Response to NT EPA Direction to provide additional information #2

Australia-Asia Power Link

Environmental Impact Statement

March 2024

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ACRONYMS

AAPowerLink	Australia-Asia Power Link
BESS	Battery Energy Storage System
dB	decibel – unit used to measure sound power
dB(A)	estimated average sound power
DC	direct current
DCS	Darwin Converter Site, a component of the AAPowerLink Project
DCCEEW	Department of Climate Change, Energy, Environment and Water (Commonwealth)
DEIS	Draft EIS
DEPWS	Department of Environment, Parks and Water Security (NT Government)
EIS	Environmental Impact Statement – DEIS, SEIS, Additional Information docs combined
EMF	electromagnetic fields
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
NT EPA	Northern Territory Environmental Protection Authority
NT EPA Act	*Environment Protection Act (NT)*
NTG	Northern Territory Government
OHTL	Overhead Transmission Line
SEF	static electric field
SEIS	Supplementary Environmental Impact Statement
SME	Subject matter expert
SMF	static magnetic fields
TPWC Act	*Territory Parks and Wildlife Conservation Act*

1 INTRODUCTION

This document responds to the direction received from the NT Environment Protection Authority (NT EPA) on 10 January 2024 to provide additional information to the Australia-Asia Power Link (AAPowerLink) Environmental Impact Statement (EIS). The project is being assessed under the *Environment Protection Act 2019* (EP Act) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the assessment process is well advanced having commenced in October 2020. Table 1 summarises the EIS process milestones completed to date.

Table 1. Summary of AAPowerLink EIS process milestones

Milestones	Timing
Referral public comment	19 Oct – 27 Nov 2020
NT EPA assessment decision – standard assessment by EIS	12 Jan 2021
Terms of Reference approved by NT EPA	19 Jan 2021
Draft EIS public consultation period	20 Apr to 15 Jul 2022
Direction to prepare Supplementary EIS issued by NT EPA	28 Sept 2022
Supplementary EIS public consultation period	7 Dec 2022 to 31 Jan 2023
Direction to provide additional information #1 issued by NT EPA	19 Mar 2023
Additional information #1 public consultation period	17 Nov to 8 Dec 2023
Direction to provide additional information #2 issued by NT EPA	10 Jan 2024
Additional information #2 provided to NT EPA	8 Mar 2024
NT EPA Assessment Report and draft Environmental Approval	Indicative timing - May 2024
NT Environment Minister decision	Indicative timing - June 2024
Commonwealth Environment Minister decision	Indicative timing – July 2024

There are four items in relation to which, the NT EPA has directed SunCable to provide additional information. The matters relate to:

1. Operational noise emissions from the Darwin Converter Site (DCS) near Murrumujuk and potential impacts on future residential land use proposed under the *Litchfield Subregional Land Use Plan 2016*.
2. Uncertainty about potential impacts to the threatened Ghost Bat (*Macroderma gigas*).
3. Uncertainty about the maximum potential impact to the threatened flora species, *Cleome insolata, Stylidium ensatum* and *Helicteres macrothrix*.
4. Provision of spatial data delineating the extent of the proposed action.

A copy of the NT EPA direction to provide additional information is provided at Appendix A.

The sections respond to each of the items in the direction. The information presented in this document references and/or builds on information already provided in the Draft EIS, Supplementary EIS (SEIS) and Additional information document #1 (submitted on 17 November 2023). Therefore it is intended that this document is read in conjunction with those documents which are available online (Link to NTEPA website).

2 COMMUNITY AND ECONOMY - OPERATIONAL NOISE

2.1 Context provided by the NT EPA

The additional information did not describe potential mitigation options to fully address item 14(3) of the NT EPA's Direction and new information about noise exceedances during operation was presented. Noise modelling outputs in the additional information identified that, with all reasonable and feasible mitigation measures in place, the project specific assigned noise level (35 dBA) would be exceeded up to 1.8km from the boundary of the DCS affecting the proposed Murrumujuk residential community.

2.2 Additional information required by the NT EPA

1. Identify proposed measures to further mitigate operational noise emission exceedances from the Darwin converter site. Discuss the consideration of alternatives (available technologies, best practicable mitigation technology, methods such as underground in proximity to residences) and reasons for either selecting or not selecting the option. If the option is not selected because it was considered not economically feasible, a comparison of the environmental effectiveness of the options must still be included.
2. Provide revised noise model outputs for the Darwin converter site with all proposed mitigation measures in place. Demonstrate compliance with the Northern Territory noise management framework guideline (2018), specifically in relation to the noise-sensitive residential and rural residential land uses identified for the Murrumujuk Township within the proposed updates to the Litchfield Subregional Land Use Plan.
3. Discuss any expected residual significant impacts and proposed management of those.

2.3 Response

Appendix B *Operational Noise Modelling Report* (Hatch 2024) presents an assessment of options available to further mitigate operational noise impacts at the DCS. As background, the role of the DCS in the AAPowerLink is to receive electricity produced at the Powell Creek Solar Precinct and convert it for transmission to customers. The key operational noise sources present at the site are transformer and inverter skids, Voltage Source Converter (VSC) substations and a Battery Energy Storage System (BESS). The *Operational Noise Modelling Report* presents an alternatives assessment and modelling results for the preferred set of best achievable and economically feasible options to mitigate operational noise impacts from the DCS.

Since October 2023 when the last noise modelling report was submitted to the NT EPA, the following changes have been incorporated and evaluated:

- Litchfield Subregional Land Use Plan zoning for the Murrumujuk Township (Northern Territory Government, 2023) has been digitised in GIS and overlaid with noise modelling contours and receptors, allowing the impact assessment to be more refined and targeted (e.g. re-location of infrastructure within the DCS away from sensitive land use zones).
- Analysis includes evaluating potential noise impacts from the DCS and OHTL on rural, peri-urban and urban future land use in the proposed Murrumujuk Township as planned for in the Litchfield Subregional Land Use Plan 2016 (Version 6, March 2023).
- Project scope reduction for certain components within the DCS (e.g., reduced units of equipment), which has provided more flexibility and the ability to apply improved noise controls.
- New technology and emerging Battery Energy Storage System (BESS) noise controls have come to market for consideration.

The sections below summarise the report findings and respond to each of the three items of additional information requested by the NT EPA.

2.3.1 Noise mitigation options

Noise mitigation options for the DCS were identified by considering equipment and infrastructure selection, site configuration and at source mitigation options for individual infrastructure components (noise sources). A project benchmarking exercise and literature review were undertaken to compile best available noise reduction technology information. With this information in hand, subject matter experts (SMEs) and the project team identified nine specific mitigation options for further consideration. The options are detailed in Section 2.1 of the *Operational Noise Modelling Report* and broadly include the following types of measures:

- Shielding or enclosing infrastructure components such as batteries, inverters and transformers (i.e. at source mitigation).
- Reducing the scope of infrastructure components required at the site to the extent possible without jeopardising functionality.
- Reconfiguring the site layout to move noise sources further away from land zoned urban/peri-urban.
- Installation of an absorptive noise barrier along the northern boundary of the property.

As directed by the NT EPA, undergrounding infrastructure was also considered by the project team but was screened out from further analysis due to it being inherently unviable due to the size of the infrastructure, ventilation requirements, and associated earthworks and disturbance involved in undergrounding. If all other mitigation measures failed to reduce noise to an acceptable level, choosing a new site would be considered more viable than undergrounding the infrastructure.

Each of the nine mitigation options was subject to assessment to determine whether it is feasible to implement at the DCS. The relative impacts and benefits of each option were compared using environmental, social, technical, and economic performance criteria. Each criterion was assessed separately and then combined to provide an overall feasibility rating of preferred, acceptable, challenging, or unfeasible. The assessment methodology and criteria used are described in Section 2.2 and 2.3 of the *Operational Noise Modelling Report*.

Table 2 below presents the feasibility ratings assigned for each of the nine mitigation measures. Measures were deemed feasible to implement if they received a performance rating of preferred or acceptable.

Table 2. Feasibility ratings assigned to each potential mitigation measure (adopted from Hatch 2023)

Mitigation measure	Feasibility categories and ratings				Justification for rating	Overall feasibility rating
	Environ	Social	Technical	Economic		
Batteries containerised with Heating, Ventilation, and Air Conditioning (HVAC) silencer (BESS site)	Preferred	Acceptable	Preferred	Acceptable	• achieves a 3dBA noise reduction at source • equipment is industry standard • cost estimate at $3 million is acceptable • neutral environmental impact	**Preferred**
Inverter enclosure in single airconditioned structures (BESS site)	Acceptable	Preferred	Acceptable	Acceptable	• achieves a 7dBA noise reduction at source • enclosures have been commercially demonstrated on other projects but do impact overall efficiency of power conversion system • cost estimate at $3 million is acceptable • neutral environmental impact	**Acceptable**
Transformer enclosure with forced oil and air-cooling (BESS site)	Acceptable	Challenging	Challenging	Challenging	• negligible noise reduction • increased space requirements, reduced cooling efficiency and difficult to maintain • cost estimate at $14.5 million is challenging • neutral environmental impact	**Challenging**
Converter transformer in 4m tall, 3-sided concrete walled bunker	Acceptable	Acceptable	Acceptable	Challenging	• achieves a 2-3dBA noise reduction at source • materials are readily available and maintenance access is retained • cost estimate at $3.4 million per VSC is challenging • concrete has high embodied carbon footprint, but neutral impact for other environmental factors	**Acceptable**
Converter transformer in 7m tall, 3-sided concrete walled bunker	Acceptable	Preferred	Acceptable	Challenging	• achieves a 2-6dBA noise reduction at source • materials are readily available and maintenance access is retained • cost estimate at $5.3 million per VSC is challenging • concrete has high embodied carbon footprint, but neutral impact for other environmental factors	**Acceptable**
Reduced scope - One Voltage Source Converter only	Acceptable	Acceptable	Challenging	Preferred	• achieves a 2-3dBA noise reduction at receptors • reduced scope presents some technical risk at concept design phase limiting export volumes but retains optionality for the primary function of the DCS which is to export power to Singapore	**Acceptable**

Mitigation measure	Feasibility categories and ratings				Justification for rating	Overall feasibility rating
	Environ	Social	Technical	Economic		
					• potential commercial implications to the proponent limiting future flexibility • cost neutral • less materials required and quicker construction reduces carbon footprint • neutral impact for other environmental factors	
Reduced scope - Northern half of the BESS installation removed	Acceptable	Challenging	Unfeasible	Unfeasible	• negligible noise reduction • reduced energy storage risks project viability • significantly reduced cost • less materials reduces carbon footprint • neutral impact for other environmental factors • overall unfavourable cost-benefit analysis	**Unfeasible**
Relocation of VSC south and BESS southwest	Acceptable	Preferred	Acceptable	Preferred	• achieves a 3dBA noise reduction at receptor • no technical impact on system performance • cost neutral • noise sources moved closer to conservation areas to south of site but noise levels unlikely to impact fauna	**Preferred**
12m noise barrier along northern boundary	Challenging	Acceptable	Challenging	Unfeasible	• negligible noise reduction (2-4dBA) • technically difficult to design to withstand cyclones and may trap heat impacting system • increased construction time (~6 months) • cost estimate at $72-146 million (depending on materials used) is significant • increased environmental impact through alteration of surface flows and wildlife movement • potential adverse impacts on visual amenity • overall unfavourable cost-benefit analysis	**Unfeasible**

2.3.1 Effectiveness of mitigation options

Predictive noise modelling was undertaken to evaluate the effectiveness of the mitigation options. The sections below summarise the approach and noise model outputs.

Noise modelling approach

The noise modelling approach is detailed in Section 2.5 of the *Operational Noise Modelling Report.* Eight modelling scenarios were developed adopting the mitigation options in various site and project configurations. To provide transparent assessment of the environmental benefits of each mitigation measure, the modelling scenarios considered all measures, including those that were deemed unfeasible to implement for technical and/or economic reasons. The modelled scenarios are described in Table 3 below.

Table 3. Noise modelling scenarios

Scenario	Description
Scenario 1	Existing site layout and components with targeted (at source) mitigation.
Scenario 2	Reduced scope to 1 VSC[1]; no targeted mitigation on site components.
Scenario 3a	Reduced scope to 1 VSC (per scenario 2) + targeted mitigation on site components
Scenario 3b	Per scenario 3a + additional targeted mitigation on site components.
Scenario 4a	Reduced scope to one VSC + targeted mitigation on site components (per scenario 3b) + equipment relocation + 12m tall noise barrier
Scenario 4b	Per scenario 4a but excluding the 12m tall x 2.9km noise barrier
Scenario 5a	Reduced scope to 1 VSC + reduced BESS capacity + equipment relocation + 12m tall x 2.9km noise barrier
Scenario 5b	Per scenario 5a but excluding the 12m tall x 2.9km long noise barrier

The modelled noise levels for each scenario were assessed for compliance with the *Northern Territory Noise Management Framework Guideline (2018)* (the Guideline). Project Specific Assigned Noise Levels were determined in accordance with the Guideline for both the existing land use (rural) and proposed future land use (urban residential) at Murrumujuk. Details of the approach and methods used are provided in Section 3.1 of the *Operational Noise Modelling Report*. The Project Specific Assigned Noise Levels adopted in the assessment are:

- 35 dBA, which is consistent with the existing 'Rural' residential night-time limit.
- 40 dBA, which is consistent with a future 'Urban' (not rural) residential night-time limit.

The report presents an assessment against both the 'Rural' and 'Urban' noise limits; however, the 'Urban' (40dBA) limit is considered most relevant as it is more representative of the future conditions for the purpose of assessing impacts to urban/peri-urban land uses.

Noise levels were assessed at three indicative urban residential receptor locations within urban/per-urban zoned land in the proposed future Murrumujuk Township as identified in the *Litchfield Subregional Land Use Plan 2016* (Version 6, March 2023). The receptors referred to as Point of Receptor (POR) 128 and POR129 are consistent with the October 2023 noise assessment report[2]. Location POR 129b was added as a more accurate representation of a potential sensitive receiver than POR 129 (as the location for POR 129 falls within a proposed main road within the Litchfield Subregional Land Use Plan). Receptor locations are to the northwest

[1] The DCS concept design presented in the Draft EIS was provisioned with 4 VSC's to accommodate conversion and transmission to Singapore initially, with the option to supply Darwin in the future. As the project design has matured it has been determined that the DCS will now only be required to accommodate transmission of electricity to Singapore and as a result a single (sending) VSC could be considered for the site, albeit noting technical constraints of this arrangement. Infrastructure required to transmit electricity within the Darwin region is outside the scope of the AAPowerLink EIS.

[2] Note the receptor numbers are in the hundreds because they are part of the broader list of receptors considered in the noise impact assessment undertaken for the whole project from the Powell Creek Solar Precinct and along the OHTL from Powell Creek to Murrumujuk.

and east of the DCS and were selected with the intention to span the breadth of the entire DCS facility from one end to the other, and to capture potential noise impacts from the key noise sources which are the VSC equipment located on the west of the site and the BESS located on the east. The receptor locations are shown on Figure 1.

We note that a sensitive receptor location was not placed in 'potential rural residential' zoned land shown in *Litchfield Subregional Land Use Plan 2016* (Version 6, March 2023) immediately to the south of the DCS. The DCS noise assessment has focussed on minimising noise as far as practicable to not significantly constrain future urban/peri-urban land use to the north and east. Noise levels have however been modelled over the 'potential rural residential' zoned land and are presented and discussed in Section 2.3.2 below.

Noise model outputs

Modelling results for all eight scenarios at sensitive receptor locations POR 128 and POR 129b are presented in Table 4 below. Results for POR 129 are not presented in Table 4 because POR 129b is most relevant; however, results for POR 129 are presented in the Operational Noise Modelling Report for reference.

Scenario 1, 2, 3A, and 3B resulted in exceedance of the existing 'Rural' noise limit (35 dBA) by 3-10 dBA and the future 'Urban' noise limit (40 dBA) by 1-5 dBA.

Scenarios 4A, 4B, 5A and 5B resulted in compliance of both the existing 'Rural' noise limit (35 dBA) and the 'Urban' noise limit (40 dBA).

Table 4. Operational noise levels compliance (Source: Hatch 2024)

Receptor	Predicted noise levels (dBA) for noise modelling scenarios (see Table 3)							
	1	2	3A	3B	4A	4B	5A	5B
POR128	42	41	40	38	32	34	30	33
POR129b	45	45	42	42	31	35	30	35
Compliant with 'Urban' noise limit 40dBA	No	No	No	No	Yes	Yes	Yes	Yes
Compliant with 'Rural' noise limit 35dBA	No	No	No	No	Yes	Yes	Yes	Yes

The overall cost-benefit and acceptability of each mitigation scenario was considered in view of the noise options assessment and noise model outputs. The conclusions are summarised below for each scenario:

- **Scenario 1** represents SunCable's original concept for the site but with additional noise mitigation in place. This scenario is feasible and most preferred from a project perspective because it provides optionality moving towards more detailed design. However, it also has the highest level of potential impact in terms of encroaching on the future urban/peri-urban land use zone. For this scenario to comply with the *NT Noise Guideline* it would require changes to the future land use plan to provide for a buffer between the site and future residential land uses.
- **Scenario 2, 3A and 3B** are feasible to implement but are not preferred because they involve a significant reduction in the scope of the DCS infrastructure. The level of noise reduction achieved is limited and there will still be substantial encroachment on the future urban/peri-urban land use zone.
- **Scenario 4A** achieves a low level of encroachment on the future urban/peri-urban land use zone but is not considered feasible to implement. This scenario includes an absorptive noise barrier along the northern boundary of the site, which is considered too technically challenging and costly to implement, for the commensurate 2-4 dBA reduction in noise levels.
- **Scenario 4B** presents the best option for both feasibility and minimising encroachment on the future urban/peri-urban land use zone. While less preferred for the project than Scenario 1, it could meet the minimum requirements for the DCS and can be prosecuted to address the NT Governments concerns about encroaching on the future urban/peri-urban land use zone.

- **Scenario 5A and 5B** result in minimal encroachment on the future urban/peri-urban land use zone but are not considered feasible to implement. Both scenarios include reducing the BESS capacity which has minimal impact on noise levels (1-2 dBA) but presents a significant risk that the energy storage capacity would not be sufficient to ensure a reliable and stable transmission system operation. Scenario 5A also includes an absorptive noise barrier along the northern boundary of the site, which is considered too technically challenging and costly to implement, for the commensurate 2-4 dBA reduction in noise levels.

The *Operational Noise Modelling Report* present results discussion and noise contour figures for each of the assessed scenarios. As detailed in Section 3.5.1.1 of the report, all scenarios excepting scenario 1, achieve a substantial reduction in noise from the DCS compared to the noise levels modelled in the October 2023 noise report. This reduction has been achieved by facilitating a deeper understanding of noise sources and available at source mitigation options, relocation of noise sources as far away as practicable from the sensitive urban/per-urban land use zones to the north and reducing the scope of the infrastructure at the site to the extent practicable without jeopardizing functionality. Residual impacts are discussed below considering implementation of scenario 4B, which is determined to be the best option for both feasibility and achieving the lowest level of encroachment on urban/peri-urban land use zones in the future Murrumujuk Township.

2.3.2 Residual impacts – mitigation scenario 4B

The modelling results for Scenario 4B indicate noise impacts from the DCS can be almost fully mitigated. Scenario 4B contains only one sending VSC shifted approximately 200 m south from the original location designated in the concept design. The BESS is shifted approximately 400 m west and 90 m south to tie into the relocated VSC. At source mitigation (enclosures/shielding) is placed on the inverters, battery, and transformer skids. In addition, a 7m tall 3-sided concrete/brick walled bunker is added to the VSC transformers and step-up transformer. With these mitigation measures in place the noise model outputs show very marginal exceedances of the 'Urban' and 'Rural' noise levels over the future urban/peri-urban land use zones.

As Figure 1 shows, considering the 'Rural' (35 dBA) noise limit, increased noise levels are predicted to extend locally from the DCS property boundary for approximately 730 m to the north, 155 m to the east, 990 m to the south and 815 m to the west until the 35 dBA limit is met. The affected area is almost halved when considering the 'Urban' 40 dBA limit; the impact extends locally for 450 m to the north, 590 m to the south, and 325 m to the west, , with no impacts to the east of the site – see Figure 1. Table 5 summarises the area of the 'urban/peri-urban' residential land use zone and 'potential rural residential' land use zone potentially affected by noise levels that exceed the noise limits set in accordance with the *NT Noise Guidelines*.

Table 5. Percentage of land use zone affected by increased noise levels (Source: Hatch 2024)

Future land use zone	Percentage of land use zone affected	
	Rural 35dBA level	Urban 40dBA limit
Urban/ peri-urban	4.5%	0.5%
Potential rural residential	35.8%	28.0%

718000 720000 722000 724000 726000 728000

8646000 8644000 8642000 8640000

1378
2727
2626
2203
POR128
Gunn Point Prison Farm Access
Gunn Point
Leaders Creek Boat Ramp Access
Murrumujuk Drive
450m
730m
POR129b
POR129
815m
325m
Track
590m
990m
Darwin Converter Site (DCS)
Tree Point Access
4476
6166
3101
6166
5911
3104
5911
155m
1:6,000
Gunn Point Road

Darwin
Main Map
700 km
Adelaide River
600 km
Pine Creek
500 km
Katherine
400 km
1
1
300 km
200 km
80
87
100 km
Elliott
96
0 km

- Sensitive Receptor

Project Specific Assigned Noise Level
- 35 dBA
- 40 dBA
- 45 dBA
- Populated Place
- AAPowerLink Infrastucture
- Road
- Land Parcel

Proposed Draft Concept Plan for Murrumujuk Township[4]
- Urban/Peri-urban
- Potential Rural Residential in Response to Biting Insects
- Rural Area
- Potential Sites for Tourism Development
- Potential Managed Waterbody

Recreation
- Open Space/Natural Area

Infrastructure
- Planned Rail
- Proposed Main Road
- Utility Corridor

Other
- Conservation
- Future Development
- Strategic Industry
- Agriculture/Grazing

NOTES:
1. Contains information under the Creative Commons Attribution 4.0 International Licence (CC BY 4.0).
2. Projection: GDA2020 MGA Zone 52
3. Imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.
4. Digitized from Figures 4 and 9 in the Proposed Updates to Litchfield Subregional Land Use Plan - Gunn Point Peninsula, July 2020 (https://planningcommission.nt.gov.au/__data/assets/pdf_file/0006/909996/LSLUP-2020-V2_1.pdf)

0 0.5 1 2 Kilometres

1:30,000

NORTH

Figure 1
Sun Cable
Australia-Asia PowerLink Project

Scenario 4B - DCS Operational Night-time Modelled Noise Levels (Dry Season) with Proposed Murrumujuk Township Land Use

suncable

HATCH

File: SUN-NOI-044

2.3.3 Management of residual impacts

The *Operational Noise Modelling Report* demonstrates that there are a range of feasible mitigation options that can be adopted to minimise operational noise impacts from the DCS. It is noted that the noise assessment is based on several conservative modelling assumptions, which when refined through the detailed design phase, would be expected to decrease predicted noise levels. SunCable is committed to ongoing evaluation of all options and implementing the mitigation hierarchy through detailed design with the objective of minimising encroachment on the future urban/peri-urban land use zones as far as practicable while still maintaining the functionality of the DCS.

The modelling results indicate there could be exceedance of noise limits for urban residential land uses on a very small portion of the future urban/peri-urban land use zones to the north and east of the DCS, and on a larger portion of the 'potential rural residential' zoned land to the south. As the area of land potentially affected constitutes a small portion of the land available for future urban/peri-urban uses, any residual exceedance of the noise limits can be managed by maintaining buffer zones between the DCS and surrounding land use.

SunCable is committed to working with the NT Government to ensure that the operation of the DCS does not significantly reduce the area of land available for future urban/peri-urban land uses at the Murrumujuk Township. As the DCS is planned to be developed many years before the Murrumujuk Township, residual noise impacts will be well understood before any residential land uses are present in the area and therefore, residual impacts can be adaptively managed through the strategic planning and development assessment processes under the *Planning Act 1999*.

2.3.4 Significance of residual impacts

The significance of residual impacts from operational noise emissions at the DCS was assessed using the impact assessment framework described in Chapter 4 of the Draft EIS. As per the *Environment Protection Act 2019*, the framework considers the context and intensity of the impact, the sensitivity, value and quality of the environment impacted on, and the duration, magnitude and geographic extent of the impact.

When adopting the 'Urban' 40 dBA noise limit, which best represents future conditions, the residual impacts from mitigation scenarios 1 and 2 were rated as **Moderate**, and for all other scenarios were rated as **Minor**. These ratings indicate that the impact of the DCS operations on future urban/peri-urban land uses, under any of the mitigation scenarios, are unlikely constitute a significant impact according to the definition provided under NT *Environment Protection Act 2019*. Minor to moderate residual impacts can be managed and it is expected that the NT EPA's objective for the community and economy factor will be met, particularly when the residual impacts are balanced against the significant carbon reduction opportunities and future economic development opportunities the AAPowerLink Project itself represents and will induce in the region.

3 TERRESTRIAL ECOSYSTEMS – GHOST BAT

3.1 Context provided by the NT EPA

Although additional information has been provided, uncertainty regarding the potentially significant impacts to Ghost bats associated with the proposed action remain.

The proponent:

- did not provide avoidance/ mitigation approaches nor any substantial discussion about the effectiveness and confidence in the measures and any residual significant impacts as per item 8(4) of the NT EPA's Direction.
- has not demonstrated how the precautionary principle was applied (as per item 8(5) of the NT EPA's Direction).
- has not adequately demonstrated that the OHTL alignment will not have unacceptable impacts on the globally-important Kohinoor Adit specifically, and on Ghost Bats in both the Pine Creek and Katherine regions more generally.

3.2 Additional information required by the NT EPA

1. Taking into account confidential information provided by DEPWS Flora and Fauna Division, identify and assess avoidance and mitigation measures for significant impact on Ghost bats from:

   - OHTL operational noise
   - risk of collision with powerlines
   - static magnetic field and/or static electric field that will be emitted by the OHTL
   - all of the above combined / cumulative impacts.

   Avoidance by relocation of the OHTL further away from the Kohinoor Adit must be considered and discussed. Include discussion about the effectiveness and confidence in the measures.

2. Compare the selected measures and alternatives and provide reasons for selecting or not selecting each. If an option is not selected because it was considered not economically feasible, a comparison of the environmental effectiveness of the options must still be included.

3. Demonstrate how the environment protection and management measures (Part 2 of the EP Act – including the precautionary principle) have been applied. Include an evaluation of how serious or irreversible harm to Ghost Bats has been avoided to the maximum extent practicable. Provide an assessment of the risk weighted consequences of various management options.

4. Discuss any expected potentially significant residual impacts and proposed offsets.

3.3 Response

SunCable is committed to identifying an OHTL route that minimises impacts to environmental, cultural and heritage values, landowners, and the community. As the AAPowerLink progresses through detailed design, land tenure negotiations and regulatory approvals, deviations and refinements to the OHTL route will need to be considered to respond to newly identified constraints. The SEIS Chapter 2 Section 2.8 presents a qualitative assessment approach that is used by SunCable to assess project alternatives against environmental, social, technical and economic performance objectives. The approach was used in the SEIS to consider a range of project alternatives and has been used again here to consider alternative OHTL routes around Pine Creek with the objective of relocating further away from the Kohinoor adit and avoiding and mitigating impacts to the Ghost Bat more generally.

3.3.1 Background on current preferred OHTL route

The current preferred OHTL route through Pine Creek was selected using the approach described above. Alternative routes were considered as described in SEIS Chapter 2 Project Refinements. The preferred route was selected as it aligns with the existing rail and road corridors. Co-location with existing linear infrastructure is considered good practice for minimising the area of land disturbance and impacts to affected landholders, and also avoids areas of higher topographic relief further to the west and drainage systems further to the east through the Pine Creek region.

The current preferred route is located approximately 395 m from the Kohinoor adit on the eastern side of the Stuart Highway. The assessment of that route presented in the *'Response to NT EPA Direction to provide additional information*' (3 November 2023) considered potential impacts to the Ghost Bat from noise affecting bats using the adit, direct collision with powerlines and any Electric and Magnetic Field (EMF). The assessment referenced the best publicly available scientific data and concluded that the OHTL is unlikely to have a significant impact on the Kohinoor adit directly, or on bats flying to and from the adit. However, the recent direction received from the NT EPA (on the advice received from the Department of Environment, Parks and Water Security (DEPWS) and Ghost Bat expert) forms a view that there is not enough known about the threat to Ghost Bats from transmission lines to be confident that significant impacts are unlikely.

3.3.2 Alternatives assessment

SunCable has adopted the precautionary principle in consideration alternative routes through the Pine Creek region to decrease the likelihood of impacts on Ghost Bats. Appendix C documents the Pine Creek OHTL route alternatives assessment that was undertaken in response to the concerns raised. The objective of the alternatives assessment was to identify a preferred route that balances the need to adopt the precautionary principle with respect to protecting important habitats for the Ghost Bat, with the need to also avoid and minimise the impact of the OHTL on affected landowners and other environmental factors.

As directed by the NT EPA, SunCable has identified and assessed alternative routes that would allow for the OHTL to be relocated further away from the Kohinoor adit, which is the most important roost site for the Ghost Bat across its entire range. The alternatives assessment also considered:

- proximity to other Ghost Bat sites identified in the confidential information provided by the DEPWS
- impacts on landowners and other land uses, such as Minerals Titles
- technical constraints associated with topography and hydrology
- cost to implement
- impacts on other environment and heritage values as described in the desktop assessment attached at Appendix D.

The routes considered are shown on Figure 2 and are located between approximately 4 km and 13 km from the Kohinoor adit with options both to the east and west of the existing route and Pine Creek. Routes further away were not identified as they were considered by the project team to present a very high level of project risk due to those areas having not been surveyed, and there being no engagement with landholders and other stakeholders in those areas to date. Further, the best available data in relation to Ghost Bat movements provided in DEPWS (2023) indicates that while the bats do fly long distances, most movements are within 10 km from the roost (as further discussed below), and therefore this distance was considered to provide a precautionary approach to minimising the potential for impacts.

Routes C and E to the west of Pine Creek, while achieving a greater level of separation from the Kohinoor adit (up to 13 km), are considered challenging because they are constrained by topography, have a higher potential for encountering sacred sites and archaeological heritage sites associated with hilly terrain, and landowners in this area have not been engaged as their properties are not affected by the existing preferred route. For these reasons the routes to the west are not preferred by SunCable.

Route H, 4 km to the east of the adit, was initially identified as SunCable's preferred alternative. This route achieves a greater separation from the adit than the current preferred route, limits impact on landowners to the greatest extent practicable and does not impact other known environmental or heritage values. However, early feedback received from the DEPWS on this route indicated that the separation distance achieved from

the Kohinoor adit is unlikely to satisfactorily address their concerns because Ghost Bats in the region have been recorded travelling significant distances from roost sites to forage. Limited data available from a recent study near Katherine (DEPWS unpublished) recorded a maximum nightly travel distance from the roost of 23 km, with 90% of all location records recorded within approximately 10.3 km from the roost. While the limitations of the data are acknowledged, they are the best available and therefore were used to further refine the route selection, targeting a route that limits impact to foraging areas within approximately 10 km from the Kohinoor adit.

Route D2 was selected as the most 'acceptable' alternative route. This route departs the railway corridor south of Pine Creek, traversing east/north-east across predominately pastoral land to provide an 8-10 km buffer to the Kohinoor adit, before rejoining the railway corridor. The aim of this route was to avoid disturbance within 10 km of the roost based on the above-mentioned data that suggests this is where most Ghost Bat foraging occurs. Total avoidance was not able to be achieved without crossing an additional property and therefore the route skirts around the edge of property boundaries attempting to achieve a balance between limiting the number of landholders affected, limiting impacts on affected landowners, and maximising the distance of the OHTL from the Kohinoor adit. The desktop assessment presented at Appendix D indicates that this route does not intersect any known environmental or heritage values, and therefore is unlikely to increase the level of impact when compared to the existing preferred route put forward and assessed in the SEIS.

In presenting this alternative route for the purpose of minimising impacts to the Ghost Bat it is acknowledged that the final alignment of the OHTL route is subject to agreement with landholders and other stakeholders. This situation applies along the length of the proposed OHTL. Negotiations are underway and through this process there is potential that realignments will be needed in some areas to achieve a route that is acceptable to all parties. Should realignments be needed, SunCable is committed to ensuring there is no increase in the level of impact to the Ghost Bat or other environmental factors, and it is understood that any changes could trigger further assessment under the NT EP Act.

