation present as those with abundant vegetation (Garvey *et al.*, 2022).

The importance placed on the presence of riparian vegetation for GGF (and similar pond-breeding amphibians) has resulted in skewed conservation policy and management actions which prioritise an idealised aquatic habitat, while ignoring the broad spectrum of conditions GGF are practically found to occupy, frequently ignoring critical terrestrial (non-breeding) habitat. Where riparian vegetation is not available in sufficient density adjacent terrestrial habitat (remnant vegetation, woodland patches) can offer suitable non-breeding habitat to fulfil the bi-phasic lifecycle of Green and Gold Frogs (Garvey *et al.*, 2022), providing foraging areas and refuges to over-winter (Trenham and Shaffer, 2005; Harper, Rittenhouse and Semlitsch, 2008; Sawatzky, Martin and Fahrig, 2019). In cooler climates GGF are recorded to hibernate in terrestrial refugia including vegetation mounds, under woody-debris and leaf-litter, or in dense vegetation (Clemann *et al.,* 2013; White and Pyke, 2015).

Anthropogenic waterbodies, farm dams, reservoirs, recreational lakes and ornamental ponds; can provide supplemental wetland habitat for amphibians in increasingly dry and or modified regions (Hazell et al., 2001; Knutson *et al.*, 2004; Scheffers and Paszkowski, 2013; Holzer, 2014; Johnson, Homyack, *et al.,* 2016). Within pastoral Australian landscapes the presence of manmade farm dams function as isolated, improving landscape connectivity for endemic GGF populations (Garvey *et al.*, 2022). Due to their practical function as a watering source for livestock and crops farm dams are typically characterised by limited riparian vegetations and evidence of heavy mechanical disturbance.

Farm dams with limited vegetation and evidence of significant frequent disturbance are not likely to fulfill the criteria required for designation as significant GGF habitat provided in state and Commonwealth guidelines. However, they have been shown to provide accessible available breeding habitat for local GGF communities and aid in improving wider wetland connectivity within modified landscape (Garvey *et al.*, 2022). The presence of remnant vegetation patches in agricultural matrixes, often in the form of fragmented woodlands, provides off-breeding season terrestrial habitat where farm-dams fail to provide sufficient in-situ riparian vegetation.

The loss of farm dams in modified Australian systems increases inter-wetland distances and breeding-non-breeding habitat distances, raising the likelihood of local GGF population declines and extirpation. Where the distances between wetlands remains significant or impeded by landscape features which prove significantly resistant to movement (roads, fencing etc.) colonisation of waterbodies may be accidentally facilitated by activities such irrigation and pumping(Mathwin *et al*., 2020). Farm dams located in the arid southern plains of New South Wales were observed to be occupied by GGF in significant numbers despite significant distances to neighbouring waterbodies, occupancy at physically isolated dams may be enabled by the artificial movement of water via piping across the landscape, potentially dispersing eggs, tadpole or adults across disparate waterbodies (pers obs. Garvey)

Breeding

Green and Gold Frogs breed in the Austral spring and summer, (typically between August to March), though the onset of breeding can occur slightly later in cooler territories (Ashworth, 1998; Pyke, 2002). Male GGF will typically congregate along shorelines or on floating rafts of vegetation to call, with calling occurring both diurnally and nocturnally (Pyke, 2002; Casey, 2019). Female GGF produce eggs in large numbers as floating gelatinous mats (Cree, 1984) the average number of eggs produced is usually given as approximately 3,000 (Anstis, 2017) but can be as much as 11,000 in one reproduction event (van de Mortel and Goldingay 1998).

It has been suggested females may have the capacity to regulate the size of clutches they produce and have multiple clutches a season in a 'bet-hedging' strategy (Christy, 2001).

Tadpoles emerging 2-4 days post laying (Ehmann and White, 1997), with tadpoles growing to large sizes (up to 95 mm) this enables larval GGF to predate on conspecific tadpoles and invertebrates through development (Anstis, 2017). Metamorphosis typically occurs after three months, though this development can be delayed until the following spring where eggs have been laid late in the season (Pyke, 2002). Newly emerged froglets range from 25-35 mm in body length (Pyke, 2002) with attainment of adult sizes occurring predominantly in the first-year post-emergence (Ashworth, 1998).

Dispersal

Members of the Bell Frog complex (*Litoria, raniformis*, *L. aurea, L. castanea*) are considered capable of significant dispersal events, with reports of individuals moving hundreds of metres over relatively short periods of time (Van De Mortel and Goldingay, 1998; Pyke and White, 2001; Goldingay and Newell, 2005; Hamer, Lane and Mahony, 2008). This includes movement across diverse habitats including wetlands (Heard, Robertson and Scroggie, 2008; Wassens *et al.*, 2010), urban-fringes (Hamer and Organ, 2008), industrial forestry (Garvey *et al.*, 2022) and agricultural spaces (Wassens *et al.*, 2007, 2008, 2010; Pyke and Muir, 2008; Garvey *et al.*, 2022). In drier ecosystems GGF movement is reported to respond to seasonal artificial watering regimes (Wassens *et al.*, 2007; Wassens *et al.*, 2008).

Site fidelity in amphibians, even ones with capable of long-distance, is not unusual in pond-breeding amphibians, including GGF (Sinsch, 1990; Pittman *et al.*, 2008; Matthews and Preisler, 2010). Mark-recapture and telemetric tracking studies of GGF confirm the significant capacity of GGF to move long distances but report a behavioural trend towards site fidelity (Hamer and Organ, 2008; Heard, Scroggie and Malone, 2012a; Garvey *et al.*, 2022). A mark-recapture study in an urban environment recorded a significant majority of identified individual animals were recaptured at the original waterbody where they were captured; with a maximum dispersal distance of 430 m recorded for an individual moving from a permanent pool to an ephemeral stream tributary (Heard, Scroggie and Malone, 2012a).

A cyclical movement between aquatic (breeding) and terrestrial (non-breeding) habitat is a common seasonal behaviour in many pond-breeding amphibians (Semlitsch, 1998; Trenham and Shaffer, 2005; Veysey, Babbitt and Cooper, 2009; Freidenfelds, Purrenhage, and Babbitt, 2011; Veysey Powell and Babbitt, 2015; Hamer, 2018; Hansen *et al.*, 2019). A telemetric tracking (VHF) study of 25 adult GGF in modified landscapes (pastoral, plantation) saw tagged individuals quickly abandon vegetation-poor post-breeding, moving through low-cropped farmland and plantation under-story into adjacent (<500 m) native dry eucalypt woodland (Garvey et al., 2022). This retreat to proximate terrestrial habitat is likely in response to limitations in foraging opportunities or suitable over-wintering habitat (Semlitsch, 1998; Richter *et al.*, 2001). Conversely GGF individuals tagged at densely vegetated dams were recorded to remain in-situ for the duration of the breeding season with no evidence of dispersal by the end of the tracking period (mid-April) (Garvey *et al.*, 2022). No instances of inter-wetland (farm-dam) movement were observed during the tracking period (Garvey *et al.*, 2022,).

Juvenile dispersal is less not well documented, and it is unclear if newly emerged individuals remain in-situ at their natal waterbody to overwinter, or dispersal to adjacent terrestrial habitat, or into a neighbouring wetland.

Population Stressors

Green and Gold Frogs were formerly wide ranging across the southeast of mainland Australia, Tasmania, and the islands of the Bass Strait (Pyke, 2002). A decline in local abundance and evidence of significant range contractions has seen the distribution of GGFs contract southward on the Australian mainland (Pyke, 2002; Wassens, 2008; Hamer, Lane and Mahony, 2010). This decline was first reported in the 1970s and 1980s (Osborne, Littlejohn and Thomson, 1996) and has been primarily attributed to habitat loss and degradation resulting from wide-scale land-use change and improvements to land drainage methodologies (Pyke, 2002;

Wassens, 2008; Hamer, Smith and McDonnell, 2012; Heard, Scroggie and Malone, 2012a, 2012b; Hale *et al.*, 2013).

Compounding stressors include the introduction of foreign pathogens including Chytrid fungus (Heard, Scroggie and Malone, 2012b; Mahony *et al.*, 2013; Voyles *et al.*, 2014; Klop-Toker *et al.*, 2017), the increasing intensity and duration of drought periods (Clemann *et al.*, 2013), declining water-quality due to pollution, sedimentation, and run-off (Egea-Serrano *et al.*, 2012; Baker, Bancroft and Garcia, 2013), and the introduction of invasive predatory species, in particular the eastern mosquito fish, *Gambusia hobrooki* (Reynolds, 2009; Klop-Toker *et al.*, 2018).

Habitat Loss

Habitat loss and fragmentation is considered the primary cause for global amphibian decline (Wake and Vredenburg, 2008; Bishop *et al.*, 2012). Amphibians may be particularly vulnerable to declining landscape connectivity associated with anthropogenic land-use change due to their biphasic life history, limited vagility, reliance on available sources of moisture, and for certain species limited distribution. For pond-breeding species such as the GGF, which cyclically utilise both aquatic (breeding) and terrestrial (non-breeding) habitat, a decline in availability and proximity for these spaces can cause local population extinctions (Leibowitz, 2003; Parris and Lindenmayer, 2004; Parris, 2006;). Landscape modification usually results in significant homogenisation of ecosystems, including a reduction in the number of freshwater sources in a landscape; this limits the ability for local amphibians to occupy these spaces, breaking down broader population connectivity.

Chytrid

Green and Gold Frogs were previously recorded to occupy regions up to 1200 m in elevation (Hero, Williams and Magnusson, 2005);he retreat of the species to below 200 m is similar to other montane amphibian species which are exposed to longer periods of chytrid infection at the cooler higher altitudes (Hero, Williams and Magnusson, 2005; Kriger and Hero, 2007; Hamer, Lane and Mahony, 2010). The arrival of warmer temperatures earlier and for a longer duration in the Australian lowlands may sufficiently reduce the severity of Chytrid infection in individuals such that local extirpations are less likely to occur. GGF have been regularly reported to bask along shorelines during the spring and summer, it is unclear if this behaviour serves as an additional anti-fungal role for the species, via raising their body-temperature. Members of the Bell Frog complex are also commonly recorded occupying salinized waterbodies (Kearney, Byrne and Reina, 2012; Heard *et al*., 2014) which may passively treat individuals for Chytrid infection. In Tasmania Chytrid fungus is assumed to have spread to wild populations of frogs prior to 2004 when it was first reported (Obendorf and Dalton, 2006), with subsequent studies having recorded Chytrid fungus across much of the island, and particularly associated with areas of high human activity or modification (Obendorf and Dalton, 2006; Philips *et al.*, 2010).

Impacts and Mitigation

Pumping and irrigation

Agricultural landowners often pump water directly from farm dams to surrounding lands to irrigate their crops when seasonally required. Dams where water is actively pumped for irrigation may result in a number of impacts to local GGF populations, including but not limited to:

- Mortality or injury to eggs, tadpole or adult GGF during the pumping process
- Premature evaporation of the waterbody resulting in:
    - Reduced breeding opportunities for local GGF
    - Mortality of GGF tadpoles present at the time of evaporation
- Disconnection of riparian vegetation from the waterline

GGFs, across all life stages, present at the time of active pumping may be at risk of injury, fatal wounding or drowning in the process of active pumping and irrigation. This is dependent on the machinery used in the process.

The amount of water removed from the waterbody combined with seasonal conditions have the potential to see the evaporation of a waterbody during the GGF breeding season. Irrigation predominantly occurs during the spring and summer months, corresponding to the when GGF are in-situ at waterbodies to mate and where tadpoles will develop prior to metamorphosis. Farm dams due to their smaller scale will naturally experience seasonal evaporation with water levels declining over the warming spring and summer season.

GGF tadpoles develop within 3-4 months, this indicates that eggs laid earlier in the breeding (spring) are more likely to successfully develop prior to the onset of significant water-level declines or complete loss of aquatic habitat. The ephemerality of farm dams while potentially limiting aquatic habitat later in the summer season may provide compensatory benefits to larval GGF through the exclusion of aquatic predators such as fish (Klop-Toker *et al.*, 2018). Tadpoles and newly emerged froglets were recorded at Tasmanian farm dams which had experienced significant drops in water level late into the breeding season (March-April) (Garvey *et al*., 2022), indicating a capacity to persist in systems as long as waterbodies did not dry out completely.

A drop in water-level at a dam may see the physical disconnect of the waterline from ringing riparian vegetation. Adult GGF are unlikely to be impacted by this disconnect between the waterline and the riparian vegetation with the ability to move between both spaces easily. GGF were observed using waterbodies with significantly reduced water levels across the spring and summer period at Tasmanian farm dams, with adults utilising marginal plants (*Eleocharis sphacelata*, *Juncus* spp., *Typha* spp.) and adjacent tufted grasses (Poa spp.) as refuge during the day and moving to the reduced waterline at night to forage and breed (Garvey et al., 2022).

The drop in water level does have the potential to deprive GGF tadpoles present within the waterbody of foraging habitat and physical refuge where the waterline is detached from riparian vegetation. This impact may be mitigated where significant amounts of native or non-native floating and aquatic vegetation are present (*Elodea canadensis*, *Potamogeten* ssp., *Ranunculus amphitrichus*, *Ottelia ovalifolia*) to provide these opportunities to GGF tadpoles. GGF tadpoles were observed at dams where the waterline naturally declined below the vegetated line due to seasonal evaporation (Garvey *et al.,* 2022).

Mitigation measures to reduce the potential impacts of pumping during the GGF breeding season could include a combination of the following:

- Designating a drawn down dam while leaving inter-connected dams free of disturbance from active pumping and vehicle intrusion.
- Setting a maximum draw from dams to ensure enough water remains in the basin to avoid premature evaporation of the waterbody.
- Timely top-up of depleted dams post draw-down to restore water levels for GGF breeding and development for the remainder of the breeding season.
- Employment of irrigation fish screens when pumping to prevent GGF injury/mortality during the irrigation process.

Habitat Disturbance

Farm dams are typically characterised by limited riparian vegetation, high turbidity/sedimentation, and evidence of mechanical disturbance where livestock intrude along the shoreline often causing pugging of the substrate (Timms, 1980). The lifetime of a farm dam is often determined by how rapidly the walls/banks of the waterbody deteriorate causing basin sedimentation, with landowners commonly creating a new farm dam when the utility of the old one has declined significantly.

Waterbodies in other modified landscapes such as commercial forestry often have an exclusionary buffer zone of a prescribed distance provided in environmental legislation to prevent the disturbance of ringing vegetation, erosion of shorelines, or sedimentation/pollution of the waterbody (Semlitsch, 1998; Freidenfelds, Purrenhage and Babbitt, 2011; Harper, Patrick and Gibbs, 2015; Powell and Babbitt, 2015; Veysey Powell and Babbitt, 2015; Guzy *et al.,* 2019; Sawatzky, Martin and Fahrig, 2019). Due to the practical function of farm dams for livestock watering/storage a complete exclusionary buffer zone would not be feasible as a means for habitat conservation. Access to the waterbody is necessary year-round for pumping and livestock watering, meaning that some level of disturbance remains unavoidable.

One methodology to improve farm dam longevity and increase local biodiversity complexity and abundance is by "enhancing farm dams" which involves the fencing off all or a portion of the dam banks limiting access to livestock/machinery. Complete and partial fencing of waterbodies has been associated with improved water quality, increased vegetation cover and greater biodiversity in several taxa including macroinvertebrates and birds (Hamilton *et al.,* 2017; Lewis-Phillips *et al.,* 2019; Westgate *et al.,* 2021). Fencing, potentially coupled with active planting, could provide in-situ riparian habitat for GGF including areas to forage and take refuge throughout the breeding season, and may allow individuals to remain at a waterbody longer, providing opportunities for multiple breeding events. Undisturbed riparian vegetation bounding the shoreline may also act as a nursery for larval GGF increasing foraging opportunities and a retreat from predators.

While the complete exclusion of livestock from the farm dam is not always possible, intrusion by machinery should be limited as much as possible to avoid heavy turbation and compaction of the substrate, the loss of ringing vegetation, and the potential for sediment and chemical run-off into the waterbody. Pumping should see the machinery kept at a suitable distance from the shoreline with a hose connected to the pump extended to the waterbody.

Mitigation measures to reduce the potential impacts of habitat disturbance available GGF habitat could include a combination of the following:

- Protect riparian vegetation via complete or partial fencing of farm dam shorelines to prevent intrusion by livestock and machinery,
- Exclusion of vehicles and heavy machinery from the shoreline to prevent compaction of substrate and sedimentation of farm dam basins
- Retention of adjacent remnant native vegetation which may act as terrestrial (non-breeding) habitat

Pollution

Poor and declining water quality is commonly associated with landscape modification including agricultural land-use. Primarily this derives from chemical and sediment runoff and intrusion by livestock and machinery, (Saunders, Hobbs and Margules, 1991; Conroy *et al.,* 2016; Hughes *et al.,* 2016; Hughes and Quinn, 2019). Exclusion of machinery from the shoreline can reduce the potential for accidental chemical run-off, while the retention of riparian vegetation where present can help to mitigate the impact of sedimentation and eutrophication caused by livestock intrusion (Westgate *et al.,* 2021). All efforts should be made to reduce the potential for run-off (mechanical, pesticides, herbicides) into waterbodies, by maintaining a distance while travelling through the area or actively applying pesticides, herbicides and fertilisers.

Mitigation measures to reduce the potential impacts of reduce the potential impacts of habitat disturbance available GGF habitat could include a combination of the following:

- Exclusion of vehicles and heavy machinery from the shoreline to prevent pollution and sedimentation of the water column
- Protect riparian vegetation via complete and partial fencing of farm dam shorelines, preventing intrusion by livestock and machinery,
- Buffer zones which are excluded from spraying of pesticides, herbicides, fertilisers to avoid chemical run-off

Chytrid

Chytrid fungus, *Batrachochytrium dendrobatidis* (Bd), was first recorded in mainland Australia in 1998 (Berger *et al.,* 1998) and confirmed in Tasmania in 2004 (Obendorf and Dalton, 2006). Increased instance of Chytrid infection in waterbodies is associated with higher human activities and habitation. Wetlands which have higher connectivity may be more prone to Chytrid infection; with the probability of Chytrid spread likely further exacerbated where non-declining local amphibian species are recorded in high abundance.

Due to the significant modification experienced within pastoral areas of Tasmania and the regular human activity from agricultural machinery, active irrigation and the rotation of livestock between paddocks, there is a high likelihood of Chytrid infection within agricultural farm dams.

The movement of amphibians, including GGF, between waterbodies also increases the likelihood of introducing Chytrid to any farm dam which have yet to be exposed. Endemic species such as *Crinia signifera* are commonly found in high abundance in areas of high disturbance and seem little affected by the Chytrid fungus, these populations may act as viral reservoir for Chytrid within a system (Brannelly *et al.,* 2018),

The level of farm dam occupancy observed within the Subject Area during spring and summer surveys season indicates that GGF are already present across the landscape in significant numbers; this would indicate that the presence of Chytrid fungus is not providing a barrier to waterbody occupation/colonisation by the species.

The intended pumping and irrigation of the surrounding landscape via farm dam water, with the top up of depleted dams from other sources raises the infection potential where there is the potential for an uninfected farm dam to be included in the scheme.

It is unclear what practical precautions could be put into place to significantly mitigate the risk of Chytrid spread to new waterbodies within large heavily disturbed area, which is likely to already be impacted by the presence of Bd in the twenty years since it's arrival on the island.

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APPENDIX O – LANDOWNER WATER USE SURVEY RESULTS REPORT

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Memorandum

From:	John Wright
To:	Jared Parry (NBES)
Cc:	Charles Livesey (TI), Sophie Grace (TI), Cassie Tickner-Smith (TI)
Date:	10.10.2024
Project:	Sassafras Wesley Vale Irrigation Scheme (SWISA)
Subject:	Dam usage across the proposed SWISA district - green and gold frog phone survey

Purpose

This memorandum is to accompany data collected to inform the natural values assessment undertaken by North Barker Ecosystem Services (NBES)

Introduction

The Sassafras Wesley Vale Irrigation Scheme Augmentation (SWISA) is a proposed redevelopment of the Sassafras Wesley Vale Irrigation Scheme (SWIS) (EPBC Ref: 2010/5327). SWIS was developed by Tasmanian Irrigation (TI) and commenced operations in the 2011-12 irrigation season. Water is sourced from the Great Bend pump station and services an irrigation district between Devonport, Port Sorell, and Sassafras in Northern Tasmania.

The proposed pipeline network consists of approximately 104km of large diameter high-density polyethylene pipeline, which will deliver 14,860ML over a 150-day summer period between the 1st of November and the 31st of March and, pending licence approval, 7800ML over a 215-day winter period between the 1st of April and 31st of October. The scheme is constrained to an existing irrigation district with an estimated area of 16,381 ha with the infrastructure having a design lifespan of 100 years. Most of the augmentation falls within the existing irrigation district which requires an amendment of the district of less than 10% to a proposed 18,000 ha.

Despite the level of modified land due to farming in the SWIS area, green and gold frogs (Litoria raniformis) are relatively prevalent in the district; a 2023-24 survey conducted by North Barker of 106 dams found 64 dams containing green and gold frogs (GGF)

Although it is not anticipated that the construction or operation of SWISA will pose significant direct or indirect impacts to GGF, particularly given the existing scheme and land use across the district, a short study was undertaken to review potential accumulative impacts.

Methodology

A phone survey was determined to be the most efficient method for contacting a statistically significant number of individuals. The questions were drafted in collaboration with North Barker, with phone calls undertaken by Tasmanian Irrigation due to familiarity with the area and local irrigators.

Landowners were called to provide data regarding current and planned future dam usage across the proposed SWISA irrigation district.

The survey was divided into two Parts; Part A was designed to determine if the presence or absence of frogs found during the 2023-2024 summer season relates to dam usage, in particular fluctuations in dam height, and therefore presence of water in the vegetated habitat area of those dams (typically the top 5m of dams). Part A questions were asked to owners or users of dams that had either; GGF identified 'yes' or absence was confirmed 'no' during the 2023-24 survey conducted by NBES.

Part B asked a broader range of proposed SWISA irrigators how they expected to use new scheme water in the future. The questions asked were to ascertain whether there would be a decrease of dam use resulting in less fluctuations to dam levels or more water remaining in the dams (+1 score), no change to dam usage/levels (0 score), or an expected increase in dam usage resulting in greater fluctuations or lower dam levels (-1 score).

The questions were as follows:

Part A: Yes/No Frog Dams

1. Thinking about summer 2023-24, how often was the top 5m/vegetated area of the dam full?
    a. How many times did it drop? (numerical answer)
    b. How long was it below the top 5m? (e.g. once for a month, or ten times in one week)
2. Is that dam level/change fairly typical, and do you think it will change after SWISA commences? (Y/N) (Y/N)

Part B: SWISA irrigators, not frog specific dams.

1. How many dams are on your property/ies? (Number of dams and address)
    a. how are they currently used in summer - specific to water movement? (Topped up frequently/rarely, water source, water use stock/irrigation).
2. Relative to the last approx. 20 years, assuming similar climate/season conditions: Will SWISA water change the way you use those dams? (Y/N, Y = stock, irrigation, more frequent top ups/drawn downs)
3. Will there be more, or less, water in the dams on your property over summer?

    [Scoring: +1 (positive change for frog), 0 (no change), -1 (negative change for frog)]

    a. If 1 or -1: Which dams do you think will be more likely to change?

The results were collated and provided to North Barker to analyse and summarise in their detailed impact assessment.

Yours sincerely

John Wright
SWISA Project Manager

Table O1: Results of landowner water use surveys: current water use and likely change in water use with the SWISA.

Address	Property ID	FWAPID	Number of Dams	Dam Use	Will SWISA change dam water use		More or less water in dams? 1 / 0 / -1
[redacted]		FWAP-SWIS-026	8	Irrigation / Livestock	Yes	More water in dams	1
		FWAP-SWIS-004	2	Irrigation	Yes	SWISA water will go to other dam, this dam will become storage	1
		New SWISA	5	Not used	No	Direct irrigate with SWISA water	0
		FWAP-SWIS-056	3	Irrigation	Yes	Irrigation practice won't change, but he will keep his dam fuller to irrigate longer	1
		FWAP-SWIS-018	2	Irrigation	No	SWISA water is back-up turned on in Feb, dams spilling by April	0
		New SWISA	1	Not used	No	SWISA water into tanks, and direct irrigate berry tubes	0
		FWAP-SWIS-012	9	Irrigation	No	Will irrigate for longer, but won't change use of dam	0
		FWAP-SWIS-028	10	Irrigation	No	SWISA water will only used only when dry	0
		FWAP-SWIS-030	8	Irrigation	No		0
		New to SWISA	9	Irrigation / Livestock	No	Direct irrigation, always above 50%	0
		FWAP-SWIS-076	5	Irrigation	No		0
		New to SWISA	6	Livestock	No		0
		FWAP-SWIS-036	6	Irrigation	Yes	More water planned to stay in dam due to direct irrigation	1

Address	Property ID	FWAPID	Number of Dams	Dam Use	Will SWISA change dam water use		More or less water in dams? 1 / 0 / -1
[redacted]	[redacted]	New to SWISA	8	Irrigation	No	May direct irrigate depending on pressure, but dam stays pretty full	1
[redacted]	[redacted]	New to SWISA	1	Irrigation / Livestock	No	Dam size may increase depending on permit approval. May direct irrigate depending on pressure, which leaves dam more full	0
[redacted]	[redacted]	FWAP-SWIS-032	1	Livestock	No	Retired dam, lot of frogs witnessed	0
[redacted]	[redacted]	FWAP-SWIS-001	5	Irrigation / Livestock	No	Keeps dams 70% full	0
[redacted]	[redacted]	FWAP-SWIS-031	2	Irrigation / Livestock	No		0
[redacted]	[redacted]	FWAP-SWIS-026	4	Irrigation	Yes	Hoping to direct irrigate	1
[redacted]	[redacted]	FWAP-SWIS-061a	6	Irrigation / Livestock	Yes	Hoping to direct irrigate	1
[redacted]	[redacted]	New to SWISA	2	1 Not in use (404), other dam used for irrigation	No		0
[redacted]	[redacted]	FWAP-SWIS-064	6	Irrigation / Livestock	Yes	Will keep dams higher	1
[redacted]	[redacted]	FWAP-SWIS-011	14	Irrigation / Livestock	Yes	Direct Irrigation	1
[redacted]	[redacted]	FWAP-SWIS-043	8	Irrigation / Livestock	Yes	Direct Irrigation	1
[redacted]	[redacted]	New to SWISA	4	Irrigation	Yes	More water will keep dams higher	1
[redacted]	[redacted]	New to SWISA	4	Irrigation	Yes	Will keep dams at 70%	1

Address	Property ID	FWAPID	Number of Dams	Dam Use	Will SWISA change dam water use		More or less water in dams? 1 / 0 / -1
[redacted]	[redacted]	New to SWISA	4	Irrigation / Livestock	Yes	Increased water from SWISA will make dams higher	1
[redacted]	[redacted]	FWAP-SWIS-049	2	Irrigation / Livestock	Yes	More water to stay in dam	1
[redacted]	[redacted]	FWAP-SWIS-045	6	Irrigation / Livestock	Yes	Direct Irrigation	1
[redacted]	[redacted]	FWAP-SWIS-066	5	Irrigation / Livestock	Yes	Stops irrigation around December usually, but will have more water with SWISA and dams will stay more full	1
[redacted]	[redacted]	FWAP-SWIS-054	1	Irrigation / Livestock	No		0
[redacted]	[redacted]	FWAP-SWIS-085	1	**Irrigation** 1 small 2ML dam, level fluctuates, refilled from SWIS	N	Aiming to now finish the season with full dams to enable autumn watering if required. Autumn irrigated pasture has changed their farm, with grass to knees during winter months where paddocks used to be bare fallow and wash out in storms.	1
[redacted]	[redacted]		3	**Irrigation** Level fluctuates, refilled from SWIS & Cradle Coast 'potable' water (not for drinking)	N	Aiming to now finish the season with full dams to enable autumn watering if required. Autumn irrigated pasture has changed their farm, with grass to knees during winter months where paddocks used to be bare fallow and wash out in storms.	1
[redacted]	[redacted]		4	**1 Irrigation, 3 not used** 4 little dams, 3 don't have power so aren't used - mostly full.	N	Aiming to now finish the season with full dams to enable autumn watering if required. Autumn irrigated pasture has changed their farm, with grass to knees during winter months where paddocks used to be bare fallow and wash out in storms.	1

Address	Property ID	FWAPID	Number of Dams	Dam Use	Will SWISA change dam water use		More or less water in dams? 1 / 0 / -1
[redacted]	[redacted]	NA	4	**Stock & irrigation** level fluctuates, refills naturally/month, cleaned out a few years ago.	Y	Will use SWISA water direct & top up at least two dams :. will be filled more often.	1
[redacted]	[redacted]	NA	2	Stock & irrigation	N	Purchased SWISA water more so farm value	1
[redacted]	[redacted]		8	**Stock & irrigation** Drained almost fully end of year, some creek top up out of greens creek in a dry year - dry year only	Y	Three dams will be topped up with TI water, five won't be used	1
[redacted]	[redacted]	FWAP-SWIS-003	6	One **irrigation**, one **stock water** for the neighbour 6 dams, 5 irrigation & 1 waterhole One fills only with SWIS water	Y	Depends on the crop rotation (some get down to 30-50%, but one dam will always be full), SWISA won't change much, but will provide more water, particularly in drier years. Use TI water to provide an 'autumn break' to grow grass and prevent erosion.	1
[redacted]	[redacted]	FWAP-SWIS-003	2	Top used for stock and neighbour, bottom irrigation	N	Not planning to use on this property	0

APPENDIX P – GREEN AND GOLD FROG TARGETED SURVEY RESULTS

Results of targeted green and gold frog surveys within the SWISA Project Area. Number of breeding habitat sites with confirmed positive and confirmed negative green and gold frog records within habitat breeding zones. Results taken from ground and song meter surveys. Number of breeding habitat sites where green and gold frogs were not detected during ground surveys shown only where for breeding habitat zones where green and gold frog absence is likely (number of undetected sites shown in brackets) in order to show validity of frog absence in the breeding habitat zone.

Table P1: Confirmed presence and absence of green and gold frogs within breeding habitat zones during the 2023/2024 green and gold frog breeding season

Breeding Habitat Zone	Number of Potential Breeding Sites with Positive Record	Number of Potential Breeding Sites with Confirmed Absence	Presence Within Breeding Habitat Zone
1	3	1	Present
2	4	-	Present
3	3	-	Present
4	3	-	Present
5	3	-	Present
6	2	-	Present
7	7	-	Present
8	1	2	Present
9	2	1	Present
10	1	-	Present
11	1	-	Present
12	1	-	Present
13	1	-	Present
14	1	1	Present
15	1	-	Present
16	1	-	Present
17	6	-	Present
18	1	-	Present
19	1	-	Present
20	1	2 (3)	Present

Breeding Habitat Zone	Number of Potential Breeding Sites with Positive Record	Number of Potential Breeding Sites with Confirmed Absence	Presence Within Breeding Habitat Zone
21	3	-	Present
22	1	-	Present
23	1	-	Present
24	1	-	Present
25	-	1 (2)	?
26	1	-	Present
27	-	(1)	?
28	2	-	Present
29	2	-	Present
30	-	1 (3)	?
31	1	-	Present
32	1	1	Present
33	-	1 (2)	?
34	-	(1)	?
35	-	1 (2)	?
36	-	1 (1)	**Absent**
37	1	-	Present
38	1	-	Present
39	1	-	Present
40	2	-	Present
41	1	-	Present
43	1	-	Present
Total Number of Sites	**63**	**13**	**1 Absent (6 Potentially Absent)**

Table P2: Habitat core scores for farm dams in which green and gold frogs were confirmed as present of absent during the 2023/2024 breeding season and water use of farm dams in which green and gold frogs were confirmed as present of absent during the 2023/2024 breeding season

Breeding Habitat Unique ID	Ecological Survey Results for 2023/2024 Breeding season[948]				Qualitative Landowner 2023/2024 Season Dam Water Use Survey Results[949]		
	Survey Type	Green and Gold Frog Status	Habitat Core Score	Habitat Total Score	Number of up to 5 m Water Level Drops During Summer	Duration of Decreased Water level	Notes
TFHpoly283	Ground survey	Present	High (6)	17	0		Keeps dam above 50 %
TFHpoly242	Ground survey	Present	High (6)	18	0		Shallow dam. Not used
TFHpoly272	Ground survey	Present	High (6)	16	0		1.2 m dam. Retired, doesn't really use except for a bit of livestock water, stay full
TFHpoly268	Ground survey	Present	High (6)	17	0		Shallow dam. Stays at 50 % all season
TFHpoly266	Ground survey	Present	High (6)	16	0		3.6 m dam. Spring keep dam full
TFHpoly247	Ground survey	Present	High (6)	12	0		2.5 m dam. Keeps above 50 %, quick recovering dam, good runoff
TFHpoly264	Ground survey	Present	High (6)	10	0		Shallow dam
TFHpoly277	Ground survey	Present	High (6)	13	0		3 m dam
TFHpoly275	Ground survey	Present	High (6)	17	0		3 m dam
TFHpoly228	Ground survey	Present	High (6)	19	1	5 Months	Uses dam and then uses TI water
TFHpoly224	Ground survey	Present	High (6)	16	1	once late in season	1/year. Use large draw then small tops up when half empty. Every 5 years get below half.
TFHpoly270	Ground survey	Present	High (6)	15	1	1 Months	Dry season, very unusual for it to get that low