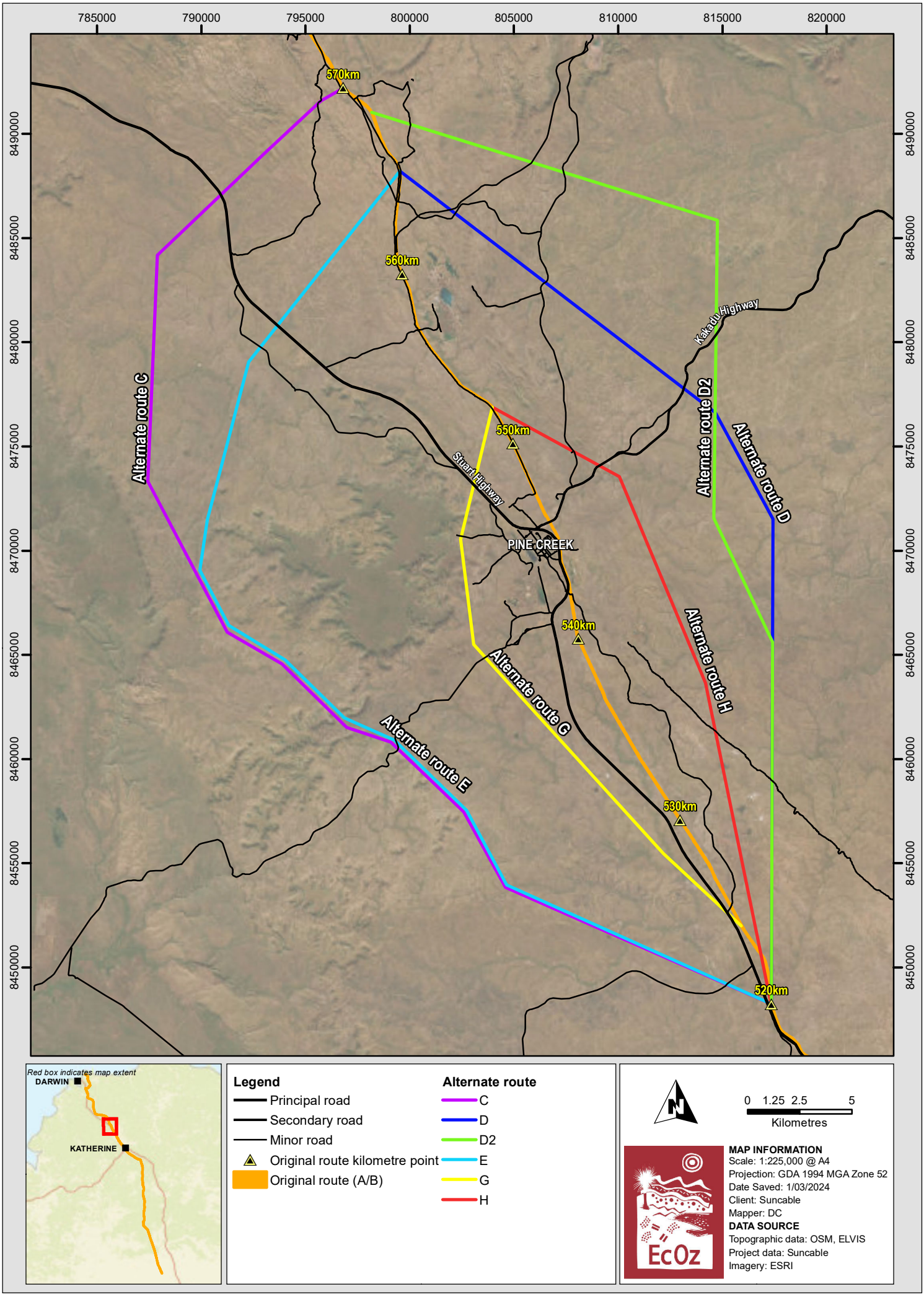

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Figure 2. Alternative OHTL routes assessed to avoid potential impacts to Ghost Bats

3.3.3 Avoiding potential impacts

This section examines the potential impacts to Ghost Bats and explains how re-routing the OHTL to Route D2 further decreases the likelihood of there being a significant impact to the species. The response proposed by SunCable is based on the premise that significant impacts can be avoided by a combination of:

- **Limiting impacts on foraging habitats around the Kohinoor adit complex, which is a very significant roost site for the species and supports most bats within the important Pine Creek sub-population.**

DEPWS (2023) states that the population of the Kohinoor adit fluctuates from 350-1,500 individuals within a year, with the most recent count in May 2023 recording 1,460 individuals. The available regional population estimate from 2008 is 570-1,132 individuals (Barden and Armstrong 2019), although it is evident from the Kohinoor adit estimates that the regional population is larger than this count indicates. Irrespective of the regional population size, it is widely accepted that the Kohinoor adit is the most important roost site for the species and therefore warrants a high level of protection. The alternate OHTL route has been moved away from the Kohinoor adit and is now 8 km away at its closest point.

- **Maintaining connectivity between the Kohinoor adit and other important roosts in the Pine Creek region.**

(DEPWS 2024) presents locations of all known roosts in the Pine Creek region with a qualitative assessment of roost 'significance'. The data provided indicates there are three sites in the region rated as 'high' significance: Kohinoor, Spring Hill adit complex and Bean's Tin Mine. There are seven sites in the region rated as 'moderate' significance: Teachers' adit, North Point complex, Unions Reef complex, Union Extended Chinese Shaft, Mount Wells complex, Wild Bull, Umbrawarra Gorge. The alternate OHTL route maintains a high level of connectivity with the Kohinoor adit as it traverses to the east of all but two of these roosts; only the Mount Wells complex and Wild Bull roost lie to the east of the OHTL.

The OHTL route has not been changed in the Katherine region. This decision has been made because the focus of the NT EPA's Direction, and previous advice received from DEPWS over the past two years, is on the need to protect the Kohinoor adit due to the significance of that site. A deviation of the OHTL through the Katherine region presents significant challenges and risks to the project for the following reasons:

- The route cannot be moved to the east because of the presence of Tindal airbase and Katherine township.
- Movement of the route to the west would require a significant deviation to avoid the Kintore Caves Conservation Reserve.
- Many landholders would be affected by any changes to the route through the Katherine region due to the number of smaller land holdings. Deviating the route through many properties that have not been engaged at all through the route selection process to date presents a significant risk to the project.

In relation to the potential for the OHTL to impact Ghost Bats in the Katherine region, three observations are made from the data provided in DEWPS (2023):

1. The closest the route traverses to important roost sites for that sub-population is more than 4 km for Kintore Cave and more than 14 km for Tindal and Cutta Cutta Caves.
2. The extent to which bats fly between the roost sites in the region is unknown. There is currently no evidence of interchange between roosts at Cutta Cutta Caves Nature Park and Kintore Caves Conservation Reserve/Charle's Darwin University's Katherine Campus. However, the available data is limited.
3. Radio-tracked Ghost Bats from Kintore Cave have shown a preference for foraging in areas that are in opposite directions of the roost site from the proposed OHTL route (i.e. to the west).
4. Radio-tracked Ghost Bats from Tindal and Cutta Cutta Caves have shown a preference for foraging in cleared areas near to the roost and to the east of the OHTL route.

5. Notwithstanding, the above preferences, there are records of Ghost Bats from the Kintore Cave adit using areas proximate to the OHTL route, and in the case of the Tindal and Cutta Cutta Caves roosts, there are records of Ghost Bats using areas proximate to and to the west of the OHTL route.

Again, whilst the limitations of the data provided by DEPWS (2023) are noted, they are the best available and have informed the above decision.

The sections below further discuss specific impacts raised in the NT EPA direction and address how the alternate route D2 avoids and minimises these impacts to the important population of Ghost Bats in the Pine Creek region.

3.3.4 Electric and magnetic fields (EMF)

The OHTL will emit static electric fields and static magnetic fields (SEF and SMF). It was acknowledged in the *'Response to NT EPA Direction to provide additional information'* (3 November 2023) that EMF could have an impact on Ghost Bats; however, based on studies undertaken on other mammal species it was reasoned that any effect is unlikely to be significant. The submission from DEPWS focussed on concerns that EMF from the OHTL may cause harm to Ghost Bats (particularly from SEF) and that it may deter Ghost Bats from crossing the OHTL, thereby creating a barrier to foraging habitat and local movements between roosts within the relevant sub-populations. While there are no specific studies that indicate EMF will impact on Ghost Bats, equally there is insufficient evidence to be confident it will not.

Isolation of foraging habitats

As directed, SunCable has moved the OHTL further away from the Kohinoor adit. The alternative route (D2) increases the distance between the OHTL and the Kohinoor adit complex from 395 m at its closest point, to 8,015 m at its closest point (see Figure 2). This route deviation also increases the distance between the OHTL route and the Union Reef adit complex from 1,410 m at its nearest point to 6,380 m. The distance between route D2 and the other important roost complex in the region, Spring Hill, remains the same as the previous route at 1,041 m.

As detailed in Section 3.3.2 above, SunCable chose the proposed deviation route not only in consideration of the impact on Ghost Bats, but also weighing up the environmental, economic, heritage and social implications associated with alternative deviation routes. The OHTL route will continue to pass the Spring Hill adit complex at 1,041 m at its closest point. The surrounding topography is either riverine or very rugged (the route runs through a valley). The significant increase in the cost and project risks – as well as environmental impacts – precludes the viability of moving the OHTL route further away from the Spring Hill adit complex.

The key benefit of the alternate OHTL route D2 is that the proportion of potential foraging habitat in the vicinity of the Kohinoor adit complex that would be alienated if EMF does present a barrier to movement of Ghost Bats is significantly reduced. Based on the data presented in DEPWS (2023), to quantify the area of foraging habitat potentially impacted, it has been assumed that:

- Most foraging occurs within approximately 10 km from the roost site. This is based on 90% of location records from the recent Katherine study being within 10.3 km of the roost[3].
- Ghost Bats forage in all directions from the roost.

Assuming that foraging mainly occurs within a 10 km radius circle centred on Kohinoor adit complex, the location of the alternative route D2 could isolate up to 3.3 % of the main foraging area. This is significantly less than the previously preferred route, which could isolate 48.4 % of the main foraging area. The location of both the existing preferred route and alternate route D2 in relation to the main foraging area around the adit are shown in Figure 3.

When considering the potential for significant impact, it is important context that both the SMF and SEF that the OHTL will emit are very localised and attenuate rapidly to background levels within 200 m from the powerlines. Studies of impacts on other mammal species (referenced in the previous information provided in November 2023) indicate that individual Ghost Bats flying close to the wires may be disorientated or feel some

[3] It is noted that this is based on data from a limited sampling size and time duration. However, it is also the best available information.

discomfort, but it is not known whether that reaction will prevent individuals from crossing the OHTL. Nevertheless, it is SunCable's contention that because Ghost Bats have a broad carnivorous diet, no critical foraging habitat has been identified, and recent DEPWS studies show that Ghost Bats disperse significant distance from roosts to forage in all directions – the alternative route D2 makes available large areas of foraging habitat without the need for bats to cross the OHTL.

Connectivity between roosts

The alternate route D2 also minimises potential impacts due to loss of connectivity between roosts. The OHTL route is now east of all the 'high' significance roosts and is also to the east of five out of the seven 'moderate' significance roosts, and therefore will not limit movement of Ghost Bats between these roosts. The only roosts to the west of the OHTL route are the Mount Wells complex and Wild Bull complex.

Using the above reasoning, the potential for a significant impact due to EMF is therefore considered to be low. The OHTL will have minimal impact on foraging habitats around the Kohinoor adit roost site and will not limit movement of Ghost Bats between the most important roost sites in the region.

Collision

It is acknowledged that Ghost Bats are known to collide with barbed wire fences (in which the wires are a few centimetres apart). Barbed wire fences will not be used along the OHTL. As presented in previous information submitted to the NT EPA, SunCable considers that the risk of Ghost Bats colliding with larger conductor cables that are 10 m apart is inherently low. This risk is further reduced now that the OHTL has been moved a significant distance further away from the most significant roost site in the region. Nevertheless, as per recommendations in Bat Call WA (2022), in the vicinity of the nearest significant roost site – Spring Hill adit complex – SunCable maintains the commitment made in the SEIS to apply a visual cue such as white bunting on OHTL conductors.

Noise (operations)

Noise modelling presented in *'Response to NT EPA Direction to provide additional information'* (3 November 2023) showed that at the powerlines, the sound pressure will be approximately 50 db. This is equivalent to the volume of noise in a quiet office or during moderate rainfall. With the re-routing of the OHTL, that already low noise level will be now many kilometres away and will occur in an area where there are no other unnatural noise sources (e.g. roads, railway lines). In that context, it is very likely that the impacts on Ghost Bats of noise or vibration from the operation of the OHTL will be negligible. Nevertheless, to further minimise the likelihood of impacts to breeding Ghost Bats in the vicinity of the nearest significant roost site – Spring Hill adit complex – construction will not be undertaken during Ghost Bat breeding season.

Cumulative

Based on the arguments presented above – whereby impacts from noise or collision are now negligible – the potential for cumulative impacts to Ghost Bats from noise, collisions and EMF associated with the OHTL is very low.

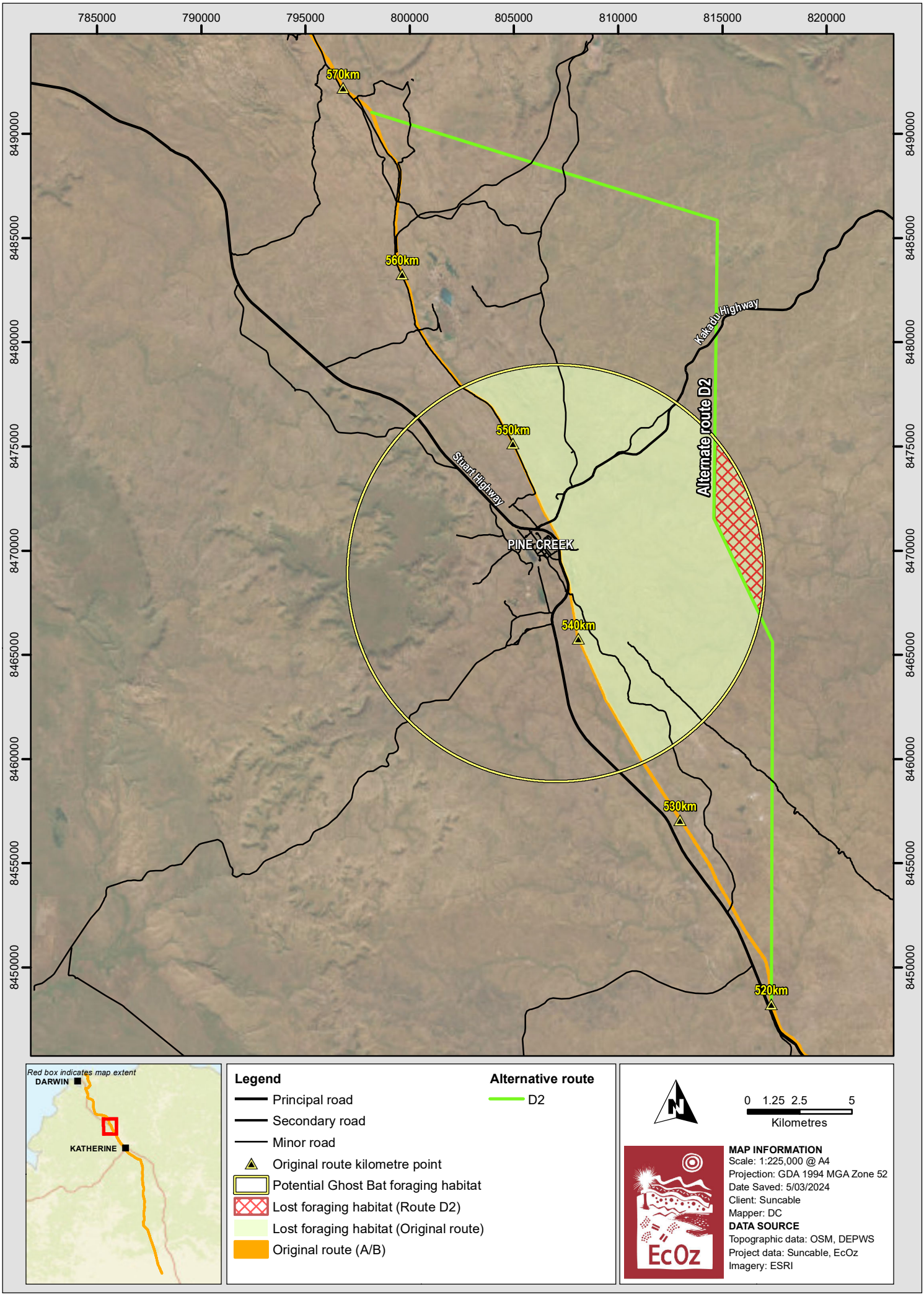

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Figure 3. Map of potentially impacted Ghost Bat foraging habitat

3.3.5 Application of the precautionary principle

Given uncertainty as to whether, and to what degree, EMF influences Ghost Bat movements, SunCable has applied the precautionary principle as per Section 19 of the *EP Act*. Specifically, by re-locating the OHTL route away from the most important roost site for the Ghost Bat (the Kohinoor adit) to a distance that indicates it is unlikely that EMF effects, if they did occur, would result in a significant impact. SunCable undertook:

1. A careful evaluation to avoid serious or irreversible damage to the environment – as per section 19(1) of the Act.
2. Assessment of the risk-weighted consequences of various options – as per section 19(2) of the Act, as summarised in Section 3.3.2 above.

In addition, section 20 of the Act requires that decisions should be based on the best available evidence in the circumstances that is relevant and reliable. This principle has been followed using the unpublished DEPWS bat survey data to guide the re-routing of the OHTL. It is noted that compared to previous studies this data indicates that long distances are regularly flown by Ghost Bats and that home ranges and movements are substantially larger. Using the DEPWS data supports a precautionary approach to decision-making about the separation distance required from the Kohinoor adit and provides a level of confidence that significant and irreversible impacts will be avoided.

Finally, section 26 of the Act requires that proponents follow the environmental decision-making hierarchy relating to first avoid, then minimise impact before considering and offsets as a last resort. The points below summarise how rerouting the OHTL to alternate route D2, avoids and minimises impacts:

- Route D2 entirely avoids impacts from operational noise on all Ghost Bat roost sites, as the distances are such that noise levels will not be altered by the presence of the OHTL.
- Route D2 minimises the potential for EMF to interrupt foraging activities by significantly increasing the separation distance between the Kohinoor adit and the OHTL. The route traverses 8-10 km from the Kohinoor adit therefore limiting the area of foraging habitat that would be isolated from bats using the adit if EMF does present a barrier to movement.
- Route D2 minimises the potential for EMF to interrupt movement between the Kohinoor adit and the other important adits at Union Reefs and Spring Hill by traversing to the east of all three adits.
- Route D2 minimises risks of Ghost Bats colliding with the conductors as the nearest roost (in the Spring Hill adit complex) is at least 1 km way from the OHTL. To further minimise potential for collision with the conductors, SunCable maintains the commitment made in the SEIS to apply a visual cue such as white bunting on the conductors near the Spring Hill adit complex.

3.3.6 Significance of residual impacts

Taking into account all of the information presented in the draft EIS, SEIS, the *'Response to NT EPA Direction to provide additional information'* (3 November 2023) and this report, Table 6 presents an assessment as to whether project activities are likely to have a significant impact upon the Ghost Bat. The focus is on the Pine Creek sub-population of Ghost Bats because the OHTL does not pass close any important roost sites of the Katherine or Adelaide River sub-populations. The distance between the OHTL and the most important roost sites in the region, and the mitigations proposed, mean that impacts to this species associated with the Project are unlikely to constitute a significant impact.

SunCable notes that it is uncertain whether EMF impacts bats in general, and Ghost Bats specifically. In the case of the AAPowerLink Project the precautionary principle has been applied with a focus on maintaining the value of the Kohinoor adit roost. However, it is also acknowledged that the OHTL does still traverse through other areas in the Pine Creek and Katherine region where Ghost Bats have been recorded. To improve our understanding of whether the OHTL presents a barrier to Ghost Bat movements SunCable proposes implementing a monitoring program to study interactions. The results of the monitoring program will contribute to understanding of threats to the Ghost Bat and to other bat species from energy infrastructure projects.

Table 6. Significant impact assessment table for the Ghost Bat

Criterion	Summary of mitigation measures and significant impact assessment
Lead to a long-term decrease in the size of an important population	The Pine Creek sub-population of Ghost Bats is an important population; the Kohinoor adit complex supports most bats within the sub-population, and therefore the avoidance of impacts to the bats that roost within the Kohinoor adit complex – and maintaining connectivity between other important roosts – equates to an avoidance of impacts to an important population of the Ghost Bat. Given the mobile nature of this species – and the fact that barbed wire will not be used – there is unlikely to be any direct mortality of individual Ghost Bats, including because of interactions with construction machinery. Moreover, the small size and the agility of this species reduces the likelihood of negative interactions with powerlines that are 16 m off the ground at the lowest point and spaced 10 m apart. The likelihood is further reduced now that the OHTL is at least 8 km from the Kohinoor adit at the closest point. Nevertheless, to minimise the chances of Ghost Bats colliding with powerlines, in the vicinity of the nearest significant roost site – Spring Hill adit complex – SunCable maintains the commitment made in the SEIS to apply a visual cue such as white bunting on OHTL wires.
Reduce the Area of Occupancy (AOO) of an important population	The AOO of the Ghost Bat is estimated to be <10 km^2. However, this is limited to roost sites (Woinarski et al. 2014). Applying the controls described above, development of the Project is unlikely to lead to a loss in any roost sites. If foraging habitat was included in the AOO, it would be many orders of magnitude larger. The loss of some of that habitat cannot be avoided. Under the grid cell method, the only way that a habitat loss can lead to a reduced AOO is if it is entirely confined to within the OHTL footprint. In other words, if the Ghost Bat foraging resources lost constitute the entire local occurrence of those resources, and there are no other nearby occurrences, then this could lead to a reduced AOO. However, because Ghost Bats foraging habitat options are widespread in the region, habitat is not restricted to the OHTL footprint. Therefore, its loss will not result in a reduced AOO.
Fragment an existing important population into two or more populations	Even if the EMF from the OHTL creates a barrier for movement of Ghost Bats, the OHTL route is now east of all 'high' significance roost sites and most 'moderate' significance roost sites used by the Pine Creek sub-population. There are only two moderate significance roost sites that could be potentially isolated, the Mount Wells complex and Wild Bull adit. The OHTL is unlikely to significantly limit movement of Ghost Bats between roosts in the region and therefore is unlikely to fragment the important population.
Disrupt the breeding cycle of an important population	The increased distance between important roosts sites and the OHTL deviation route, and the commitment to undertaking any construction work of the OHTL at locations in the vicinity of the Spring Hill adit outside the breeding season, the likelihood of a maternity colony's breeding cycle being disrupted is low.
Adversely affect habitat critical to the survival of the species	Critical habitat for the Ghost Bat is diurnal roosting habitat (Bat Call WA 2021). Such habitat will not be directly impacted by project activities.
Modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent the species is likely to decline	There will be no disturbance to roost sites. As detailed above, the proportion of potential foraging habitat in the vicinity of the Kohinoor adit complex that is potentially isolated from Ghost Bats by the OHTL is approximately 3.3 %. For this site, and all other important roost sites used by the Pine Creek and Katherine sub-populations, there remains available large areas of suitable foraging habitat. The proportion of Ghost Bat foraging habitat present within the project footprint compared within the surrounding 20 km is 0.12%. This occurs across 581 km of the OHTL and at Gunn Point. The loss of such a small and narrow area of habitat is unlikely to modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent the species is likely to decline.
Result in invasive species, that are harmful to the species, becoming established in the species' habitat	Poisoning by Cane Toads, prey competition with (and predation by) Feral Cats and disturbance of roosts by Feral Pigs are all potential threatening processes for Ghost Bat (Bat Call WA, 2021 and TSSC, 2016). These species are already common in the region, and development of the Project is unlikely to lead to any substantial change in their occurrence.

Criterion	Summary of mitigation measures and significant impact assessment
Introduce disease that may cause the species to decline	Disease is considered a potential threatening process for Ghost Bat (Bat Call WA, 2021 and TSSC, 2016c). Regardless of how real this threat is to Ghost Bats, there is no nexus between the activities associated with the Project and introduction of a disease into the region.
Interfere substantially with the recovery of the species	Despite being recommended by TSSC (2016), there is no recovery plan or actions for this species. The primary conservations actions in the Conservation Advice (TSSC, 2016) are to protect roost sites from mining, human disturbance and collapse, and replace the top strands of barbed wire in fences near roost sites with single-strand wire. Development of the Project will not interfere with these actions.

4 TERRESTRIAL ECOSYSTEMS-THREATENED FLORA

4.1 Context provided by the NT EPA

The additional information states that further surveys are proposed to determine the presence and extent of *Cleome insolata* (Vulnerable under the *Territory Parks and Wildlife Act 1976*), *Stylidium ensatum* (Endangered under TPWC Act and EPBC Act) and *Helicteres macrothrix* (Endangered under TPWC Act and EPBC Act) within the disturbance footprint. However, the maximum potential impact has not been assessed (NT EPA Direction items 5(2), 6(2), and 9(2)).

4.2 Additional information required by the NT EPA

1. Provide the maximum proportion of suitable habitat for *Cleome insolata*, *Stylidium ensatum* and *Helicteres macrothrix* (across the total range, and in a local context) that would be cleared.
2. Discuss any potential significant residual impacts (e.g. habitat loss and removal of any plants) that cannot be avoided or mitigated and proposed offsets.

4.3 Response

The maximum potential impact was not assessed for *Cleome insolata*, *Stylidium ensatum* or *Helicteres macrothrix* because there is a high level of confidence that if surveys find these species to be present, impacts can be avoided by the Overhead Transmission Line (OHTL). This will be achieved by minor localised re-alignment of the route, span adjustment to increase the distance between poles/towers and ensuring access methodologies to install & maintain infrastructure are designed to avoid and protect recorded occurrences of these species. The *'Response to NT EPA Direction to provide additional information*' (3 November 2023) sections 5, 6 and 9, describe the approach that will be taken to avoid impacts. Consequently, there is not expected to be any residual impacts in terms of habitat loss or removal of plants.

To provide further context for the NT EPA's assessment of the potential for significant impacts to these species, the sections below provide the maximum proportion of suitable habitat for each species that occurs in the OHTL footprint. It is noted that most areas of potential suitable habitat for these three species have already been surveyed. The information gaps pertain to the occurrence *Cleome insolata* and *Stylidium ensatum* (within Section 572), and the occurrence of *Helicteres macrothrix* (within the southern section of the OHTL corridor near Adelaide River).

4.3.1 Cleome insolata

Apart from within Section 572, all suitable habitat for *Cleome insolata* (i.e. sandsheet heath) has been surveyed using an approved methodology and an appropriate time of the year. The species was not detected.

Within the OHTL corridor in Section 572, there is 0.8 ha of mapped suitable *Cleome insolata* habitat. In comparison, locally (i.e. within 1 km of the OHTL corridor), there is 316.9 ha of mapped suitable *Cleome insolata* habitat – of which 0.25 % occurs within the corridor. Across the species entire range, there is 4,530.4 ha of mapped *Cleome insolata* habitat – of which 0.02 % occurs within the OHTL corridor.

4.3.2 Stylidium ensatum

Apart from within Section 572, all modelled high-likelihood habitat for *Stylidium ensatum* has been surveyed using an approved methodology and an appropriate time of the year. The species has been located within the OHTL corridor, with 4.2 ha of suitable habitat verified as present that will be avoided by localised spanning and/or realignment of the OHTL.

Within the OHTL corridor in Section 572, there is an additional 3.9 ha of modelled *Stylidium ensatum* habitat that is yet to be surveyed. In comparison, locally (i.e. within 1 km of the OHTL corridor) there is 1,038.8 ha of *Stylidium ensatum* modelled habitat – of which 0.78 % occurs within the OHTL corridor. In total, across the

range of the species, there is 33,760.8 ha of *Stylidium ensatum* modelled habitat – of which 0.02 % occurs within the OHTL corridor.

4.3.3 Helicteres macrothrix

High-likelihood *Helicteres macrothrix* habitat has been modelled as present in the OHTL Adelaide River diversion from the rail corridor. All the high likelihood habitat in the northern section of the diversion has been surveyed for *Helicteres macrothrix* using an approved methodology and an appropriate time of the year. The species was not detected.

High-likelihood *Helicteres macrothrix* habitat modelled as present in the southern section of the diversion (13.1 ha) has not yet been surveyed due to access restrictions. In comparison, locally (i.e. within 1 km of the OHTL corridor) there is 1,980.5 ha of *Helicteres macrothrix* modelled habitat – of which 0.66% occurs within the OHTL corridor. In total, across the range of the species, there is 95,846.2 ha of *Helicteres macrothrix* modelled habitat – of which 0.01% occurs within the OHTL corridor.

4.3.4 Residual impacts

The information presented above indicates that the area of mapped potential habitat for *Cleome insolata, Stylidium ensatum* and *Helicteres macrothrix* in the OHTL corridor footprint represents a very small portion of the mapped potential habitat both locally and across the species range. As indicated above, there is a high level of confidence that if these species are found to be present, impacts can be avoided. Therefore, it is unlikely that there will be residual impacts to these species. In the unlikely event that avoidance is not possible, the very small portion of potential habitat within the OHTL corridor indicates that impacts would not be significant.

5 EXTENT OF THE PROPOSED ACTION

5.1 Context provided by the NT EPA

The extent of the action described in the 'Response to NT EPA Direction to provide additional information' (3 November 2023), was increased by 57 ha due to increasing the OHTL construction footprint by 81 ha to allow for the use of 60 m wide construction pads for all structures as contingency.

5.2 Additional information required by the NT EPA

1. Provide shape files of all components of the proposed action footprint, as described and illustrated in the 'Response to NT EPA Direction to provide additional information', including:
    - Powell Creek Solar Precinct
    - Overhead transmission line
    - Darwin converter site
    - Cable transition facilities
    - Subsea cable system.

5.3 Response

The extent of the action described in the *'Response to NT EPA Direction to provide additional information*' (3 November 2023) has been subject to further changes due to the requirement to identify an alternative OHTL route around Pine Creek to address concerns about potential impacts to the Ghost Bat (refer Section 3). The OHTL construction footprint has been increased by 26 ha compared to the previous submission. All other components remain the same. The tables provided in the November 2023 document have been updated to reflect the new OHTL route and are provided as Table 7 and Table 8 below. A corresponding shape file accompanies this submission.

Table 7. Summary of the extent of the proposed action.

Project Component	Construction footprints	Reinstatement[1] footprints (post-construction)	Operations footprints	
			Cleared ground and infrastructure	Vegetation management
Powell Creek Solar Precinct	12,403 ha	124 ha	12,279 ha	-
Overhead Transmission Line	2,813 ha	2,267 ha	546 ha	2,459 ha
Darwin Converter Site	60 ha	-	60 ha	-
Cable Transition Facilities	45 ha	45 ha	-	17 ha[2]
Total Land Disturbance Footprint	15,321 ha[3]	2,436ha	12,885 ha	2,476 ha
			15,361 ha	
Subsea Cable System	6,400 ha	6,400 ha	-	-
Total Sea Disturbance Footprint	6,400 ha	6,400 ha	0 ha	0 ha

Notes:

1 - Reinstatement refers to leaving the land in a condition that allows for natural regeneration of vegetation (in the land footprint) and benthic habitats and communities (in the sea footprint). Most of the OHTL construction footprint will be reinstated; however, the vegetation communities will be different to the pre-construction communities due to the ongoing requirement for vegetation management to protect the infrastructure – refer OHTL Vegetation Management Framework (refer SEIS Appendix 5.4).

2 - This figure relates to the Underground Cable Corridor footprint where vegetation will regenerate but ongoing vegetation management will be required.