948 Green and gold frog targeted surveys December 2023/January 2024 (Table 4)
949 Tasmanian Irrigation qualitative survey of 2023/2024 season dam water use,

Breeding Habitat Unique ID	Ecological Survey Results for 2023/2024 Breeding season[948]				Qualitative Landowner 2023/2024 Season Dam Water Use Survey Results[949]		
	Survey Type	Green and Gold Frog Status	Habitat Core Score	Habitat Total Score	Number of up to 5 m Water Level Drops During Summer	Duration of Decreased Water level	Notes
TFHpoly271	Ground survey	Present	High (6)	17	1	5 Months	Uses dam and then uses TI water
TFHpoly286	Ground survey	Present	High (6)	19	1	Mid-late Dec onwards	2/3 summer. Newer dam, built for 'safety', currently sell water to neighbour, has been emptied over summer last two years & not refilled. Pumped from Dec, so below 5 m Dec onwards.
TFHpoly269	Ground survey	Present	High (6)	17	3	Dependent on rain, approx two months at a time	3/year. Has vegetation at all depths. Fills and evaporates naturally, down to 1/4, not used for irrigation.
TFHpoly219	Ground survey	Present	High (6)	12			
TFHpoly290	Ground survey	Present	High (6)	17			
TFHpoly222	Ground survey	Present	Low (1)	6	0		Dam is only 3 m
TFHpoly308	Song meter	Present	Low (3)	8	0		Shallow dam
TFHpoly259	Ground survey	Present	Low (3)	12	0		3 m dam
TFHpoly317	Song meter	Present	Low (3)	6	0		Shallow dam
TFHpoly234	Ground survey	Present	Low (3)	7	0		Down 40 % in last dry season. Retired dams, tries to keep full
TFHpoly221	Ground survey	Present	Low (3)	7	0		3 m dam. Not currently in use except for livestock, keeps pretty full
TFHpoly227	Ground survey	Present	Low (3)	11	0		3.7 m dam. Very dry 2023/24 season
TFHpoly238	Ground survey	Present	Low (3)	13	0		Shallow dam. Dam not used for anything so no draw down

Breeding Habitat Unique ID	Ecological Survey Results for 2023/2024 Breeding season[948]				Qualitative Landowner 2023/2024 Season Dam Water Use Survey Results[949]		
	Survey Type	Green and Gold Frog Status	Habitat Core Score	Habitat Total Score	Number of up to 5 m Water Level Drops During Summer	Duration of Decreased Water level	Notes
TFHpoly213	Ground survey	Present	Low (3)	7	0		Shallow dam. Keeps full, down to 50 % when used and recovers in 1 day
TFHpoly231	Ground survey	Present	Low (3)	10	1	5 Months	
TFHpoly307	Song meter	Present	Low (4)	11	0		Unknown height. Keeps above 50 %
TFHpoly253	Ground survey	Present	Low (4)	13	0		4.6 m dam. Keeps full due to run off from other dams
TFHpoly315	Song meter	Present	Low (4)	18	0		4 m dam. Stays above 50%
TFHpoly291	Ground survey	Present	Low (4)	16	0		5m dam. Hasn't been used in 8 years, just livestock water, saw 25 % evaporation in dry period 2024
TFHpoly260	Ground survey	Present	Low (4)	13	0		5.4 m dam. Not used, stays 90 % full
TFHpoly311	Song meter	Present	Low (4)	9	0		Dam is only 4 m
TFHpoly223	Ground survey	Present	Low (4)	13	0		2 m dam, Keeps above 50 %
TFHpoly282	Ground survey	Present	Low (4)	12	0		3 m dam, Keeps above 50 %
TFHpoly310	Song meter	Present	Low (4)	15	1	5 Months	More water planned to stay in dam due to direct irrigation
TFHpoly251	Ground survey	Present	Low (4)	12	1	5 Months	Doesn't allow dam below 50 %. Pumps TO water to ensure
TFHpoly252	Ground survey	Present	Low (4)	15	1	5 Months	Doesn't allow dam below 50 %. Pumps TO water to ensure
TFHpoly216	Ground survey	Present	Low (4)	8			
TFHpoly274	Ground survey	Present	Low (4)	11			

Breeding Habitat Unique ID	Ecological Survey Results for 2023/2024 Breeding season[948]				Qualitative Landowner 2023/2024 Season Dam Water Use Survey Results[949]		
	Survey Type	Green and Gold Frog Status	Habitat Core Score	Habitat Total Score	Number of up to 5 m Water Level Drops During Summer	Duration of Decreased Water level	Notes
TFHpoly225	Ground survey	Present	Moderate (5)	9	0		Shallow dam. Semi-retired, not a lot of use
TFHpoly237	Ground survey	Present	Moderate (5)	15	0		4 m dam. Stays at 70 % most years, down to 50% in dry season 2024
TFHpoly276	Ground survey	Present	Moderate (5)	17	0		2.4 m dam. Keeps above 60 %
TFHpoly312	Song meter	Present	Moderate (5)	16	0		4 m dam. 50 % all season, used for irrigation
TFHpoly314	Song meter	Present	Moderate (5)	17	0		Hasn't been full for 8-9 years, always below 5 m. 2-3 years fills naturally
TFHpoly254	Ground survey	Present	Moderate (5)	15	0		6 m dam. Normally stays 90 % all year, dropped to 60 % in 2024 dry season
TFHpoly226	Ground survey	Present	Moderate (5)	16	0		4.4 m dam. 20 % left in dam in 2024 dry season, usually 60 %
TFHpoly232	Ground survey	Present	Moderate (5)	15	0		Shallow dam. Semi-retired, not a lot of use
TFHpoly239	Ground survey	Present	Moderate (5)	12	0		Shallow water body. Not registered as dam on the list
TFHpoly267	Ground survey	Present	Moderate (5)	16	0		Dam is only 5 m, cannot be drained to bottom,
TFHpoly220	Ground survey	Present	Moderate (5)	12	0		2.5 m dam. Not currently in use except for livestock, keeps pretty full
TFHpoly287	Ground survey	Present	Moderate (5)	11	0		Shallow dam. Plans to fill in, not related to SWISA
TFHpoly217	Ground survey	Present	Moderate (5)	12	1	once late in season	Once late in season. Only fills with TI water (SWIS and will be SWISA)
TFHpoly215	Ground survey	Present	Moderate (5)	12	1	once per season - January	1/year. Used for stock water & irrigation, natural refill. Goes down over the season, fairly low during summer 2023-24 with 1 m left. Recently cleaned out so not much vegetation. No plans to change - no SWIS or SWISA water

Breeding Habitat Unique ID	Ecological Survey Results for 2023/2024 Breeding season[948]				Qualitative Landowner 2023/2024 Season Dam Water Use Survey Results[949]		
	Survey Type	Green and Gold Frog Status	Habitat Core Score	Habitat Total Score	Number of up to 5 m Water Level Drops During Summer	Duration of Decreased Water level	Notes
TFHpoly320	Song meter	Present	Moderate (5)	13	1	Mid-late Dec onwards	2/3 summer
TFHpoly243	Ground survey	Present	Moderate (5)	16	6	two weeks up then down	Two weeks/month
TFHpoly235	Ground survey	Present	Moderate (5)	15	Monthly	3 weeks/month	Leased. Focus dam is more likely to be drawn down than the others that top it up. Filled with SWIS & western dam, often gets down to last 10-20 %, doesn't fill by itself.
TFHpoly303	Song meter	Present	Moderate (5)	10			
TFHpoly250	Ground survey	Present	Moderate (5)	16			
TFHpoly284	Ground survey	Present	Moderate (5)	16			
TFHpoly318	Song meter	Absent	High (6)	11	0		1.8 m dam. 60 % full all season
TFHpoly322	Song meter	Absent	High (6)	13	0		5 m dam. Rarely used, stays full
TFHpoly302	Song meter	Absent	High (6)	13	1	5 months	Stays below for full irrigation season, Pick-up is 2 m above dam bottom. No ability to completely empty
TFHpoly316	Song meter	Absent	Low (1)	3	0		Shallow dam
TFHpoly309	Song meter	Absent	Low (3)	7	0		6 m dam. Kept at 50 %, great catchment from creek
TFHpoly258	Song meter	Absent	Low (3)	11			
TFHpoly262	Song meter	Absent	Low (3)	7			
TFHpoly313	Song meter	Absent	Low (4)	11	0		Shallow dam

Breeding Habitat Unique ID	Ecological Survey Results for 2023/2024 Breeding season[948]				Qualitative Landowner 2023/2024 Season Dam Water Use Survey Results[949]		
	Survey Type	**Green and Gold Frog Status**	**Habitat Core Score**	**Habitat Total Score**	**Number of up to 5 m Water Level Drops During Summer**	**Duration of Decreased Water level**	**Notes**
TFHpoly257	Ground survey (6 visits)	Absent	Low (4)	12	1	5 Months	Uses dam and then uses TI water
TFHpoly319	Song meter	Absent	Low (4)	11			
TFHpoly321	Song meter	Absent	Moderate (5)	19	0		6 m dam. Doesn't pump from that dam, so cannot go very low. Stays full
TFHpoly305	Song meter	Absent	Moderate (5)	11	0		Shallow dam. Retired storage dams, stay full
TFHpoly280	Song meter	Absent	Moderate (5)	18	0		Shallow dam
TFHpoly306	Song meter	Absent	Moderate (5)	17	1	5 Months	Uses dam and then uses TI water

APPENDIX Q – GREEN AND GOLD FROG DIRECT IMPACT AND HABITAT MANAGEMENT PROTOCOL

SCOPE

This natural values assessment undertaken for the Sassafras – Wesley Vale Irrigation Scheme Augmentation identified approximately 58 potential breeding habitat areas for the green and gold frog within or close to the Construction Corridor. Additionally, a further 44 potential dispersal routes are within or close the Construction Corridor.

Green and gold frogs are a mobile species and are likely to move into the Construction Corridor but may be unable to move out during construction without assistance. The greatest risk of encountering a green and gold frog is in areas immediately surrounding water bodies, particularly in remnant vegetation, and within dispersal habitat corridors connecting water bodies.

A Green and Gold Frog Habitat Management Protocol for the SWISA has been developed to mitigate impacts to green and gold frogs and their habitat during the construction of the project. This includes the implementation of habitat exclusion zones and pre-clearance surveys to locate and remove any frogs that are potentially at risk of mortality through direct construction impact.

During the construction phase of the action, the civil contractor must comply with the green and gold frog habitat management measures as detailed in this document, including hygiene management, establishing exclusion areas, record keeping, reporting and managing compliance.

<u>Timeframes</u>

Application of the protocols is required for all ground works undertaken within the construction phase of the project. Pre-clearance surveys must be undertaken daily before works occur in a Protocol Application Area.

<u>Responsible parties</u>

The protocol clauses are to be carried out by suitably qualified ecologists (the Ecologist). The protocol will be overseen by the Ecologist and Tasmanian Irrigation. Some oversight and control of hold-points will be required by either regulators or the proponent and in that case linked to contract requirements for the Contractor. Responsible personnel for each task within the protocol are set out in the document.

<u>Protocol Area</u>

The Protocol Survey Area is defined as the Construction Corridor, and a 20 m buffer of the Construction Corridor. The Protocol Application Area is defined as any area within this Survey Area that is within 20 m of breeding and dispersal habitat (**Figures Q1-17**).

<u>Permit requirements</u>

Application of this protocol will require an approved permit to take threatened species issued by the Tasmania Department of Natural Resources and Environment under the Tasmanian *Nature Conservation (Wildlife Regulations) 2021* and will require regulatory oversight for release of hold points for clearance. Any conditions within the associated permit/s must be adhered to and may supersede clauses in the protocol.

<u>Definitions</u>

Suitably qualified ecologist – a consultancy or individual who has relevant professional qualifications, permits, and ethics approval, and at least 3 years of work experience writing and implementing management plans for the relevant protected matter; has implemented and reported on management plans for the habitat of the particular protected matter; can demonstrate the efficacy of those management plans, and in the event of ineffective measures, can demonstrate and implement corrective actions and solutions to achieve the desired outcomes; and can give authoritative assessment and advice on offset management to improve the habitat quality of the protected matter using relevant protocols, standards, methods and/or literature. Additionally, the ecologist must have experience in the identification of fauna and fauna habitat, and animal handling experience for all species listed within the protocol.

CHECKLIST

Pre-works

- ☐ TI to apply for a permit to take threatened species from the Tasmanian Department of Natural Resources and Environment, and a permit to take products of wildlife under the Tasmanian *Nature Conservation (Wildlife) Regulations 2021* (NC Act) for the relocation of other frog species (**Section A-**).
- ☐ TI to identify and communicate location of known potential habitat areas and the provisions of the Green and Gold Frog Management Protocol to the Contractor (**Section A-**).
- ☐ Ecologist to conduct training for all site workers in the identification of green and gold frogs (**Section A-**).
- ☐ Contractor to implement site hygiene measures including cleaning of vehicles, machinery, materials, equipment, and footwear using appropriate disinfectant (**Section C-**).
- ☐ Contractor to erect a 5 m exclusion zone around all identified habitat within 20 m of the Construction Corridor prior to any breaking of ground (**Section D-**).

Pre-clearance survey and construction

- ☐ Ecologist to conduct pre-clearance checks daily prior to any works in the area (**Section E-**).
- ☐ Ecologist with relevant animal handling experience will relocate any frogs to the 'relocation area' prior construction activities (**Section E-**).
- ☐ Ecologist will report any sick or injured frogs to NRE Wildlife Services. Where required these animals are to be euthanised by a veterinarian or experienced individual under humane stipulations outlined in the permit to take (**Section E-**).
- ☐ Ecologist and TI to maintain a register of up-to-date searches, including videos or photos of each capture and relocation, for inclusion on a register for permit submission (**Section E-**).
- ☐ Contractor to adhere to hygiene, vehicle access, water course management, unanticipated habitat discovery and vegetation removal protocols throughout the construction phase of the project (**Section F-**).

Post-works

- ☐ Contractor to commence rehabilitation of disturbed vegetation within 30 days (**Section G-**).
- ☐ TI to complete any data submission requirements to NRE associated with the permit to take (**Section G-**).

GREEN AND GOLD FROG HABITAT MANAGEMENT PROTOCOL

A- Application of the protocol

(i) The protocol can only be conducted under the provisions of a permit to take threatened species issued by the Tasmanian Department of Natural Resources and Environment under the Tasmanian *Nature Conservation (Wildlife Regulations) 2021*. Additionally, a permit to take products of wildlife must be obtained for the relocation of non-threatened frogs listed under the *Wildlife Regulations*.

(ii) The protocol must be applied to any potential green and gold frog habitat area (including Horizontal Directional Drill areas) as set out by the Protocol Application Area - **Figures Q1-17**.

(iii) The protocol may additionally apply to any potential habitat area suspected/confirmed during later investigations (such as observed during works) within the Protocol Application Area.

(iv) All contractors must be aware of the location of potential green and gold frog habitat and the provisions of the habitat management protocol.

(v) All site workers must be trained to be able to identify the green and gold frog.

(vi) All site workers must be trained to be able to identify green and gold frog habitat elements.

(vii) All site workers must be trained to be able to identify signs and symptoms of chytrid fungus infection on green and gold frogs.

B- Timing of works

(i) Application of the protocol is required for the duration of the construction phase of the Project.

(ii) Pre-clearance surveys for green and gold frogs must be undertaken within the Protocol Application Area immediately prior to (the day of) any construction activity being undertaken within 100 m of the Protocol Application Area.

C- Amphibian chytrid fungus (Batrachochytrium dendrobatidis) protocols

(i) Prior to any personnel, equipment, materials, or machinery entering the site, actions must be taken to reduce the risk of introducing or spreading amphibian chytrid fungus in accordance with relevant best practice guidelines[950].

(ii) Application of hygiene protocols must occur where run off will not enter the water bodies that are at risk of contamination, with waste being appropriately disposed of.

(iii) Personnel entering the development site must check and clean gear and equipment, such as footwear and hand tools, for foreign particulates, such as mud and debris, and remove them. Gear and equipment are then to be disinfected (recommended disinfectant include Phytoclean or F10 Super Concentrate[951]).

(iv) Vehicles and machinery entering the development site must be checked and cleaned for foreign particulates, such as mud and debris, and they must be removed. Vehicles and machinery are then to be disinfected (recommended disinfectant include Phytoclean or F10 Super Concentrate[952]).

(v) Any materials entering the development site must be checked and cleaned, removing any foreign particulates, such as mud and debris. Materials are then to be disinfected (recommended disinfectant includes Phytoclean or F10 Super Concentrate[953]).