3 - The Additional Information submission in November 2023 stated 15,295 ha. The increase of 26ha is due to increasing the OHTL construction footprint by introducing the Pine Creek deviation

Table 8. Basis of construction, reinstatement, and operational footprints for each component

Component	Footprint	Sub-component	Assumptions	Subtotal	Total
Solar Precinct	Construction	Solar Precinct	Solar arrays, Battery Energy Storage Systems (BESS), electrical and ancillary infrastructure, and access roads – as per Draft EIS Chapter 2 Table 2-2	12,269ha	**12,403ha**
		Ancillary infrastructure	10ha for landfill, water bores, access tracks – as per SEIS Chapter 2 Table 2-3	10ha	
		Temporary construction areas	124ha for laydown, accommodations, support areas, borrow pits – as per SEIS Chapter 2 Table 2-3	124ha	
	Reinstatement	Temporary construction areas	Temporary construction areas will be reinstated – as per SEIS Chapter 2 Table 2-3	124ha	**124ha**
	Operations	Solar Precinct Ancillary infrastructure	Construction footprint minus reinstatement footprint = operational footprint required for Solar Precinct infrastructure. Not stated in Draft EIS or SEIS.	12,279	**12,279ha**
OHTL	Construction	OHTL Construction Corridor	791km x 22m - note increase in OHTL length from SEIS Chapter 2 Table 2-3 due to Pine Creek deviation	1,740ha	**2,813ha**
		Construction pads for structures	Additional 38m x 100m alongside construction corridor for each structure = 0.38ha/structure x 2,808structures. Refer table presented in Additional Information November 2023 for rationale.	1,067ha	
		Temporary construction areas	Areas outside the construction corridor required for laydown and OHTL mobile camps – as per SEIS Chapter 2 Table 2-3.	6ha	
	Reinstatement	Reinstatement footprint - complete	Approximately 19% or 538ha of the construction footprint can be completely reinstated, without requiring ongoing vegetation management. This is the area of the OHTL structure construction pads that lie outside of the vegetation management corridor. These areas will be allowed to naturally regenerate over time and will be monitored. Refer table presented in Additional Information November 2023 for rationale.	538ha	**2,267ha**
		Reinstatement footprint - partial	A further 61% of the construction footprint can be partially reinstated post construction. These areas will regrow grasses, shrubs and trees <6m tall, but may need to be subject to vegetation management to protect the OHTL infrastructure – see vegetation management corridor below. This was described in the SEIS but footprints weren't provided - refer OHTL Vegetation Management Framework (refer SEIS Appendix 5.4). Refer table presented in Additional Information November 2023 for rationale.	1,729ha	
	Operations	Permanent access track and structure pads	This is the construction footprint minus area reinstated. The cleared footprint required for operations will comprise a 6m wide access track and 2,808 permanent structure pads, each 16m x 16m wide	546ha	**3,006ha**

Component	Footprint	Sub-component	Assumptions	Subtotal	Total
			around the base of the structures. Refer table presented in Additional Information November 2023 for rationale.		
		Vegetation management corridor	Vegetation in a 38m wide corridor around the OHTL will be managed in accordance with the OHTL Vegetation Management Framework (refer SEIS Appendix 5.4) to protect the infrastructure. The corridor footprint is 2,459ha with the Pine Creek deviation change. Refer table presented in Additional Information November 2023 for rationale.	2,459ha	
Darwin Converter Site	Construction	Converter site	All construction activities can be accommodated within the 60ha footprint required for the facility infrastructure and operations. No additional land required for laydown etc. The 60ha footprint is as per SEIS Chapter 2 Table 2-3.	60ha	**60ha**
	Reinstatement	Converter site	No reinstatement will occur. The construction footprint is inside the operational footprint.	-	
	Operations	Converter site	60ha site to accommodate up to 4 x Voltage Source Converters, batteries, AC substations and ancillary infrastructure. The 60ha footprint is as per SEIS Chapter 2 Table 2-3.	60ha	
Cable Transition Facilities	Construction	Underground Cable Corridor	63 m wide 2.7 km corridor required to accommodate installation of six cables plus bundled fibre optic cable connection from DCS to Land Sea Joint Station. The 17ha is less than the 18.5ha footprint stated in SEIS Chapter 2 Table 2-3. The decrease is due to the corridor width decreasing to 63m wide.	17 ha	**43.5ha**
		Land Sea Joint Station	1.5ha required to accommodate six bays. The 1.5ha footprint is as per SEIS Chapter 2 Table 2-3.	1.5 ha	
		Shore Crossing Site	500m x 500m area within which cables will be laid in open trenches crossing the intertidal zone and beach, and then back filled. The 25ha footprint is as per SEIS Chapter 2 Table 2-3.	25 ha	
	Reinstatement	Underground Cable Corridor Land Sea Joint Station Shore Crossing Site	Vegetation will be allowed to regrow in the reinstated underground cable corridor and land sea joint station. The Shore Crossing Site will be reinstated and left to naturally recolonise.	45ha	**45ha**
	Operations	Underground Cable Corridor Land Sea Joint Station Shore Crossing Site	There is no requirement to maintain above-ground clearing or infrastructure for the Cable Transition Facilities.	0ha	**0ha**
Subsea Cable System	Construction	Subsea cables	Approximately 895km of the Subsea Cable System is in the Australian jurisdiction. Up to 6 cables will be installed, spaced 50-200 m apart. Cable installation will disturb a 12m wide area of seabed around each cable.	6,400ha	**6,400 ha**
	Reinstatement	Subsea cables	The seabed will be left to naturally recolonise with benthic habitats/communities over time. As per Draft EIS.	6,400ha	**6,400 ha**

Component	Footprint	Sub-component	Assumptions	Subtotal	Total
	Operations	Subsea cables	There is no requirement to maintain a cleared footprint for operation of the Subsea Cable System. In the event of a failure, the seabed in the vicinity of the affected cable/s will be disturbed and reinstated.	0ha	**0ha**

6 REFERENCES

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NT Planning Commission (March 2023) *Litchfield Subregional Land Use Plan 2016. Version 6*. https://planningcommission.nt.gov.au/__data/assets/pdf_file/0004/409063/Litchfield-Subregional-Land-Use-Plan.pdf

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Woinarski, J. C. Z., Burbidge, A. A., and Harrison, P. L. (2014). *The Action Plan for Australian Mammals 2012*. Collingwood, Australia: CSIRO Publishing.

APPENDIX A NT EPA DIRECTION (RECEIVED 10 JANUARY 2024)

Northern Territory
Environment Protection Authority

DIRECTION TO PROVIDE ADDITIONAL INFORMATION

Direction given under regulation 83 of the Environment Protection Regulations 2020

Name of proposed action	Australia-Asia PowerLink Project (AAPowerLink)
Proponent	AA Powerlink Australia Assets Pty Ltd
NT EPA reference	EP2020/002
Description of proposed action	To establish: • a large-scale (12, 000 hectare) solar farm and energy storage facility on Powell Creek Station (NT Portion 2094), near Elliot in the Barkly region, NT • a high-voltage direct current transmission network including approximately 800 km of overhead transmission lines, from the solar farm to Murrumujuk on Gunn Point Peninsula, north-east of Darwin • the Darwin converter site (DCS) incorporating up to 4 voltage source converters, batteries, alternating current (AC) substations and ancillary infrastructure • a sub-sea cable through Northern Territory, National and International waters to Singapore.
Nature of proposed action	Energy (renewable)
Method of environmental impact assessment	Assessment by Environmental Impact Statement (EIS)
Direction	The proponent is directed to provide additional information in relation to the EIS (refer to Attachment A)
Submission period	The additional information must be submitted to the NT EPA within 12 months of the date of this Direction.
Document to be published	Additional information to the EIS
Person authorised to give direction	Dr Paul Vogel AM – Chairperson, Northern Territory Environment Protection Authority (NT EPA) Delegate of the NT EPA under section 36 of the *Northern Territory Environment Protection Authority Act 2012*.
Signature	
Date of direction	10 January 2024

Attachment A – Additional information

AA PowerLink Assets Pty Ltd – AA PowerLink Project

Table 1. Additional information to be provided in accordance with regulation 83

Item #	Context	Additional information required
1.	**Community and economy – noise from operation of the proposed action** The Additional information did not describe potential mitigation options to fully address item 14(3) of the NT EPA's Direction and new information about noise exceedances during operation was presented. Noise modelling outputs in the Additional information identified that, with all reasonable and feasible mitigation measures in place, the project specific assigned noise level (35 dBA) would be exceeded up to 1.8 km from the boundary of the DCS affecting the proposed Murrumujuk residential community.	a) Identify proposed measures to further mitigate operational noise emission exceedances from the Darwin converter site. Discuss the consideration of alternatives (available technologies, best practicable mitigation technology, methods such as underground in proximity to residences) and reasons for either selecting or not selecting the option. If the option is not selected because it was considered not economically feasible, a comparison of the environmental effectiveness of the options must still be included. b) Provide revised noise model outputs for the Darwin converter site with all proposed mitigation measures in place. Demonstrate compliance with the Northern Territory noise management framework guideline (2018), specifically in relation to the noise-sensitive residential and rural residential land uses identified for the Murrumujuk Township within the proposed updates to the Litchfield Subregional Land Use Plan[1]. c) Discuss any expected residual significant impacts and proposed management of those.
2.	**Terrestrial ecosystems – Ghost bat** Although additional information has been provided, uncertainty regarding the potentially significant impacts to Ghost bats associated with the proposed action remain. The proponent: • did not provide avoidance/ mitigation approaches nor any substantial discussion about the effectiveness and confidence in	a) Taking into account confidential information provided by DEPWS Flora and Fauna Division, identify and assess avoidance and mitigation measures for significant impact on Ghost bats from: • OHTL operational noise • risk of collision with powerlines • static magnetic field and/or static electric field that will be emitted by the OHTL • all of the above combined / cumulative impacts.

[1] Proposed updates to Litchfield subregional land use plan Gunn Point peninsula, July 2020

Item #	Context	Additional information required
	the measures and any residual significant impacts as per item 8(4) of the NT EPA's Direction. • has not demonstrated how the precautionary principle was applied (as per item 8(5) of the NT EPA's Direction). • has not adequately demonstrated that the OHTL alignment will not have unacceptable impacts on the globally-important Kohinoor Adit specifically, and on Ghost Bats in both the Pine Creek and Katherine regions more generally.	Avoidance by relocation of the OHTL further away from the Kohinoor Adit must be considered and discussed. Include discussion about the effectiveness and confidence in the measures. b) Compare the selected measures and alternatives and provide reasons for selecting or not selecting each. If an option is not selected because it was considered not economically feasible, a comparison of the environmental effectiveness of the options must still be included. c) Demonstrate how the environment protection and management measures (Part 2 of the EP Act – including the precautionary principle) have been applied. Include an evaluation of how serious or irreversible harm to Ghost Bats has been avoided to the maximum extent practicable. Provide an assessment of the risk weighted consequences of various management options. d) Discuss any expected potentially significant residual impacts and proposed offsets.
3.	**Terrestrial ecosystems – threatened flora** The Additional information states that further surveys are proposed to determine the presence and extent of *Cleome insolata (Vulnerable under the Territory Parks and Wildlife Act 1976)*, *Stylidium ensatum* (Endangered under TPWC Act and EPBC Act) and *Helicteres macrothrix* (Endangered under TPWC Act and EPBC Act) within the disturbance footprint. However the maximum potential impact has not been assessed (NT EPA Direction items 5(2), 6(2), and 9(2)).	a) Provide the maximum proportion of suitable habitat for *Cleome insolata*, *Stylidium ensatum* and *Helicteres macrothrix* (across the total range, and in a local context) that would be cleared. b) Discuss any potential significant residual impacts (e.g. habitat loss and removal of any plants) that cannot be avoided or mitigated and proposed offsets.
4.	**Extent of the proposed action** The extent of the action described in the 'Response to NT EPA Direction to provide additional information' (3 November 2023), was increased by 57 ha due to increasing the OHTL construction footprint by 81 ha to allow for the use of 60 m wide construction pads for all structures as contingency.	a) Provide shape files of all components of the proposed action footprint, as described and illustrated in the 'Response to NT EPA Direction to provide additional information', including: • Powell Creek solar precinct • Overhead transmission line • Darwin converter site • Cable transition facilities • Subsea cable system.

APPENDIX B OPERATIONAL NOISE MODELLING REPORT

Project Report

March 05, 2024

Sun Cable

Australia-Asia PowerLink

Darwin Converter Site Operational Noise Model – Additional modelling for noise mitigation scenarios

			[illegible]	[illegible]	[illegible]	
2024-03-07	1	Approved for Use	S. Gibbons J. Vairo	R. Morizzi	M. Winfield-Lesk	Not Required
DATE	**REV.**	**STATUS**	**PREPARED BY**	**CHECKED BY**	**APPROVED BY**	**APPROVED BY**
				Discipline Lead.	Functional Manager.	**Client**

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Acronyms

BESS	Battery Energy Storage System
DCS	Darwin Converter Site
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
E&S	Environment and Social
EPA	Environment Protection Authority
$HVAC_a$	Heating, Ventilation, and Air Conditioning
$HVAC_b$	High voltage alternating current
HVDC	High voltage direct current
NT	Northern Territory
OEM	Original Equipment Manufacturer
OHTL	Overhead Transmission Line
POR	Point of Reception
RBL	Rating Background Level
SEIS	Supplement to the EIS
SMEs	Subject Matter Experts
VSC	Voltage Source Converter

1. Introduction

Sun Cable is proposing Australia Asia PowerLink - the development of a 17-20 GW solar farm, battery energy storage system (BESS) facilities and overhead transmission line (OHTL) to export high voltage direct current (HVDC) power from Powell Creek, Northern Territory (NT), Australia with offtakes in Darwin and Singapore (the 'Project').

A noise modelling report was prepared in October 2023 to respond to a request for additional information from the NT Environment Protection Authority (EPA) (received in March 2023) regarding operational noise impacts at the Solar Precinct and Darwin Converter Site (DCS), including further analysis of various OHTL operating configurations. The October 2023 modelling work built upon the airborne noise assessment methodology used in the Draft Environmental Impact Statement (Draft EIS; April 2022) and Supplement to the EIS (SEIS; November 2022), in accordance with the Northern Territory Noise Management Framework Guideline (2018).

After reviewing the October 2023 report, NT EPA issued further direction on 10 January 2024, requesting more assessment of potential noise emissions from the DCS, after consideration of alternative equipment, project component re-configurations, and additional mitigation measures.

This Report responds to NT EPA's January 2024 request by completing an alternatives assessment and presenting modelling results for the preferred set of best achievable and economically feasible options to mitigate operational noise impacts from the DCS. Since October 2023, the following changes have been incorporated and evaluated:

- Litchfield Subregional Land Use Plan zoning for the Murrumujuk Township (Northern Territory Government, 2023) has been digitised in GIS and overlaid with noise modelling contours and receptors, allowing the impact assessment to be more refined and targeted (e.g., re-location of infrastructure within the DCS away from sensitive land use zones).
- Analysis includes evaluating potential noise impacts from the DCS and OHTL on rural, peri-urban and urban future land use in the proposed Murrumujuk Township as planned for in the Litchfield Subregional Land Use Plan 2016 (Version 6, March 2023).
- Project scope reduction for certain components within the DCS (e.g., reduced units of equipment), which has provided more flexibility and the ability to apply improved noise controls.
- New technology and emerging BESS noise controls have come to market for consideration.

1.1 Direction to Provide Additional Information

On 10 January 2024, the NT EPA directed Sun Cable to:

a) Identify proposed measures to further mitigate operational noise emission exceedances from the Darwin Converter Site. Discuss the consideration of alternatives (available technologies, best practicable mitigation technology, methods such as underground in proximity to residences) and reasons for either selecting or not selecting the option. If the option is not selected because it was considered not economically feasible, a comparison of the environmental effectiveness of the options must still be included.

b) Provide revised noise model outputs for the Darwin Converter Site with all proposed mitigation measures in place. Demonstrate compliance with the Northern Territory Noise Management Framework Guideline (2018), specifically in relation to the noise-sensitive residential and rural residential land uses identified for the Murrumujuk Township within the proposed updates to the Litchfield Subregional Land Use Plan 1.

c) Discuss any expected residual significant impacts and proposed management of those.

The above requests are addressed in the following sections of this Report as detailed in Table 1-1.

Table 1-1: Table of Concordance

Paraphrased NT EPA Comment (Requested Information)	Report Section
1. Proposed measures to further mitigate operational noise emissions, including identifying alternatives (e.g., available technologies, best practicable mitigation technology, methods such as underground in proximity to residences) and providing rationale for selecting / not selecting options considered.	Section 2
2. Provide revised noise model outputs for emissions from the DCS with suitable mitigation measures in place, demonstrating compliance with the NT 2018 noise guideline, specifically in relation to the noise-sensitive residential and rural residential land uses identified for the Murrumujuk Township.	Section 3

Paraphrased NT EPA Comment (Requested Information)	Report Section
3. Discuss any expected residual significant impacts and proposed management of those.	Section 3.7

2. Assessment of Alternative Options to Mitigate Operational Noise Impacts at the Darwin Converter Site

An assessment of alternative options to mitigate operational noise emissions from the DCS on existing and future land use conditions was completed for the Project.

This alternatives assessment involved the systematic and transparent evaluation of a range of mitigation measures that compared the relative impacts and benefits of environmental, social, technical and economic performance criteria to ultimately assess the feasibility of each mitigation option for the Project. The assessment screened mitigation options into ratings of ‘preferred’, ‘acceptable’, ‘challenging’ or ‘unfeasible’, allowing the identification of a set of suitable mitigation options that were used as inputs in this revised noise model. The following steps were undertaken:

- Step 1: Identify alternative mitigation options for consideration (see Section 2.1).
- Step 2: Define assessment criteria for the alternatives assessment (see Section 2.2.1).
- Step 3: Qualitatively and quantitatively (where data is available) analyse the feasibility of each option by evaluating disadvantages and advantages, and rating alternatives relative to each other in order of preference (see Section 2.3).
- Step 4: Identify the set of mitigation options to be carried forward and adopted in a range of various configurations (i.e., scenarios) to assess the effectiveness and feasibility of each (see Section 2.4)

2.1 Overview of Alternatives Considered

To identify relevant noise mitigation options, a review of potential equipment and infrastructure type and selection options was completed, along with a review of configuration and at source mitigation options for individual components of the DCS. This review included a project benchmarking exercise and literature review to compile best available noise reduction technology information, followed by consultation with subject matter experts (SMEs) and the project engineering design team to:

- identify opportunities to maximise efficiencies in design,
- reduce scope while maintaining functionality or reasonable alternative to achieving functionality,

- review the technical project layout configuration,
- minimise footprint and size of infrastructure components; and
- identify opportunities for at source mitigation – including building structures and enclosures for individual equipment.

A description of each mitigation option is provided below.

2.1.1 Batteries Containerised with HVAC$_a$ Silencer

The current configuration consists of 456 batteries being housed in modular containers (i.e., containerised). This option would reduce noise by integrating Heating, Ventilation, and Air Conditioning (HVAC$_a$) duct silencers into the ventilation system.

2.1.2 Inverter Enclosure

The operational configuration involves 76 4.2 MVA inverters without any surrounding enclosures/containers. This option would reduce noise by enclosing the inverters in single air-conditioned structures (e.g., insulated container) that are noise attenuated. Inverter enclosures consists of 4 walls and 1 roof section manufactured out of acoustic panels with an integrated acoustic door, acoustic intake louver, outlet silencer and additional forced-air ventilation fan, all which is typically mounted to the supplied skid and framework.

2.1.3 Transformer Enclosure

The current configuration consists of the transformers to be in open air, with no surrounding enclosures/walls. This option would reduce noise by building an enclosure with forced oil and air-cooling around the MV AC transformers (38x, nominally 8.4 MVA, 1 per inverter station). A block structure has been assumed. Transformer enclosures are typically constructed using strong and durable materials that can withstand high temperatures, such as steel, aluminium, or other metals.

2.1.4 3-Sided Bunker around the Converter Transformer

The current configuration consists of the transformers to be in open air, with no surrounding enclosures/walls. This option would reduce noise by locating the 500 MVA converter transformer in open air, surrounded by a 3-sided concrete/brick walled bunker. One side is left open for access and ventilation.

Wall heights of 4m and 7m were considered for the 3-sided concrete walled bunker.

2.1.5 Reduced DCS Scope – One sending VSC

The current configuration for the DCS is to operate using up to four VSCs to export approximately 6.4GW of HVDC power to Singapore. Two receiving VSCs would

convert HVDC to high voltage alternating current ($HVAC_b$) from the OHTL and provide the option to supply power to the Darwin region. Another two sending VSCs would re-convert $HVAC_b$ to HVDC for export to Singapore. A reduced scope option involves one sending VSC at the DCS that would export approximately 2.4GW of power to Singapore via the subsea cable system. Power will still be made available for the Darwin region, however, as indicated in the Draft EIS, provision of physical infrastructure to supply power is outside this scope and will require separate assessment and approval.

2.1.6 Re-configuration of DCS Layout

The VSC building is located approximately 95m south of Murrumujuk Drive within the current DCS layout. This option involves re-locating:

- the one sending VSC approximately 200m south, and;
- the BESS approximately 400m west then 90m south to tie into the re-located VSC.

This would reduce potential noise impacts by moving the infrastructure within the DCS away from sensitive land use zones to the north.

2.1.7 Noise Barrier

The current DCS configuration does not include any noise barriers. This option would reduce noise by constructing a 12m tall and 2,950 m long absorptive noise barrier positioned along the northern boundary of the DCS property parcel (i.e., along Murrrumujuk Drive).

2.1.8 Reduced BESS Installation

The current configuration of the BESS includes 456 containerised batteries to be installed, with an associated step-up transformer of 250 MVA. This option would reduce noise by removing the northern half of the DCS BESS installation and halve the associated step-up transformer size to 125 MVA.

2.1.9 Undergrounding of infrastructure in proximity to residences

As requested by the NT EPA in their direction, the undergrounding of DCS infrastructure in proximity to residences was considered by the Project team. Undergrounding of DCS infrastructure has a number of significant technical and economic constraints due to the size of the DCS and proximity to Beagle Gulf. Each of the main valve hall buildings (two per VSC) are approximately 25m tall and 50m x 60m in area. As the DCS is in a low-lying coastal area with a shallow groundwater table, this option would require extensive groundwater dewatering during construction and ongoing maintenance during the operation phase. Additionally,

treatment of water (i.e., for salinity prior to discharge) would be required and other technical constraints such as ground settlement and subsidence may arise. Even with an undergrounding option, infrastructure generating noise on the surface would still be needed to provide ventilation and cooling for the equipment underground. Construction costs would also be prohibitive, well over $100M in capital cost. Accordingly, the project design team considers this option to be a fatal flaw and would consider re-locating the entire DCS away from Murrumujuk before exploring this option further. Therefore, undergrounding of infrastructure at the DCS was screened out from further analysis.

2.2 Methodology

A qualitative and quantitative assessment was undertaken to systematically assess and compare the various noise mitigation options against environmental, social, technical, and economic performance objectives to identify feasible mitigation options for the Project. The performance objectives are defined in Section 2.2.1 and are consistent with the performance objectives used for AAPowerlink (see Chapter 2 Project Refinement, Supplemental EIS; November 2022). The definitions also reflect Sun Cable's risk management tolerance levels for cost, schedule, environmental, reputation, community, health and safety, quality, and security considerations.

The attributes for each option are rated as 'preferred', 'acceptable', 'challenging', or 'unfeasible' depending on how well they meet the requirements and goals for each performance objective. These ratings were supported by quantitative information where available (e.g., noise reductions from modelling; cost estimates).

Once the attributes for each option were rated, an overall rating of 'preferred', 'acceptable', 'challenging', or 'unfeasible' was assigned for each option, by applying the following rules:

- If any one of the four performance objectives received a rating of unfeasible, the whole mitigation option was considered unfeasible.
- For an alternative to be rated as preferred overall, it must contain at least one attribute characterised as preferred along with, at worst, acceptable ratings for *all* its other attributes (i.e., alternatives with any attributes rated as challenging or unfeasible will not receive a preferred rating).
- When preference between alternatives does not clearly emerge from the assessment, priorities based on the Project requirements and goals as well as professional judgement were used to select alternatives, and a rationale for the decision was provided in the accompanying text.

2.2.1 Performance Objectives and Assessment Criteria

Performance objectives and their criteria used to assess the alternative options are defined in Table 2-1.

Table 2-1: Performance Objectives and Assessment Criteria

Performance Objective Categories and Assessment Criteria	
Environmental and Social Performance Objectives	
Preferred	Alternative has the least adverse environmental and social (E&S) impact(s) or vulnerabilities when compared to other alternatives; may also provide positive benefits and project opportunities (e.g., reduced site hazards). Option unlikely to result in significant complaints from community or cause worker / community health and safety concerns (e.g., sleep disturbance, loss of hearing, amenity / annoyance impacts).
Acceptable	Alternative has measurable sustained reduction in impacts (i.e., improvement in noise levels), resources used and/or biodiversity impacts. Minor residual impacts could still be experienced primarily restricted to within site and marginal exceedances off-site in local area.
Challenging	Alternative mitigation option has no E&S improvement; likely to result in regulatory exceedances and/or the potential for community complaints off Project site.
Unfeasible	Unacceptable adverse effects that could not be reasonably mitigated. Significant regulatory non-compliance (exceedances) off Project site. Community opposition expected.

Performance Objective Categories and Assessment Criteria	
Technical Performance Objectives	
Preferred	Alternative option is most likely to be effective to implement, with the lowest risk and contingencies (mitigation) in place to address risks. Mitigation option can be implemented with less than a 1-month delay impact. Minimal operational disruptions expected. Demonstrated at commercial scale. May be considered best industry practice. Maintains project capacity and overall viability.
Acceptable	Implementation of alternative likely to be effective, with contingencies to address risks. Option considered industry standard and widely implemented in the industry. Schedule delays of 1 to 3 months. Routine maintenance required. Project capacity may be reduced but overall Project viability maintained.
Challenging	Significant barriers to implement, or to reduce risk to acceptable levels, even with contingencies. Schedule delays of 3 to 6 months. Ongoing maintenance required. Reduces Project capacity, severely limiting viability of overall Project.
Unfeasible	Unacceptable risk, even with contingencies, or alternative is unfeasible to implement. Multiple months (> 6 months) impact on schedule. Pilot scale technology that is not widely adopted. Significant and frequent maintenance required (e.g., inspections, repair, replacement, etc). Reduces project capacity such that overall project not viable.

Performance Objective Categories and Assessment Criteria	
Economic Performance Objectives	
Preferred	Lowest cost option or gives the best return on investment. Capital expenditure less than $1M. Operations expenditure < $200K per annum. Opportunity for cost savings > $10M.
Acceptable	Reasonable cost or gives an acceptable return on investment. Capital expenditure $1M to $10M. Operations expenditure $200K – $2M per annum.
Challenging	High costs, leading to budgetary issues. Capital expenditure $10M - 100M. Operations expenditure $2M – $20M per annum.
Unfeasible	Not economically viable under project budgets. Capital expenditure greater than $100M. Operations expenditure > $20M per annum. No opportunity for cost savings. Impacts ability to successfully negotiate offtake agreements.

2.3 Alternatives Assessment

The noise mitigation options presented in Section 2.1 were evaluated against the four performance objectives described above. The results of the alternatives analysis are presented in Table 2-2 below.

Table 2-2: Alternatives Assessment of Potential Mitigation Options

Option/Alternative[1]	Comparison of mitigation options rated against performance objectives and relative to each other				Overall Rating
	Environmental	Social	Technical	Economic[2]	
Batteries Containerised with $HVAC_a$ Silencer (BESS Site)[1,3A,3B,4A, 4B, 5A, 5B]	This mitigation option results in an equal or reduced level of noise impact on the surrounding environment when compared to the configuration assessed in the Draft EIS and SEIS. This mitigation is generally neutral in impact across all environmental factors.	Sound level reduction of estimated 3 dBA at source, with reduction of noise levels at indicative receptor locations of an est. 2-3 dBA. The $HVAC_a$ silencer with the containerised battery noise results in a noise contribution of 21 dBA at sensitive receiver locations Point of Reception (POR) 128 and 32 dBA at POR 129, as opposed to the 23 dBA and 35 dBA without the $HVAC_a$ silencer respectively.	There are Original Equipment Manufacturers (OEM) on the market who offer a $HVAC_a$ Silencer Option. This mitigation is considered widely available and industry standard.	The cost per battery container with a $HVAC_a$ silencer is approximately $5,434. The cost for 456 battery containers with $HVAC_a$ silencers installed is approximately $3 million.	**Preferred**
	Preferred	Acceptable	Preferred	Acceptable	
Inverter Enclosure (BESS Site)[1,3A,3B,4A,4B,5A,5B]	Additional materials required for the enclosure. Common materials used (e.g., steel, aluminum, or other metals) with high embodied carbon footprints. This mitigation option results in an equal or reduced level of noise impact on the surrounding environment when compared to the configuration assessed in the Draft EIS and SEIS. This mitigation is generally neutral in impact for other environmental factors.	Sound level reduction of estimated 7 dBA at source. With the inverter enclosure the contribution of the inverter and transformer skid is reduced to 23 dBA and 35 dBA at POR 128 and POR 129 respectively. Without the inverter enclosure, noise contributions are 32 dBA and 44 dBA respectively. Reduction of receptor noise levels by 9 dBA.	Inverter enclosures have been commercially demonstrated on similar sized projects (Sungrow Project). Heat needs to be appropriately managed with ventilation and cooling to prevent overheating. This will impact the overall efficiency of the power conversion system.	Noise inverter enclosure to cost approximately $39,000. Cost includes mounting onto supplied inverter skid skeleton framework, 4 walls and 1 roof section manufactured out of acoustic panels with integrated acoustic door, acoustic intake louver, outlet silencer and additional forced-air ventilation fan. The cost for 76 inverters is approximately $3.5 million. The ventilation system will contribute to operating costs (due to maintenance and energy costs).	**Acceptable**
	Acceptable	Preferred	Acceptable	Acceptable	

[1] Numbers listed after the option/alternative refer to the modelled scenario(s) that incorporate the noise mitigation.

[2] A 30% contingency has been assumed.

Option/Alternative[1]	Comparison of mitigation options rated against performance objectives and relative to each other				Overall Rating
	Environmental	Social	Technical	Economic[2]	
Transformer Enclosure (BESS Site inverter skids) [3A,3B]	Additional materials required for the enclosure (higher resource consumption). Provides additional protection against weather events such as high winds and rain, improving infrastructure durability and reducing replacement rate. This mitigation is generally neutral in impact for all environmental factors.	Negligible noise reduction.	Cooling efficiency will be reduced. Space requirements may increase. Maintenance access will be more difficult.	The cost of a 4m x4m x 4m block work building with a cooling system for each transformer is estimated to be $330k. This includes a $100k allowance per system for customisation. The cost for 38 transformers is approximately $14.5 million.	**Challenging**
	Acceptable	Challenging	Challenging	Challenging	
Converter transformer in open air in a 4m tall 3-sided concrete walled bunker [1,3A,3B]	This mitigation option results in an equal or reduced level of noise impact on the surrounding environment when compared to the configuration assessed in the Draft EIS and SEIS. Additional materials (e.g., concrete) required for construction of the wall. Concrete has high embodied carbon footprint due to cement content. This mitigation is generally neutral in impact for other environmental factors.	Reduced noise at source of 2 – 3 dBA. With the 4m tall 3-sided concrete walled bunker, noise contributions at POR 128 and POR 129 are 37 dBA and 39 dBA. Without the 4m tall 3-sided concrete walled bunker, noise contributions are 40 dBA and 41 dBA respectively.	Access to the transformer for maintenance, inspections, and repairs retained. Materials are readily available. Wind ratings need to be designed for cyclone conditions (e.g., strong foundation).	Assumed 200m in length of noise wall per VSC to enclose the transformers on all 3 sides. The cost for one 4m tall noise wall is approximately $3.425 million. A 4m tall noise wall for four VSCs would cost approximately $13.7 million.	**Acceptable**
	Acceptable	Acceptable	Acceptable	Challenging	
Converter transformer in open air in a 7m tall 3-sided concrete walled bunker [4A,4B,5A,5B]	This mitigation option results in an equal or reduced level of noise impact on the surrounding environment when compared to the configuration assessed in the Draft EIS and SEIS. Additional materials (e.g., concrete) required for construction of the wall. Concrete has a high embodied carbon footprint due to cement content. This mitigation is generally neutral in impact for other environmental factors.	Overall reduction in noise at source ranging from 2 – 6 dBA. With the 7m tall 3-sided concrete walled bunker noise contributions at POR 128 and POR 129 are 34 dBA and 39 dBA. Without the 7m tall 3-sided concrete walled bunker noise contributions are 40 dBA and 41 dBA respectively.	Access to the transformer for maintenance, inspections, and repairs retained. Materials are readily available. Wind ratings need to be designed for cyclone conditions (e.g., strong foundation).	Assumed 200m in length of noise wall per VSC to enclose the transformers on all 3 sides. The cost for one 7m tall noise wall is approximately $5.3 million. A 7m tall noise wall for four VSCs will cost approximately $21.2 million.	**Acceptable**
	Acceptable	Preferred	Acceptable	Challenging	

Option/Alternative[1]	Comparison of mitigation options rated against performance objectives and relative to each other				Overall Rating
	Environmental	Social	Technical	Economic[2]	
Reduced DCS Scope – One Sending VSC [2,3A,3B,4A,4B,5A,5B]	Reduced scope would result in less materials required. This mitigation option results in an equal or reduced level of noise impact on the surrounding environment when compared to the configuration assessed in the Draft EIS and SEIS. This mitigation is generally neutral in impact for other environmental factors.	Noise contributions from the existing four VSC design at POR 128 and POR 129 are 43 dBA and 46 dBA. Noise contributions from the one VSC design at POR 128 and POR 129 are 40 dBA and 44 dBA. 2-3 dBA reduction anticipated at sensitive receptors.	This configuration reduces capacity of power supply from the DCS. Reduced scope at DCS would result in a simplified design and shorter construction schedule at this site. Amendments to the Project configuration will result in separate assessment requirements and schedule delays.	This option is approximately cost neutral for the Project.	**Acceptable**
	Acceptable	Acceptable	Challenging	Preferred	
Relocation of VSC south and BESS site southwest [4A,4B,5A,5B]	This mitigation is generally neutral in impact for environmental factors.	Shifting the one sending VSC provides 3 dBA reduction to POR 129 but minimal impacts to POR 128. May improve visual amenity by increasing distance from potential future sensitive receptors.	Relocating the VSC and BESS within the site, will not result in a technical impact (beyond that discussed in the previous mitigation).	This option is approximately cost neutral for the Project.	**Preferred**
	Acceptable	Preferred	Acceptable	Preferred	
12m Noise Barrier [4A,5A]	This mitigation option results in an equal or reduced level of noise impact on the surrounding environment when compared to the configuration assessed in the Draft EIS and SEIS. The barrier could cause the noise (e.g., road noise) to deflect in other directions, however, this could be managed with an appropriate setback and double-sided absorption. The extended length of the noise barrier (2,950 m) may affect and impact on overland water flow and hydrology during the wet season. This may affect water	12m noise barrier reduces the noise contribution of the DCS by 2 dBA at POR 128 and 4 dBA at POR 129 during operations. Additional noise from construction to build the noise barrier can be mitigated (e.g., temporary noise walls). Construction noise impacts would be temporary and short in duration. Potential adverse impacts on visual amenity for future residents. Fence can be designed to reduce impact on visual amenity where possible (e.g., colours that blend into the surrounding landscape, incorporating greenery).	The likelihood of being affected by severe thunderstorms and cyclones is high at the DCS. Strong winds from extreme weather events may lead to structural failure. Design of barrier needs to have high wind load resistance, durable materials, high impact resistance (for flying debris) and stable foundation, requiring greater level of engineering and technical design. Design of noise barrier may trap heat.	A 12m tall noise barrier (2950 m in length) using concrete panels would cost approximately $146.3 million. A 12m tall noise barrier (2950 m in length) using sound cladding would cost approximately $72.1 million. Increased OPEX costs.	**Unfeasible**

Option/Alternative[1]	Comparison of mitigation options rated against performance objectives and relative to each other				Overall Rating
	Environmental	Social	Technical	Economic[2]	
	drainage and movement in the locality and on surrounding land use and environment. Barrier may impede wildlife movement for any fauna traversing the area.	Noise barrier to be made of non-combustible and/or fire-resistant material, preventing heat transfer, increasing safety, and reducing risk from fires (both from system and wildfires). Safety concern as barrier may create a blind spot/ hazard and block viewpoints. Placement of noise barrier to consider natural airflow/ventilation to avoid heat buildup and contribution to urban heat island effect. Block/restrict site access at the northern boundary of Murrumujuk Drive.	Construction of noise barrier could lead to significant project schedule impact (delay) of > 6 months. Additional maintenance of noise barrier during operations required (i.e., inspections, repairs, replacements over time).		
	Challenging	Acceptable	Challenging	Unfeasible	
Northern half of the BESS installation removed from the DCS, with associated step-up transformer size halved accordingly from 250 MVA to 125 MVA [5A,5B]	Less materials required. This would decrease water consumption from the production of the BESS components. Decreased waste generated from required replacements over time. This mitigation option results in an equal or reduced level of noise impact on the surrounding environment when compared to the configuration assessed in the Draft EIS and SEIS. This mitigation is generally neutral in impact for other environmental elements and considerations.	Minimal reduction in overall noise levels (1-2 dBA). Reduced benefit of improved energy access and affordability.	The minimum energy storage requirements for the DCS are the subject of ongoing technical studies. There is a significant risk that the energy storage capacity depicted in this scenario would not be sufficient to ensure a reliable and stable transmission system operation. Lower storage capacity reduces resilience for providing backup power during emergencies, power outages, and other grid disruptions (i.e., reduced grid reliability and stability).	Halving the BESS installation will reduce CAPEX by the order of $200 million. However, reducing energy storage capacity may make the project unviable due to being unable to meet system performance specifications imposed under offtake agreements. Technical constraints may preclude ability to finalise offtake agreements, fundamentally affecting the Project's financial model.	**Unfeasible**
	Acceptable	Challenging	Unfeasible	Unfeasible	

2.4 Preferred Mitigation Option(s)

The alternatives assessment and supporting modelling exercise identified four mitigation options as **acceptable** based on their performance ratings, namely:

- Inverter Enclosure (BESS Site)
- Converter and step-up transformer in open air in a 4m tall 3-sided concrete walled bunker
- Converter and step-up transformer in open air in a 7m tall 3-sided concrete walled bunker
- Reduced DCS Scope – One Sending VSC

The alternatives assessment identified the following mitigation options as **preferred** based on their environmental, social, technical, and economic performance:

- Batteries containerised with $HVAC_a$ Silencer (BESS Site)
- Relocation of the VSC south and BESS site southwest

The above **acceptable** and **preferred** mitigation options were used to develop a range of different modelling scenarios. To support a comparative evaluation of 'social performance' and to understand the effectiveness of the proposed mitigation options on reducing operational noise levels for a range of different site and project configurations, mitigation options identified as **challenging** or **unfeasible** were also considered and incorporated into additional modelling scenarios for assessment.