(vi) Only the suitably qualified and equipped Ecologist can handle any amphibians at any time.

D- Pre-clearance procedure

(i) Pre-clearance checks are required for any work within a Protocol Application Area:

[950] Allan & Gartenstein (2010); Department of Primary Industries, Parks, Water, and Environment (2015)
[951] Allan & Gartenstein (2010)
[952] Allan & Gartenstein (2010)
[953] Allan & Gartenstein (2010)

a. No vehicle may enter the Protocol Application Area without a pre-clearance check

b. No ground breaking or construction work may occur without a pre-clearance check

(ii) The Construction Corridor must be clearly demarcated and narrowed to the minimum extent through any identified dispersal habitat.

(iii) A 5 m exclusion zone must be erected around all identified habitat within 20 m of the Construction Corridor prior to any breaking of ground (even in areas where horizontal directional drilling rather than excavation will occur).

(iv) Exclusion zones must be checked by a suitably qualified ecologist prior to ground-breaking activity.

(v) No more than two protocol application areas can be active at any given time.

E- Pre-clearance checks

(i) Pre-clearance checks for green and gold frogs must be undertaken by the Ecologist immediately prior to (the day of) any activity being undertaken within 20 m of a Protocol Application Area. The Ecologist must remain present at the construction area to manage the relocation of any frogs for the duration of works.

(ii) The area will be searched on foot by the Ecologist and any individuals captured and transported to a water body within the same habitat system, a minimum of 100 m from the Protocol Survey Area (unless suitable habitat is not available, in which case a habitat area can be selected at the discretion of the Ecologist) following the animal handling procedure detailed below:

a. When handling frogs, a new set of well-rinsed single use, non-powdered vinyl gloves must be used for each animal.

b. Frogs are to be transported in a single use clean and dry individual container (i.e., one frog per container). A new container should be used for each animal and no containers are to be reused. The transport container must be cleaned and dried with an amphibian friendly chemical between frogs.

c. Suitable release habitat must be a still or slow flowing waterbody of appropriate size with vegetated margins, no observed predators, and connectivity to other waterbodies (within 300 m).

d. If a sick frog is found (e.g., abnormal posture or behaviour, such as hind legs stretched behind body, wobble or lack of fleeing, or skin changes such as skin discolouration, peeling or ulceration), then do not release the frog. Dead amphibians or live animals showing clinical signs of chytrid disease should be collected using gloves and are to be preserved in a container with 70% ethanol for later investigation and disease diagnosis. Injured or sick animals may need to be euthanised under stipulations of the permit to take and should be followed using NRE's *Best Practice Guidelines for Wildlife Rehabilitation*. This can only be conducted under approval from the NRE Wildlife Services (Ph: (03) 6165 4305 or email wildlife.services@nre.tas.gov.au)

e. In the event that frogs are present in a high density (i.e. more than 5 frogs within a protocol application area[954]), frog-proof fencing will be installed to prevent ingress of frogs into the construction area after relocation has taken place. Exclusion fencing must remain in place for the duration of the works in a given protocol application area. The design and

[954] This figure is based on observed densities during field surveys, understanding levels of practicality during construction, as well as the heightened risk of frogs re-entering the construction area after being relocated as green and gold frogs display high fidelity.

parameters of the exclusion fencing will be developed in collaboration with a suitably qualified ecologist and will incorporate findings from published trials[955].

In areas where exclusion fencing is required, the Ecologist must be present during all construction activities within the applicable protocol application area to manage and relocate frogs as required.

(iii) A register of searches must be kept up to date, as well as videos or photos of each capture and relocation, which will also need to be recorded on a register for permit submission. The register must include the species, time/date, location, relocation area, and any additional information collected at the time of capture.

F- During construction

(i) Pre-clearance checks must be conducted daily as per the methods in Section E-.

(ii) No more than two protocol application areas can be active at any given time.

(iii) A suitably qualified ecologist must be available at any time when construction is being undertaken, noting that multiple works areas may be active at a given time, to address any potential incidents and to implement relocation procedures in the event that a contractor identifies a green and gold frog in the vicinity of a works area.

(iv) All personnel, equipment, materials, or machinery entering the works area must be cleaned in accordance with hygiene protocols (Section C-) to minimise the risk of introducing or spreading chytrid fungus.

(v) Vehicle traffic through habitat areas must be strictly controlled. Access to construction sites must be contained within the Construction Corridor, or on pre-existing roads and tracks. Vehicles must not be parked within the Protocol Application Area unless required directly for construction.

(vi) Vegetation removal must only occur to the extent necessary to complete construction.

(vii) Watercourses must not be impeded (i.e. preventing flow of water) by construction activities:

a. Any roading over drainage lines is to include large culverts suitable for the movement of frogs.

(viii) Any pipes required for works must have their ends capped to prevent frogs becoming trapped inside.

(ix) Upon completion of works within a Protocol Application Area, no vehicles are to re-enter the area without further application of the protocol.

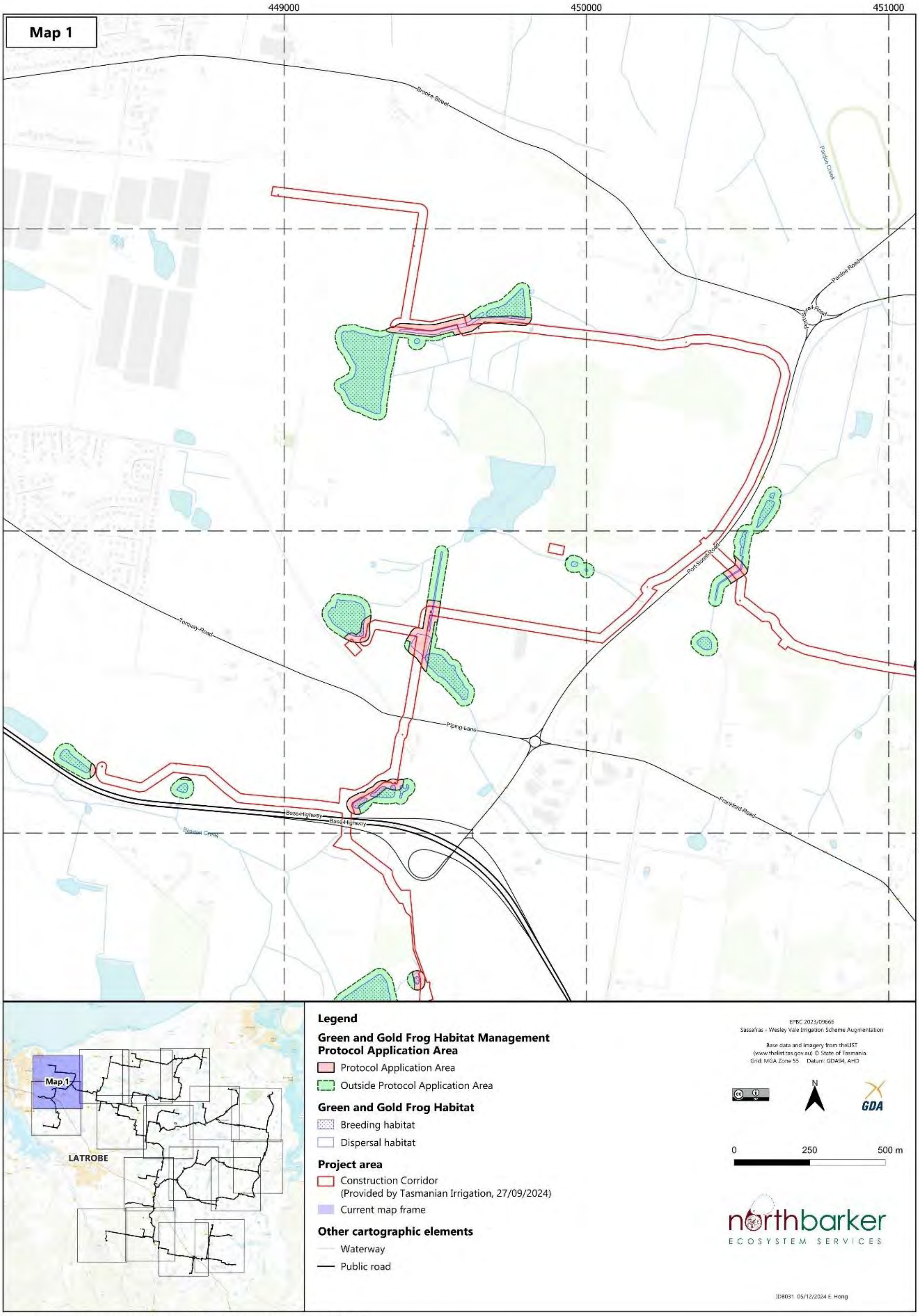
G- Post-construction

(i) Rehabilitation of disturbed vegetation must commence within 30 days with the aim to replace or improve impacted habitat areas, particularly within mapped dispersal areas. This must adhere to revegetation requirements detailed in the **Section 4.1.1** of the NVA report.

(ii) Data associated with the permit to take must be submitted to NRE within the timeframes specified in the permit.

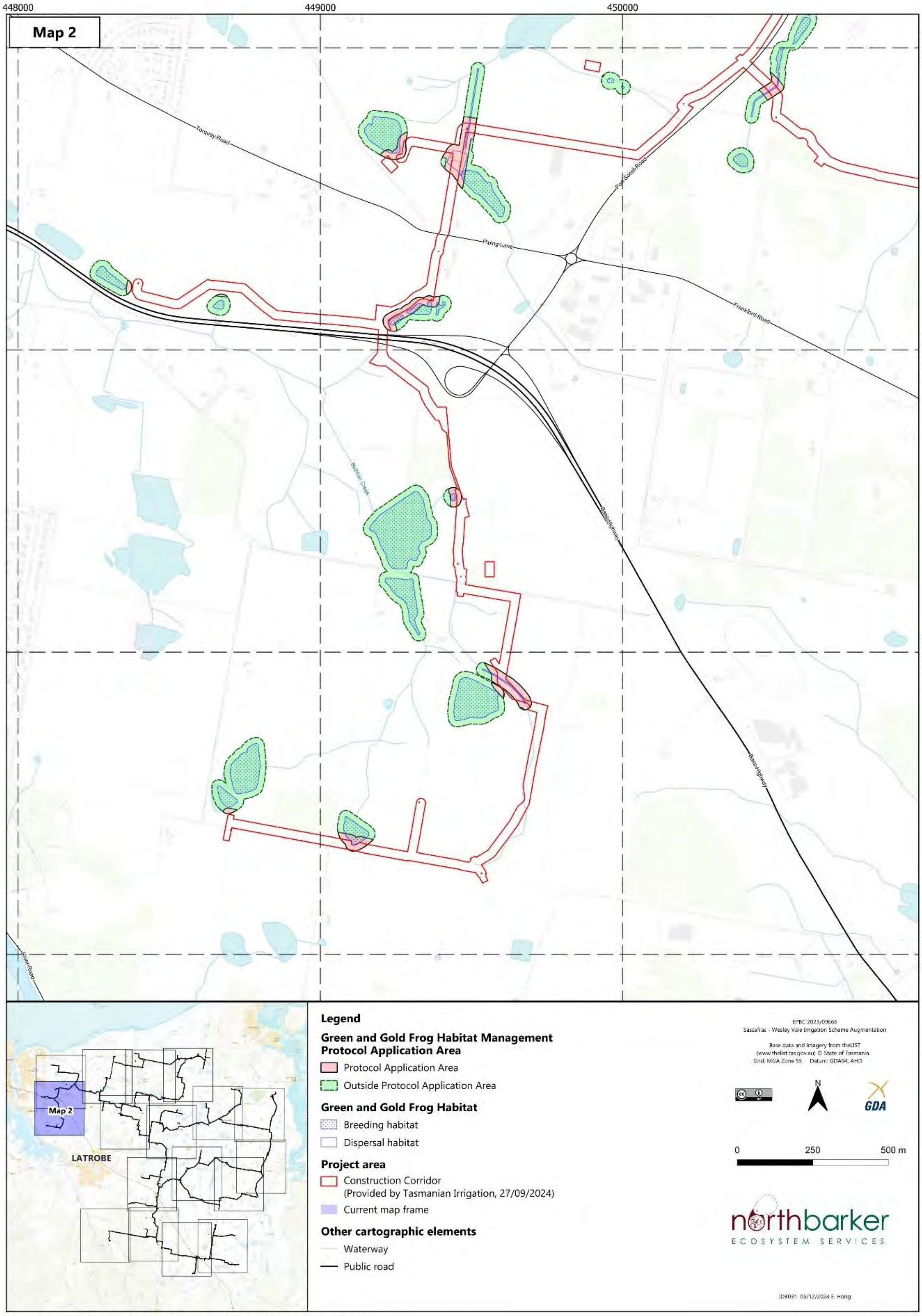
[955] Conan *et al.* (2023); Gould *et al.* (2024)

Green and Gold Frog Habitat Management Protocol Application Area



The mapping has been undertaken using a hand held GPS and subjective interpretation. Consequently it should be considered indicative only.

Figure Q1: Green and gold frog habitat management protocol application area



The mapping has been undertaken using a hand held GPS and subjective interpretation. Consequently it should be considered indicative only.

Figure Q2: Green and gold frog habitat management protocol application area

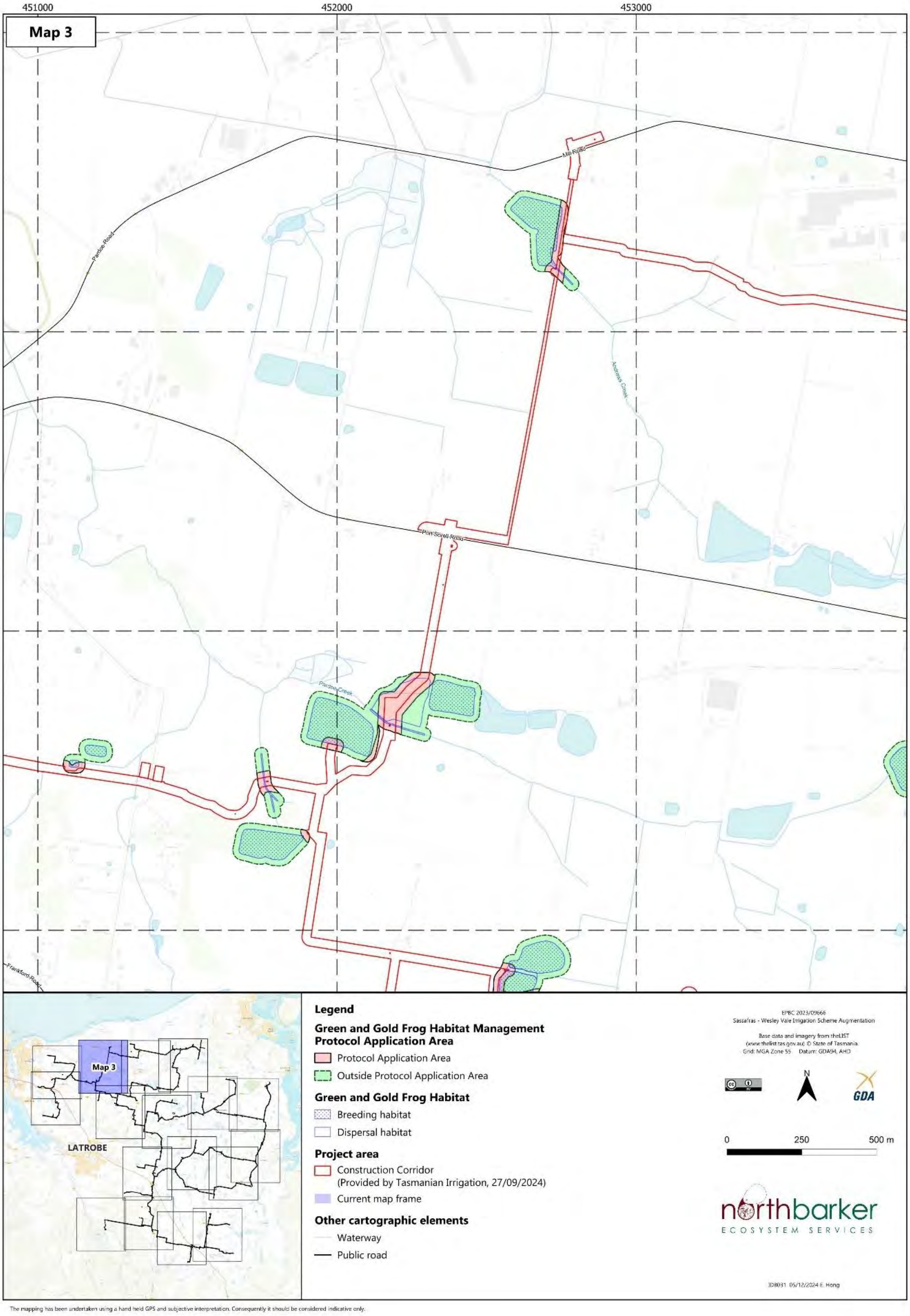


Figure Q3: Green and gold frog habitat management protocol application area

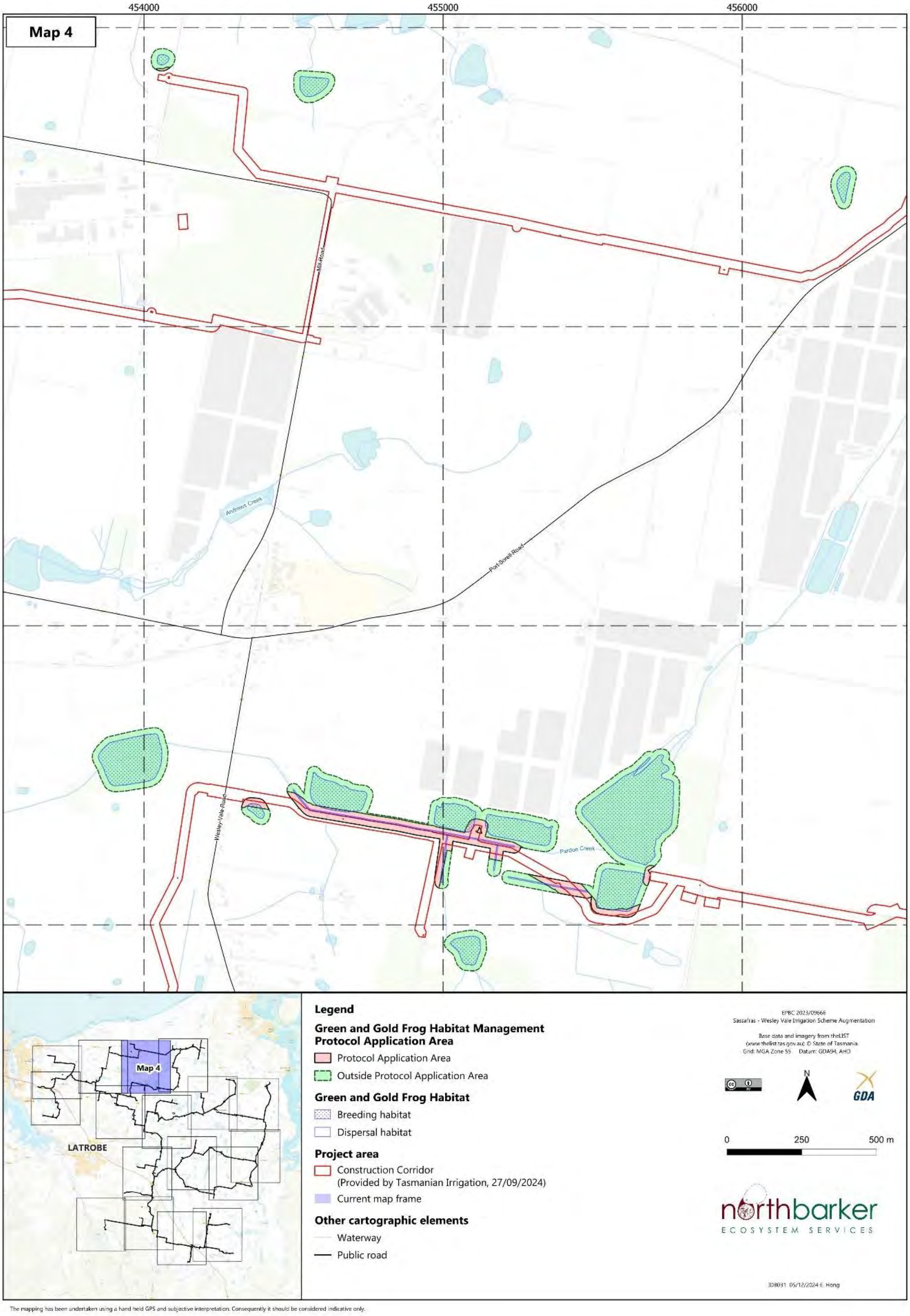
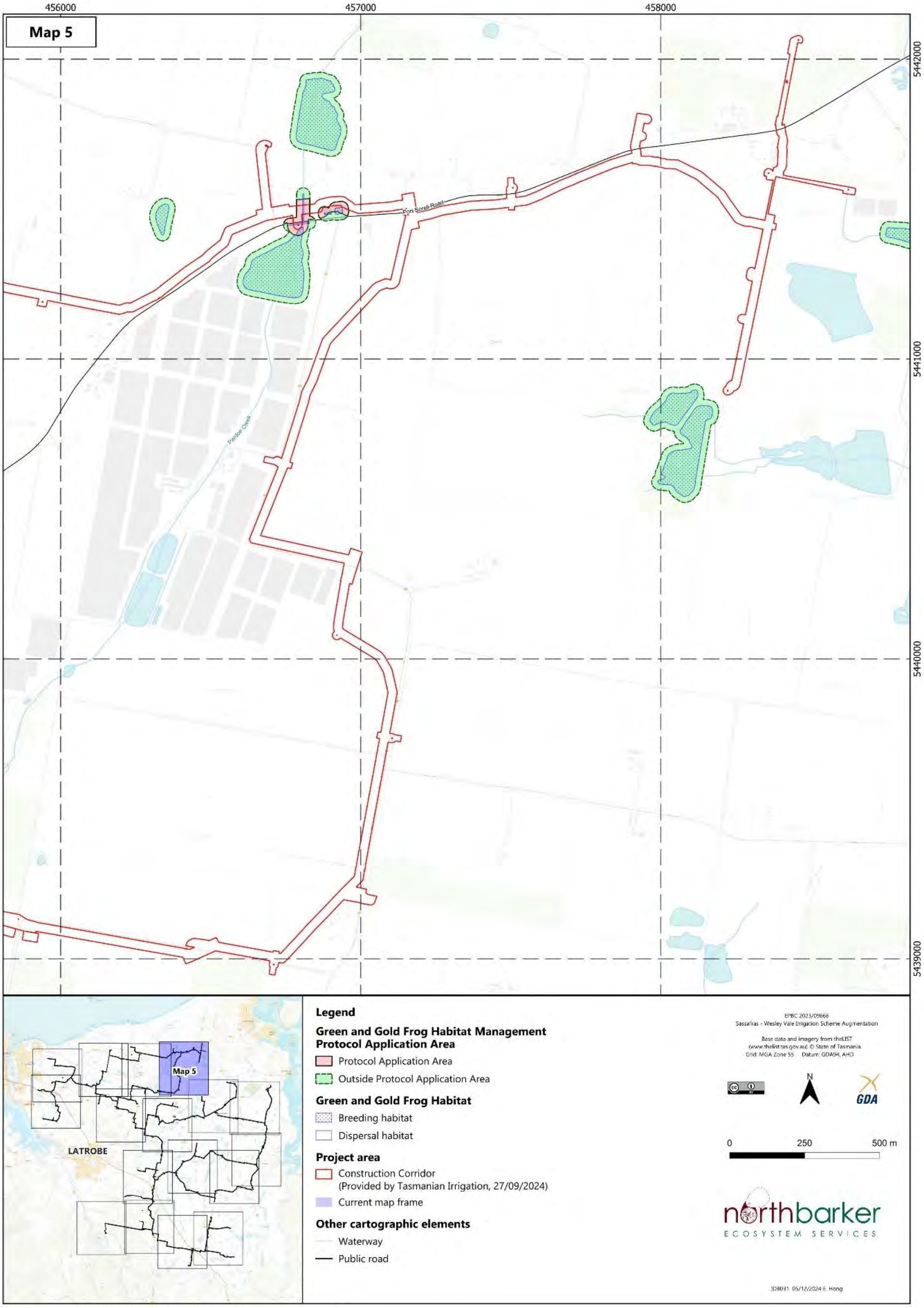
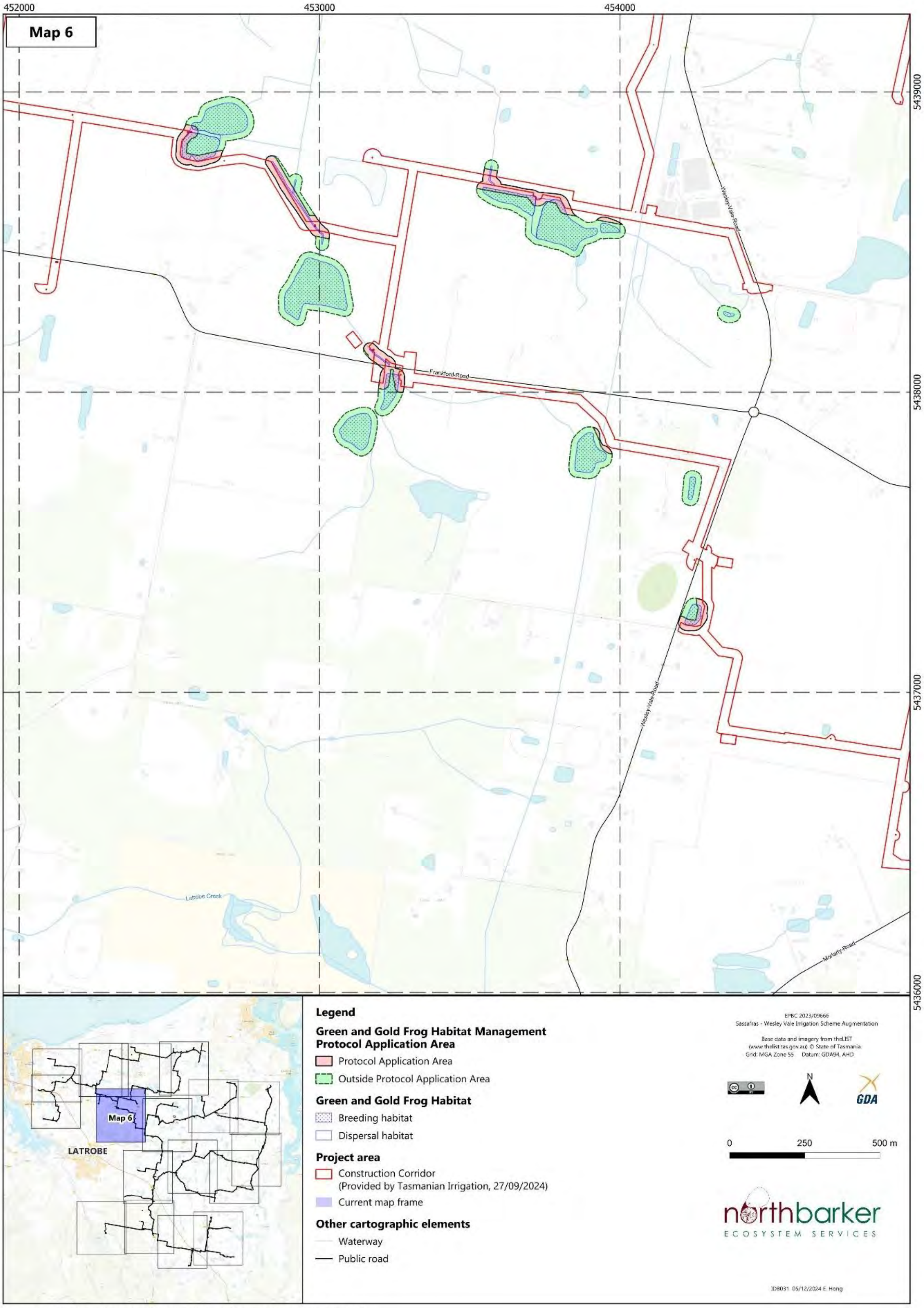


Figure Q4: Green and gold frog habitat management protocol application area



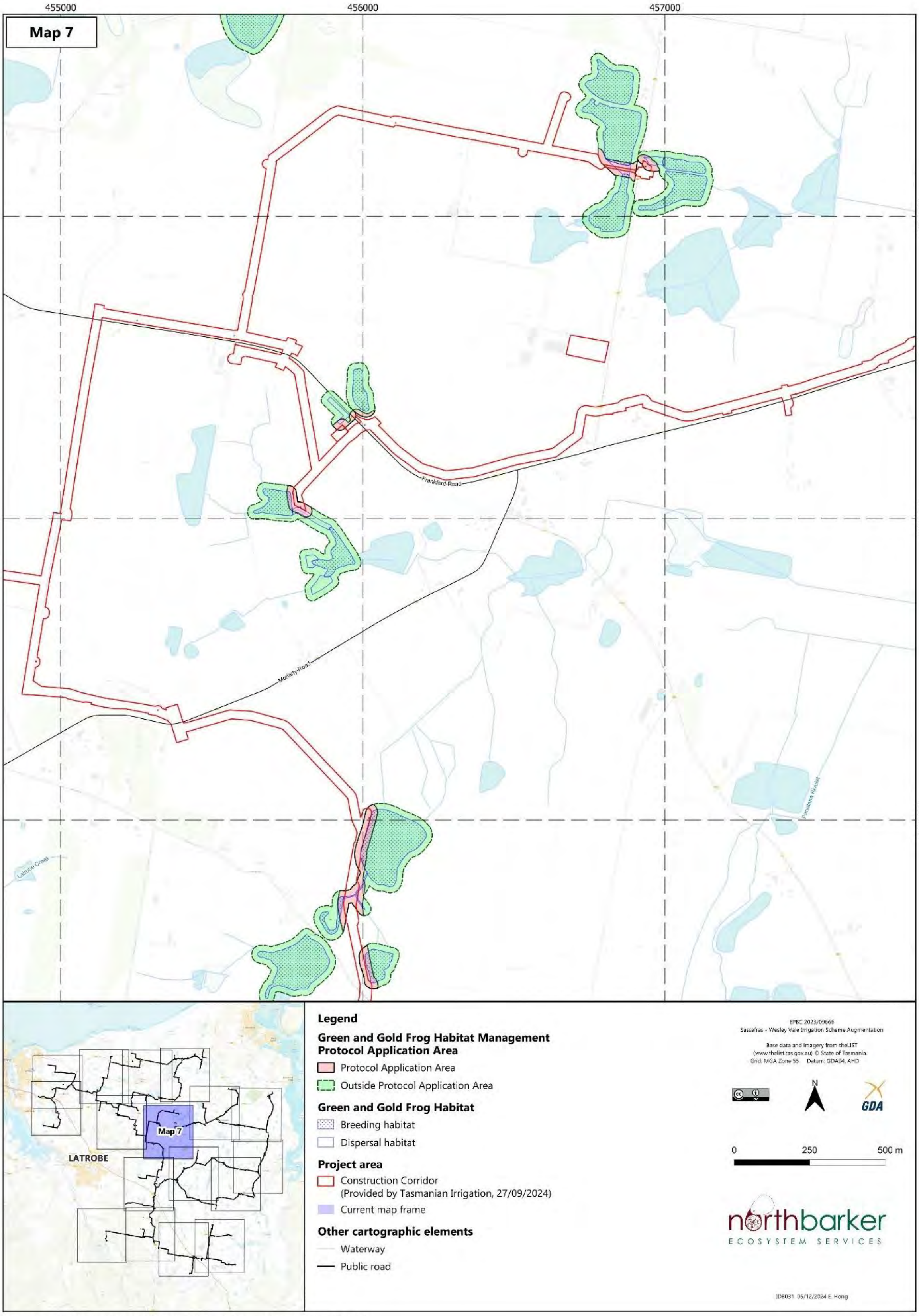
The mapping has been undertaken using a hand held GPS and subjective interpretation. Consequently it should be considered indicative only.