2.5 Modelling Scenarios

Based on the assessment of mitigation options, eight modelling scenarios were developed for predictive noise modelling. The eight scenarios developed were: Scenario 1, Scenario 2, Scenario 3A, Scenario 3B, Scenario 4A, Scenario 4B, Scenario 5A, and Scenario 5B. Project components applicable to each scenario are summarised in Table 2-3. Modelling followed the previous approach described in the October report (Hatch, 2023) and is further detailed in Section 3.3 below.

The scenarios are:

Scenario 1 – Existing DCS layout + targeted mitigation

a. Targeted mitigation scenario:
    i. Enclosing the inverters in single air-conditioned structures (e.g., insulated container) that are noise attenuated, and

ii. 500MVA converter transformer in an open air in a 3-sided concrete/brick walled bunker.

iii. The battery containerised with $HVAC_a$ silencer.

iv. The electronic noise from the VSCs, with buildings constructed around them with air conditioning to control temperature in the building.

Scenario 2 – Reduced scope at the DCS (unmitigated)

a. VSC configuration reflecting a sending VSC only at the site (i.e., for export to Singapore).
   i. One Sending VSC 2.4GW

b. Energy Storage
   i. Battery storage system sizing as per Scenario 1 Existing DCS layout
   ii. Step up transformer: 250/125/125MVA 33kV to 330kV or 500kV connecting into the incoming HVAC switchyard.

General notes to be considered:

i. The HVAC incoming yard (at 330kV or 500kV) will be outdoors, the remainder of the equipment would be circuit breakers, isolation switches, and control equipment, which are negligible for noise emissions.

ii. There may also be some additional electronic voltage and frequency control equipment not in the core VSC design.

iii. Assume the export HVDC switchyard will be outdoors, the 525kV electro-mechanical equipment will be contained within the VSCs, so the switchyard may just be busbars, circuit breakers and isolation switches.

Scenario 3A – Reduced scope at the DCS + targeted mitigation

a. Configuration per New Scenario 2, plus the following mitigation scenario was considered:
   i. Enclosing the inverters in single air-conditioned structures (e.g. insulated container) that are noise attenuated.
   ii. MV AC transformers (38x, nominally 8.4MVA, 1 per inverter station) enclosed with forced oil and air-cooling building (assume block structure).
   iii. The battery containerised with $HVAC_a$ silencer.

iv. The electronic noise from the VSCs, with buildings constructed around them with air conditioning to control temperature in the building.

Scenario 3B – Reduced scope at the DCS + targeted mitigation

a. Configuration per Scenario 3A, plus the following mitigation scenario was considered:
    i. 330kV or 500kV AC 500MVA converter transformers in an open air in a 3-sided concrete/brick walled bunker with a height of 4 m.

Scenario 4A – Reduced Scope at the DCS + Targeted mitigation + DCS Equipment Relocation

a. Configuration per Scenario 3B, plus the following mitigation scenario was considered:
    i. Relocated the VSC south approximately 200m. Updated location is approximately equivalent to the future sending VSC location as shown in Figure 2-1 and Figure 2-2.
    ii. Relocated the BESS approximately 400 m west and 90 m south to tie into the relocated VSC.
    iii. 330kV or 500kV AC 500MVA converter transformers in an open air in a 3-sided concrete/brick walled bunker with a height of 7 m.
    iv. 250/125/125MVA 33kV to 330kV or 500kV connecting into the incoming HVAC switchyard step up transformer in an open air in a 3-sided concrete/brick walled bunker with a height of 7 m.
    v. Containerising the 38 x battery skid transformers are no longer considered due to little noise reduction benefit and high technical constraints during implementation.
    vi. 12 m tall and 2950 m long absorptive noise barrier positioned at the northern project boundary of the DCS.

Scenario 4B – Reduced Scope at the DCS + Targeted mitigation + DCS Equipment Relocation

a. Configuration per Scenario 4A (see Figure 2-1 and Figure 2-2), except the following mitigation scenario was excluded:
    i. 12 m tall and 2950 m long absorptive noise barrier positioned at the northern project boundary of the DCS.

Scenario 5A – Further Reduced Scope at the DCS + Targeted Mitigation + DCS Equipment Relocation

a. Configuration per Scenario 4A, plus the following mitigation scenario was considered:
    i. Northern half of the BESS installation removed from the DCS, with associated step-up transformer sized halved accordingly from 250 MVA to 125 MVA.

Scenario 5B – Further Reduced Scope at the DCS + Targeted Mitigation + DCS Equipment Relocation

a. Configuration per Scenario 5A, except the following mitigation scenario was excluded:
    i. 12 m tall and 2950 m long absorptive noise barrier positioned at the northern project boundary of the DCS.

722500 723000 723500 724000 724500

8643500 8643000 8642500 8642000 8641500

Draft EIS DCS Layout

Murrumujuk Drive

Track

Offshore VSC

Onshore VSC

OHTL

Gunn Point Road

Future VSC

Switchyard

Future VSC

BESS

Darwin Converter Site (DCS)

DCS Layout - Reduced Scope

Murrumujuk Drive

Track

OHTL

Gunn Point Road

Offshore VSC

BESS

Switchyard

Darwin Converter Site (DCS)

AAPowerLink Infrastucture

Road

DCS Layout

BESS

Future VSC

Offshore VSC

Onshore VSC

Switchyard

NOTES:
1. Contains information under the Creative Commons Attribution 4.0 International Licence (CC BY 4.0).
2. Projection: GDA2020 MGA Zone 52
3. Imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

0 100 200 400 Metres

1:10,000

NORTH

Figure 2-1
Sun Cable
Australia-Asia PowerLink Project
Draft EIS DCS Layout vs. Reduced DCS Scope

suncable

HATCH

File: SUN-NOI-047

723200 723400 723600 723800 724000 724200

8642800 8642600 8642400 8642200

Offshore VSC

Switchyard

Onshore VSC

OHTL

BESS

200 m

Offshore VSC

185 m

400 m

BESS

Future VSC

Future VSC

Switchyard

90 m

Darwin Converter Site (DCS)

AAPowerLink Infrastucture
Road
Draft EIS DCS Layout
DCS Layout - Reduced Scope
BESS
Offshore VSC
Switchyard

NOTES:
1. Contains information under the Creative Commons Attribution 4.0 International Licence (CC BY 4.0).
2. Projection: GDA2020 MGA Zone 52
3. Imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

0 50 100 200 Metres

1:3,000

NORTH

Figure 2-2
Sun Cable
Australia-Asia PowerLink Project
Draft EIS DCS Layout vs. Reduced DCS Scope - Equipment Shift

suncable

HATCH

File: SUN-NOI-048

Table 2-3: Summary – Scenario Equipment

Noise Sources / Equipment	Controls	Scenario (Quantities)							
		1	2	3A	3B	4A	4B	5A	5B
500MVA converter transformer	-		6	6					
	3-sided barrier	24			6	6	6	6	6
250MVA/125MVA step up transformer	-		1	1	1				
	3-sided barrier					1	1	1	1
VSC Building	-	8	2	2	2	2	2	2	2
Battery Storage Units (containers)	-		456						
	Containerised	456		456	456	456	228	228	228
Battery Column Skid Inverter Units	-		76						
	Containerised	76		76	76	76	76	38	38
Battery Column Skid Transformers	-	38	38			38	38	19	19
	Containerised			38	38				

3. Noise Impact Assessment

3.1 Noise Baseline Setting

Baseline noise measurements are not currently available for the assessment area. The Project has adopted the minimum assumed Rating Background Levels (RBL) from the Northern Territory Noise Management Framework Guideline (2018) (the Guideline) for the purposes of this assessment.

Currently, the proposed DCS is located in a predominantly rural land use setting, with Gunn Point Beach, a beach recreation and camping area, located to the west of the site, and the Tree Point Conservation Reserve and Shoal Bay Coastal Reserve located to the southwest and south of the site.

In accordance with the Guideline, a minimum assumed RBL for residential settings of 30 dBA has been adopted as the basis for determining the Project Specific Assigned Noise Level which reflects the existing surrounding land use (see Section 3.2.3). With an RBL of 30 dBA, the Project Specific Assigned Noise level is set to 35 dBA (30 dBA + 5 dBA), in-line with the 'Rural' residential night-time limit.

The DCS and surrounding lands are however zoned for future development under the Litchfield Subregional Land Use Plan (2023). As requested by NT EPA, the focus of this Report is not to assess impacts of the Project on the existing adjacent land use, but to carry out a cumulative impact assessment on the far future land use proposed as part of the land use plan.

The Litchfield Subregional Land Use Plan proposes the expansion of a transportation road and rail network, aquaculture and industrial development, and urban / peri-urban residential and development activities. This future land use plan varies significantly from the current rural land use. As such, the future Murrumujuk Township RBL is anticipated to be in line with an 'Urban' residential night-time limit, consistent with future development in the area. Accordingly the Murrumujuk RBL is anticipated to reasonably increase from 30 to 35 dBA, applying +5 dBA (refer to Section 0 below) results in a future Project Specific Assigned Noise level of 40 dBA as a residential night-time limit (refer to Table 3-2 below).

3.2 Industrial Noise Limits and Project Noise Criteria

Section 3.2 Commercial and Industrial Noise of the Guideline (2018) provides the framework for the assessment and management of commercial and industrial noise. The below Project noise criteria has been established consistent with these guidelines and requirements.

3.2.1 Amenity

The combined (total) noise level from all industrial noise sources is to remain below the Maximum Assigned Amenity Noise Levels shown in Table 3-1. The Project Specific Amenity Noise Level shall be below the Maximum Assigned Amenity Noise Level to ensure the cumulative noise impact from all industrial noise sources in the area does not exceed these limits. Typically, the Project Specific Amenity Noise Level is the maximum assigned amenity noise levels minus 5 dBA as shown in Table 3-1.

Table 3-1: Recommended assigned amenity noise levels for operational airborne noise at sensitive land uses

Receptor	Noise Amenity Area	Time of Day	Maximum Assigned Amenity Noise Level, L_{Aeq} dBA	Project Specific Amenity Noise Level, L_{Aeq} dBA
Residential	Rural	Day* (7 am to 6 pm)	50	45
		Evening** (6 pm to 10 pm)	45	40
		Night*** (10 pm to 7 am)	40	35
	Suburban	Day* (7 am to 6 pm)	55	50
		Evening** (6 pm to 10 pm)	45	40
		Night*** (10 pm to 7 am)	40	35
	Urban	Day* (7 am to 6 pm)	60	55
		Evening** (6 pm to 10 pm)	50	45
		Night*** (10 pm to 7 am)	45	40
Hotels, motels, caretakers quarters, holiday	See Column 4	See column 4	5 dBA above the recommended amenity noise	5 dBA below the Maximum assigned

Receptor	Noise Amenity Area	Time of Day	Maximum Assigned Amenity Noise Level, L_{Aeq} dBA	Project Specific Amenity Noise Level, L_{Aeq} dBA
accommodation, permanent resident caravan parks			level for a residence for the relevant noise amenity area and time of day	Amenity Noise Level
Classrooms at schools and other educational institutions	All	Noisiest 1-hour period when in use	35 (internal)	30 (internal)
Hospital Wards and operating theatres	All	Noisiest 1 hour	35 (internal) 50 (external)	30 (internal) 45 (external)
Places of worship	All	When in use	40 (internal)	35 (internal)
Active Recreation Areas	All	When in Use	55 (external)	50 (external)
Passive Recreation Areas	All	When in Use	50 (external)	45 (external)
Industrial Premises	All	When in Use	70 (external)	65 (external)
Commercial Premises	All	When in Use	65 (external)	60 (external)

*Day is 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holiday
**Evening is 6 pm to 10 pm Monday to Sunday including public holidays
***Night is 10 pm to 7 am Monday to Saturday or 10 pm to 8 am on Sundays and public holidays

3.2.2 Intrusiveness

The Project Intrusiveness noise level seeks to protect against significant changes to ambient noise levels caused by the Project. The Intrusiveness constraint requires that the L_{Aeq} measured over a 15-minute period shall not exceed the background noise level by more than 5 dBA. Where the background noise levels are unavailable,

minimum background levels are identified in the Guideline. The project intrusiveness criteria is the greater of either the measured RBL plus 5 dBA or the minimum assumed RBL plus 5 dBA as shown in Table 3-2.

As measured RBL for the Project are not available, the proposed minimum RBL in the Guideline is adopted for the existing rural surrounding land use. Given that the Litchfield Subregional Land Use Plan (2023) is proposing a significantly developed urban, commercial, and industrial community in the future, a future urban RBL is expected to be on the order of 35 dBA.

Intrusive noise levels are only applied to residential receptors; for all other receptor types, the limits outlined in Table 3-1 shall be used.

Table 3-2: Recommended assigned Project Intrusiveness noise levels for operational airborne noise at residential land uses

Receptor	Noise Amenity Area	Time of Day	Project Intrusiveness noise levels, Laeq, 15 min dBA	Project Intrusiveness Noise Limit dBA	
				Existing (Rural)	Future (Urban)
Residential	All	Day**	Higher of 40 dBA OR RBL* + 5 dBA	40	40
		Evening***	Higher of 35 dBA OR RBL* + 5 dBA	35	40
		Night****	Higher of 30 dBA OR RBL* + 5 dBA	35	40

*RBL represents the measured background level to be used for assessment purposes, as determined by the method outlined in Fact Sheets A and B in the NSW EPA Noise Policy for Industry.
**Day is 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holiday;
***Evening is 6 pm to 10 pm Monday to Sunday including public holidays;
****Night is 10 pm to 7 am Monday to Saturday or 10 pm to 8 am on Sundays and public holidays

3.2.3 Project Specific Assigned Noise Level

The Project Specific Assigned Noise Level is the lower value of the Project intrusiveness noise level and Project amenity noise level as determined by the NSW EPA Noise Policy for Industry 2017 and reproduced in section 3.2 of the Guideline.

Per the Guideline, the Project Specific Assigned Noise Levels differentiate between noise impacts during the day, evening, and night, with more stringent levels applied during the more sensitive evening and night-time periods. As the operations at all Project sites are considered continuous 24-hours, seven days per week, only the more stringent nighttime noise levels have been considered for the purposes of this assessment and in establishing the Project Specific Assigned Noise Levels.

Where a premise, operation, or proposed project exceeds or is expected to exceed the Project Specific Assigned Noise Levels at existing sensitive receivers, the Guideline requires that reasonable and feasible mitigation measures be considered to reduce the actual or predicted noise level.

The process outlined in Figure 3-1, and as described in the Guideline has been used to determine the Project Specific Assigned Noise Level. The nighttime period Project intrusiveness noise level has been identified as the lowest of the values from Table 3-1 (Amenity noise levels) and Table 3-2 (Project intrusiveness noise level) and has been assigned as the Project Specific Assigned Noise Level (also referred to as 'noise limits') for the purposes of this assessment.

Given that the Solar Precinct, DCS, and various operating configurations of the OHTL are designed to operate continuously for 24-hours on any given day, the noise limits are identified as:

- 35 dBA for existing land use
- 40 dBA for future land use[3].

[3] Based on the urbanised community proposed by the Litchfield Subregional Land Use Plan (2023)

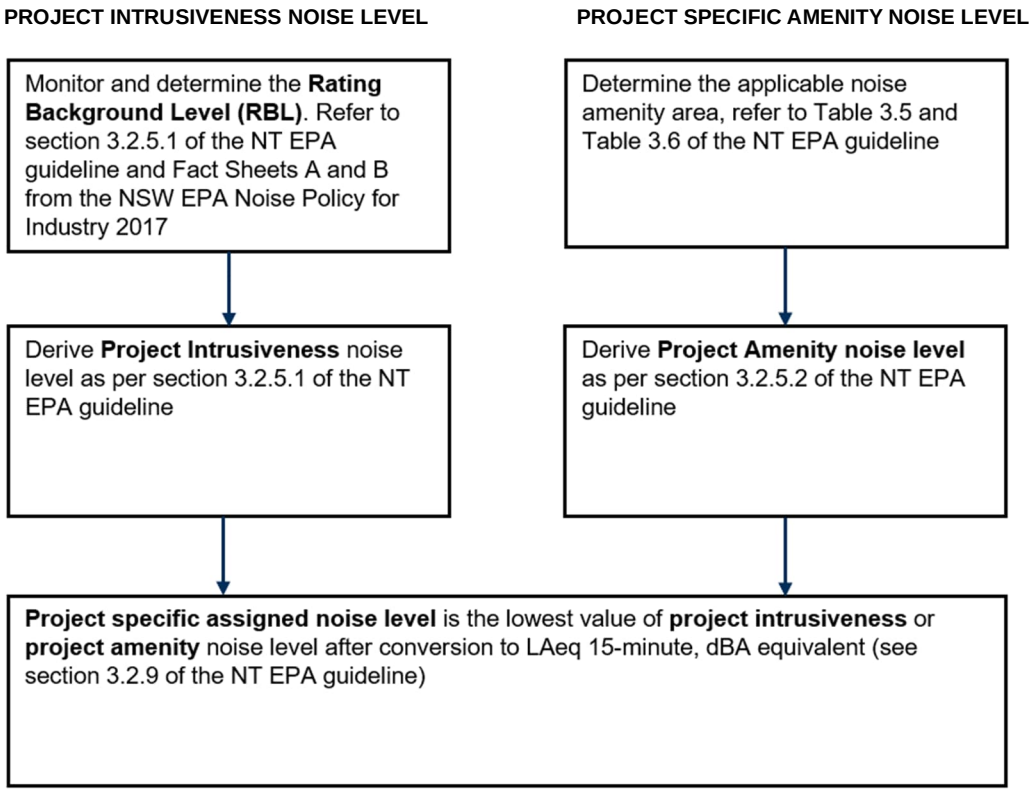


Figure 3-1: Procedure to derive Project Specific Assigned Noise Level (reference: the Guideline)

3.3 Operational Noise Modelling Approach

3.3.1 Modelling Inputs

The eight scenarios modelled were based on the set of suitable mitigation options identified in Section 2 and considered impacts to three indicative receptors within the proposed future Murrumujuk Township as identified in the Litchfield Subregional Land Use Plan 2016 (Version 6, March 2023). Sensitive receiver locations POR 128 and POR 129 were selected, consistent with the October 2023 assessment, as representative possible receptor locations within the proposed future Murrumujuk Township based on property boundaries and the initial layout of the DCS. Sensitive receiver location POR 129b was added to this assessment as a more accurate representation of a potential sensitive receiver than POR 129 (as the location for POR 129 falls within a proposed main road within the Litchfield Subregional Land Use Plan). Receptor locations were selected with the intention to span the breadth of the entire DCS facility from one end to the other, with the VSC equipment focused to the west and BESS equipment focused to the east. The sensitive receiver locations were selected based on existing property boundaries and were selected as representative of potential future residential properties in lieu of these being unknown at this time.

The land located south of the DCS is designated as ‘potential rural residential’ as part of the future Murrumujuk Township. Potential noise impacts on this land use have been considered and are discussed in Section 3.5.1; however, given its proximity to seasonal swamps and Shoal Bay, and the strong presence of biting insects, the feasibility of the area being designated as a rural residential area in the future remains uncertain. Therefore, an indicative sensitive receiver was not considered at this location.

The impacts of noise from operational activity were assessed using the CadnaA software application developed by DataKustik. CadnaA models atmospheric sound propagation following the ISO 9613-2 standard (ISO, 1996). The model considers geometrical dispersion (how noise propagates from the source), atmospheric decay (the amount of acoustic energy that is absorbed by the atmosphere), ground absorption (the amount of acoustic energy loss from reflection off the ground) and ground topography (natural landscape and ground elevation changes that act as barriers to noise).

For this study, a dry season configuration has been assumed. This is representative of worse case weather conditions for noise propagation and is consistent with the modelling approach used in the October 2023 assessment. As such ground

absorption was set to a value of 0.5, with a temperature of 17°C and relative humidity of 35%.

The following base-case operational phase Project components and noise sources (unmitigated) were used as inputs to the model (Table 3-3).

Table 3-3: Operational Noise Sources – Modelling Inputs

Project Component	Operational Noise Source	Comments
Darwin Converter Site (DCS)	Transformer and Inverter Skid	- 76 4.2 MVA inverters (2 per skid) modelled as point sources as part of the 38 skids over the DCS battery container area - 38 8.4 MVA / 33/0.69 kV transformer (1 per skid) modelled as point sources as part of the 38 skids over the DCS battery container area - Point sources located 2 m above grade
	Voltage Source Converter (VSC) / Substation	- DCS will operate with up to four VSC substations - Converter coolers (1 per pole) estimated based on Hatch Repository of sound power data for a 2 GW Converter Station. Sound Power prorated for a 3 / 2.4 GW facility (depending on the modelling scenario) and modelled as a point source 2 m above grade - 3 500 MVA single phase converter transformers per pole modelled as a point source 2 m above grade - VSC control building noise (1 per pole) estimated based on Hatch Repository of sound power data for a 2 GW Converter Station. Sound power prorated for a 3 / 2.4 GW facility (depending on the modelling scenario) and modelled as a point source 10 m above grade

Project Component	Operational Noise Source	Comments
		- Switching station and harmonic filter noise is negligible
	Battery Energy Storage System (BESS)	- 456 battery containers (estimated to be 0.25P SolBank batteries) modelled as line sources over the battery container area - Line sources are consistent with 12, 10, and 5 container arrangements - Line sources located 2 m above grade - 1 300 MVA step up transformer connecting into the incoming high voltage alternating current switchyard
Cable Transition Facilities	None	- No operational noise is anticipated for the Cable Transition Facilities as the cabling will be buried underground

The total sound power for each Project Component modelled is provided in Table 3-4.

Table 3-4: Project Component Overall Sound Power Data

Project Component	1/1 Octave Band Frequencies, Sound Power, dB									Overall
	31	63	125	250	500	1k	2k	4k	8k	dBA
DCS Battery 12 Containers (unmitigated)	91	90	84	96	87	80	73	67	59	90
DCS Battery 12 Containers (mitigated)	88	87	81	93	84	77	70	64	56	87
DCS Battery 10 Containers (unmitigated)	90	89	83	95	86	79	72	66	58	89
DCS Battery 10 Containers (mitigated)	87	86	80	92	83	76	69	63	55	86
DCS Battery 5 Containers (unmitigated)	87	86	80	92	83	76	69	63	55	86
DCS Battery 5 Containers (mitigated)	84	83	77	89	80	73	66	60	52	83
DCS Inverter and Transformer Skid (unmitigated)	97	98	97	99	97	93	90	95	85	100
DCS Inverter and Transformer Skid (Both mitigated)	97	88	87	89	82	73	70	80	70	86
DCS Inverter and Transformer Skid (Inverter mitigated Only)	97	91	92	90	87	80	76	80	70	89
VSC Transformer	107	113	115	110	110	104	99	94	87	110
VSC Cooler	110	110	107	105	100	97	89	86	82	102
Battery Yard Transformer (unmitigated 250 MVA)	104	110	112	107	107	101	96	91	84	107

Project Component	1/1 Octave Band Frequencies, Sound Power, dB									Overall
	31	63	125	250	500	1k	2k	4k	8k	dBA
Battery Yard Transformer (mitigated 125 MVA)	100	106	108	103	103	97	92	87	80	103
VSC Control Building	Modelled as a single band at 1 kHz									91

The calculation configurations to be applied in the model are shown in Table 3-5.

Table 3-5: Modelling Calculation Configurations

Inputs	Value	Comments
Ground Absorption	0.5	Ground absorption is measured on a scale from 0 to 1. An absorption of 0 indicates the ground is fully reflective (e.g., body of water) and an absorption of 1 indicates the surface is fully absorptive. An absorption of 0.5 was used to model a harder ground scenario (dry season).
Topographical Data	1 m resolution	Topographical elevation data with a 1 m resolution extending 1 km on all sides of the project boundaries.
Order of Reflection	1	The maximum order up to which reflections are considered. Higher orders of reflection result in more accurate models with higher calculation times. Generally, 1 order of reflection is sufficient.
Temperature / Humidity	Dry Season: (May – October): Temperature 17°C Humidity 35%	Air absorption is calculated based on the temperature and the relative humidity according to ISO 9613-1 standard.

Inputs	Value	Comments
Noise Contour Maps	Produced for 4.5 m above grade	Noise contours were calculated at a noise sensitive receptor height of 1.5 m for the daytime and 4.5 m for the night-time and evening scenarios. Noise contours were overlaid with sensitive land uses (as listed in Table 3-1) and land parcel data to visually identify locations that exceed the noise limits. As operational activity occurs continuously over 24 hrs, only the more stringent night-time scenario was plotted and assessed.

3.4 Modelling Results Summary – All Scenarios

Modelling results for all eight scenarios at sensitive receptor locations POR 128, POR 129, and POR 129b are presented in Table 3-6. All sensitive receptor locations have been assessed for potential impacts against the *existing* residential rural land use noise night-time limit (35 dBA) and the *future* residential urban land use noise night-time limit (40 dBA).

In summary:

- Scenario 5A (further reduced scope at the DCS including a halved BESS site + targeted mitigation + DCS equipment relocation) resulted in the lowest anticipated level of impact at all receivers but is not considered operationally feasible as it includes the reduction of the northern portion of the BESS installation.
- Scenario 1 (Existing DCS layout + targeted mitigation) and Scenario 2 (Reduced scope at the DCS (unmitigated)) resulted in the highest level of impact at all receivers.

Table 3-6: Darwin Converter Site Noise Modelling Results (Operational Phase; Dry Season)

Point of Receptor (POR)	Noise Modeling Results – All Scenarios								Easting/Northing	
	Scenario 1 (dBA)	Scenario 2 (dBA)	Scenario 3 (dBA)		Scenario 4 (dBA)		Scenario 5 (dBA)			
			3A	3B	4A	4B	5A	5B	X	Y
POR128	42	41	40	38	32	34	30	33	722268	8643322
POR129	45	46	43	43	32	36	31	36	724666	8642734
POR129b	45	45	42	42	31	35	30	35	724763	8642862
	Exceeds 40 dBA Future Urban Noise Criteria									
	Exceeds 35 dBA Rural Noise Criteria but complies with 40 dBA Future Urban Noise Criteria									

With consideration of the outcomes of the analysis of options, the modelling results, feasibility, and functionality, Scenario 4B (i.e., reduced scope to one sending VSC, targeted mitigation, and equipment relocation) is the scenario most compliant with the noise guideline. Scenario 4B results in a very similar level of impact to Scenario 5B (within 1 dBA) and is compliant with both the existing rural residential criteria (35 dBA) and future urban residential criteria (40 dBA) at both POR 128 and POR 129b.

Scenario 4B is also considered preferrable as it did not include any mitigation option deemed unfeasible, and allowed for a full scope BESS installation for the DCS infrastructure, resulting in viable operational feasibility. Section 3.5 provides a deeper analysis of the modelling results for Scenario 4B.

Further results discussion and noise contour figures for each of the other assessed scenarios (1, 2, 3A, 3B, 4A, 5A, 5B) are included in Appendix A.

3.5 Modelling Results – Scenario 4B

Modelling results at sensitive receptor locations POR 128, POR 129, and POR 129b are summarised in Table 3-7 below.

Scenario 4B complied with the existing rural noise limit at POR 128 (34 dBA) and POR 129b (35 dBA) but exceeded the limit marginally by 1 dBA at POR 129 (36 dBA) (Table 3-7; Figure 3-2).

For the future residential urban land use noise limit, Scenario 4B met or was below 40 dBA at all three sensitive receiver locations (Figure 3-2).

Table 3-7: Darwin Converter Site Operational Night-time Modelled Noise Levels (Dry Season), Scenario 4B

Point of Receptor (POR)	Existing residential rural noise limit	Future residential urban noise limit	Easting/Northing	
	35 dBA	40 dBA	X	Y
POR128	34	34	722268	8643322
POR129	36	36	724666	8642734
POR129b	35	35	724763	8642862
	Exceeds Noise Criteria			

3.5.1 Results Discussion

Scenario 4B contains only one sending VSC shifted approximately 200m south. The BESS is shifted approximately 400m west and 90m south to tie into the relocated VSC. Mitigation is placed on the inverters, battery, and transformer skids. In addition, a 7m tall 3-sided concrete/brick walled bunker is added to the VSC transformers and step-up transformer.

As Figure 3-3 shows, increased noise levels are predicted to extend locally from the DCS property boundary for a distance of approximately 730m to the north, 155m to the east, 990 m to the south and 815 m to the west until the 35 dBA limit is met. The affected area is almost halved when considering the 40 dBA limit; the impact extends locally for a distance of 450m to the north, 0m to the east, 590m to the south, and 325m to the west.

The total area of urban/peri-urban residential land use zone affected by increased noise levels beyond the DCS boundary is 82.4 ha (35 dBA residential *rural* noise limit), representing approximately 4.5% of the total area of this land use zone within the proposed Murrumujuk Township Litchfield Subregional Land Use Plan (V.6, 2023). When considering the 40 dBA residential *urban* noise limit, a reduced total area of 8.1 ha is affected, impacting approximately 0.5% of this land use zone.

The total area of potential rural residential land use zone in response to biting insects affected by increased noise levels beyond the DCS boundary is 120.4 ha (35 dBA residential *rural* noise limit), representing approximately 35.8% of the total area of this land use zone within the proposed Murrumujuk Township. When considering the 40 dBA residential *urban* noise limit, a reduced total area of 93.9 ha is affected, impacting approximately 28% of this land use zone.

Table 3-8 summarises the total areas affected for urban/peri urban residential land uses, as well as additional land use zones within the proposed Murrumujuk Township.

Table 3-8: Land Use Area Affected by Increased Noise Levels Beyond the DCS Boundary

Land Use	Percentage of Land Use Zone Area Affected by Noise Levels Beyond the DCS	
	35 dBA	40 dBA
Urban/Peri-Urban	4.5%	0.5%
Rural Residential in Response to Biting Insects	35.8%	28%

720000 722000 724000 726000

8644000 8642000 8640000

Gunn Point Prison Farm Access

Gunn Point

POR128

Track

Murrumujuk Drive

POR129b

POR129

Leaders Creek Boat Ramp Access

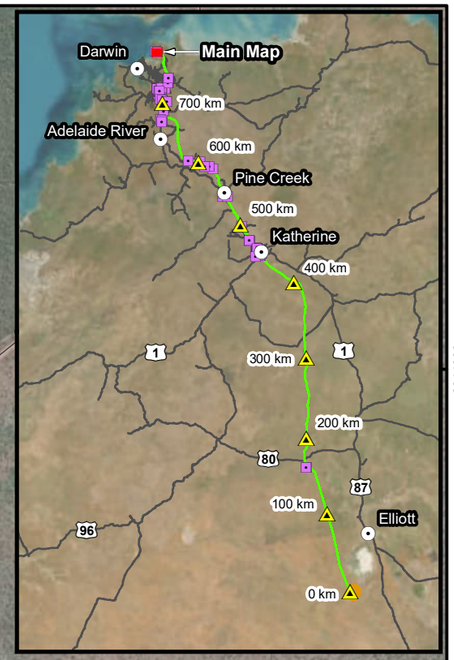
783.2 km

Darwin Converter Site (DCS)

Tree Point Access

Gunn Point Road

780 km



- Populated Place
- Sensitive Receptor
- Kilometre Points
- OHTL Corridor
- VSC Building
- AAPowerLink Infrastucture
- Road
- Noise Barrier

Cumulative Operational Noise (dB)

- 35 - 45
- 45 - 55
- 55 - 65
- > 65

NOTES:
1. Contains information under the Creative Commons Attribution 4.0 International Licence (CC BY 4.0).
2. Projection: GDA2020 MGA Zone 52
3. Imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

0 0.25 0.5 1 Kilometres

1:20,000

NORTH

Figure 3-2
Sun Cable
Australia-Asia PowerLink Project

Scenario 4B - DCS Operational Night-time Noise Levels in the Dry Season

suncable

HATCH

File: SUN-NOI-043

718000 720000 722000 724000 726000 728000

8646000 8644000 8642000 8640000

1378
2727
2626
2203
4476
6166
3101
5911
3104

Gunn Point Prison Farm Access
Gunn Point
Leaders Creek Boat Ramp Access
Murrumujuk Drive
Track
Tee Point Access
Gunn Point Road
Darwin Converter Site (DCS)

POR128
POR129
POR129b

450m
730m
815m
325m
590m
990m
155m

Darwin
Main Map
700 km
Adelaide River
600 km
Pine Creek
500 km
Katherine
400 km
300 km
200 km
100 km
Elliott
0 km
1
80
87
96

1:6,000

- Sensitive Receptor

Project Specific Assigned Noise Level
- 35 dBA
- 40 dBA
- 45 dBA
- Populated Place
- AAPowerLink Infrastucture
- Road
- Land Parcel

Proposed Draft Concept Plan for Murrumujuk Township[4]
- Urban/Peri-urban
- Potential Rural Residential in Response to Biting Insects
- Rural Area
- Potential Sites for Tourism Development
- Potential Managed Waterbody

Recreation
- Open Space/Natural Area

Infrastructure
- Planned Rail
- Proposed Main Road
- Utility Corridor

Other
- Conservation
- Future Development
- Strategic Industry
- Agriculture/Grazing

NOTES:
1. Contains information under the Creative Commons Attribution 4.0 International Licence (CC BY 4.0).
2. Projection: GDA2020 MGA Zone 52
3. Imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.
4. Digitized from Figures 4 and 9 in the Proposed Updates to Litchfield Subregional Land Use Plan - Gunn Point Peninsula, July 2020 (https://planningcommission.nt.gov.au/__data/assets/pdf_file/0006/909996/LSLUP-2020-V2_1.pdf)

0 0.5 1 2 Kilometres

1:30,000

NORTH

Figure 3-3
Sun Cable
Australia-Asia PowerLink Project

Scenario 4B - DCS Operational Night-time Modelled Noise Levels (Dry Season) with Proposed Murrumujuk Township Land Use

suncable

HATCH

File: SUN-NOI-044

3.5.1.1 *Comparison to October 2023 Best Case Scenario*

Each of the eight scenarios considered as part of this assessment were re-evaluated against the October 2023 assessment to facilitate a deeper understanding of progress and improvements the Project has made to mitigate noise levels and address NT EPA concerns.

As a point of comparison, the extent of noise affected area and buffer distances has been compared across all scenarios. Table 3-9 provides a summary of the extent of noise affected areas encroaching the proposed Murrumujuk Township urban / peri-urban land use zone, applying the 35 dBA noise limit.

The comparison confirms that seven of the eight scenarios substantially reduce the extent of noise affected areas above 35 dBA. The only exception is Scenario 1 (similar to the October 2023 mitigated scenario) which showed an increased extent to the north and east, but a reduced area to the south and west.

The improvement and reduced extent of impact area is substantially greater when applying the 40 dBA noise limit, with the two scenarios (4A and 5A) including the noise barrier resulting in no encroachment over the proposed Murrumujuk Township urban / peri-urban areas (Table 3-10)[4].

Table 3-9: Comparison Between Modelling Scenarios – Direction / Extent of Impact Where Noise Level > 35 dBA

Direction	January – February 2024								October 2023
	Scenario 1	Scenario 2	Scenario 3		Scenario 4		Scenario 5		Mitigated Scenario
			3A	3B	4A	4B	5A	5B	
North	2200m	1635m	1550m	1100m	485m	730m	425m	715m	1800m
East	1300m	535m	385m	385m	0m	155m	0m	120m	1000m
South	2350m	1635m	1595m	1405m	900m	990m	835m	865m	2500m
West	1550m	890m	890m	570m	815m	815m	770m	770m	1700m

[4] A comparison to the October 2023 modelled scenario was not carried out as the 40 dBA noise limit was not included in that assessment.

Table 3-10: Comparison Between Modelling Scenarios – Direction / Extent of Impact Where Noise Level > 40 dBA

Direction	January – February 2024							
	Scenario 1	Scenario 2	Scenario 3		Scenario 4		Scenario 5	
			3A	3B	4A	4B	5A	5B
North	925m	1035m	960m	740m	0m	450m	0m	360m
East	450m	400m	165m	165m	0m	0m	0m	0m
South	1400m	1415m	1215m	700m	525m	590m	465m	505m
West	625m	365m	290m	0m	325m	325m	300m	300m

3.6 Mitigation Measures and Management

As requested by NT EPA, proposed measures and alternatives to further mitigation operational noise emissions were considered (Section 2.3) and the noise model was updated with all proposed mitigation options in place (Section 3.4). The mitigation measures and configuration arrangements in Scenario 4B included:

- Enclosed inverters in single air-conditioned structures;
- Building constructed around the VSC with air conditioning to control temperature;
- Reduced VSC configuration reflecting only one sending VSC at the site (i.e., for export to Singapore) with capacity of 2.4GW;
- VSC relocated approximately 200m to the south (location is approximately equivalent to the future sending VSC location);
- 330kV or 500kV AC 500MVA converter transformers in an open air in a 3-sided concrete/brick walled bunker with a height of 7 m.
- BESS sizing per Table 3-3 and Scenario 1 Existing DCS layout with associated step-up transformer: 250/125/125MVA 33kV to 330kV or 500kV connecting into the incoming $HVAC_b$ switchyard. Note the $HVAC_b$ switchyard (at 330kV or 500kV) is located outdoors; the remainder of the equipment would be circuit breakers, isolation switches, and control equipment which are not associated with noise emissions;

- BESS re-located approximately 400m west and 90m to the south to tie into the relocated VSC;
- Batteries containerised with $HVAC_a$ silencer; and
- 250/125/125MVA 33kV to 330kV or 500kV connecting into the incoming $HVAC_b$ switchyard step-up transformer located in open air surrounded by a 3-sided concrete/brick walled bunker with a height of 7m.

The results of Scenario 4B indicate impacts are almost fully mitigated with very marginal exceedances of the 35 dBA noise limit at one receptor.

Further mitigation and configuration opportunities will continue to be evaluated as project design and development progresses. These measures and opportunities will be subject to a similar options analysis that considers feasibility and effectiveness prior to adoption.

It is additionally noted that the results of this assessment are based on a number of conservative modelling assumptions, which when refined with additional information, would be expected to decrease predicted noise levels, as discussed below.

3.6.1 Baseline Noise Monitoring

The noise limits used for the purposes of this assessment are considered conservative and were developed using the Guideline assigned minimum RBL value for residential land use – 35 dBA.

To establish a more accurate Project Specific Assigned Noise Criteria, it is recommended that baseline noise monitoring and measurement be completed.

Baseline monitoring would aim to further refine the RBL used in the noise criteria selection at selected receptor locations and provide a more definitive understanding of likelihood of impact. A background noise level-based Project Specific Assigned Noise Level would also allow for the more accurate selection of potential noise mitigation controls.

The results of the baseline monitoring and subsequent data and analysis would be provided to the NT EPA to inform future discussion and project development.

3.6.2 Equipment Sound Power Validation

Validating equipment noise during detailed design once a selected product is chosen is recommended to ensure the noise model is accurately predicting the potential environmental noise impact of the Project. Supplier product specifications and

equipment sound powers are to be updated in the model once their values are known.

3.6.3 Follow-up Monitoring and Adaptive Management

3.6.3.1 Operational Noise Monitoring and Complaint Mechanism

Ambient noise monitoring combined with a complaints process is recommended once the Project is in operation to support an adaptive management approach to mitigating noise impacts as or when they may occur.

Operational noise monitoring data can be provided and reported to the NT EPA and other regulatory bodies as a condition of approval and to demonstrate performance. Baseline and operational monitoring data can also be used to inform future permitting processes and land use planning development changes.

3.6.3.2 Future Land Use Planning Area Discussions

The timing, type and location of development contemplated in the Litchfield Subregional Land Use Plan 2016 (V.6, 2023) is unknown at this time and is dependent on 'first movers' investing and successfully obtaining approvals to promote commercial and industrial activity in the area. Without a commercial / industrial economic base, the prospect of future residential urban development in Murrumujuk is uncertain. It is also expected there will be frequent opportunities for the proponent to be involved in future land use planning discussions for this area. It is anticipated these discussions can be supported with and will benefit from access to noise baseline data and actual equipment operating sound levels that can serve to more accurately guide future management actions and planning decisions.

3.7 Residual Impact Assessment and Significance

All scenarios result in residual impacts after considering mitigation. The potential significance of these impacts was assessed using the Environmental Impact Assessment (EIA) approach and methods adopted for the AAPowerLink EIA (Draft EIS, Chapter 3). This approach aligns with the NT EPA's *Guidelines for Preparing an Environmental Impact Statement* (2021).

The extent of residual impact associated with the DCS varies for each of the scenarios assessed.

Scenarios 1 and 2 resulted in an overall residual impact rating of **major** (significant) and **moderate** (potentially significant) when assessed against the Project Specific Assigned Noise Level (35 dBA) and the future urban residential noise criteria (40 dBA) respectively.

Scenarios 3A and 3B resulted in an overall residual impact rating of **major** (significant) and **minor** (not significant) for the Project Specific Assigned Noise Level (35 dBA) and the future urban residential noise criteria (40 dBA) respectively.

Scenarios 4A, 4B, 5A, and 5B resulted in an overall residual impact rating of **minor** (not significant) for both the Project Specific Assigned Noise Level (35 dBA) and the future urban residential noise criteria (40 dBA). Residual impacts for all scenarios are considered likely to occur.

The overall level of confidence in the assessment is considered moderate; while it is noted that residual impacts are based on a number of conservative assumptions using industry standard modelling techniques and software, there is moderate uncertainty in the location of future sensitive receptors, timing of future land use, and actual noise emission outputs based on installed equipment.

Results are summarised in Table 3-11.

Table 3-11: Residual Impact Assessment for Modelled Scenarios (Operations)

Scenario	Magnitude	Geographic Extent	Frequency/ Duration	Reversibility	Resilience	Likelihood	Certainty	Overall Rating
Project Specific Assigned Noise Criteria (35 dBA)								
1	Major	Regional	Continuous / Long-term	Reversible	Medium	Likely	Moderate	**Major**
2	Major	Regional	Continuous / Long-term	Reversible	Medium	Likely	Moderate	**Major**
3A	Major	Regional	Continuous / Long-term	Reversible	Medium	Likely	Moderate	**Major**
3B	Major	Regional	Continuous / Long-term	Reversible	Medium	Likely	Moderate	**Major**
4A	Negligible	Localised	Continuous / Long-term	Reversible	Medium	Likely	Moderate	**Minor**
4B	Minor	Localised	Continuous / Long-term	Reversible	Medium	Likely	Moderate	**Minor**
5A	Negligible	Localised	Continuous / Long-term	Reversible	Medium	Likely	Moderate	**Minor**

Scenario	Magnitude	Geographic Extent	Frequency/ Duration	Reversibility	Resilience	Likelihood	Certainty	Overall Rating
5B	Minor	Localised	Continuous / Long-term	Reversible	Medium	Likely	Moderate	**Minor**
Future Urban Residential Noise Criteria (40 dBA)								
1	Moderate	Regional	Continuous / Long-term	Reversible	Medium	Likely	Moderate	**Moderate**
2	Moderate	Regional	Continuous / Long-term	Reversible	Medium	Likely	Moderate	**Moderate**
3A	Minor	Regional	Continuous / Long-term	Reversible	Medium	Likely	Moderate	**Minor**
3B	Minor	Localised	Continuous / Long-term	Reversible	Medium	Likely	Moderate	**Minor**
4A	Negligible	Localised	Continuous / Long-term	Reversible	Medium	Likely	Moderate	**Minor**
4B	Negligible	Localised	Continuous / Long-term	Reversible	Medium	Likely	Moderate	**Minor**
5A	Negligible	Localised	Continuous / Long-term	Reversible	Medium	Likely	Moderate	**Minor**

Scenario	Magnitude	Geographic Extent	Frequency/ Duration	Reversibility	Resilience	Likelihood	Certainty	Overall Rating
5B	Negligible	Localised	Continuous / Long-term	Reversible	Medium	Likely	Moderate	**Minor**

Legend

	Minor (Not significant)
	Moderate (Potentially significant)
	Major (Significant)

As Scenario 4B was considered the most compliant and feasible of the scenarios assessed, a deeper analysis of extent of potential residual impacts was completed. A residual night-time noise impact for Scenario 4B is predicted in a localised area affecting 82.4 ha beyond the DCS parcel boundary to the north/ northeast.

Under a future residential urban land use case with the adoption of the future urban residential land use criteria (40 dBA), it is anticipated that there would be no residual noise impacts predicted at the sensitive receiver locations, although 8.1 ha of the proposed urban residential land use zone is expected to fall within the exceedance area, north and north-east of the DCS. Potential residual impacts can be adaptively managed through a follow-up monitoring program during operations with consideration of additional feasible noise mitigation if needed, based on monitoring outcomes and community complaints. The proposed baseline monitoring and validation monitoring described in Section 3.6 will provide a more accurate representation of residual impacts associated with the DCS and allow for confirmation of the level and appropriateness of mitigation measures selected and implemented. This additional assessment would also provide any future land use planning development effort a more accurate understanding of the potential for residual impact that could then be considered in the planning and development of that proposal.

As part of the Stakeholder Engagement Strategy for the Project, it is recommended that Sun Cable continue to engage with relevant stakeholders on the issue of residual impacts and be included in and participate in future surrounding land use designation and planning discussions. Additionally, it is recommended that Sun Cable continue to provide details and information to relevant stakeholders of the ongoing acoustic performance output of the DCS to help facilitate and inform future land use planning decisions.

4. Summary

This noise impact assessment of the operational activity at the DCS was completed consistent with the Northern Territory Noise Management Framework Guideline and is provided as a response to NT EPA comments.

Eight different Project scenarios were developed to test feasibility assumptions related to potential design, layout, and mitigation options, with an overall objective of reducing off-site noise impacts in the Murrumujuk Township.

Scenario 4B was identified as the most compliant and feasible scenario, as it offered the most optimal approach when considering environmental, social, technical and economic performance objectives. This scenario requires the re-location of one-sending VSC to the south of the DCS, relocation of the BESS, inverter enclosures, and construction of a 7m high concrete bunker surrounding the $HVAC_b$ switchyard transformer on three sides.

An assessment of residual impacts was completed for all eight scenarios considered. The assessment determined that Scenario 4B resulted in a minor, not significant residual impact predicted for both rural and urban land use settings in a localised area around the DCS. Due to the minor magnitude and local extent of impact, and uncertain timing of future development, it is recommended that the residual impacts from noise be adaptively managed, using a combination of follow-up monitoring and community noise complaint mechanisms.

It is also proposed to continue engagement with both planning and regulatory authorities to manage any residual noise impacts adaptively post project approval, including through operational permitting processes, future area planning discussions, equipment selection and validation, and an operational monitoring and complaints procedure.

Approvals of renewable energy projects, and commercial and industrial development more broadly in the region are recognised as key enablers of the future urban development expansion plans for the Murrumujuk Township. Should the Project be approved to proceed, it is recommended the proponent be invited to participate in future area planning initiatives to discuss the need for compatible land uses in the Project area and region.

This evidence-based analysis provides certainty there are Project options available that meet the compliance objectives of the noise guideline, thus enabling an approval decision to be taken. Minor to moderate not significant residual impacts are expected

to allow the objectives of the community and economy environmental factor[5] to be met, particularly when balanced against the significant future economic development opportunities the Project itself represents and will induce in the region.

[5] Community and economy factor objectives: to enhance communities and the economy for the welfare, amenity and benefit of current and future generations in the Northern Territory (NT EPA, 2022).

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Appendix A Results of Additional Scenarios Modelled

Scenario 1

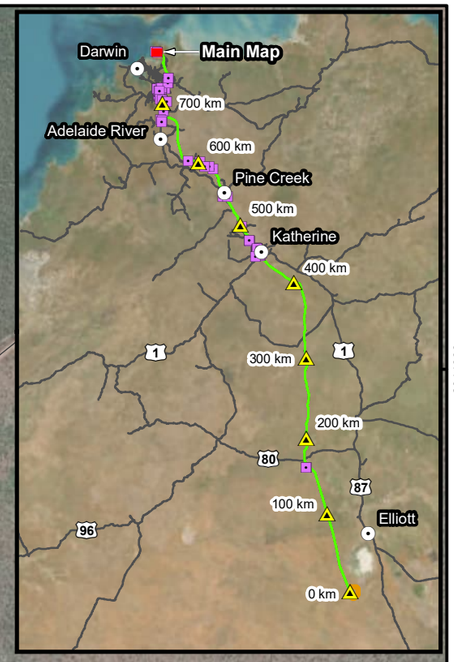
Scenario 1 contains the full existing DCS layout with mitigation on the inverters, a 4m tall 3-wall bunker enclosing the transformers, and a containerised battery with $HVAC_a$ silencer. All VSC sites are contained in this configuration. The noise levels at the receptors were 42 dBA, 45 dBA, and 45 dBA at POR128, POR129, and POR129b respectively. This scenario results in the highest level of impact at POR128 due to the proximity of this receptor to the VSC and BESS site.

Figure A-1 provides the operational noise contours from the DCS respective to POR 128, POR 129, and POR 129b.

Figure A-2 provides an overlay of the Project Specific Assigned Noise Level (35 dBA) contour and the expected future urban residential noise criteria (40 dBA) contour over the proposed Murrumujuk Township. It is anticipated that this scenario would result in an exceedance of the project specific assigned noise level for a distance of 2200m to the North, 1300m to the East, 2350m to the South, and 1550m to the West. It is anticipated that this scenario would result in an exceedance of the expected future urban residential noise criteria for a distance of 925m to the North, 450m to the East, 1400m to the South, and 625m to the West.

720000
722000
724000
726000
8644000
8642000
8640000

Gunn Point Prison Farm Access
Gunn Point
POR128
Track
Murrumujuk Drive
POR129b
POR129
Leaders Creek Boat Ramp Access
783.2 km
Darwin Converter Site (DCS)
Tree Point Access
Gunn Point Road
780 km



- Populated Place
- Sensitive Receptor
- Kilometre Points
- OHTL Corridor
- VSC Building
- AAPowerLink Infrastucture
- Road
- Noise Barrier

Cumulative Operational Noise (dB)

- 35 - 45
- 45 - 55
- 55 - 65
- > 65

NOTES:
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2. Projection: GDA2020 MGA Zone 52
3. Imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

0 0.25 0.5 1 Kilometres

1:20,000

NORTH

Figure A-1
Sun Cable
Australia-Asia PowerLink Project

Scenario 1 - DCS Operational Night-time Noise Levels in the Dry Season

suncable

HATCH

File: SUN-NOI-031

718000 720000 722000 724000 726000 728000

8646000 8644000 8642000 8640000

1378 2727 2626 2203 2626 3101 6166 5911 3104 5911 4476 6166

Gunn Point Prison Farm Access

Gunn Point

Leaders Creek Boat Ramp Access

Murrumujuk Drive

Track

Tree Point Access

Darwin Converter Site (DCS)

Gunn Point Road

POR128 POR129 POR129b

2200m 925m 1550m 625m 450m 1300m 1400m 2350m

- Sensitive Receptor
- **Project Specific Assigned Noise Level**
  - 35 dBA
  - 40 dBA
  - 45 dBA
- Populated Place
- AAPowerLink Infrastucture
- Road
- Land Parcel
- **Proposed Draft Concept Plan for Murrumujuk Township**[4]
  - Urban/Peri-urban
  - Potential Rural Residential in Response to Biting Insects
  - Rural Area
  - Potential Sites for Tourism Development
  - Potential Managed Waterbody
- **Recreation**
  - Open Space/Natural Area
- **Infrastructure**
  - Planned Rail
  - Proposed Main Road
  - Utility Corridor
- **Other**
  - Conservation
  - Future Development
  - Strategic Industry
  - Agriculture/Grazing

NOTES:
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2. Projection: GDA2020 MGA Zone 52
3. Imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.
4. Digitized from Figures 4 and 9 in the Proposed Updates to Litchfield Subregional Land Use Plan - Gunn Point Peninsula, July 2020 (https://planningcommission.nt.gov.au/__data/assets/pdf_file/0006/909996/LSLUP-2020-V2_1.pdf)

0 0.5 1 2 Kilometres

1:30,000

NORTH

Figure A-2
Sun Cable
Australia-Asia PowerLink Project
Scenario 1 - DCS Operational Night-time Modelled Noise Levels (Dry Season) with Proposed Murrumujuk Township Land Use

suncable

HATCH

File: SUN-NOI-032

Scenario 2

Scenario 2 contains only one sending VSC with no mitigation on any of the equipment. The noise levels at the receptors were 41 dBA, 46 dBA, and 45 dBA at POR128, POR129, and POR129b respectively. This is the loudest scenario at POR129 due to the proximity of the receptor to the battery storage area which is unmitigated in this scenario.

Figure A-3 provides the operational noise contours from the DCS respective to POR 128, POR 129, and POR 129b.

Figure A-4 provides an overlay of the Project Specific Assigned Noise Level (35 dBA) contour and the expected future urban residential noise criteria (40 dBA) contour over the proposed Murrumujuk Township for this unmitigated scenario. It is anticipated that this scenario would result in an exceedance of the project specific assigned noise level for a distance of 1635m to the North, 535m to the East, 1635m to the South, and 890m to the West. It is anticipated that this scenario would result in an exceedance of the expected future urban residential noise criteria for a distance of 1035m to the North, 400m to the East, 1415m to the South, and 365m to the West.

720000 722000 724000 726000

8644000 8642000 8640000

Gunn Point Prison Farm Access

Gunn Point

POR128

Track

Murrumujuk Drive

POR129b

POR129

Leaders Creek Boat Ramp Access

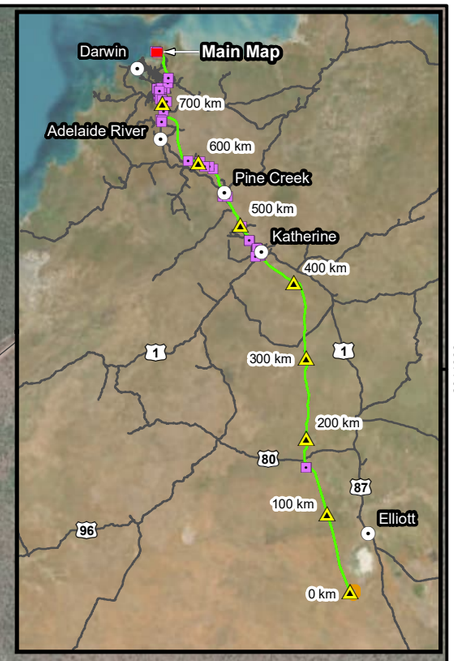
783.2 km

Darwin Converter Site (DCS)

Tree Point Access

Gunn Point Road

780 km



- Populated Place
- Sensitive Receptor
- Kilometre Points
- OHTL Corridor
- VSC Building
- AAPowerLink Infrastucture
- Road

Cumulative Operational Noise (dB)

- 35 - 45
- 45 - 55
- 55 - 65
- > 65

NOTES:
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2. Projection: GDA2020 MGA Zone 52
3. Imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

0 0.25 0.5 1 Kilometres

1:20,000

NORTH

Figure A-3
Sun Cable
Australia-Asia PowerLink Project

Scenario 2 - DCS Operational Night-time Noise Levels in the Dry Season

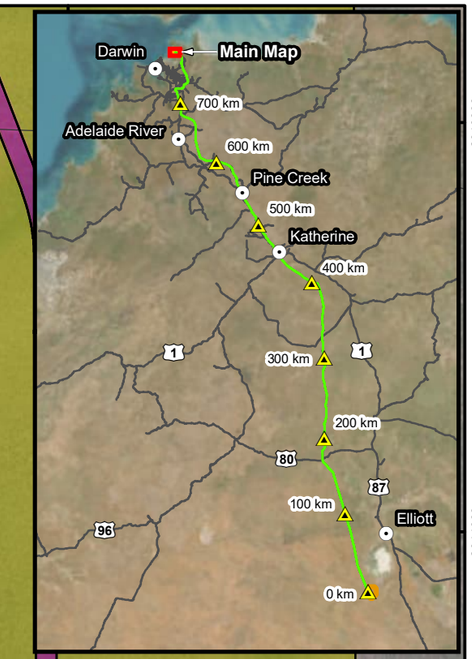
suncable

HATCH

File: SUN-NOI-033

718000 720000 722000 724000 726000 728000

8646000 8644000 8642000 8640000



1378
2727
2626
2203
4476
6166
3101
5911
3104

Gunn Point Prison Farm Access
Gunn Point
Leaders Creek Boat Ramp Access
Murrumujuk Drive
Track
Tree Point Access
Gunn Point Road
Darwin Converter Site (DCS)

POR128
POR129
POR129b

1635m
1035m
365m
890m
400m
535m
1415m
1635m

Sensitive Receptor

Project Specific Assigned Noise Level
- 35 dBA
- 40 dBA
- 45 dBA

Populated Place
AAPowerLink Infrastucture
Road
Land Parcel

Proposed Draft Concept Plan for Murrumujuk Township[4]
- Urban/Peri-urban
- Potential Rural Residential in Response to Biting Insects
- Rural Area
- Potential Sites for Tourism Development
- Potential Managed Waterbody

Recreation
- Open Space/Natural Area

Infrastructure
- Planned Rail
- Proposed Main Road
- Utility Corridor

Other
- Conservation
- Future Development
- Strategic Industry
- Agriculture/Grazing

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2. Projection: GDA2020 MGA Zone 52
3. Imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.
4. Digitized from Figures 4 and 9 in the Proposed Updates to Litchfield Subregional Land Use Plan - Gunn Point Peninsula, July 2020 (https://planningcommission.nt.gov.au/__data/assets/pdf_file/0006/909996/LSLUP-2020-V2_1.pdf)

0 0.5 1 2 Kilometres

1:30,000

NORTH

Figure A-4
Sun Cable
Australia-Asia PowerLink Project

Scenario 2 - DCS Operational Night-time Modelled Noise Levels (Dry Season) with Proposed Murrumujuk Township Land Use

suncable

HATCH

File: SUN-NOI-034

Scenario 3A

Scenario 3A contains the same configuration as Scenario 2 but with mitigation added back to the inverters, battery, and transformer skids. The noise levels were 40 dBA, 43 dBA, and 42 dBA at POR128, POR129, and POR129b respectively. The mitigation adopted at the DCS battery storage site in this scenario resulted in a reduction of noise by 1 dBA at POR 128 and 3 dBA at POR129 and POR 129b when compared to Scenario 2.

Figure A-5 provides the operational noise contours from the DCS respective to both POR 128, POR 129, and POR 129b.

Figure A-6 provides an overlay of the Project Specific Assigned Noise Level (35 dBA) contour and the expected future urban residential noise criteria (40 dBA) contour over the proposed Murrumujuk Township for this mitigated scenario. It is anticipated that this scenario would result in an exceedance of the project specific assigned noise level for a distance of 1550m to the North, 385m to the East, 1595m to the South, and 890m to the West. It is anticipated that this scenario would result in an exceedance of the expected future urban residential noise criteria for a distance of 960m to the North, 165m to the East, 1215m to the South, and 290m to the West.

720000 722000 724000 726000

8644000 8642000 8640000

Gunn Point Prison Farm Access

Gunn Point

POR128

Track

Murrumujuk Drive

POR129b

POR129

Leaders Creek Boat Ramp Access

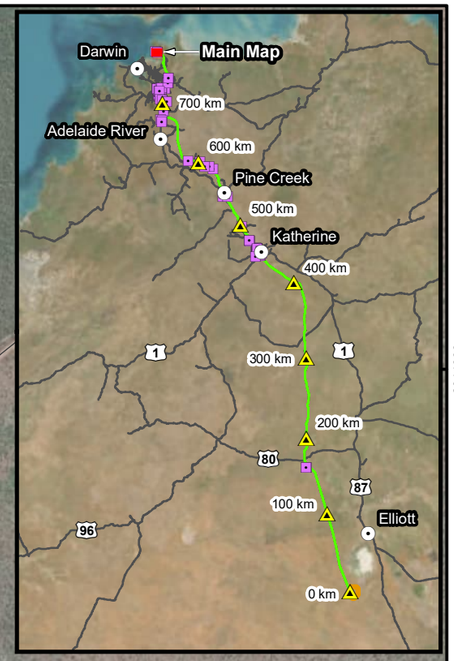
783.2 km

Darwin Converter Site (DCS)

Tree Point Access

Gunn Point Road

780 km



- Populated Place
- Sensitive Receptor
- Kilometre Points
- OHTL Corridor
- VSC Building
- AAPowerLink Infrastucture
- Road

Cumulative Operational Noise (dB)

- 35 - 45
- 45 - 55
- 55 - 65
- > 65

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3. Imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

0 0.25 0.5 1 Kilometres

1:20,000

NORTH

Figure A-5
Sun Cable
Australia-Asia PowerLink Project

Scenario 3A - DCS Operational Night-time Noise Levels in the Dry Season

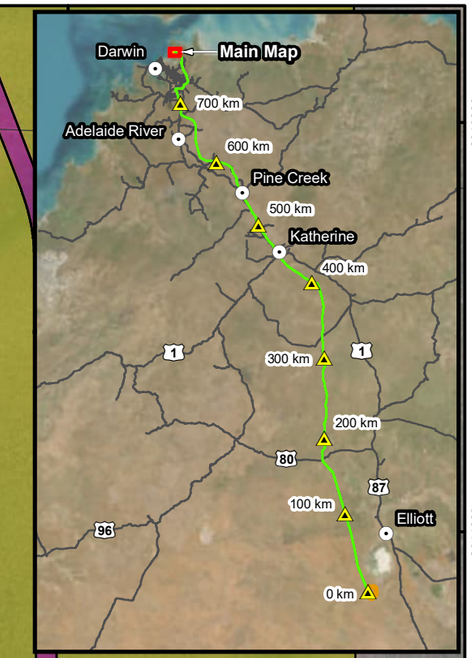
suncable

HATCH

File: SUN-NOI-035

718000 720000 722000 724000 726000 728000

8646000 8644000 8642000 8640000



1378
Gunn Point Prison Farm Access
2727
Gunn Point
2626
2203
POR128
1550m
960m
Murrumujuk Drive
POR129
POR129b
Leaders Creek Boat Ramp Access
890m
290m
385m
Track
Darwin Converter Site (DCS)
1215m
1595m
Tree Point Access
4476
6166
Gunn Point Road
3101
6166
165m
1:6,000
5911
3104
5911

Sensitive Receptor

Project Specific Assigned Noise Level
- 35 dBA
- 40 dBA
- 45 dBA

Populated Place
AAPowerLink Infrastucture
Road
Land Parcel

Proposed Draft Concept Plan for Murrumujuk Township[4]
- Urban/Peri-urban
- Potential Rural Residential in Response to Biting Insects
- Rural Area
- Potential Sites for Tourism Development
- Potential Managed Waterbody

Recreation
- Open Space/Natural Area

Infrastructure
- Planned Rail
- Proposed Main Road
- Utility Corridor

Other
- Conservation
- Future Development
- Strategic Industry
- Agriculture/Grazing

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3. Imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.
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0 0.5 1 2 Kilometres

1:30,000

NORTH

Figure A-6
Sun Cable
Australia-Asia PowerLink Project

Scenario 3A - DCS Operational Night-time Modelled Noise Levels (Dry Season) with Proposed Murrumujuk Township Land Use

suncable

HATCH

File: SUN-NOI-036

Scenario 3B

Scenario 3B contains the same configuration as Scenario 3A with mitigation added back to the inverters, battery, and transformer skids. In addition, a 4 m tall 3-sided concrete/brick walled bunker is added to the VSC transformers. The noise levels at receptors were 38 dBA, 43 dBA, and 42 dBA at POR128, POR129, and POR 129b respectively. Mitigation applied at the VSC and battery storage site in this scenario results in a reduction of noise by 3 dBA at POR128, POR129 and POR 129b when compared to Scenario 2.