Figure Q5: Green and gold frog habitat management protocol application area



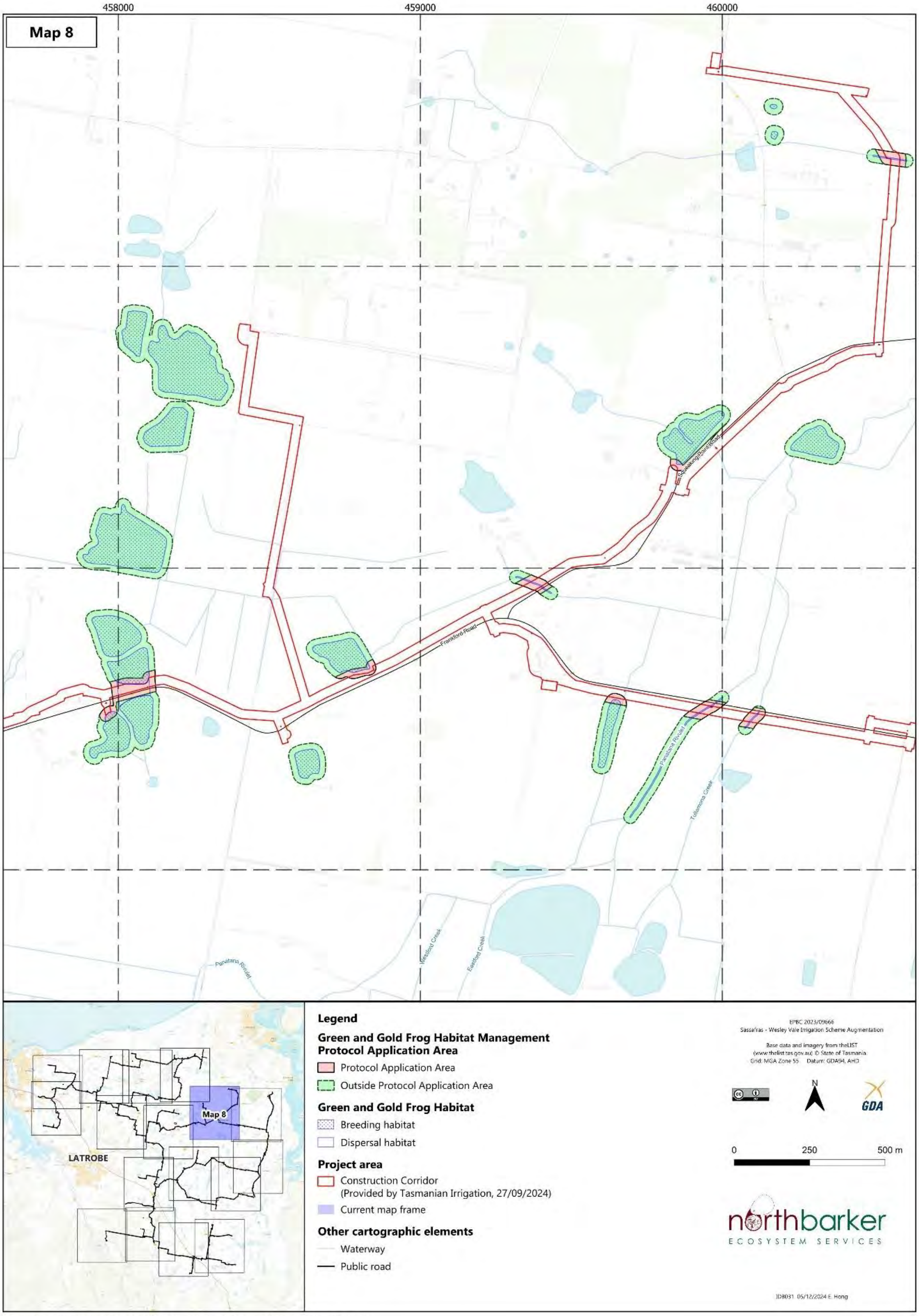
The mapping has been undertaken using a hand held GPS and subjective interpretation. Consequently it should be considered indicative only.

Figure Q6: Green and gold frog habitat management protocol application area



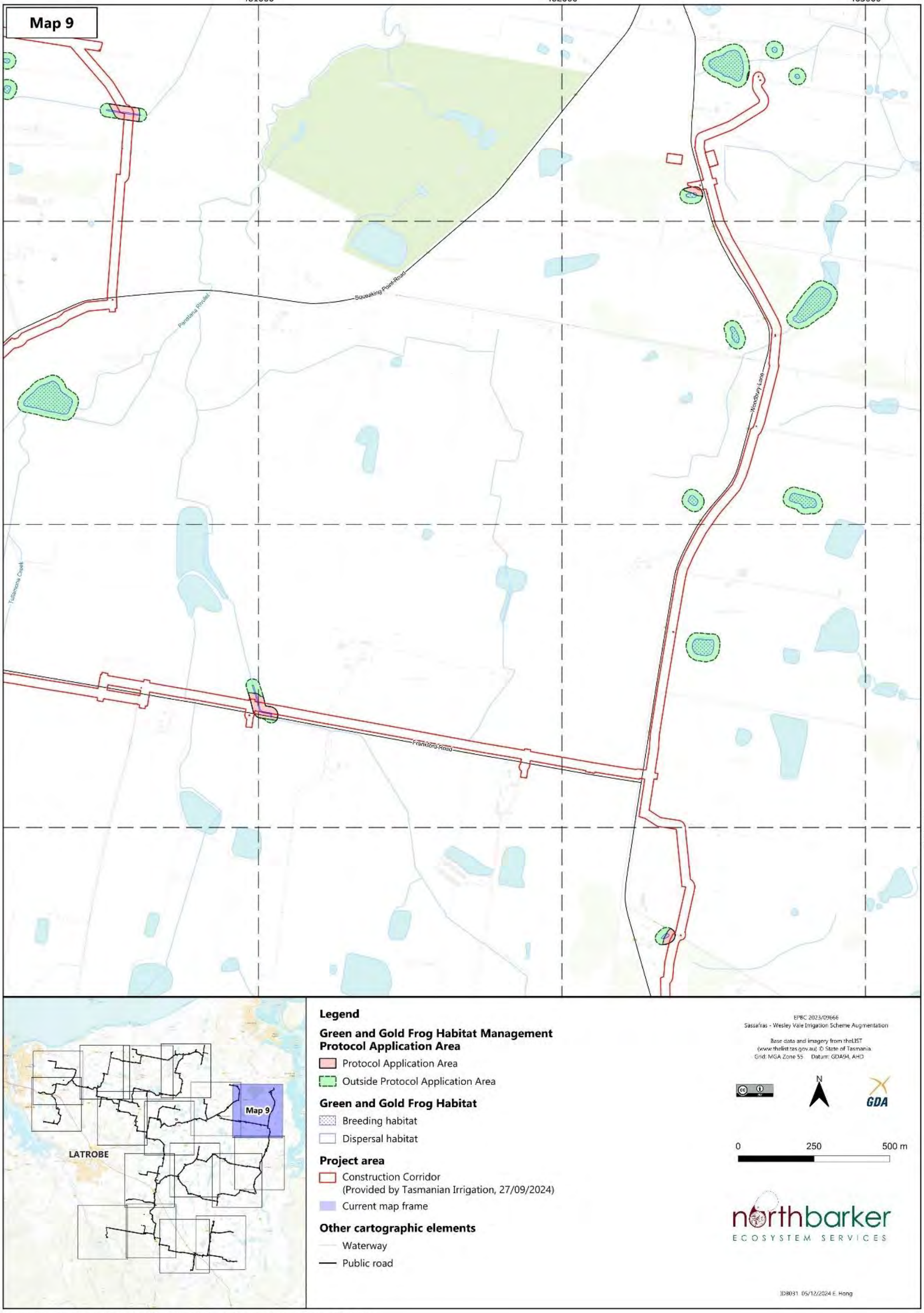
The mapping has been undertaken using a hand held GPS and subjective interpretation. Consequently it should be considered indicative only.

Figure Q7: Green and gold frog habitat management protocol application area



The mapping has been undertaken using a hand held GPS and subjective interpretation. Consequently it should be considered indicative only.

Figure Q8: Green and gold frog habitat management protocol application area



The mapping has been undertaken using a hand held GPS and subjective interpretation. Consequently it should be considered indicative only.

Figure Q9: Green and gold frog habitat management protocol application area

northbarker
ECOSYSTEM SERVICES

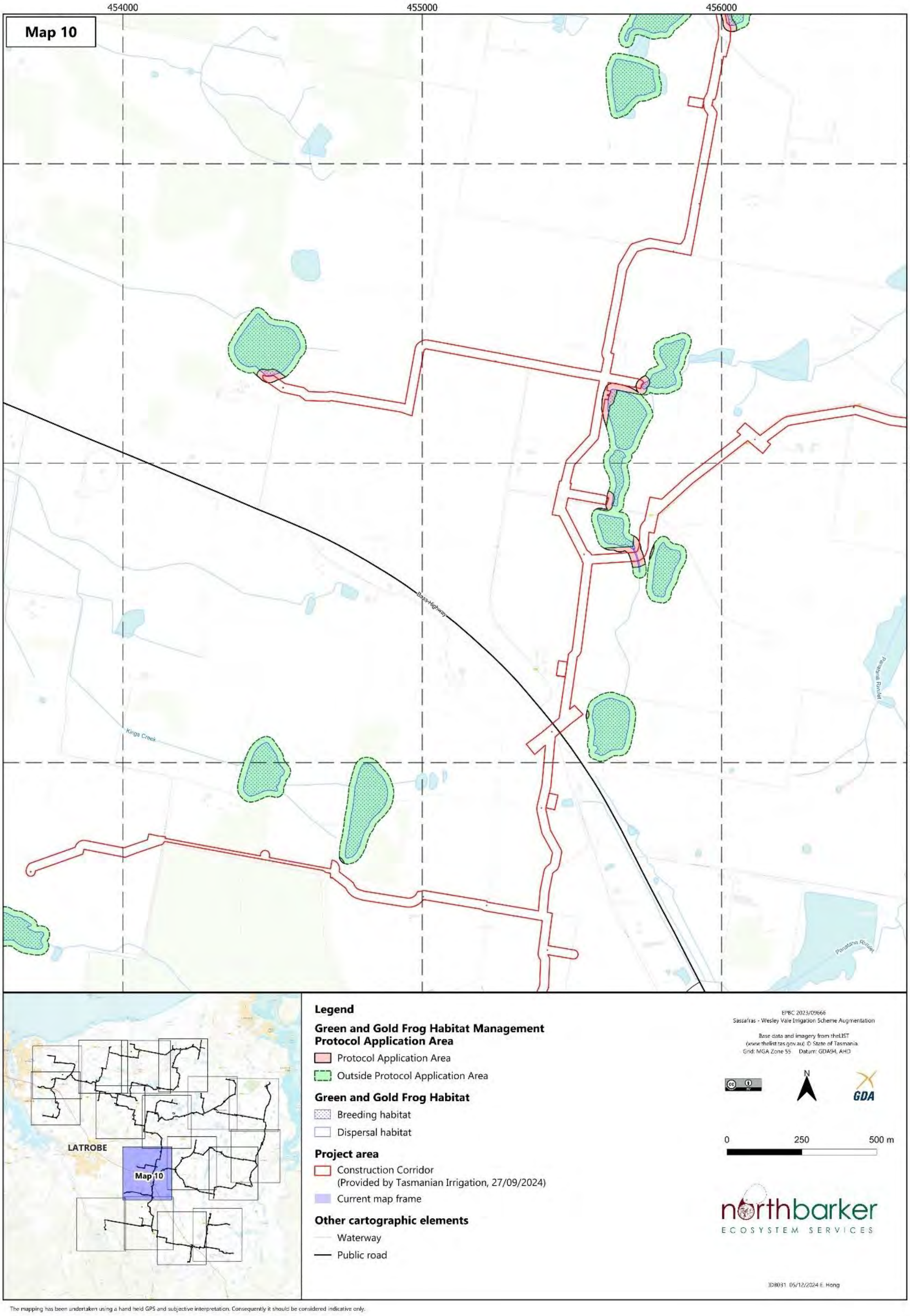
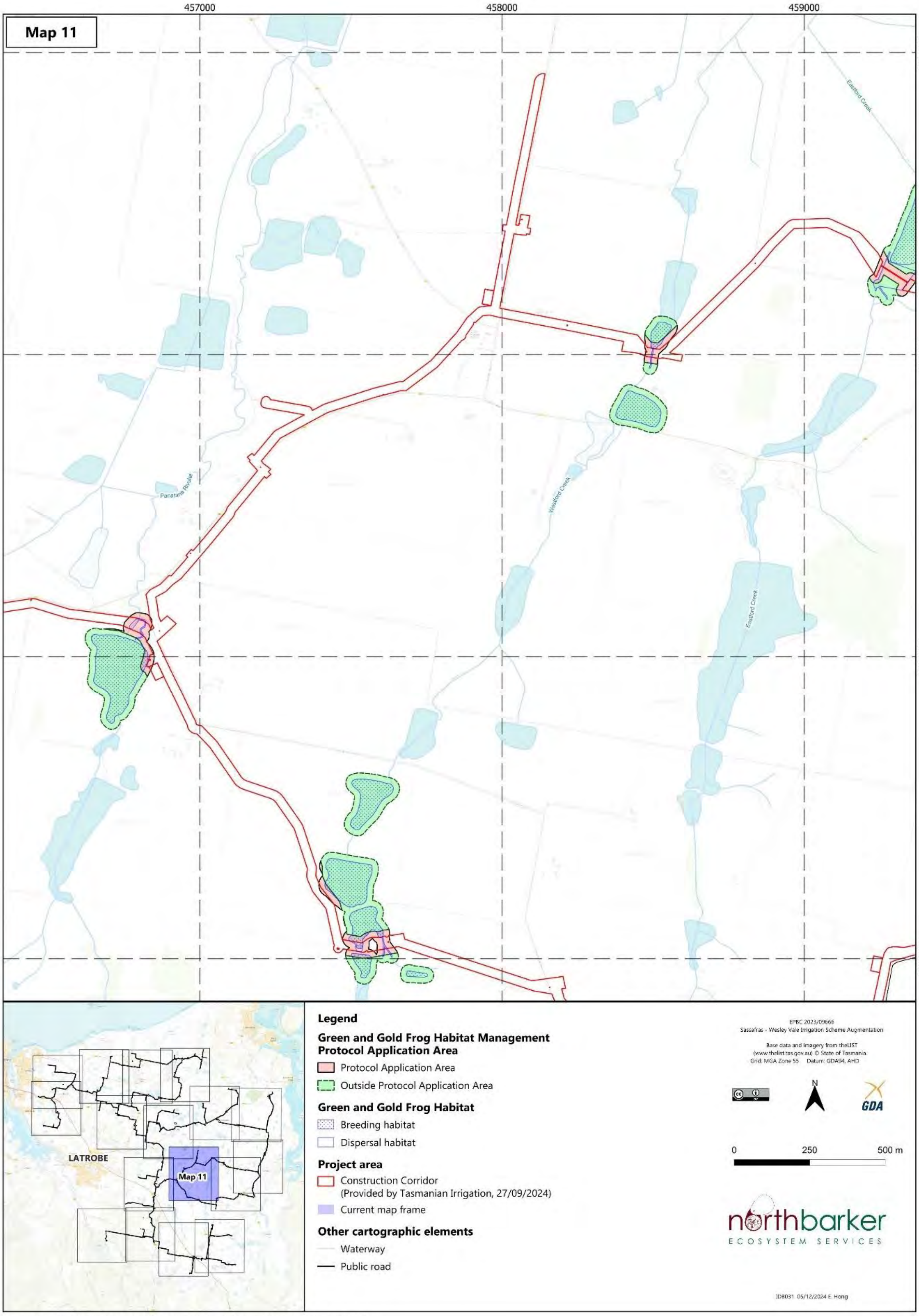


Figure Q10: Green and gold frog habitat management protocol application area



The mapping has been undertaken using a hand held GPS and subjective interpretation. Consequently it should be considered indicative only.