Figure A-7 provides the operational noise contours from the DCS respective to both POR 128, POR 129, and POR 129b.

Figure A-8 provides an overlay of the Project Specific Assigned Noise Level (35 dBA) contour and the expected future urban residential noise criteria (40 dBA) contour over the proposed Murrumujuk Township for this mitigated scenario. It is anticipated that this scenario would result in an exceedance of the project specific assigned noise level for a distance of 1100m to the North, 385m to the East, 1405m to the South, and 570m to the West. It is anticipated that this scenario would result in an exceedance of the expected future urban residential noise criteria for a distance of 740m to the North, 165m to the East, 700m to the South, and 0m to the West.

720000 722000 724000 726000

8644000 8642000 8640000

Gunn Point Prison Farm Access

Gunn Point

POR128

Track

Murrumujuk Drive

POR129b

POR129

Leaders Creek Boat Ramp Access

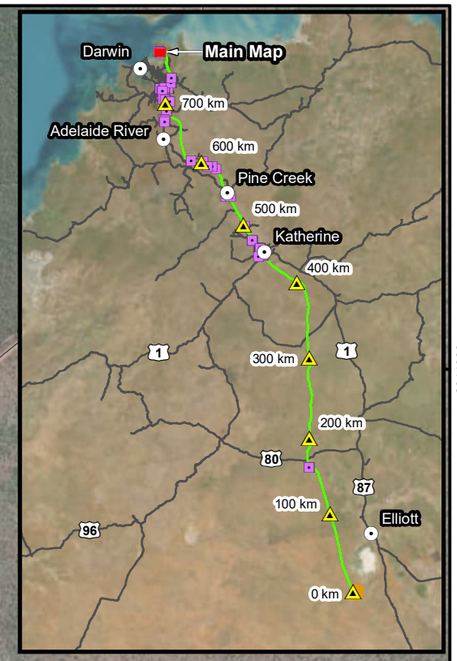
783.2 km

Darwin Converter Site (DCS)

Tree Point Access

Gunn Point Road

780 km



- Populated Place
- Sensitive Receptor
- Kilometre Points
- OHTL Corridor
- VSC Building
- AAPowerLink Infrastucture
- Road
- Noise Barrier

Cumulative Operational Noise (dB)

- 35 - 45
- 45 - 55
- 55 - 65
- > 65

NOTES:
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3. Imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

0 0.25 0.5 1 Kilometres

1:20,000

NORTH

Figure A-7
Sun Cable
Australia-Asia PowerLink Project

Scenario 3B - DCS Operational Night-time Noise Levels in the Dry Season

suncable

HATCH

File: SUN-NOI-037

718000 720000 722000 724000 726000 728000

8646000 8644000 8642000 8640000

1378 2727 2626 2203 2626 4476 6166 3101 6166 5911 3104 5911

Gunn Point Prison Farm Access

Gunn Point

Leaders Creek Boat Ramp Access

Murrumujuk Drive

Track

Tee Point Access

Darwin Converter Site (DCS)

Gunn Point Road

POR128 POR129 POR129b

1100m 740m 700m 1405m 570m 385m 165m

1:6,000

Darwin Main Map 700 km Adelaide River 600 km Pine Creek 500 km Katherine 400 km 300 km 200 km 100 km Elliott 0 km

1 1 80 87 96

- Sensitive Receptor

Project Specific Assigned Noise Level

- 35 dBA
- 40 dBA
- 45 dBA
- Populated Place
- AAPowerLink Infrastucture
- Road
- Land Parcel

Proposed Draft Concept Plan for Murrumujuk Township[4]

- Urban/Peri-urban
- Potential Rural Residential in Response to Biting Insects
- Rural Area
- Potential Sites for Tourism Development
- Potential Managed Waterbody

Recreation

- Open Space/Natural Area

Infrastructure

- Planned Rail
- Proposed Main Road
- Utility Corridor

Other

- Conservation
- Future Development
- Strategic Industry
- Agriculture/Grazing

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0 0.5 1 2 Kilometres

1:30,000

NORTH

Figure A-8
Sun Cable
Australia-Asia PowerLink Project

Scenario 3B - DCS Operational Night-time Modelled Noise Levels (Dry Season) with Proposed Murrumujuk Township Land Use

suncable

HATCH

File: SUN-NOI-038

Scenario 4A

Scenario 4A contains the same configuration as Scenario 3B with the one sending VSC shifted south approximately 200m. The BESS is shifted approximately 400 m west and 90 m south to tie into the relocated VSC. Mitigation is added back to the inverters, battery, and transformer skids except for containerising the 38 x Battery Skid Transformers. Containerising the battery skid transformers is no longer considered due to little noise reduction benefit and high technical constraints during implementation. In addition, a 7m tall 3-sided concrete/brick walled bunker is added to the VSC transformers and step-up transformer. Finally, a 12m tall and 2950m long absorptive noise barrier is positioned at the northern project boundary of the DCS as shown in Figure A-9.

The noise levels at receptors were 32 dBA, 32 dBA, and 31 dBA at POR128, POR129, and POR 129b respectively. Mitigation applied at the VSC and battery storage site including the equipment relocation and project boundary noise barrier resulted in a reduction of noise by 5 dBA at all three receiver locations when compared to Scenario 3B.

Figure A-9 provides the operational noise contours from the DCS respective to both POR 128, POR 129, and POR 129b.

Figure A-10 provides an overlay of the Project Specific Assigned Noise Level (35 dBA) contour and the expected future urban residential noise criteria (40 dBA) contour over the proposed Murrumujuk Township for this mitigated scenario. It is anticipated that this scenario would result in an exceedance of the Project Specific Assigned Noise Level for a distance of 485m to the North, 0m to the East, 900m to the South, and 815m to the West. It is anticipated that this scenario would result in an exceedance of the expected future urban residential noise criteria for a distance of 0m to the North, 0m to the East, 525m to the South, and 325m to the West.

720000 722000 724000 726000

8644000 8642000 8640000

Gunn Point Prison Farm Access

Gunn Point

POR128

Track

Murrumujuk Drive

POR129b

POR129

Leaders Creek Boat Ramp Access

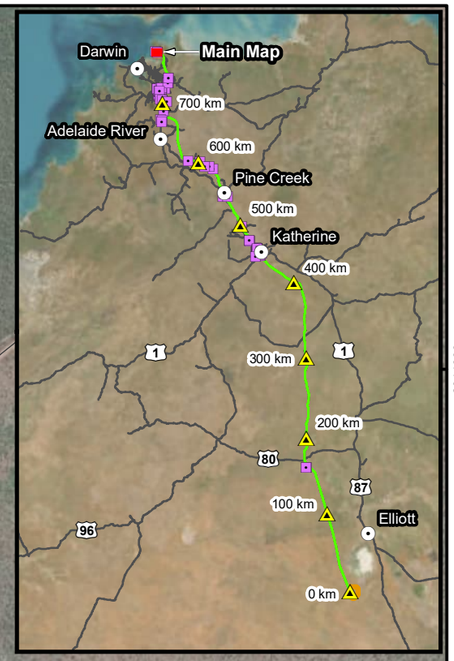
783.2 km

Darwin Converter Site (DCS)

Tree Point Access

Gunn Point Road

780 km



- Populated Place
- Sensitive Receptor
- Kilometre Points
- OHTL Corridor
- VSC Building
- AAPowerLink Infrastucture
- Road
- Noise Barrier

Cumulative Operational Noise (dB)

- 35 - 45
- 45 - 55
- 55 - 65
- > 65

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0 0.25 0.5 1 Kilometres

1:20,000

NORTH

Figure A-9
Sun Cable
Australia-Asia PowerLink Project

Scenario 4A - DCS Operational Night-time Noise Levels in the Dry Season

suncable

HATCH

File: SUN-NOI-039

718000 720000 722000 724000 726000 728000

8646000 8644000 8642000 8640000

1378 2727 2626 2203 2626 3101 6166 5911 3104 5911 4476 6166

Gunn Point Prison Farm Access

Gunn Point

Leaders Creek Boat Ramp Access

Murrumujuk Drive

Track

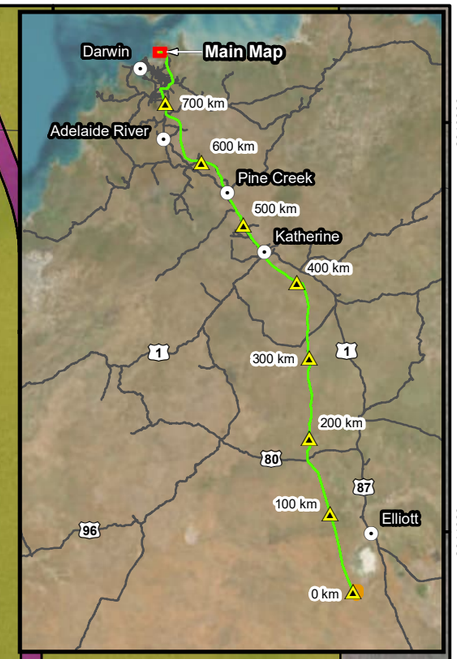
Tree Point Access

Gunn Point Road

POR128 POR129 POR129b

485m 815m 325m 525m 900m

Darwin Converter Site (DCS)



- Sensitive Receptor

Project Specific Assigned Noise Level

- 35 dBA
- 40 dBA
- 45 dBA
- Populated Place
- AAPowerLink Infrastucture
- Road
- Land Parcel

Proposed Draft Concept Plan for Murrumujuk Township[4]

- Urban/Peri-urban
- Potential Rural Residential in Response to Biting Insects
- Rural Area
- Potential Sites for Tourism Development
- Potential Managed Waterbody

Recreation

- Open Space/Natural Area

Infrastructure

- Planned Rail
- Proposed Main Road
- Utility Corridor

Other

- Conservation
- Future Development
- Strategic Industry
- Agriculture/Grazing

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0 0.5 1 2 Kilometres

1:30,000

NORTH

Figure A-10
Sun Cable
Australia-Asia PowerLink Project

Scenario 4A - DCS Operational Night-time Modelled Noise Levels (Dry Season) with Proposed Murrumujuk Township Land Use

suncable

HATCH

File: SUN-NOI-040

Scenario 5A

Scenario 5A contains the same configuration and mitigation as Scenario 4A, with the northern half of the BESS installation removed from the DCS and the associated step-up transformer sized halved from 250 MVA to 125 MVA. The noise levels at receptors were 30 dBA, 31 dBA, and 30 dBA at POR128, POR129, and POR 129b respectively. Mitigation applied at the VSC and battery storage site including the equipment relocation, halved BESS installation, and project boundary noise barrier resulted in a reduction of noise by 7 dBA at all three receiver locations when compared to Scenario 3b.

Figure A-11 provides the operational noise contours from the DCS respective to both POR 128, POR 129, and POR 129b.

Figure A-12 provides an overlay of the Project Specific Assigned Noise Level (35 dBA) contour and the expected future urban residential noise criteria (40 dBA) contour over the proposed Murrumujuk Township for this mitigated scenario. It is anticipated that this scenario would result in an exceedance of the project specific assigned noise level for a distance of 425m to the North, 0m to the East, 835m to the South, and 770m to the West. It is anticipated that this scenario would result in an exceedance of the expected future urban residential noise criteria for a distance of 0m to the North, 0m to the East, 465m to the South, and 300m to the West.

720000 722000 724000 726000

8644000 8642000 8640000

Gunn Point Prison Farm Access

Gunn Point

POR128

Track

Murrumujuk Drive

POR129b

POR129

Leaders Creek Boat Ramp Access

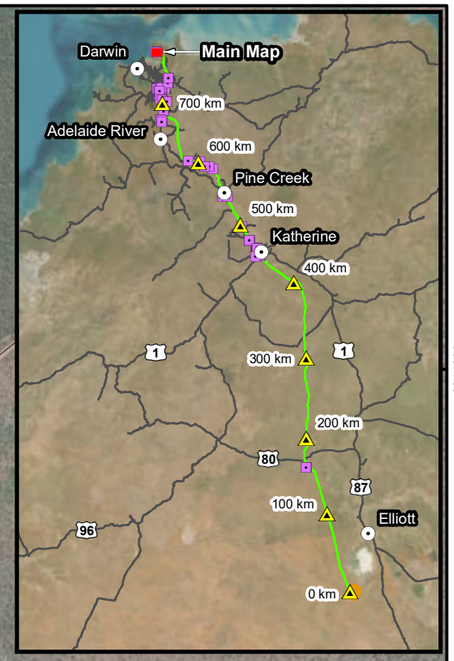
783.2 km

Darwin Converter Site (DCS)

Tree Point Access

Gunn Point Road

780 km



- Populated Place
- Sensitive Receptor
- Kilometre Points
- OHTL Corridor
- VSC Building
- AAPowerLink Infrastucture
- Road
- Noise Barrier

Cumulative Operational Noise (dB)

- 35 - 45
- 45 - 55
- 55 - 65
- > 65

NOTES:
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2. Projection: GDA2020 MGA Zone 52
3. Imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

0 0.25 0.5 1 Kilometres

1:20,000

NORTH

Figure A-11
Sun Cable
Australia-Asia PowerLink Project

Scenario 5A - DCS Operational Night-time Noise Levels in the Dry Season

suncable

HATCH

File: SUN-NOI-041

718000 720000 722000 724000 726000 728000

8646000 8644000 8642000 8640000

1378
2727
2626
2203
2626
4476
6166
3101
6166
5911
3104
5911

Gunn Point Prison Farm Access
Gunn Point
Leaders Creek Boat Ramp Access
Murrumujuk Drive
Tree Point Access
Track
Gunn Point Road

POR128
POR129
POR129b

425m
770m
300m
465m
835m

Darwin Converter Site (DCS)

- Sensitive Receptor

Project Specific Assigned Noise Level
- 35 dBA
- 40 dBA
- Populated Place
- AAPowerLink Infrastucture
- Road
- Land Parcel

Proposed Draft Concept Plan for Murrumujuk Township[4]
- Urban/Peri-urban
- Potential Rural Residential in Response to Biting Insects
- Rural Area
- Potential Sites for Tourism Development
- Potential Managed Waterbody

Recreation
- Open Space/Natural Area

Infrastructure
- Planned Rail
- Proposed Main Road
- Utility Corridor

Other
- Conservation
- Future Development
- Stretegic Industry
- Agriculture/Grazing

NOTES:
1. Contains information under the Creative Commons Attribution 4.0 International Licence (CC BY 4.0).
2. Projection: GDA2020 MGA Zone 52
3. Imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.
4. Digitized from Figures 4 and 9 in the Proposed Updates to Litchfield Subregional Land Use Plan - Gunn Point Peninsula, July 2020 (https://planningcommission.nt.gov.au/__data/assets/pdf_file/0006/909996/LSLUP-2020-V2_1.pdf)

0 0.5 1 2 Kilometres

1:30,000

NORTH

Figure A-12
Sun Cable
Australia-Asia PowerLink Project
Scenario 5A - DCS Operational Night-time Modelled Noise Levels (Dry Season) with Proposed Murrumujuk Township Land Use

suncable

HATCH

File: SUN-NOI-042

Scenario 5B

Scenario 5B contains the same configuration and mitigation as Scenario 5A, with the 12m tall and 2950m long absorptive noise barrier at the northern project boundary of the DCS removed.

The noise levels at receptors were 33 dBA, 36 dBA, and 35 dBA at POR128, POR129, and POR 129b respectively.

Figure A-13 provides the operational noise contours from the DCS respective to both POR 128, POR 129, and POR 129b.

Figure A-14 provides an overlay of the Project Specific Assigned Noise Level (35 dBA) contour and the expected future urban residential noise criteria (40 dBA) contour over the proposed Murrumujuk Township for this mitigated scenario. It is anticipated that this scenario would result in an exceedance of the project specific assigned noise level for a distance of 715m to the North, 120m to the East, 865m to the South, and 770m to the West. It is anticipated that this scenario would result in an exceedance of the expected future urban residential noise criteria for a distance of 360m to the North, 0m to the East, 505m to the South, and 300m to the West.

720000 722000 724000 726000

8644000 8642000 8640000

Gunn Point Prison Farm Access

Gunn Point

POR128

Track

Murrumujuk Drive

POR129b

POR129

Leaders Creek Boat Ramp Access

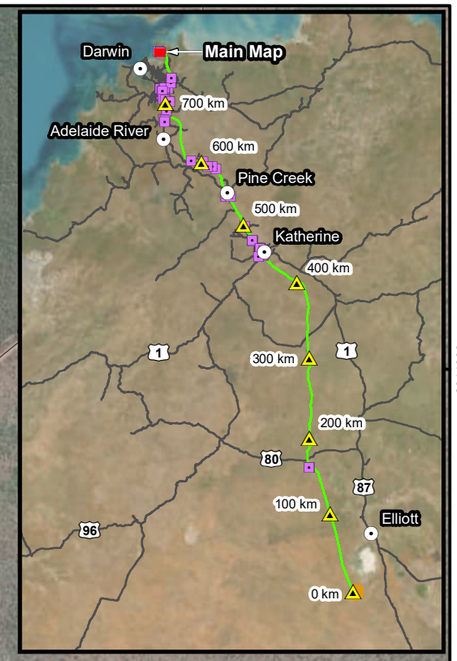
783.2 km

Darwin Converter Site (DCS)

Tree Point Access

Gunn Point Road

780 km



- Populated Place
- Sensitive Receptor
- Kilometre Points
- OHTL Corridor
- VSC Building
- AAPowerLink Infrastucture
- Road
- Noise Barrier

Cumulative Operational Noise (dB)

- 35 - 45
- 45 - 55
- 55 - 65
- > 65

NOTES:
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2. Projection: GDA2020 MGA Zone 52
3. Imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

0 0.25 0.5 1 Kilometres

1:20,000

NORTH

Figure A-13
Sun Cable
Australia-Asia PowerLink Project

Scenario 5B - DCS Operational Night-time Noise Levels in the Dry Season

suncable

HATCH

File: SUN-NOI-045

718000 720000 722000 724000 726000 728000

8646000 8644000 8642000 8640000

1378 2727 2626 2203 4476 3101 6166 5911 3104

Gunn Point Prison Farm Access

Gunn Point

Leaders Creek Boat Ramp Access

Murrumujuk Drive

POR128 POR129 POR129b

715m 360m 770m 300m 505m 865m

Track

Darwin Converter Site (DCS)

Tiee Point Access

Gunn Point Road

120m 1:6,000

Darwin Main Map 700 km Adelaide River 600 km Pine Creek 500 km Katherine 400 km 300 km 200 km 100 km Elliott 0 km

1 1 80 87 96

- Sensitive Receptor
- **Project Specific Assigned Noise Level**
  - 35 dBA
  - 40 dBA
- Populated Place
- AAPowerLink Infrastucture
- Road
- Land Parcel

Proposed Draft Concept Plan for Murrumujuk Township[4]

- Urban/Peri-urban
- Potential Rural Residential in Response to Biting Insects
- Rural Area
- Potential Sites for Tourism Development
- Potential Managed Waterbody

Recreation

- Open Space/Natural Area

Infrastructure

- Planned Rail
- Proposed Main Road
- Utility Corridor

Other

- Conservation
- Future Development
- Stretegic Industry
- Agriculture/Grazing

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4. Digitized from Figures 4 and 9 in the Proposed Updates to Litchfield Subregional Land Use Plan - Gunn Point Peninsula, July 2020 (https://planningcommission.nt.gov.au/__data/assets/pdf_file/0006/909996/LSLUP-2020-V2_1.pdf)

0 0.5 1 2 Kilometres

1:30,000

NORTH

Figure A-14
Sun Cable
Australia-Asia PowerLink Project

Scenario 5B - DCS Operational Night-time Modelled Noise Levels (Dry Season) with Proposed Murrumujuk Township Land Use

suncable

HATCH

File: SUN-NOI-046

APPENDIX C PINE CREEK OHTL ROUTE ALTERNATIVES

1. Appendix C - OHTL Corridor route option assessment – Pine Creek, March 2024.

1.1. Location and context

In the Supplementary Environmental Impact Statement (SEIS) lodged in 2022, a corridor for the entire length of the OHTL was presented. The corridor proposed ran 783km primarily through the existing railway corridor, prior to entering the proposed NTG utilities corridor to the Darwin Converter Site at Murrumujuk.

Three primary areas for deviation from the railway corridor were proposed at Katherine, Pine Creek and Adelaide River. These deviations were precipitated by spatial constraints within the existing railway corridor. Each deviation is a proposed mitigation measure to avoid the constraints present within the railway corridor.

The Department of Environment, Parks and Water Security (DEPWS) has raised concerns with regard to the Pine Creek deviation presented through the SEIS, and its potential impact on known Ghost Bat roost sites close to Pine Creek township. The existing Pine Creek deviation traverses within 500m of a significant roost site. Per comments received 10 January 2024 via the NTEPA, DEPWS has recommended that the project undertake further investigations and demonstrate application of the precautionary principle to avoid impacts on the roost site.

Accordingly, alternative OHTL routes around the Pine Creek township have been considered to reduce the potential impact to the local Ghost Bat population.

A route considered acceptable for the OHTL Corridor and providing a significant buffer to the primary roost site is identified below. This route is subject to further detailed design, engagement with affected stakeholders and ongoing route refinement. An overview of the OHTL Corridor deviation at Pine Creek is shown (ID D2 in Figure 1-1 - Alternative OHTL options in the Pine Creek area). The estimated overall length of the OHTL Corridor is now 791km.

1.2. Route Selection

Following DEPWS' advice in January 2024, six additional routes to the existing route around the Pine Creek township were considered, refer Figure 1-1 - Alternative OHTL options in the Pine Creek area. Whilst avoidance to Ghost Bat habitat precipitated this review, analysis also considered constraints including

land access potential, areas of cultural heritage significance, sacred sites, ecology, geology, and flooding potential. A review of NTG's strategic planning policy documents, as well as engagement with Government, has also occurred. It should be noted that significant work is to be undertaken to proof route options, refer Section 1.4 below.

In 2021-2022, engagement with impacted landowners was undertaken for the original Pine Creek deviation. Engagement will be continued given the assumptions expressed below. The objective is to ensure that an opportunity for securing appropriate tenure exists, and if not, potential mitigations or alternative considerations are identified.

Six alternative route alignments for the OHTL Corridor were deemed 'challenging' or worse and therefore not preferred. All alternative routes are discussed in Figure 1-3 below.

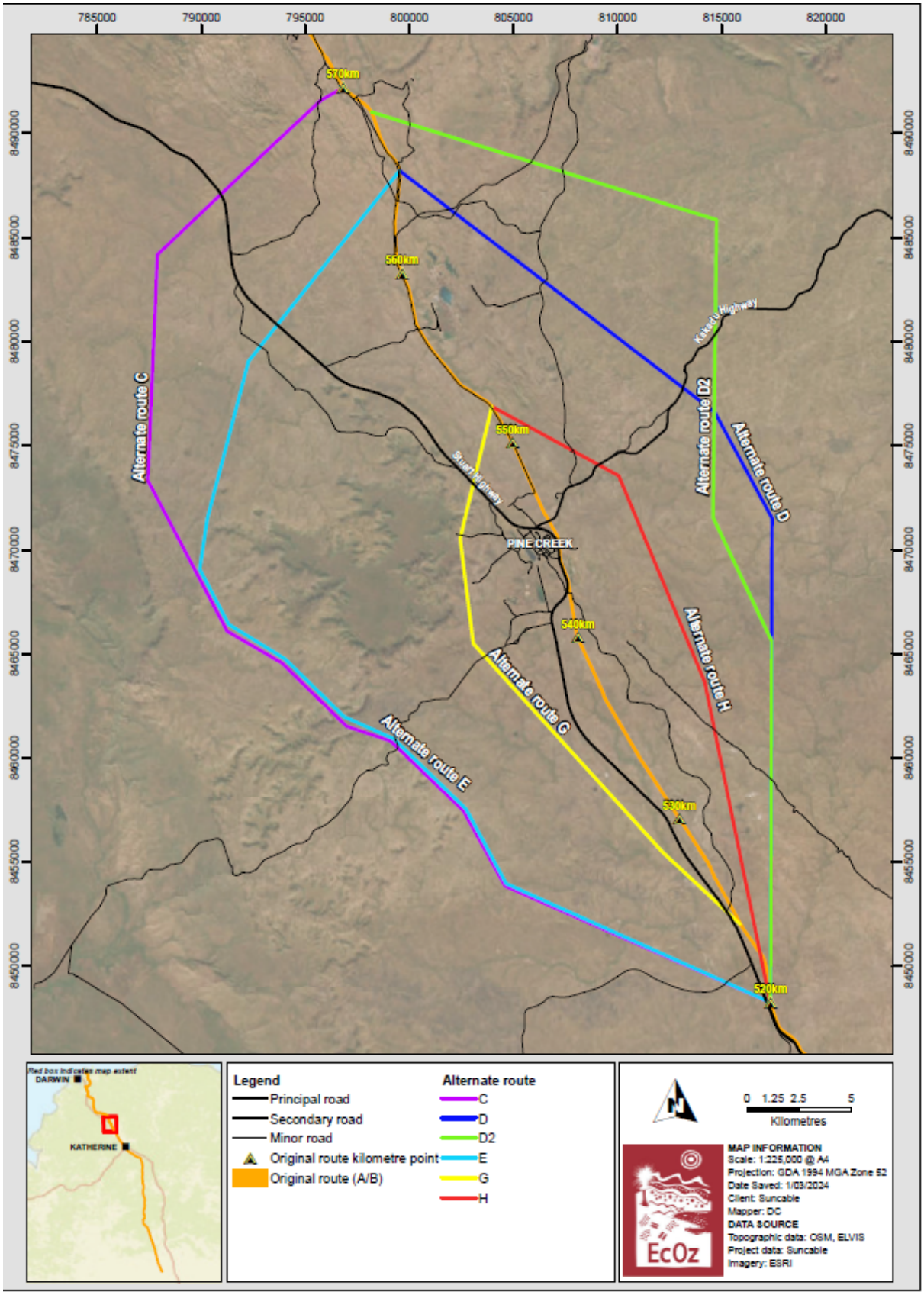

Figure 1-1 - Alternative OHTL options in the Pine Creek area

1.3. Alternative Route Assessment

A qualitative assessment approach to rank attributes of each alternative according to selected performance objectives (of the project) was undertaken; performance objectives and their ratings are defined in Figure 1-2 below. The results of the alternatives assessment when considered against environmental, social, technical, and economic attributes are summarised in Figure 1-3 below.

Performance Objective Attribute Categories	
Environmental and Social Performance Objectives	
Preferred	Alternative has the least adverse effect(s) without mitigation when compared to other alternatives; may also provide positive benefits.
Acceptable	Acceptable alternative: adverse effect addressed with mitigation.
Challenging	Alternative has significant adverse effects, and there are technical, financial, or other barriers to mitigation.
Unfeasible	Unacceptable adverse effects that could not be reasonably mitigated.
Technical Performance Objectives	
Preferred	Alternative option is most likely to be effective to implement, with the lowest risk and contingencies (mitigation) in place to address risks.
Acceptable	Implementation of alternative likely to be effective, with contingencies to address risks.
Challenging	Significant barriers to implement, or to reduce risk to acceptable levels, even with contingencies.
Unfeasible	Unacceptable risk, even with contingencies, or alternative is unfeasible to implement.
Economic Performance Objectives	
Preferred	Lowest cost option or gives the best return on investment.
Acceptable	Reasonable cost or gives an acceptable return on investment.
Challenging	High costs, leading to budgetary issues.
Unfeasible	Not economically viable under project budgets.

Figure 1-2-Ranking matrix and performance objectives

1.4. Ongoing route refinement

As engineering and design progresses, further refinements of the OHTL Corridor may occur. Any refinement will consider project stakeholders' requirements (particularly landholders), environmental and social areas of sensitivity, geotechnical investigations and engineering design, including hydrology. Application of the Precautionary Principle is fundamental to the Constraints Planning and Field Development Procedure, which was submitted with the SEIS to establish the process that will be used to ensure environment, heritage and social considerations are embedded in future site selection. This Procedure will be periodically updated and informed by ongoing engagement with project stakeholders. Where the principle of avoidance of impacts is not possible,

SunCable will identify management options to mitigate potential adverse impacts.

Figure 1-3 - Alternative Route Assessment - Multi-criteria analysis

ID	Alternative Description	Environmental	Social	Technical	Economic	Overall Rating
A	***OHTL Pine Creek Preferred Option.*** *Per SEIS submission*	• Within existing area of disturbance (railway corridor, Stuart Highway), limits clearing required. • Environmental Constraints: ○ Ghost Bat Kohinoor <500m from OHTL. • **Unlikely to be acceptable given proximity to significant habitat of a threatened fauna species (Ghost Bat within the Kohinoor Adit). SunCable advised to consider moving from this alignment.**	• Impact on freehold land and pastoral land, 6 affected properties. Engagement undertaken with affected landholders (based on proposed deviations around Pine Creek). • Negative project sentiment from one landholder key to route. Remaining are neutral. • Colocation with similar linear infrastructure (Stuart Highway, railway corridor) • Cultural assessment planned (NLC and Traditional Owner engagements. Desktop constraints known. • **Current project basis considered acceptable with mitigations in place.**	• Direct alignment with high-level access for construction and operations. • Constrained corridor between rail corridor and the Stuart Highway. Challenging interface issues. Close to Stuart Highway. • Crosses significant infrastructure (Kakadu Highway, multiple electrical assets). • Moderate risk for implementation timeline • **A challenge to the project considering the interface between the Stuart Highway and railway corridor, and land constraints that exist.**	• **Original alignment follows the (adjacent and through) the railway corridor. Existing preferred.**	Unfeasible
		Unfeasible	Acceptable	Challenging	Acceptable	
B	***OHTL Pine Creek Underground Option*** *Per SEIS submission, however underground through Pine Creek*[1]	• Within existing area of disturbance (railway corridor, Stuart Highway). • Due to scope of works required to underground, environmental disturbance on ground would significantly	• Impact on freehold land and pastoral land, 6 properties affected. Engagement already undertaken with the public and landholders (based on proposed deviations around Pine Creek).	• Direct alignment with high-level access for construction, operations. • Constrained corridor between rail corridor and the Stuart Highway. Land outside of the railway corridor required.	• **Cost - magnitude (10x) higher cost as underground vs overhead construction and maintenance. Underground networks have half the life of an overhead system. Pine Creek would require a**	Unfeasible

[1] Note further information on the challenges to undergrounding the OHTL presented within Additional Information submission published on 17 November 2023.

ID	Alternative Description	Environmental	Social	Technical	Economic	Overall Rating
		increase. Construction and operational activities within a 60-80m cross-section, against 25m for overhead lines, 60m for mast construction. • Environmental Constraints ○ crossing waterways, wetlands and threatened species habitats may be undertaken by directional boring, however over the potential distances this is expected to be cost prohibitive. • **Considered a challenging proposition given potential environmental disturbance compared to overhead.**	• Neutral to negative project sentiment. • Colocation with linear infrastructure (Stuart Highway, railway corridor) • Cultural assessment planned (NLC and Traditional Owner engagements. Desktop constraints known, and potential for disturbance. • **The proposition is considered challenging. The original project basis considered overhead transmission. Underground development a significant scope change and would require renegotiation with stakeholders.**	• Crosses a large amount of infrastructure (Kakadu Highway, multiple electrical assets), close to Stuart Highway. • Timing - additional cables required to deal with power losses from underground constraints, plus HDD efforts will lead to a longer construction time. Significant access and permitting timelines. • **The proposition is considered challenging. The original project basis considered overhead transmission. Underground development is a significant scope change requiring re-mapping of project technical basis.**	**significant underground HDD exercise, due to local constraints (infrastructure & assets). Unfeasible cost.**	
		Challenging	Challenging	Challenging	Unfeasible	
C	***OHTL Pine Creek 13km+ West (from sensitive Ghost Bat Roost Site).*** *This route departs the railway corridor at KP520, traversing west/north-west across predominately pastoral land west of the Setay Valley. This affords a more than 13km*	• Deviation length outside railway corridor - increased disturbed area by length of deviation. • Predominately pastoral land with potential for increased disturbance footprint (clearing for corridor required).	• Five affected landholders • Engagement already undertaken with the public and a portion of landholders (based on proposed deviations around Pine Creek). • Negative project sentiment.	• Potentially challenging terrain around Setay Valley. No detailed topographical assessment progressed for this option. • Creek systems. Hydrology investigations required.	• 16km deviation compared to utilising the rail corridor (56%+ increase from original). High-cost **option**	Challenging

ID	Alternative Description	Environmental	Social	Technical	Economic	Overall Rating

	buffer to the sensitive roost site. The route rejoins the railway corridor at KP570 of the original OHTL.	• Environmental Constraints encountered
		  ○ Gouldian Finch modelled habitat
		  ○ Ghost Bat - 11km from Kohinoor Adit.
		  ○ Red Goshawk
		  ○ Merten's and Mitchell's water monitor.
		• **Considered an acceptable alternative, adverse effects could be addressed with mitigations.**
			• Considerable severance of five separate property's farming operations. Potentially mitigated with compensation framework.
			• No cultural or sacred site surveys undertaken in this corridor to date however understood to be high likelihood of sacred sites. Surveys Must be undertaken.
			• Known heritage sites avoided north of Pine Creek.
			• **Several landholders not yet consulted and significant potential for severance of agricultural activities. Challenging and not a preferred outcome. No cultural assessment undertaken, considerable scope change.**
				• Crossing Stuart Highway.
				• Poor access, reliance on development of new all-weather access for construction and operations.
				• No detail on ground conditions, geotechnical investigations required.
				• Represents moderate to high time risk, compared to the preferred.
				• **Significant topography to the west of Pine Creek to negotiate, a challenging proposition.**		

		Acceptable	Challenging	Challenging	Acceptable	

ID	Alternative Description	Environmental	Social	Technical	Economic	Overall Rating

D	***OHTL Pine Creek 10km East***
	
	This route departs the railway corridor at KP520, traversing east/north-east across predominately pastoral land to provide a 10km buffer to the sensitive roost site. The route re-joins the railway corridor at KP565 of the original OHTL.
		• Outside railway corridor - increased disturbed area by length of deviation.
		• Predominately pastoral land with potential for increased disturbance footprint (clearing for corridor and access to required).
		• Environmental Constraints encountered
		  ○ Gouldian Finch modelled habitat
		  ○ 10km to Kohinoor Adit.
		  ○ Red Goshawk habitat.
		  ○ Merten's and Mitchell's water monitor.
		• **Considered an acceptable alternative, adverse effects could be addressed with mitigations.**
			• Three affected landholders. Impact of properties' farming operations.
			• Little engagement with one affected landholder.
			• Two affected landholders previously engaged but not in relation to subject route. Potentially mitigated with minimising impacts on operations minimisation (via localised route refinements), compensation framework.
			• No cultural or sacred site surveys undertaken in this corridor. Established processes in place with Northern Land Council and Aboriginal Areas Protection Authority to address these matters.
			• Existing mineral titles at north end of the deviation - Union Reefs Mine. Potential to be traversed (ML27999, 31122, MLN1109).
			• **Landholder sensitivities, particularly with regard to the proliferation of infrastructure (the Stuart Highway, the Railway Line, Darwin-**
				• No detail progressed on topography in this location, desktop indicates undulating, with creek systems. Hydrology Investigations required.
				• Crossing Kakadu Highway, electrical assets (Darwin Katherine Integrated System), Amadeus Pipeline. No detailed topography assessment progressed for this option.
				• Poor access will rely on development of new all-weather access for construction, operations.
				• No detail on ground conditions, geotechnical investigations required.
				• represents moderate to high time risk, compared to the preferred.
				• **Considered an acceptable alternative, adverse effects could be addressed with mitigations.**
					• 4.9km deviation compared to using the rail corridor (17% increase from original). **moderately high-cost option.**	Challenging

ID	Alternative Description	Environmental	Social	Technical	Economic	Overall Rating
			Katherine Integrated System) across pastoral land. Introduces impact to new landholders. Potentially acceptable, if impact to landholders can be minimised, compensation framework accepted.			
		Challenging	Challenging	Acceptable	Acceptable	

E	***OHTL Pine Creek up to 13km west of Pine Creek and sensitive roost site.***
	
	This route departs the railway corridor at KP520, traversing west/north-west across predominately pastoral land west of the Setay Valley. This affords a 13km buffer to the sensitive roost site. The route rejoins the railway corridor at KP565 of the original OHTL.
		• Deviation outside railway corridor - increased disturbed area by length of deviation.
		• Environmental Constraints encountered
		  ○ Gouldian Finch modelled habitat
		  ○ Ghost Bat - 11km to the Kohinoor Adit
		  ○ Red Goshawk
		  ○ Merten's and Mitchell's water monitor.
		• **Considered an acceptable alternative, adverse effects could be addressed with mitigations.**
			• Three affected landholders. Potential impacts to properties' farming operations.
			• Engagement undertaken with the public and some landholders (based on proposed deviations around Pine Creek).
			• Negative project sentiment from landholders due to proliferation of linear infrastructure and impacts on land use on their land.
			• Impacts to land use on three separate properties. Potentially mitigated with
				• Topography around Setay Valley. Potentially challenging terrain potentially offset by opportunity for preferred OHTL Corridor width of 65m across undulating terrain.
				• Creek systems. Hydrology Investigations required.
				• Crossing Stuart Highway (twice, depending on OHTL alignment at each end).
				• Poor access will rely on development of new all-weather access, through steep terrain for construction, operations.
					• 14.5km deviation (50% increase from original). **Moderately high-cost option.**	Challenging

ID	Alternative Description	Environmental	Social	Technical	Economic	Overall Rating
			compensation framework. • No cultural or sacred site surveys undertaken in this corridor. Understood to be higher likelihood of sacred sites due to topography. Established processes in place with Northern Land Council and Aboriginal Areas Protection Authority to address these matters. • Known heritage sites avoided north of Pine Creek. Higher likelihood of encountering archaeological sites in hilly terrain and near water courses. • **Landholder sensitivities, introduces a new landholder. Unknowns with respect to cultural considerations, moderate risk. Potentially acceptable, if impact to landholders can be minimised, compensation framework accepted.**	• No detail on ground conditions, geotechnical investigations required. • Represents moderate to high time risk, compared to the preferred. • **Significant topography to the west of Pine Creek to negotiate, a challenging proposition.**		
		Acceptable	Challenging	Challenging	Acceptable	

ID	Alternative Description	Environmental	Social	Technical	Economic	Overall Rating

G	***OHTL Pine Creek 4km West***
	
	Considers a route immediately west (within 4km) of the Pine Creek township. Exits the rail corridor at KP520 and rejoins at KP552.
		• Deviation outside railway corridor - increased disturbed area by length of deviation.
		• Environmental Constraints
		  ○ Gouldian Finch habitat within concept corridor.
		  ○ Ghost Bat Adits - Kohinoor 4km from OHTL.
		  ○ Red Goshawk habitat.
		  ○ Merten's and Mitchell's water monitor.
		• **Considered a challenging proposition given proximity to habitat of a threatened fauna species (Kohinoor Adit).**
			• Three affected properties
			• considerable severance of three separate property's farming operations. Potentially mitigated with compensation framework.
			• Engagement undertaken with the public and landholders (based on proposed deviations around Pine Creek in the SEIS).
			• Negative project sentiment from landholders due to impacts on land use.
			• No cultural assessment in this corridor. Must be undertaken. Established processes in place with Northern Land Council and Aboriginal Areas Protection Authority to address these matters.
			• **Landholder sensitivities, introduces a new landholder. Unknowns with respect to cultural considerations, moderate risk. Potentially acceptable, if impact to landholders can be minimised, compensation framework accepted.**
				• Topography around Setay Valley. Potentially challenging terrain potentially offset by opportunity for preferred OHTL Corridor width of 60m
				• Creek systems. Hydrological Investigations required.
				• Crossing Stuart Highway
				• Poor access will rely on development of new all-weather access through steep terrain for construction, operations.
				• No detail on ground conditions, geotechnical investigations required.
				• Comparable construction timeline. moderate risk for land tenure and approvals.
				• **Significant topography to the west of Pine Creek to negotiate, a challenging proposition, but potential to be curtailed by mitigations.**
					• minor net reduction in deviation length compared to preferred.
					• **Comparable cost with preferred option**
						Challenging

ID	Alternative Description	Environmental	Social	Technical	Economic	Overall Rating
		Acceptable	Challenging	Challenging	Acceptable	

H	***OHTL Pine Creek_4km_East***
	
	Considers a route immediately east (within 4km) of the Pine Creek township. Close to existing Amadeus Pipeline, and within 3km of the Darwin-Katherine Transmission Line. Starts at KP520, and rejoins at KP552.
		• Deviation outside railway corridor - increased disturbed area by length of deviation.
		• Notwithstanding adjacent to existing linear infrastructure/ disturbed areas.
		• Environmental Constraints:
		  ○ Gouldian Finch habitat within concept corridor.
		  ○ Kohinoor Adit <5km from OHTL.
		  ○ Red Goshawk
		  ○ Traversing aquatic habitats – a risk for Merten's and Mitchell's water monitor.
		• Existing infrastructure corridors Amadeus Pipeline, DKIS, traverse this area. Pre-existing disturbed areas.
		• **Follows existing linear infrastructure routes, increased area of disturbance but considered an acceptable alternative, adverse effects could be addressed with mitigations (e.g. local rerouting around significant sites). Distance to Ghost Bat habitat considered a**
			• 2 affected properties.
			• Sensitive receptor within footprint. Opportunity to avoid visual amenity impacts by local re-route.
			• Severance of three separate property's farming operations. Potentially mitigated with compensation framework.
			• Engagement already undertaken with the public and affected landholders on OHTL in alignment.
			• Negative project sentiment from landholders. Potentially minimised impact on land use compared to option G. Particularly given proximity to existing linear infrastructure.
			• Landholdings already comprise DKIS transmission line, Amadeus Gas pipeline.
			• No cultural assessment in this corridor. Must be undertaken. Established processes in place with Northern Land Council and Aboriginal Areas Protection Authority to address these matters.
			• moderate risk for land tenure and approvals.
				• Crossing Kakadu Highway, Amadeus Pipeline proximate, adjacent DKIS transmission line. Infrastructure in district runs along a similar north-south alignment.
				• Considerations to the potential interactions between existing pipeline and proposed OHTL must be undertaken. Mitigations can
				• Poor access, will rely on development of new all-weather access for construction, operations.
				• LIDAR progressed on topography around this location, desktop indicates undulating, with creek systems. Hydrological Investigations required.
				• No detail on ground conditions, geotechnical investigations required.
				• Comparable construction timeline.
				• **Considered an acceptable alternative, adverse effects could be addressed with mitigations.**
					• 2.6km deviation (9% increase from original). **Comparable cost with preferred option**	Challenging

ID	Alternative Description	Environmental	Social	Technical	Economic	Overall Rating
		significant risk and therefore deemed a challenging proposition overall.	• **Landholder sensitivities regarding property severance, however minimised if following existing linear infrastructure. Unknowns with respect to cultural considerations. Adverse effects could be addressed with mitigations (compensation framework, local rerouting around significant sites).**			
		Challenging	Acceptable	Acceptable	Acceptable	
D2	***OHTL Pine Creek_10km_East – Refined*** *This route departs the railway corridor at KP520, traversing east/north-east across predominately pastoral land to provide an 8-10km buffer to the sensitive roost site and attempts to avoid severance of property operations. The route re-joins the railway corridor at KP565 of the original OHTL.*	• Deviation length outside railway corridor - increased disturbed area by length of deviation. • Predominately pastoral land with potential for increased disturbance footprint (clearing for corridor and access to required). • Environmental Constraints encountered ○ Gouldian Finch modelled habitat.	• Two affected landholders. Potential impacts to land use. • Two affected landholders previously engaged but not in relation to subject route. Negative project sentiment from landholders based on impacts to land use. Potentially mitigated with engagement and compensation framework. • No cultural or sacred site surveys undertaken in	• No detail progressed on topography in this location, desktop indicates undulating, with creek systems. Hydrology Investigations required. • Crossing Kakadu Highway, electrical assets (Darwin Katherine Integrated System), Amadeus Pipeline. No detailed topography assessment progressed for this option.	• 9.5km deviation (33% increase from original). **High-cost option.**	Acceptable

ID	Alternative Description	Environmental	Social	Technical	Economic	Overall Rating
		○ 8km to Kohinoor Adit. avoids Union Reefs complex by 6km, maintains distance from Spring Hill. Provides unfettered access between roost sites. ○ Red Goshawk ○ Riparian crossings (tributary of McKinlay River) – a risk for Merten's and Mitchell's water monitor. • **Considered an acceptable alternative, adverse effects could be addressed with mitigations.**	this corridor. Must be undertaken. Established processes in place with Northern Land Council and Aboriginal Areas Protection Authority to address these matters. • Mineral titles and exploration areas across the footprint. This interaction must be investigated and affected parties consulted. • **Land/interest holder sensitivities, particularly regarding the proliferation of infrastructure (the Stuart Highway, the Railway Line, Darwin-Katherine Integrated System) across pastoral land, potential interaction with mining tenements. Potential to be addressed with mitigations.**	• Poor access will rely on development of new all-weather access for construction, operations. • No detail on ground conditions, geotechnical investigations required. • represents moderate to high time risk, compared to the preferred. • **Whilst a challenging alternative, adverse effects could be addressed with mitigations. Acceptable.**		
		Acceptable	Challenging	Acceptable	Acceptable	

APPENDIX D DESKTOP ENVIRONMENTAL ASSESSMENT OF PINE CREEK OHTL ROUTE ALTERNATIVES

MEMORANDUM

To:	**Australia Asia Power Link Assets Pty Ltd.**
From:	EcOz Environmental Consultants (author: Alice Nicholl; reviewer: Glen Ewers)
Date:	06/03/2024
Project ref:	EZ24025 NT EPA Direction to provide additional information
Subject:	Desktop constraints assessment of alternative OHTL route near Pine Creek

1 Purpose of this memo

This memo presents the findings of a desktop environment and heritage constraints assessment undertaken for a re-alignment of the proposed AAPowerLink Overhead Transmission Line (OHTL) route near Pine Creek. Six alternative routes have been proposed in response to uncertainty about whether electromagnetic fields (EMF) from the OHTL could affect a threatened species, the Ghost Bat. The current OHTL route utilises the NT railway corridor, which passes approximately 395 m from an important Ghost Bat maternal roost site – the Kohinoor adit – near Pine Creek. Whist it is not known whether EMF could affect the Ghost Bat, given the importance of the roost site, the precautionary principle is being applied by relocating the OHTL further away from the roost to provide confidence that impacts on bat movements in the region will be minimised. The purpose of the desktop constraints assessment is to identify any environment and heritage values that could be impacted by the alternate routes, and to determine whether there is potential for significant impacts on these values, as well on any additional factors that have not been considered in the environmental assessment process to date.

2 Alignment details

Figure 1 shows the location of the current route and proposed alternative routes through Pine Creek. Six routes have been assessed in this memo as alternatives to the original route, in response to a direction from the NT EPA for further information. Table 1 provides details of each alternative route. Appendix C to the Response to NT EPA Direction to provide additional information #2 (2024) includes the MCA table. Site selection processes are described in detail in Section 3.3.2 of the Response to NT EPA Direction to provide additional information #2 (2024).

It should be noted that these routes have been considered as conceptual, and while they have been proposed based on a multi-criteria assessment process, they have not been developed to the same degree of detailed planning that has been undertaken for the OHTL route to date. While they are conceptual, they demonstrate options available for diverting around Pine Creek to avoid significant impacts to Ghost Bats. This memo supports that options assessment by identifying any major constraints on re-alignment, or any potential significant impacts resulting from selection of any of the proposed routes.

Given this assessment has been undertaken at a desktop level, it is acknowledged that any selected route would require ground-truthing and further assessment through detailed design and pre-construction phases of the project. This is consistent with the approach taken across the existing project area.

The DEIS/SEIS include provision for a micro-siting procedure to manage this uncertainty. At this time, the exact location of each (transmission) pole installation, constructions camps and laydowns are under review and assessment. A micro-siting process has been developed and will be implemented to ensure that project components are placed in locations which aim to minimise associated impacts. The site selection process will be based on a structured decision-making hierarchy that will apply the following steps:

- Identify technically- and economically-feasible alternative options and locations through consideration of space requirements, proven technology, ability to meet design criteria, constructability, schedule, cost, avoidance of environmental and social constraints and receptors etc.

- Complete ground-truthing of potential sites to verify the location of constraints and confirm site conditions.
- Select preferred option(s) and/or amend location based on the outcomes of the on-the-ground assessment.
- Assess potential impacts of the preferred option on environmental and social factors (value, severity, scale, integrity, function, likelihood, certainty, significance).

This constraints assessment has assumed implementation of the micro-siting procedure when assessing potential impacts and the capacity of AAPowerLink to avoid high values identified through ground-truthing.

Table 1. Options for OHTL route through the Pine Creek region

Route	Description
A/B (original route)	• Original preferred route through and adjacent to the rail corridor at Pine Creek. • Minimum distance between this route and the Kohinoor Ghost Bat roost is approximately 400 m.
C	• This re-alignment moves the route to the west, with a minimum distance between the OHTL and the Kohinoor Ghost Bat roost of 11 km. • Approximately 16.1 km longer than the original route.
D	• This re-alignment moves the route to the east, with a minimum distance between the OHTL, and the Kohinoor Ghost Bat roost of 10 km. • Approximately 4.9 km longer than the original route.
D2	• This re-alignment follows route D for approximately 17 km before diverting slightly to the west to meet the cadastral boundary between pastoral stations. It then follows the pastoral boundary for approximately 14 km, before turning west to rejoin the rail corridor. • This route has a minimum distance between the OHTL and the Kohinoor Ghost Bat roost of 8 km. • Approximately 9.5 km longer than the original route.
E	• This re-alignment follows route C for approximately 35 km before diverting east to rejoin the rail corridor approximately 5 km south of where route C joins the rail corridor. • This route has a with a minimum distance between the OHTL and the Kohinoor Ghost Bat roost of 11 km. • Approximately 14.5 km longer than the original route.
G	• This re-alignment moves the route to the east, with a minimum distance between the OHTL and the Kohinoor Ghost Bat roost of 4 km. • Minor net reduction in deviation length compared to routing through and adjacent the railway corridor.
H	• This re-alignment moves the route to the east, with a minimum distance between the OHTL and the Kohinoor Ghost Bat roost of 4 km. • Approximately 9.5 km longer than the original route.

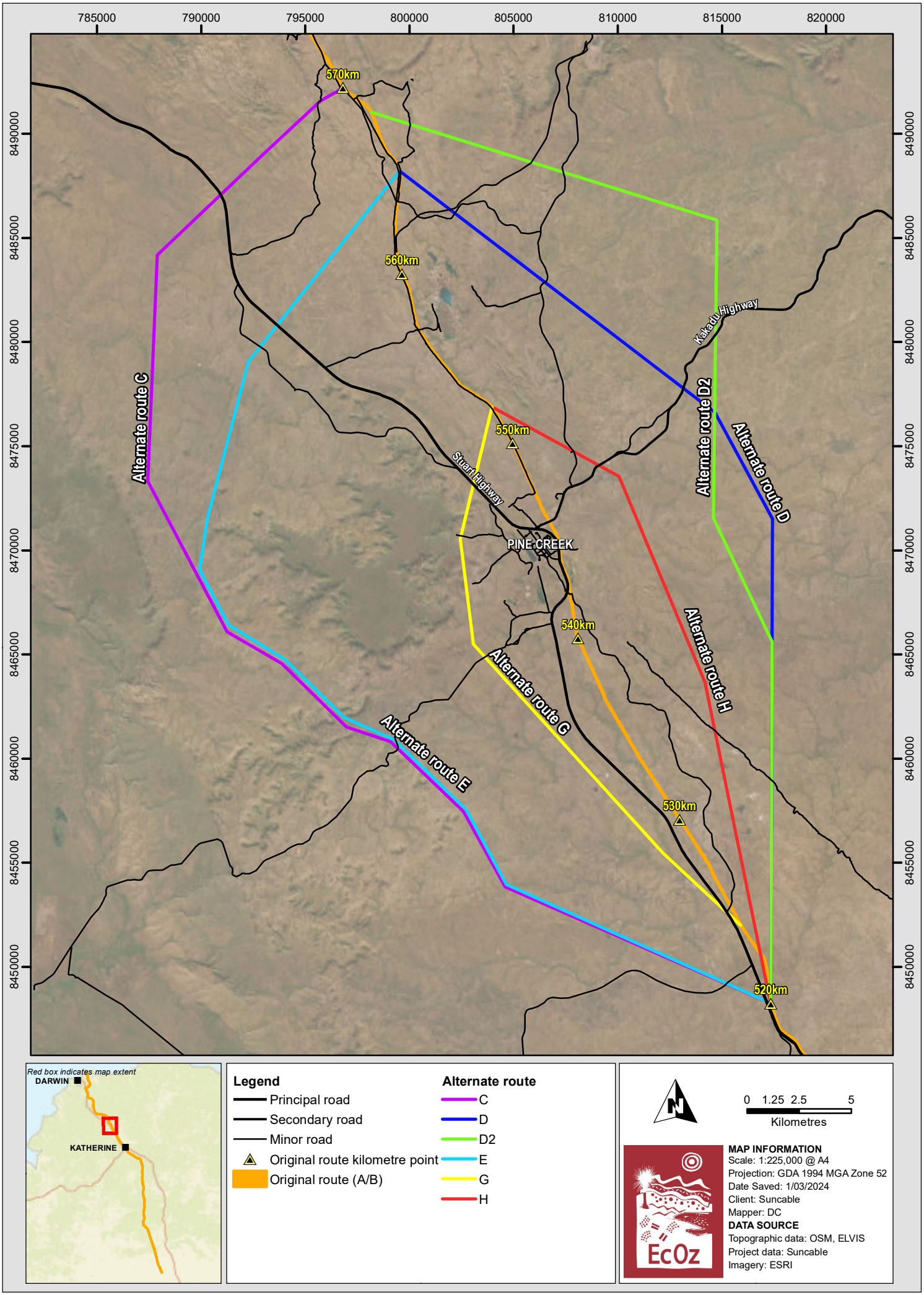

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Figure 1. Alternative OHTL options in the Pine Creek area

3 Constraints assessment

The NT Environmental Protection Authority (EPA) uses a set of defined environmental factors and objectives to organise information for the purpose of conducting environmental impact assessment under the *NT Environment Protection Act 2019*. There are 14 environmental factors categorised under 5 themes: Land, Water, Sea, Air and People. The objective set by the NT EPA for each factor reflects the expected outcomes for these parts of the environment and provides an indicator against which to assess whether the impacts from a proposed action are likely to be significant. For each of the relevant NT EPA factors, the sections below summarise the findings of desktop constraints assessment undertaken to ensure that the proposed alternative route will not introduce impacts on additional environmental factors or values that have not been considered in the EIS process to date. Note the factors under the Sea theme are not assessed because they are not impacted by the OHTL.

3.1 Landforms

Landforms were not assessed in the draft environmental impact statement (DEIS) or supplementary EIS (SEIS) because impacts on landforms were not considered significant. There are no known significant landforms within the alternative routes. Consistent with the assessment in the DEIS and SEIS, there are therefore no significant impacts on landforms associated with any of the alternative routes.

3.2 Terrestrial environmental quality

The alternative routes are unlikely to alter the level of impact to soil quality or stability. Potential impacts were assessed in Chapter 4 of the DEIS and Chapter 4 of the SEIS, which conclude that the OHTL route will have a minor level of residual impact.

The key potential impacts during construction and operation to soil quality and stability are:

- Erosion and topsoil migration
- Contamination of soil
- Disturbance of potential acid sulfate soils (PASS).

Impacts to soil quality from the alternative routes are comparable to those of the original route. There is low probability of PASS within any of the alternative routes, and fuel and hazardous chemical use is consistent with the original route. The avoidance and mitigation measures detailed in the DEIS and SEIS are relevant to managing impacts associated with all alternative routes.

While the impacts on soil stability of the alternative routes are consistent with those assessed in the DEIS and SEIS, the alternative routes will require additional pole footings over a longer OHTL corridor (except for route G which is slightly shorter than the original route), increasing the amount of clearing and exposed soil compared to the original route. Routes D, D2 and H traverse similar landform classes to the original route, generally passing areas with a low to medium risk of erosion. Routes C, E and G are generally within areas of moderate erosion risk (similar to the original route), but also traverse land that is more susceptible to erosion than the original route through some areas of steep topography – see Table 2 and Figure 2 for details.

Table 2. Soil stability characteristics for OHTL options in the Pine Creek region

Route	Description
A/B (original route)	Traverses land that has a moderate risk of erosion. Generally land is gently inclined slopes or level areas with erodible soils of granite and sandstone plains and rises.

Route	Description
C	Mostly within areas of moderate erosion risk in the same land system as routes E, H, D and D2; however, some sections of this route intersect areas of steeper slopes that are more susceptible to erosion because of the steep slopes and erodible soils, such as sandstone and granite hills and areas with lateritic soils. This route passes through relatively hilly country associated with the Baker land system for approximately 3 km just before reconnecting with the rail corridor.
D	Traverses areas of moderate risk of erosion, mostly granite plains and rises of gently inclined slopes, or level areas with erodible soils. This route passes through relatively hilly country associated with the Baker land system for approximately 1 km just before reconnecting with the rail corridor.
D2	Traverses areas of moderate risk of erosion, mostly granite plains and rises of gently inclined slopes, or level areas with erodible soils. This route passes through relatively hilly country associated with the Baker land system for approximately 500 m just before reconnecting with the rail corridor.
E	Mostly within areas of moderate erosion risk in the same land system as routes C, H, D and D2; however, some sections of this route intersect areas of steeper slopes that are more susceptible to erosion because of the steep slopes and erodible soils, such as sandstone hills and areas with lateritic soils. This route reconnects with the rail corridor approximately 5 km south of where route C reconnects, avoiding traversing relatively undulating topography.
G	Mostly within areas of moderate erosion risk in the same land system as the original route (route A/B); however, some short sections of this route intersect areas of steeper slopes that are more susceptible to erosion because of the steep slopes and erodible soils, such as sandstone and granite hills and areas with lateritic soils.
H	Traverses areas of moderate risk of erosion, mostly granite plains and rises of gently inclined slopes, or level areas with erodible soils.

Key measures to avoid and mitigate potential impacts on soil stability are detailed in the DEIS and SEIS. None of the proposed alternative routes introduce a potential for significant impacts to soil stability. While some routes travel through areas with erodible soils and steep slopes, these are for relatively short sections and potential impacts can be managed through ESCP and site-specific engineering and design measures. The larger the distance the alternative routes cover compared to the original route, the more ground disturbance is required, and therefore the more soil is susceptible to erosion. However, compared to the total length of the OHTL, these increases are not considered significant and are unlikely to introduce potential impacts not accounted for through assessment to date.

Impacts to soil quality and stability from the alternative OHTL routes are predicted to remain minor.

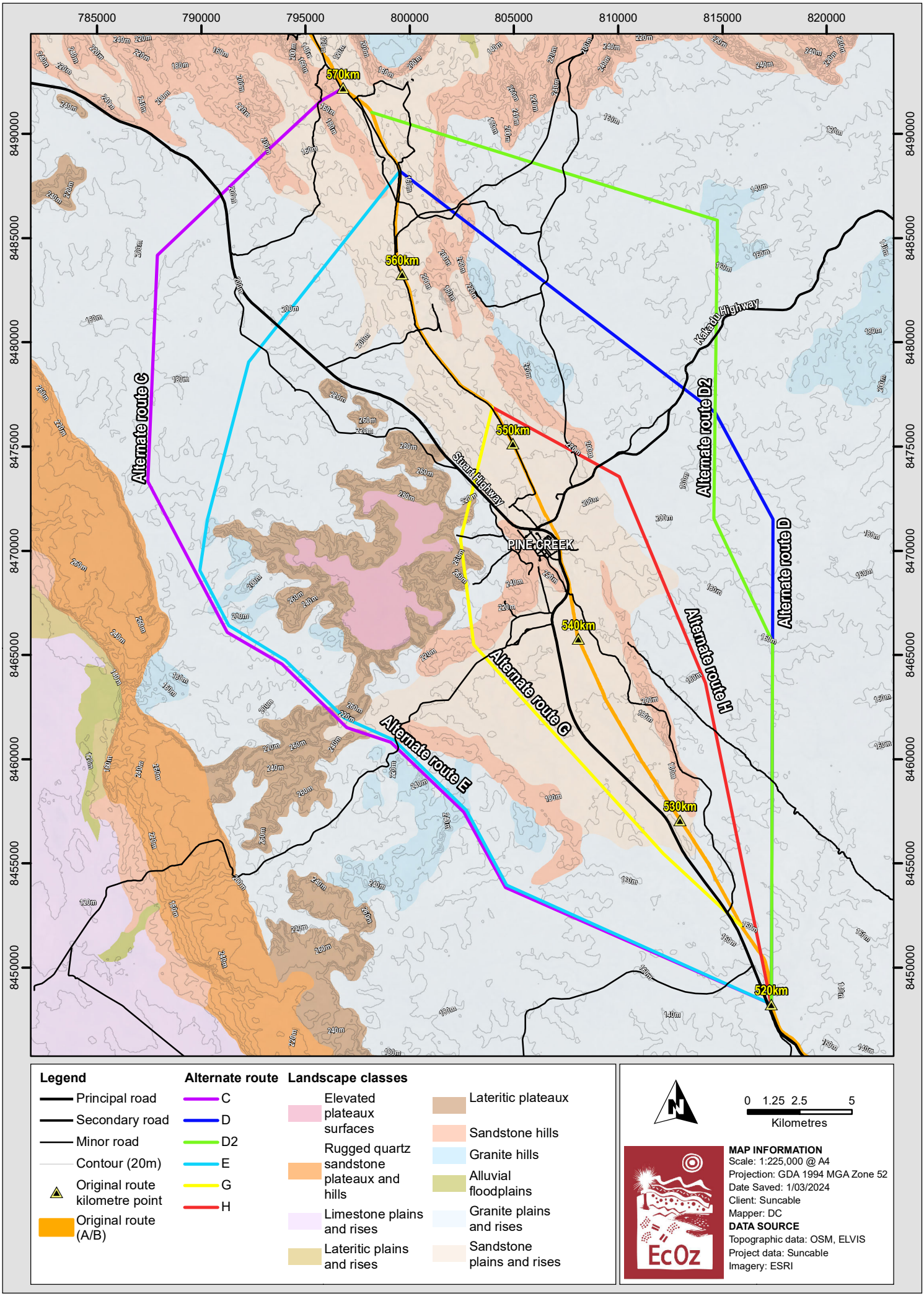

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Figure 2. Land systems in the Pine Creek area

3.3 Terrestrial ecosystems

The alternative routes are unlikely to alter the level of impact to terrestrial ecosystems. Potential impacts were assessed in Chapter 5 of the DEIS and Chapter 5 of the SEIS, which conclude that the OHTL route will have a moderate level of residual impact.

Terrestrial ecology values identified for the OHTL routes are provided in Table 3 (see Section 3.4 for details of surface water features, including wetlands). The focus is on values that are restricted in range / extent, since these are the most likely to be significantly impacted upon by a narrow linear development such as the OHTL corridor.