Figure Q11: Green and gold frog habitat management protocol application area

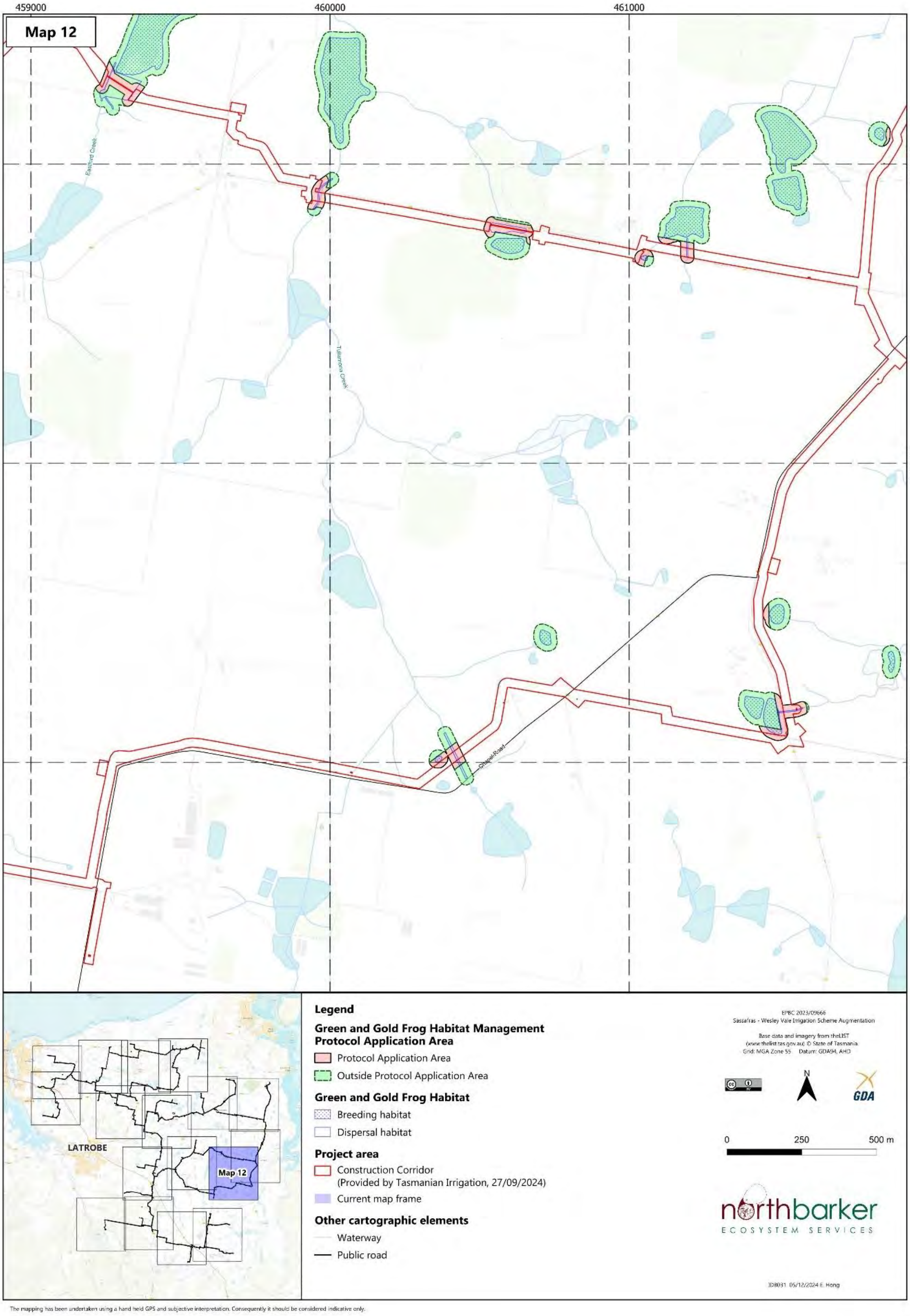


Figure Q12: Green and gold frog habitat management protocol application area

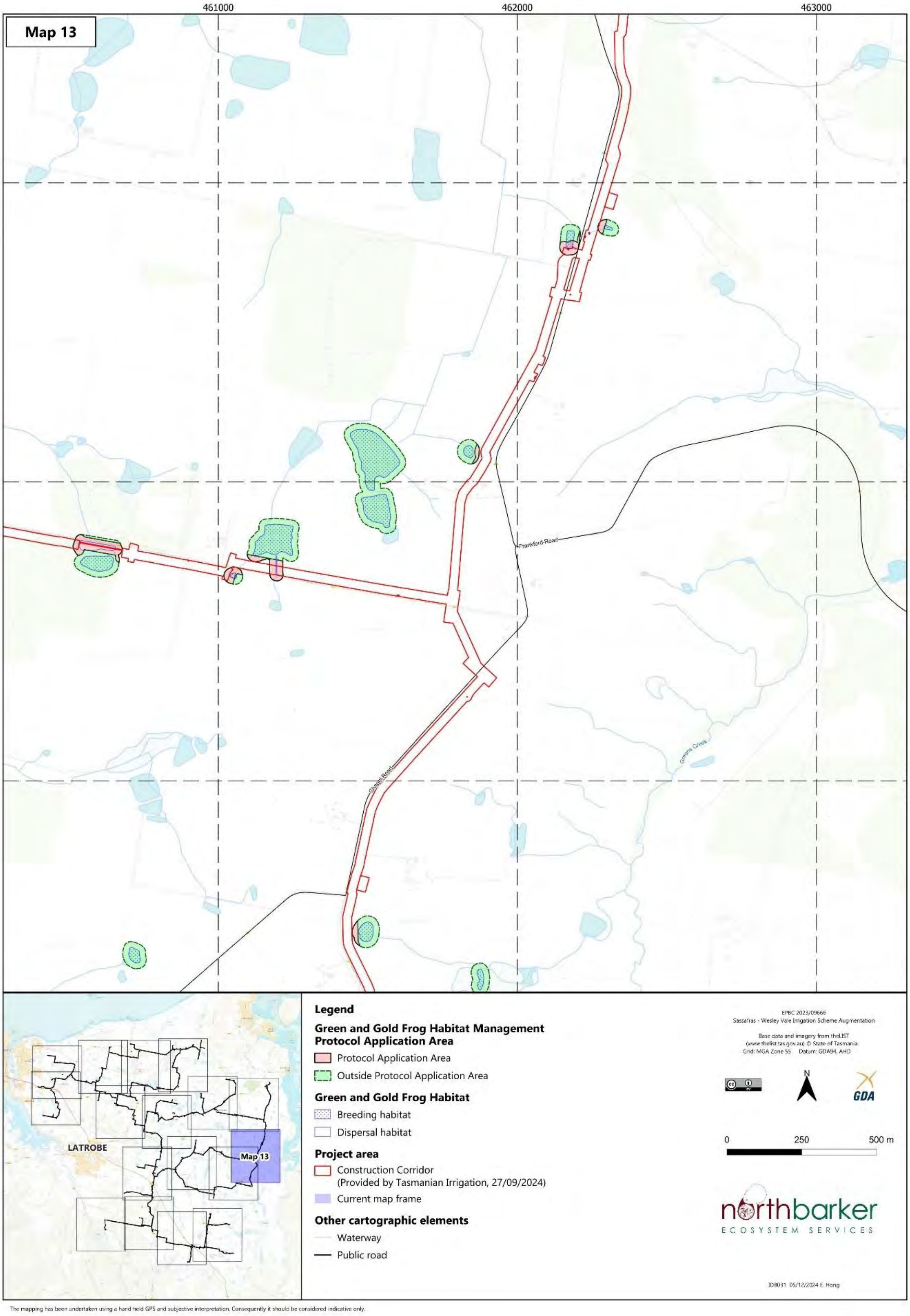


Figure Q13: Green and gold frog habitat management protocol application area

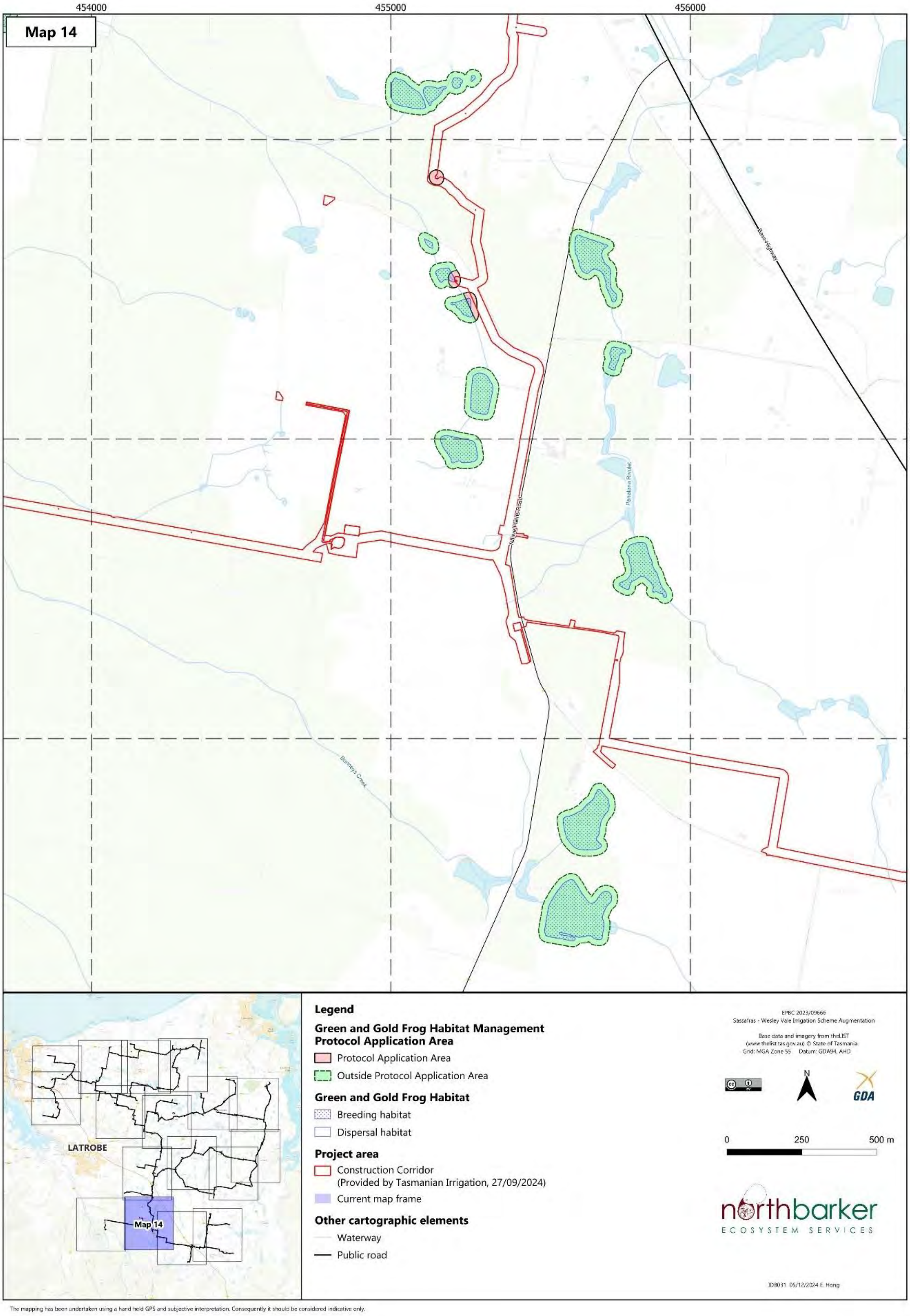
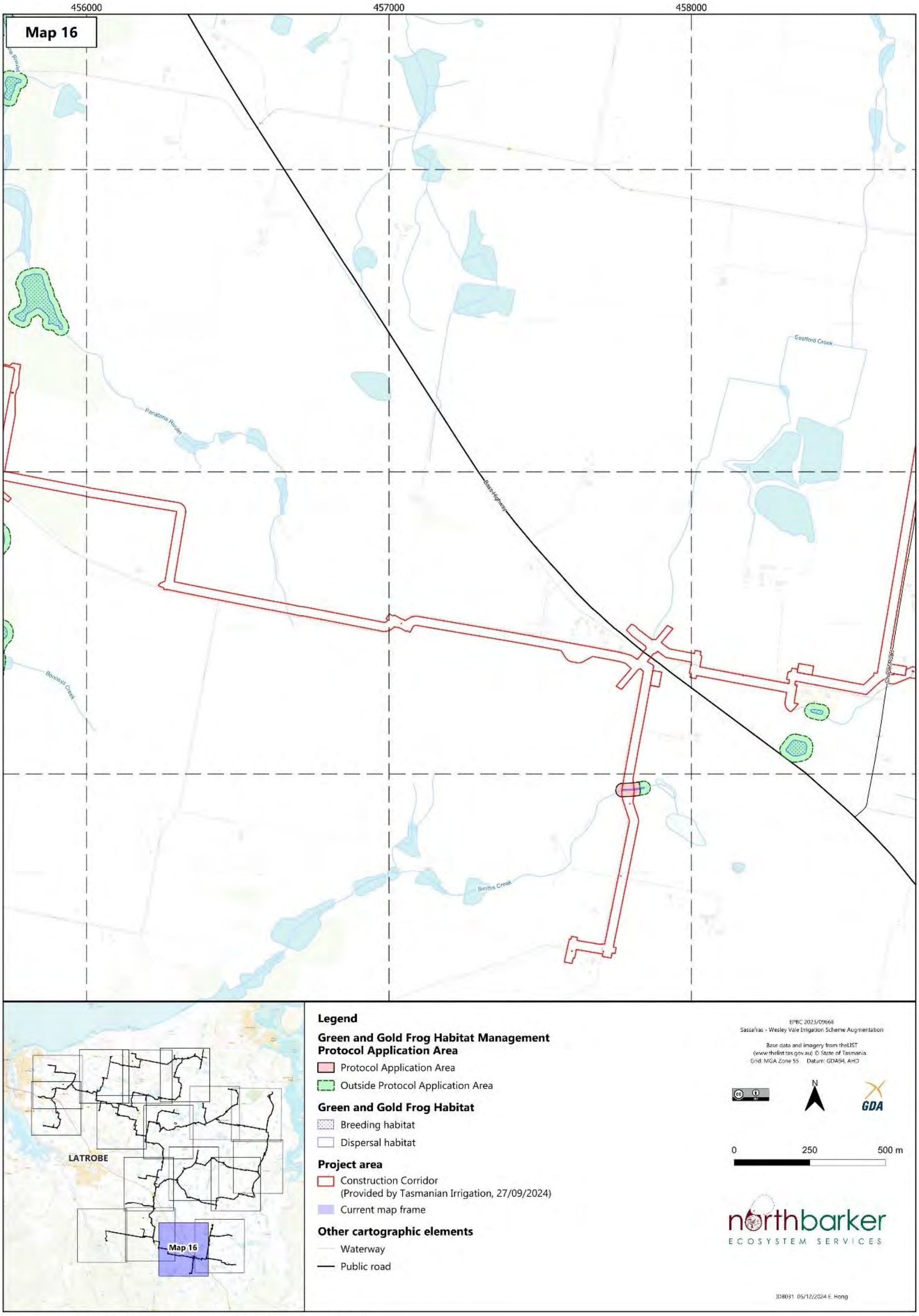


Figure Q14: Green and gold frog habitat management protocol application area

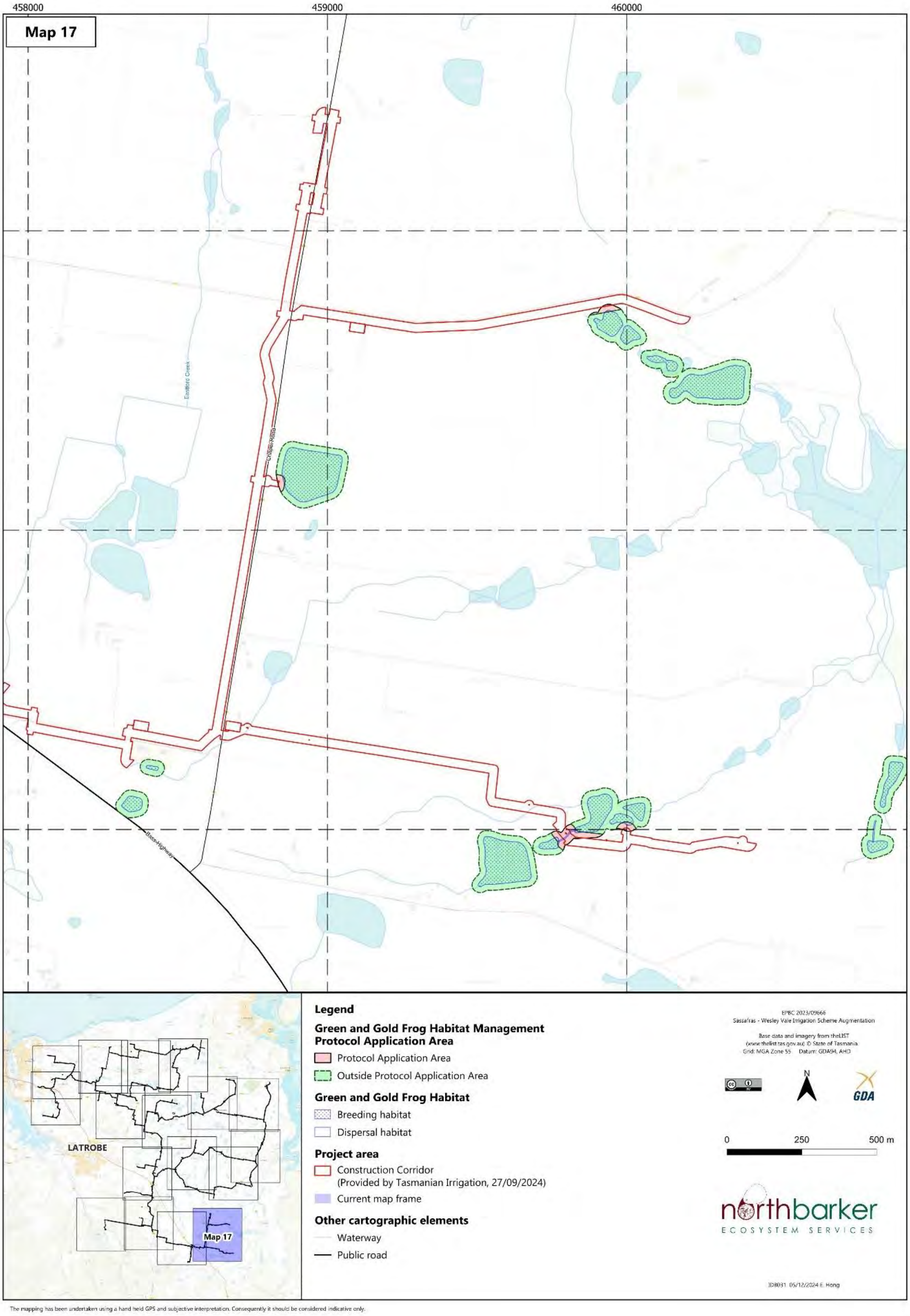
The mapping has been undertaken using a hand held GPS and subjective interpretation. Consequently it should be considered indicative only.

Figure Q15: Green and gold frog habitat management protocol application area



The mapping has been undertaken using a hand held GPS and subjective interpretation. Consequently it should be considered indicative only.

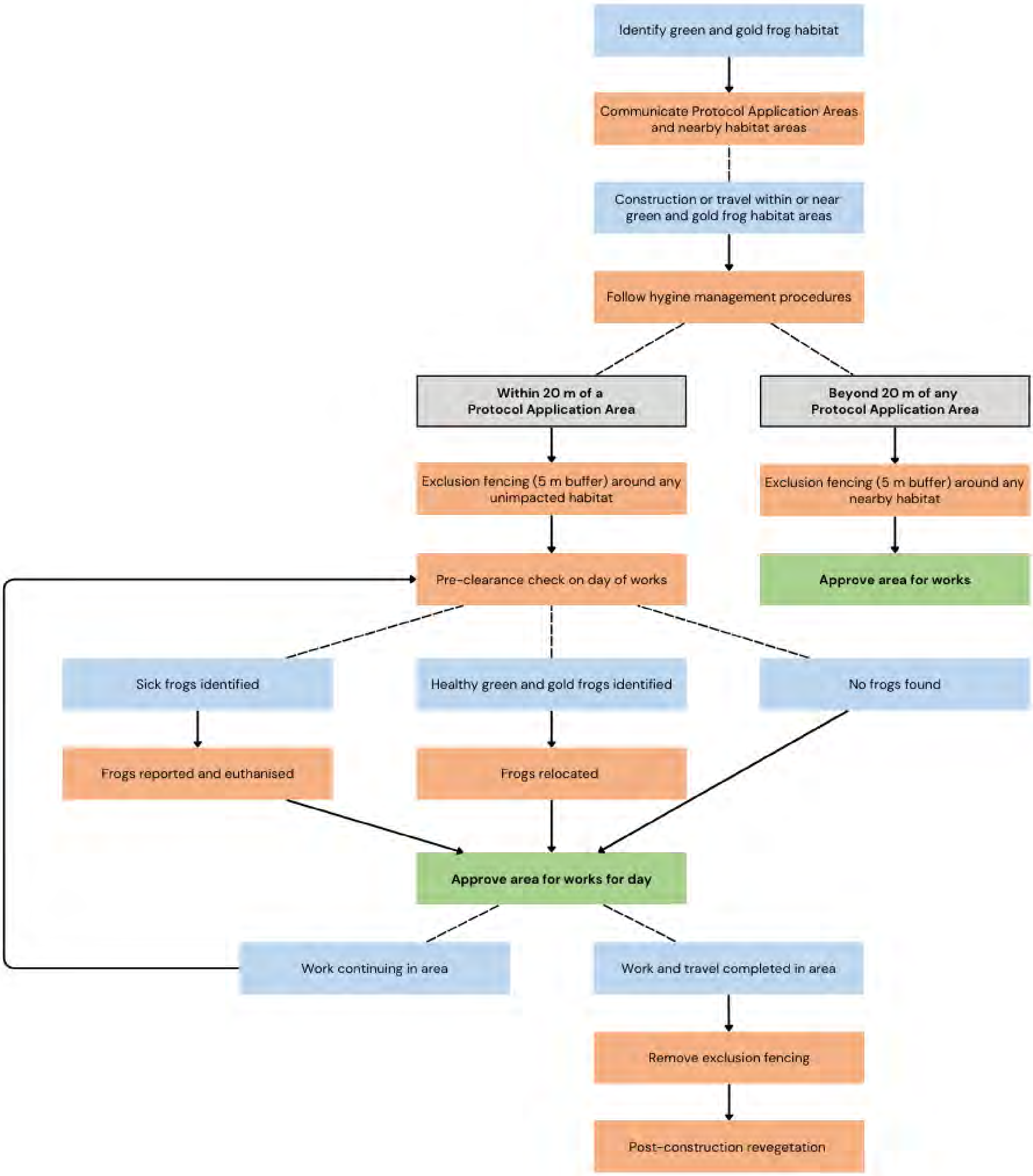
Figure Q16: Green and gold frog habitat management protocol application area



The mapping has been undertaken using a hand held GPS and subjective interpretation. Consequently it should be considered indicative only.

Figure Q17: Green and gold frog habitat management protocol application area

FLOWCHART OF PROTOCOL OPERATIONS



APPENDIX R – WEED & HYGIENE MANAGEMENT RESOURCES

Weed Management Record

Date:	
Project:	
Location:	
Name:	

For herbicide spray:

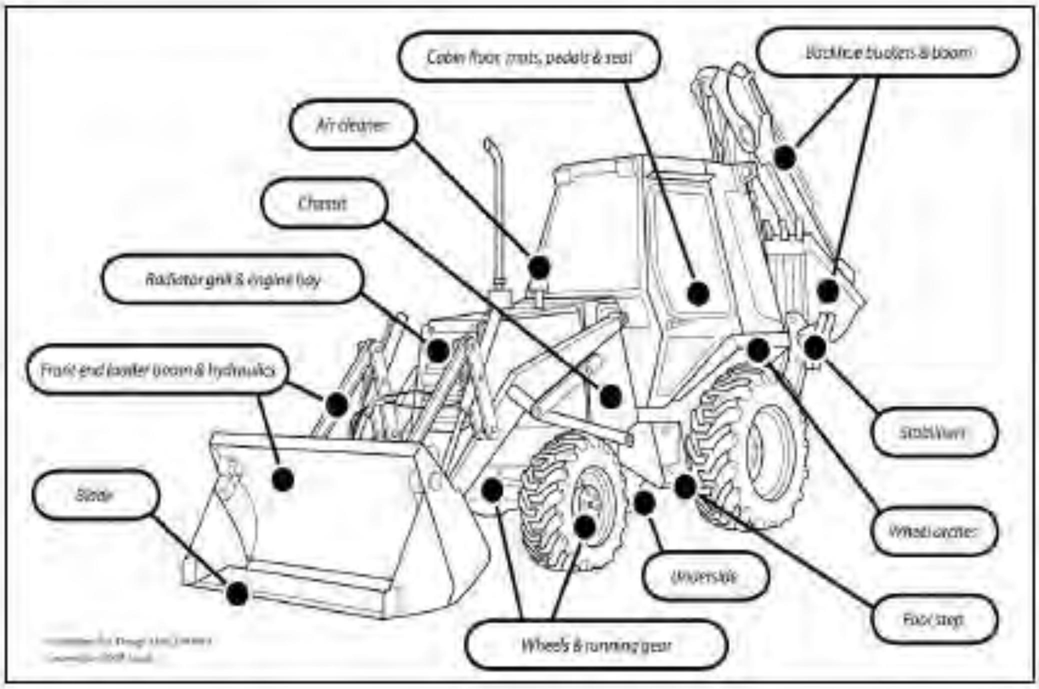
Weather:	Clear, Sunny	Light Cloud	Heavy Cloud	Showers	Rain
Wind:	Nil	Light	Moderate	Strong	Gale
	Direction:		**Variability:**		
Temp (˚C):			**Other:**		

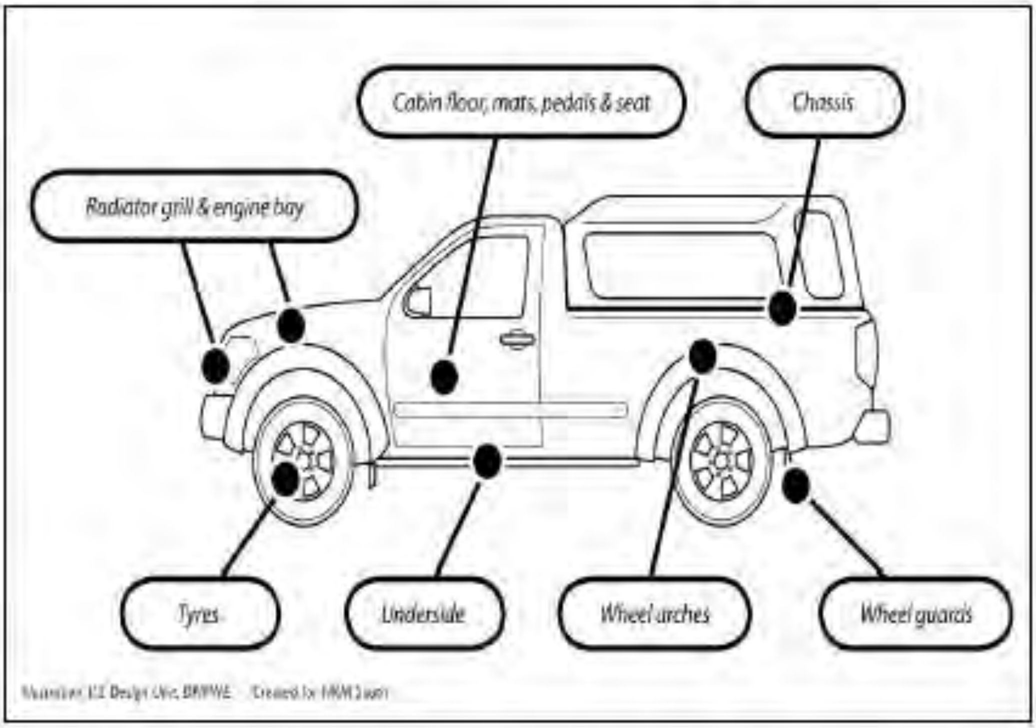
Weed Species Targeted:	**Growth Stage:**	**Control Method**	**Numbers/Area/Density:**
Notes:			
Herbicide Name:	**1.**	**2.**	**3.**
Active constituents & strength:			
Mix/rate:			
Application method:			
Amount applied:			
Area covered:		**Time taken:**	
Signed (operator):			

Wash-down Checklists

Cleandown check lists for specific vehicles and machinery

(Based on:
Far North Coast Weeds (NSW) Machinery and Vehicle cleandown checklist;
Queensland Dept. Natural Resources - Queensland checklist for Inspection Procedures)





***Examples of cleaning points - Excavator and 4wd* (source: Keeping it Clean manual)**

CLEANING/INSPECTION LIST FOR UTILITY/4WD				
Date:		Site:		
Vehicle:		Registration/ID:		
Area	**Contamination point**	**Inspected**	**Cleaned**	**Method**
Engine bay	Front grill			
	Radiator and other cooling cores or fins			
	Grill or recess under wipers			
	Engine mounts			
	Top of gearbox			
	Battery recess/tray			
	Any recesses on engine or manifold			
	Air cleaner (including element)			
Cabin	Footwells			
	Carpets and mats			
	Seats			
	Tool boxes			
	Air vents			
Wheels and arches	Tyre treads			
	Rims and wheel caps			
	Wheel arches			
	Mud flaps and brackets			
	Brakes			
Tray	Body of tray (especially any recesses)			
	Mats and toolboxes			
	Around fuel tank caps			
Under carriage	Chassis rails			
	Struts and stabilisers			
	Steering components			
	Axels and differentials			
	Spare tyre and mounts			
	Guards			
	Fuel Tank			
Attachments	Bull bar			
Cleaning method: Mechanical (M), Compressed Air (CA), Vacuum (V), High Pressure Water (HPW), Low Pressure Water (LPW)				
Inspected by:		Signature:		
Cleaned by:		Signature:		

CLEANING/INSPECTION LIST FOR AN EXCAVATOR				
Date:		Site:		
Vehicle:		Registration/ID:		
Area	**Contamination point**	**Inspected**	**Cleaned**	**Method**
Engine bay	Engine bay floor			
	Fan shroud and radiator cores			
	Air filters (shake/tap filters to determine if clean)			
	Glacier plate (near radiator)			
Cabin	Footwells			
	Carpets and mats			
	Seats			
	Tool boxes			
	Air vents			
Excavation body	Hollow section chassis channels			
	Channels for hydraulic hoses from driven motor			
	Counterweight void spaces			
	Removable track adjuster guards and lubrication points			
	Turret pivot area			
	Arms/booms - pivot points			
Bucket/Blade	Between teeth of adapters			
	Wear plates			
Rear blade (Stabiliser)	Wear plates			
	Hollow section arms			
	Hollow section blade			
Cleaning method: Mechanical (M), Compressed Air (CA), Vacuum (V), High Pressure Water (HPW), Low Pressure Water (LPW)				
Inspected by:		Signature:		
Cleaned by:		Signature:		

CLEANING/INSPECTION LIST FOR TRACK TYPE DOZERS				
Date:		Site:		
Vehicle:		Registration/ID:		
Area	**Contamination point**	**Inspected**	**Cleaned**	**Method**
Engine	Check radiator core and engine area for residues.			
	Remove and check the air filter/cleaner (these often require destruction where they are clogged with QRM).			
	Check carefully the void space between the oil and radiator cores.			
	Battery Box - Lift/remove the battery to check for contamination (battery box may be at side/rear or under seat).			
Drivers cab	Check externally under and around driver's cab.			
	Check under mats in cab.			
	Remove/lift seat; remove/lift floor pans to allow checking to top of transmission.			
	Check air conditioner filter (if fitted) – shake/tap filter to check if clean			
	Check externally under and around driver's cab.			
	Check under mats in cab.			
Body	Belly plates should be removed to allow inspection and cleaning			
	Rear plates at back of dozer should be removed to allow inspection and cleaning.			
	Hydraulic cover plates should be removed to allow inspection and cleaning.			
Tracks/track frame	Examine tracks carefully.			
	Ensure inspection/cover plates are removed to allow inside track area.			
	Check idler wheels (these support the tracks).			
Fuel cells	Are removable therefore dirt etc can pack between the tank and the frame.			
Blade	Ensure that edge of blade top/bottom is not split – this allows soil to be packed very tightly in the hollow.			
	Check cutter points/wear blades.			
	Check carefully the pivot points and adaptors at the rear of the front blade – these allow the blade to change height and angle. Sometimes soil has compacted and is difficult to dislodge.			

Area	Contamination point	Inspected	Cleaned	Method
	Check trunction arms			
	Check all hollow sections			
Ripper support frame is usually hollow	Check carefully if any contaminants have entered this section. The tynes may need to be removed.			
Tynes	Tynes need careful inspection. Contamination may often be removed by water blasting, but tynes may need to be removed in some cases.			
Ripper points	A pin holds on the ripper points. Dirt can compact under the ripper points.			
All areas	Check if any sections or channels are hollow and determine if there is a possible entry point for contamination. Check if plates are covering a compartment or space that may have collected dirt/trash.			
Cleaning method: Mechanical (M), Compressed Air (CA), Vacuum (V), High Pressure Water (HPW), Low Pressure Water (LPW)				
Inspected by:		**Signature:**		
Cleaned by:		**Signature:**		

CLEANING/INSPECTION LIST FOR WHEELED LOADERS & COMPACTORS				
Date:		**Site:**		
Vehicle:		**Registration/ID:**		
Area	**Contamination point**	**Inspected**	**Cleaned**	**Method**
Engine and running gear	Air cleaner and air filters			
	Air conditioner unit			
	Under and around removable fuel cells			
	Brake assemblies			
Canopy/cabin	Hollow channels			
	Void space between cab and body (bird's nests have been found here)			
	Footwells			
	Carpets and mats			
	Seats			
Body	Feet of adaptors on compactors			
	Hydraulic points			
	Articulation points of hydraulics			
	Counterweight void spaces			
	Between dual wheels			
Bucket/Blades	Blade wear plates			
	Blade teeth and adaptors			
Cleaning method: Mechanical (M), Compressed Air (CA), Vacuum (V), High Pressure Water (HPW), Low Pressure Water (LPW)				
Inspected by:		**Signature:**		
Cleaned by:		**Signature:**		

CLEANING/INSPECTION LIST FOR DUMP TRUCKS				
Date:			Site:	
Vehicle:		Registration/ID:		
Area	**Contamination point**	**Inspected**	**Cleaned**	**Method**
Engine and running gear	Air cleaner			
	Air conditioner unit			
Cabin	Footwells			
	Carpets and mats			
	Behind and under seats			
	Tool boxes			
	Air vents			
Body	Hollow channels in tray frame			
	Between dual wheels (where applicable)			
Cleaning method: Mechanical (M), Compressed Air (CA), Vacuum (V), High Pressure Water (HPW), Low Pressure Water (LPW)				
Inspected by:		**Signature:**		
Cleaned by:		**Signature:**		

Wash-down Ledger

A wash-down ledger, such as this, must be completed following wash-down inspections.

Date	Operator	Machine	Location