Table 3. Terrestrial ecology values identified for OHTL options in the Pine Creek region

Route	Significant vegetation	Threatened species

A/B	• Riparian vegetation	• Ghost Bat – approximately:
		  ○ 400 m from Kohinoor adit
		  ○ 1.4 km from Union Reef
		  ○ 1 km from Spring Hill
		• Red Goshawk – intersects riparian areas
		• Gouldian Finch – intersects modelled breeding habitat
		• Mertens' and Mitchell's Water Monitor – intersects watercourses

C	• Rainforest
	• Riparian vegetation
	• Large hollow-bearing trees
		• Ghost Bat – approximately:
		  ○ 11 km from Kohinoor adit
		  ○ 9.6 km from Union Reef
		  ○ 1 km from Spring Hill
		• Red Goshawk – intersects tall, open forest and riparian areas
		• Gouldian Finch – intersects modelled breeding habitat
		• Merten's and Mitchell's Water Monitor – intersects watercourses

D	• Riparian vegetation
	• Large hollow-bearing trees
		• Ghost Bat – approximately:
		  ○ 10 km from Kohinoor adit
		  ○ 2.8 km from Union Reef
		  ○ 1 km from Spring Hill
		• Red Goshawk – intersects tall, open forest and riparian areas
		• Gouldian Finch – intersects modelled breeding habitat
		• Merten's and Mitchell's Water Monitor – intersects watercourses

D2	• Riparian vegetation
	• Large hollow-bearing trees
		• Ghost Bat – approximately:
		  ○ 8 km from Kohinoor adit
		  ○ 6.3 km from Union Reef
		  ○ 1 km from Spring Hill
		• Red Goshawk – intersects tall, open forest and riparian areas
		• Gouldian Finch – intersects modelled breeding habitat
		• Merten's and Mitchell's Water Monitor – intersects watercourses

E	• Rainforest
	• Riparian vegetation
	• Large hollow-bearing trees
		• Ghost Bat – approximately:
		  ○ 11 km from Kohinoor adit
		  ○ 4 km from Union Reef
		  ○ 1 km from Spring Hill
		• Red Goshawk – intersects tall, open forest and riparian areas
		• Gouldian Finch – intersects modelled breeding habitat
		• Merten's and Mitchell's Water Monitor – intersects watercourses

Route	Significant vegetation	Threatened species

G	• Riparian vegetation
	• Large hollow-bearing trees
		• Ghost Bat – approximately:
		  ○ 4 km from Kohinoor adit
		  ○ 1.4 km from Union Reef
		  ○ 1 km from Spring Hill
		• Red Goshawk – intersects tall, open forest and riparian areas
		• Gouldian Finch – intersects modelled breeding habitat
		• Merten's and Mitchell's Water Monitor – intersects watercourses

H	• Riparian vegetation
	• Large hollow-bearing trees
		• Ghost Bat – approximately:
		  ○ 4 km from Kohinoor adit
		  ○ 1.4 km from Union Reef
		  ○ 1 km from Spring Hill
		• Red Goshawk– intersects tall, open forest and riparian areas
		• Gouldian Finch – intersects modelled breeding and foraging habitat
		• Merten's and Mitchell's Water Monitor – intersects watercourses

Key potential impacts associated with the original route through Pine Creek identified in the DEIS and SEIS are:

- Loss of vegetation and habitat due to land clearing
- Loss or deterioration of significant vegetation by land clearing
- Degradation of flora and vegetation in surrounding areas by dust deposition
- Introduction and spread of weeds
- Changes in fire regimes
- Direct fauna mortality by collision with construction vehicles
- Habitat degradation and fragmentation
- Changes to fauna behaviour due to noise, light, and waste management.
- Direct fauna mortality caused by collision with Overhead Transmission Line

There are no records of threatened flora or modelled habitat within any of the alternate routes.

There is a known population of Ghost Bats in the Pine Creek area. The purpose of assessing alternative routes is to minimise impacts to Ghost Bats – primarily by increasing the distance between the most important roost site – the Kohinoor adit complex – and by avoiding having the route crossing between other important roost sites and possibly alienating them from each other. The effectiveness of each route alternative in meeting these aims is detailed in a significant impact assessment provided in the *Response to NT EPA Direction to provide additional information #2* (2024). In summary, the distances from the Kohinoor adit to each route is provided in Table 1. The routes further from the Kohinoor adit (routes C, E, D and D2) are considered to have a lesser impact on Ghost Bats in the area than those closer. Additionally, routes C and D2 provide further separation from the important roost sites at Union Reef mine. Impacts on connectivity of the three important roost sites in the Pine Creek area (Spring Hill mine and Kohinoor adit to the west of the existing rail corridor and Union Reef mine to the east) vary between routes (if it is assumed the OHTL would present a barrier to Ghost Bat movement):

- Route G potentially isolates the Spring Hill adit complex but maintains connectivity between Union Reef adit complex and the Kohinoor adit.
- Route H potentially isolates the Union Reef adit complex but maintains connectivity between Spring Hill adit complex and the Kohinoor adit.
- Routes C and E potentially isolates the Spring Hill adit complex but maintains connectivity between Union Reef adit complex and the Kohinoor adit.

- Routes D and D2 maintain connectivity between all three sites.

Although there are other threatened fauna records in the broader area surrounding Pine Creek, as detailed below, none of the alternate routes are expected to significantly impact these species.

Red Goshawk – all routes intersect areas likely to contain tall trees proximate to watercourses, which are preferred locations for Red Goshawk nests. The SEIS provides mitigations such as avoidance of such habitat where possible by designing the OHTL to span areas of riparian vegetation where feasible. Where clearing is required in breeding habitat – i.e., stands of very tall trees within 1 km of a river – a pre-clearance survey will be undertaken by a suitably qualified ecologist to identify nests. If there are any Red Goshawk nests within the corridor, then all attempts will be made to retain the nest so as not to disrupt breeding activities. Based on this, there is a low likelihood of impacts on Red Goshawk from the alternate routes, consistent with those of the original route assessed in the DEIS and SEIS.

Gouldian Finch – there is both potential foraging and breeding habitat mapped east and west of the rail corridor – see Figure 3. There are larger patches to the west that routes C, E and G all intersect, with fewer, smaller patches to the east. The avoidance and mitigation measures in the DEIS, SEIS and *Response to NT EPA Direction to provide additional information #1* (2023) are relevant to these routes, including:

- Ground-truthing areas of mapped breeding and foraging habitat to inform micro-siting.
- Where foraging habitat is confirmed as being present, place towers to ensure the habitat will be spanned as much as possible – this is likely to be more achievable to the east where patches are fewer and smaller.
- Where breeding habitat is confirmed as being present, place towers to ensure the habitat is also spanned as much as possible. In the few instances where potential breeding habitat is unavoidably located within a tower pad disturbance footprint, it will be checked prior to construction to determine whether it is currently in use by Gouldian Finches.

Impacts on habitat from the alternate routes are considered minor in the context of the extent of habitat in the region, which is consistent with the assessment provided for the original route.

Mertens' and Mitchell's Water Monitors – while all alternate routes intersect more waterways than the original route, those that intersect more higher order waterways are more likely to intersect habitat for Mertens' and Mitchell's Water Monitors (edges of freshwater watercourses, swamps, and lagoons). As discussed in the DEIS (Chapter 5 Section 5.5.4.3) and SEIS (Chapter 5 Section 5.6.3.27), the occurrence of these species within the proposal footprint are not considered an important population. Construction within the narrow, linear corridor will only disturb small patches of preferred habitat for these species, with much of that rehabilitated afterwards. Moreover, for engineering reasons, the placement of transmission poles in riparian areas will be avoided as much as possible. Loss of habitat, and therefore impacts to these species, will be negligible.

A key rationale for selecting the original route along the rail corridor was to minimise disturbance in previously undisturbed areas by co-locating the OHTL with other linear infrastructure. As discussed in Section 3.2, all alternate routes (except for route G) are longer than the original route, and traverse areas that are largely undisturbed, resulting in additional clearing of native vegetation compared to the original route. However, given the relatively narrow corridor width, this additional area of clearing is not considered significant and is assessed as having a minor residual impact, consistent with the DEIS and SEIS. As detailed in the SEIS, clearing will be minimised where possible, and land cleared during construction will be reinstated with native vegetation, excepting for a 6 m wide access track.

All alternate routes intersect more types and total areas of significant vegetation than the original route (see Table 3). Routes C and E intersect multiple rivers with associated riparian vegetation and route D2 intersects one river with riparian vegetation. All routes intersect more minor waterways (including drainage lines, intermittent streams and creeks) and therefore more riparian vegetation than the original route. The DEIS and SEIS commit to minimising clearing at major watercourses. All routes also intersect areas likely to contain

large hollow-bearing trees that are often important habitat features for fauna. The DEIS and SEIS provide mitigations such as avoidance of large trees where possible, use of fauna spotter-catchers (to minimise impact to fauna) and avoiding disturbance of trees during breeding seasons for species using them so as not to disrupt breeding activities. Routes C and E intersect small areas of rainforest, and these areas will be avoided through detailed design, wherever possible. These mitigations are considered adequate to manage impacts associated with any of the alternate routes.

All alternate routes traverse largely undisturbed areas, and therefore clearing and activity through these areas risks weeds being introduced, compared to the original route which follows the previously-disturbed rail corridor. A weed management plan has been prepared in accordance with the requirements of the *Weeds Management Act* and relevant statutory weed management plans, and will be implemented to avoid and mitigate impacts associated with the introduction and spread of weeds.

All alternate routes will result in habitat fragmentation and disturbance that the original route did not. The original route is aligned with the rail corridor where habitat fragmentation has already occurred. Reinstatement of all temporary construction footprints and follow-up weed control post-construction will minimise disturbance in the long-term of habitats.

The remaining impacts associated with the alternate routes that are listed below are considered equivalent to the original route:

- Changes in fire regimes
- Direct fauna mortality by collision with construction vehicles
- Degradation of flora and vegetation in surrounding areas by dust deposition
- Changes to fauna behaviour due to noise, light, and waste management.
- Direct fauna mortality caused by collision with Overhead Transmission Line

These impacts are proposed to be mitigated by a suite of measures detailed in the DEIS and SEIS.

Based on the information provided in this section, impacts to terrestrial ecosystems from the alternate OHTL route are predicted to remain moderate.

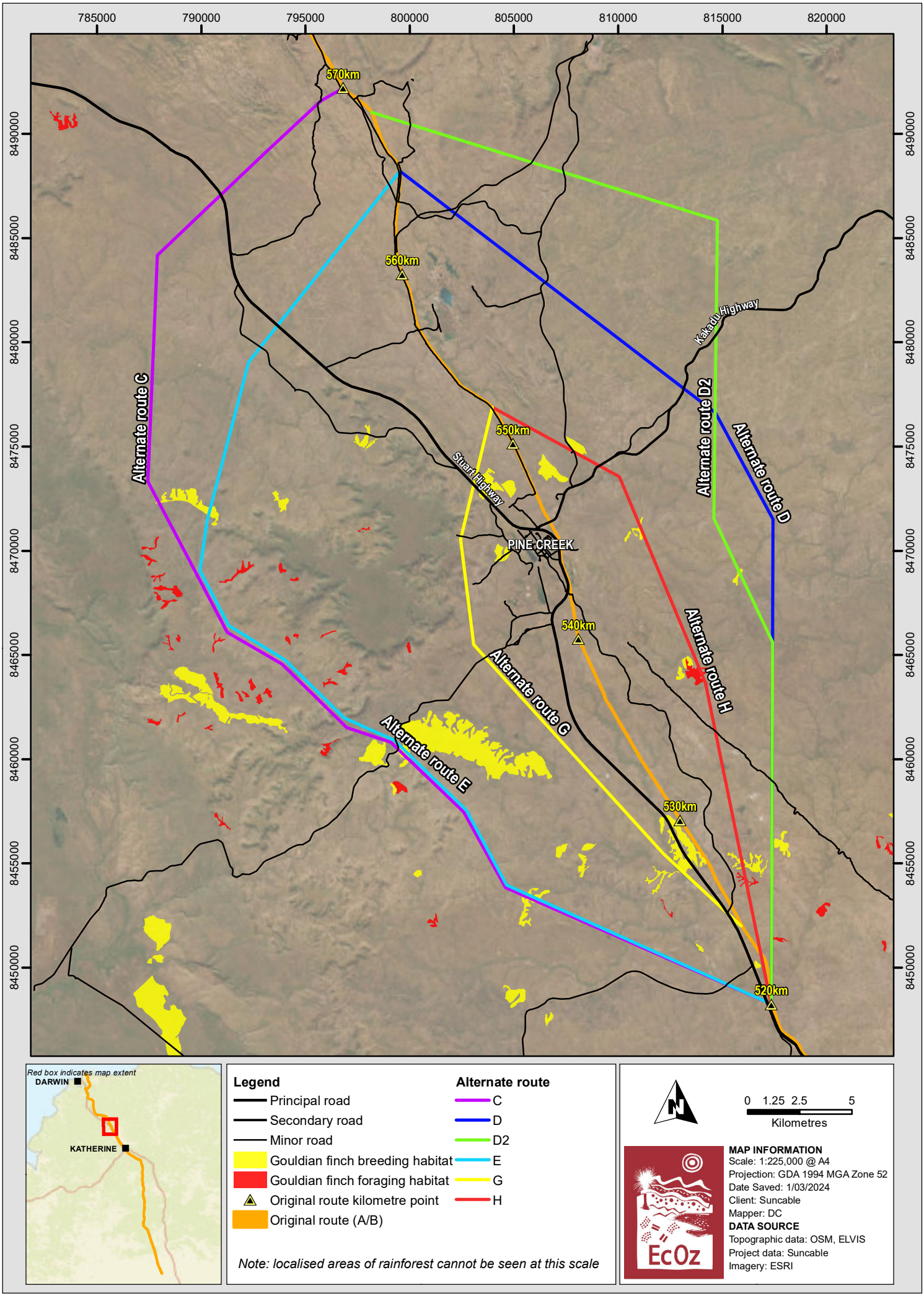

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Figure 3. Ecology values in the Pine Creek area

3.4 Hydrological processes

The alternative routes are unlikely to alter the level of impact to surface water flows or groundwater. Potential impacts were assessed in Chapter 6 of the DEIS and Chapter 6 of the SEIS, which conclude that the OHTL route will have a minor level of residual impact.

The alternative routes will not increase the volume of groundwater that is required to be extracted for construction purposes. Therefore, the impacts on groundwater from the alternative route will be the same as for the original route.

All alternative routes are within the Mary River and Daly River catchment and some intersect major watercourses – Stray Creek, Copperfield Creek, Cullen River, and Douglas River; see **Error! Reference source not found.Error! Reference source not found.**. Option C intersects the most watercourses – including the largest creek intersected by all the deviation options, a fourth-order creek, Copperfield Creek and Douglas River. Some watercourses in the area only flow after heavy rainfall events (although they may maintain some permanent spring-fed waterholes); others retain water year-round. Springs are known to occur within the region with one occurring in proximity to route H, and another in proximity to route D – see Figure 4. No other springs or wetlands were identified within the alternative routes. If any localised areas of poor drainage are identified through ground-truthing of the selected route, these can be managed through the micro-siting procedure.

Table 4. Number and type of surface water features relevant to OHTL options in the Pine Creek region

	Routes						
Waterway	**A/B**	**C**	**D**	**D2**	**E**	**G**	**H**
Drainage lines	13	25	26	22	19	12	14
Intermittent streams	2	12	4	6	13	3	1
Creeks	0	5	4	3	1	2	1
Rivers	0	3	0	1	4	0	0

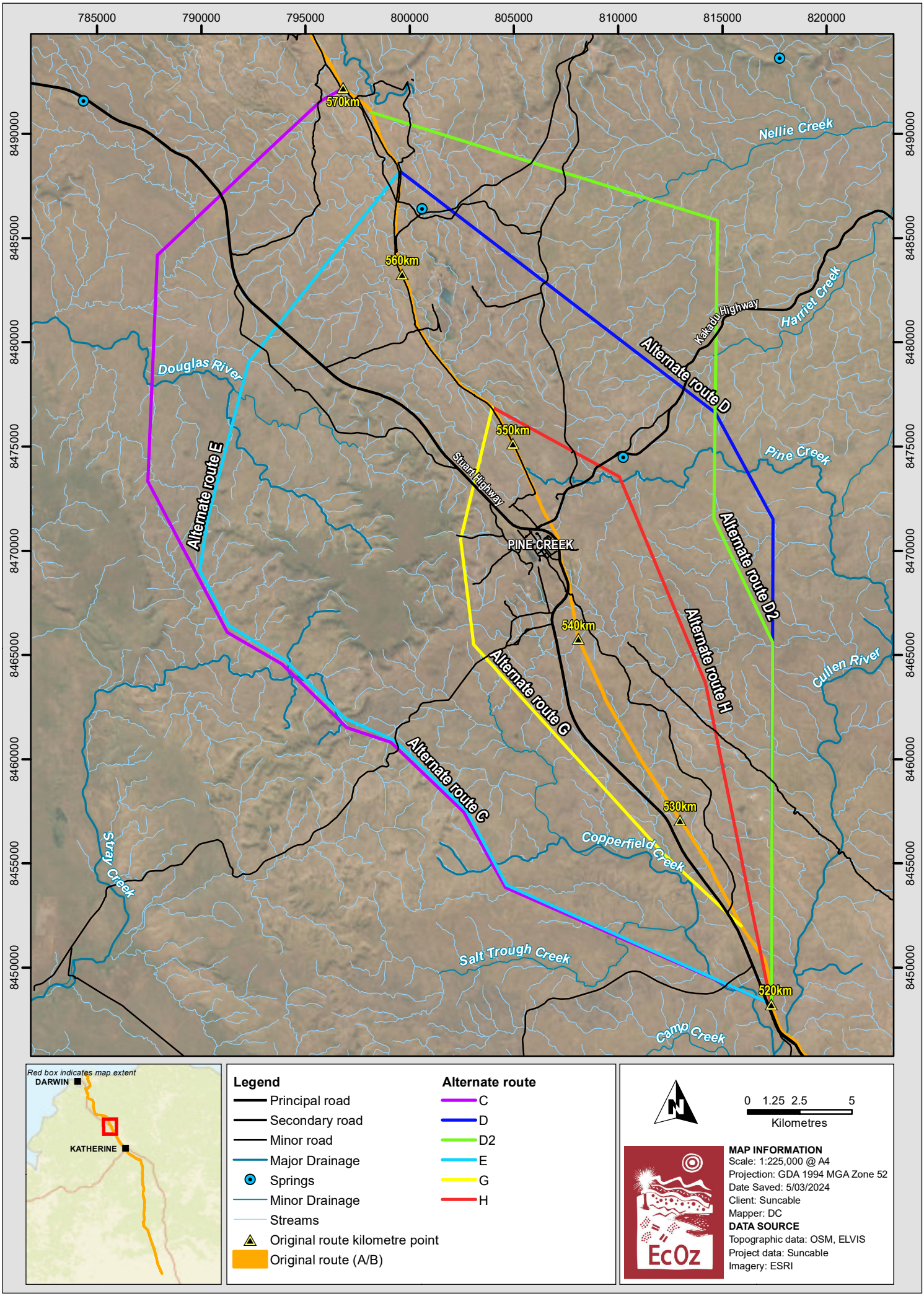

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Figure 4. Surface water features in the Pine Creek area

As described in Chapter 6 Section 6.4 of the DEIS, the key potential impacts to watercourses associated with constructing the OHTL are alteration of surface water flows in watercourses or wetlands from construction of access tracks and clearing of vegetation. Impacts to waterways where relevant to terrestrial ecosystems, aquatic ecosystems and water quality are discussed in Sections 3.3, 3.6 and 3.5 respectively. These impacts are proposed to be mitigated by a suite of measures detailed in the DEIS and SEIS.

The proposed mitigation measures are considered equally relevant to the alternative routes and there is a high level of confidence these measures will minimise impacts to surface water flows to as low as reasonably practicable. Impacts to surface water flows from the alternative routes are similar to the impacts from the current proposed route – namely minor.

3.5 Inland water environmental quality

The alternative routes are unlikely to alter the level of impact to surface water and groundwater quality. Potential impacts were assessed in Chapter 7 of the DEIS and, which conclude that the OHTL route will have a minor level of residual impact.

As described above in Section 3.4, all alternative routes would traverse more watercourses than the original proposed route and the western routes traverse land systems with a higher erosion risk. Use of hazardous materials, waste storage and disposal and requirements for camps and ablutions are consistent between the original route and the alternative routes.

As described in Chapter 7 Section 7.5 of the DEIS, the key potential impacts to water quality are:

- Increased turbidity in surface waters from erosion and sedimentation caused by soil disturbance
- Contamination of surface water or groundwater by spills/leaks from storage and handling of fuels and hazardous materials
- Contamination of surface water or groundwater from waste storage and disposal
- Contamination of surface water or groundwater by sewage from camps and ablutions.

These impacts are proposed to be mitigated by a suite of measures detailed in the DEIS and SEIS. The proposed mitigation measures are considered equally relevant to the alternative routes, and there is a high level of confidence that these measures will minimise impacts to surface water and groundwater quality as low as reasonably practicable. Consequently, impacts to surface water and groundwater quality from the alternative route are similar to the impacts from the current proposed route – namely minor.

3.6 Aquatic ecosystems

The alternative routes are unlikely to alter the level of impact to aquatic ecosystems. Potential impacts were assessed in Chapter 8 of the DEIS and Chapter 7 of the SEIS, which conclude that the OHTL route will have a minor level of residual impact.

As described above in Section 3.4, both alternative routes would traverse more watercourses which are expected to support aquatic ecosystems, than the original proposed route. Potential impacts to hydrology and water quality from the alternative routes are consistent with those considered in the DEIS for the original route, therefore the impacts to aquatic ecosystems from these pathways is considered equivalent for the alternative routes.

As described in Chapter 8 Section 8.4 of the DEIS, the key potential impacts to aquatic ecosystems are:

- Direct loss of aquatic habitat
- Reduction in aquatic habitat value due to water quality impacts
- Reduction in aquatic habitat value due to altered hydrology

While the alternative routes intersect more watercourses, the increase in disturbance to these watercourses from direct removal of riparian vegetation along the OHTL and construction of access tracks is not considered significant. As committed to in the DEIS and SEIS, no disturbance of aquatic ecosystems will occur in major perennial watercourses from any of the alternative routes. These impacts are proposed to be mitigated by a suite of measures detailed in the DEIS and SEIS.

The proposed mitigation measures are considered equally relevant to the alternative routes, and there is a high level of confidence these measures will minimise impacts to aquatic ecosystems as low as reasonably practicable. Impacts to aquatic ecosystems from the alternative route are similar to the impacts from the current proposed route – namely minor.

3.7 Air quality

The alternative routes are unlikely to alter the level of impact to air quality. Potential impacts were assessed in Chapter 11 of the DEIS and Chapter 10 of the SEIS, which conclude that the OHTL route will have a minor level of residual impact.

The air emissions zone of impact described in the DEIS (directly within the construction footprint) and zone of influence (within 500 m of construction activities) is considered relevant to the alternative routes. There are three receptors within the zone of impact for air emissions along the original route in the Pine Creek area. All alternative routes divert around Pine Creek and therefore have a greater separation distance from sensitive receptors than the original route. Assessment of aerial imagery identified one property near Route G (within 200 m) as it passes through the back of Pine Creek. The use of this property is unknown therefore it is considered a sensitive receptor for the purpose of this assessment.

All alternative routes (except route G, which would be consistent with the original route) would:

- Increase vegetation clearing and soil disturbance due to increased corridor length and increased access track requirements.
- Increase distances travelled by construction vehicles and construction time due to increased corridor length.

These increases are considered minor in regard to assessment of impacts to air quality. None of the alternative routes are expected to significantly alter construction methodology, timeframes or types of activities occurring, which also influence impacts on air quality.

As described in Chapter 11 Section 11.4 of the DEIS, the key potential impacts to air quality associated with constructing the OHTL are:

- Emissions of PM or NO_2 that could affect human health
- Emissions of Particulate matter (TSP and deposited dust) that could affect amenity.

These impacts are proposed to be mitigated by a suite of measures detailed in the DEIS and SEIS. The proposed mitigation measures are considered equally relevant to the alternative routes, and there is a high level of confidence these measures will minimise impacts to air quality to as low as reasonably practicable. Impacts to air quality from the alternative route are similar to the impacts from the current proposed route – namely minor.

3.8 Atmospheric processes

The alternative routes will not significantly alter the volume of greenhouse gas emissions over the life of the project. Potential impacts on atmospheric processes were assessed in Chapter 12 of the DEIS and Chapter 11 of the SEIS, which conclude that the OHTL route will have a minor residual impact (with the overall project having a major positive level of residual impact).

As described in Chapter 12 Section 12.4 of the DEIS, the key potential impacts to atmospheric processes associated with constructing the OHTL are:

- GHG emissions from combustion of fuel from vessels, plant and equipment for earthworks, air and land travel, logistics and power generation
- GHG emissions from land clearing and land use change
- GHG emissions from the decomposition of organic debris and loss of soil carbon during operation.

While the alternative routes will require some additional vegetation clearing and use of plant and vehicles, this will be a minor addition in the context of the estimated 4.4 million tonnes (MT) CO_2e of greenhouse gases emitted through the life of the project.

During operations, use of renewable energy generated by the project will avoid 115 MT CO_2e over the life of the project in the Northern Territory alone. Therefore, any of the proposed alternative routes will still result in significant net avoidance of emissions.

Regardless, greenhouse gas emissions are proposed to be avoided and mitigated by a suite of measures detailed in the DEIS and SEIS. The proposed mitigation measures are considered equally relevant to the alternative routes and there is a high level of confidence these measures will minimise greenhouse gas emissions to as low as reasonably practicable. Greenhouse gas emissions from the alternative routes are similar to the impacts from the original proposed route.

Impacts to atmospheric processes from the alternative OHTL route are predicted to be minor, while the project is still expected to have a major positive level of residual impact.

3.9 Culture and heritage

The alternative routes are not expected to significantly alter the level of impact to culture and heritage. Potential impacts on culture and heritage were assessed in Chapter 14 of the DEIS and Chapter 13 of the SEIS, which conclude that the OHTL route will have a moderate residual impact. It is noted that consultation with Aboriginal stakeholders and on-ground heritage surveys are ongoing as per commitments made in the DEIS and SEIS.

For this desktop assessment it is assumed there is an increased likelihood of encountering heritage materials at locations where the corridor intersects watercourses, floodplains, swamps and/or rocky country. The current route through Pine Creek does intersect some waterways, as described in Section 3.4. However, encountering heritage along this route is less likely due to the disturbance caused by construction of the railway.

Similar to the original route, it is assumed there is increased potential for heritage materials where all alternative routes intersect waterways and rocky country. The land systems to east of the rail corridor are more likely to have archaeological sites (likely restricted to artefact scatters and quarries) compared to the upland areas traversed by the western routes which are more likely to have rock art.

Routes C and E also traverse through Wagiman Aboriginal Land Trust. Consultation has not been undertaken with any Traditional Owners to determine potential cultural values for any of the alternative routes but have been scheduled by the Northern Land Council for April/May 2024. There are currently Native Title Claims for Jindare, Bonrook, Mary River West and Mary River East pastoral stations.

There are known Aboriginal archaeological features to the north of route D2 (approximately 700 m) associated with Mt Porter mine; however, these are outside the area that would be disturbed from that route.

Although there are no known sacred sites through the alternative routes or through the original route, previously unrecorded sites could be identified through the process of obtaining an Authority Certificate from the Aboriginal Areas Protection Authority (AAPA). Any potential impacts to sacred sites from any of the routes would be managed through the AAPA Authority Certificate process.

Pine Creek and the surrounding area is known to contain various historic mine workings dating back to the 1800's when gold was first discovered in the region, and there are likely to be some sites throughout the region that are of heritage value but are not formally protected under the *Heritage Act*. These would be small, discrete areas and it is assumed could be identified and avoided (if required) through detailed assessment of the chosen alignment.

The routes do not intersect any declared heritage sites; however, the following declared heritage sites exist in proximity (between 1 km – 2 km) to Route E:

- Spring Hill Battery Complex
- Cypress Pine Overland Telegraph Poles (via Pine Creek)
- 12 Mile Chinatown (Settlement and Battery).

Additionally, the McDonald Airfield WW2 Historic Site is approximately 1 km east of Route E, just before it intersects the Stuart Highway.

As described in Chapter 14 Section 14.4 of the DEIS, the key potential impacts to culture and heritage associated with constructing and operating the OHTL are:

- Direct impact to heritage features, including Aboriginal Sacred Sites, Aboriginal archaeological places and objects, historic heritage features and culturally significant landscape features.
- Indirect impact to heritage features listed above.
- Direct or indirect impact to unrecorded heritage features.

There is potential for impacts on heritage features from all alternative routes. While there is uncertainty regarding presence of heritage features within the original route, construction of the rail corridor would have likely disturbed many sites within that area compared to the alternative routes which are all largely undisturbed. Additionally, the western routes traverse rocky country that is likely more sensitive and may consist of rock art sites.

These impacts are proposed to be mitigated by a suite of measures detailed in the DEIS and SEIS. While impacts on culture and heritage from the alternative routes can be managed through the same mitigations, the original route is the least impactful based on the historic disturbance. The alternative routes present an increased risk to historic features such as mine workings, and a higher likelihood of encountering archaeological heritage features. There is a high level of confidence that significant impacts to heritage values can be avoided and mitigated through the mitigations detailed in the DEIS and SEIS.

Impacts to culture and heritage from the alternative OHTL route are predicted to remain moderate.

3.10 Community and economy

The alternative routes are unlikely to alter the overall impact rating to community and economy; however, there are impacts on pastoral properties in the area due to the alternative routes diverting through multiple pastoral properties. Potential impacts to community and economy were originally assessed in Chapter 13 of the DEIS and Chapters 10 and 12 of the SEIS, which conclude that the proposal overall will have a high level of residual impact through a variety of pathways.

The original route of the OHTL at Pine Creek begins at approximately KP 542 and is generally adjacent to the railway corridor on the eastern side of the Stuart Highway. This alignment extends for approximately 4 km until the route preferences proximity to the railway corridor, crosses the Kakadu Highway, and re-enters the railway corridor at approximately KP 546. This route prioritises a location proximate to the existing railway corridor to minimise impacts on surrounding land uses and landowners. In the absence of detailed strategic planning objectives for the Pine Creek region, the original route seeks to minimise impacts on future land uses by co-locating with existing linear infrastructure.

The SEIS determined impacts on land use would be minor due to the limited impact of the route on existing land uses and alignment of the OHTL adjacent to the rail corridor. Table 5 and Figure 5 provide details of community and economy considerations for the alternative routes. While overall the alternative routes are considered to increase the level of impact on landholders, they come with the benefit of reducing the visual impact of the OHTL passing through Pine Creek.

Table 5. Community and economy considerations for OHTL options in the Pine Creek region

Route	Description
A/B (original route)	• Limited impact on freehold land and pastoral land, six affected properties. Engagement already undertaken with the public and landholders (based on proposed deviations around Pine Creek). • Negative project sentiment from one landholder. • Co-location with similar linear infrastructure (Stuart Highway, railway corridor) Current project basis, considered acceptable with mitigations in place.
C	• Five affected properties. • Engagement already undertaken with the public and a portion of landholders (based on proposed deviations around Pine Creek). • Negative project sentiment from one landholder. • Considerable severance of five separate properties' farming operations. Potentially mitigated with compensation framework. Several landholders not yet consulted and potential for impacts on agricultural activities where the OHTL intersects pastoral properties. Challenging and not a preferred outcome.
D	• Three affected landholders. Potential for impacts on agricultural activities where the OHTL intersects pastoral properties. • No engagement with one affected landholder. • Two affected landholders previously engaged, but not in relation to subject route. • Potential for mitigation with compensation framework. • Mineral titles at north end of the deviation – Union Reefs Mine. Potential to be traversed (ML27999, 31122, MLN1109). Landholder sensitivities, particularly regarding the proliferation of infrastructure (the Stuart Highway, the Railway Line, Darwin-Katherine Integrated System) across pastoral land. Introduces a new landholder.
D2	• Two affected landholders. Reduced by one landholder in comparison to route D. Potential for impacts on agricultural activities where the OHTL intersects pastoral properties. • Two affected landholders previously engaged, but not in relation to subject route. • Potential for mitigation with compensation framework. • Avoids mineral titles. Landholder sensitivities, particularly regarding the proliferation of infrastructure (the Stuart Highway, the Railway Line, Darwin-Katherine Integrated System) across pastoral land.
E	• Three affected properties. • Engagement already undertaken with the public and landholders (based on proposed deviations around Pine Creek). • Negative project sentiment from one landholder. • Potential for impacts on agricultural activities where the OHTL intersects pastoral properties. Potentially mitigated with compensation framework. Landholder sensitivities, introduces a new landholder.

Route	Description
G	• Three affected properties. • Potential for impacts on agricultural activities where the OHTL intersects pastoral properties – relevant to three separate properties' farming operations. Potentially mitigated with compensation framework. • Engagement already undertaken with the public and landholders (based on proposed deviations around Pine Creek). Negative project sentiment from one landholder. Landholder sensitivities, introduces a new landholder.
H	• Two affected properties. • One homestead within 2 km of option. Sensitive receptor. Opportunity to avoid via amenity impacts by local re-route. • Potential for impacts on agricultural activities where the OHTL intersects pastoral properties – relevant to three separate properties' farming operations. Potentially mitigated with compensation framework. • Engagement already undertaken with the public and affected landholders on OHTL in alignment. • Negative project sentiment from one landholder. Reduced impacts on agricultural activities where the OHTL intersects pastoral properties compared to option G, particularly given proximity to existing linear infrastructure. • Landholdings already comprise DKIS transmission line, Amadeus Gas pipeline. Landholder sensitivities regarding impacts on pastoral activities; however, minimised if following existing linear infrastructure.

While all routes impact a relatively small number of landholders, the alternative routes all deviate substantially from the original alignment through Pine Creek. In particular, routes C, E, D and D2 all deviate considerably from existing infrastructure corridors intersecting multiple pastoral properties. Route D2 has been designed to follow the boundary between pastoral properties, to minimise impacts to pastoral activities as much as possible. While route D2 is 8 km from Kohinoor adit at the closest point compared to route D at 10 km from Kohinoor adit, route D2 results in better outcomes compared to route D by impacting two rather than three landowners, and by following boundaries between properties where possible. Route D also intersects mineral titles in the north associated with Union Reef. Micro-siting would aim to avoid this constraint, in consultation with the relevant interested parties.

Consultation with landholders is required to determine the significance of impacts to land use and mitigations available.

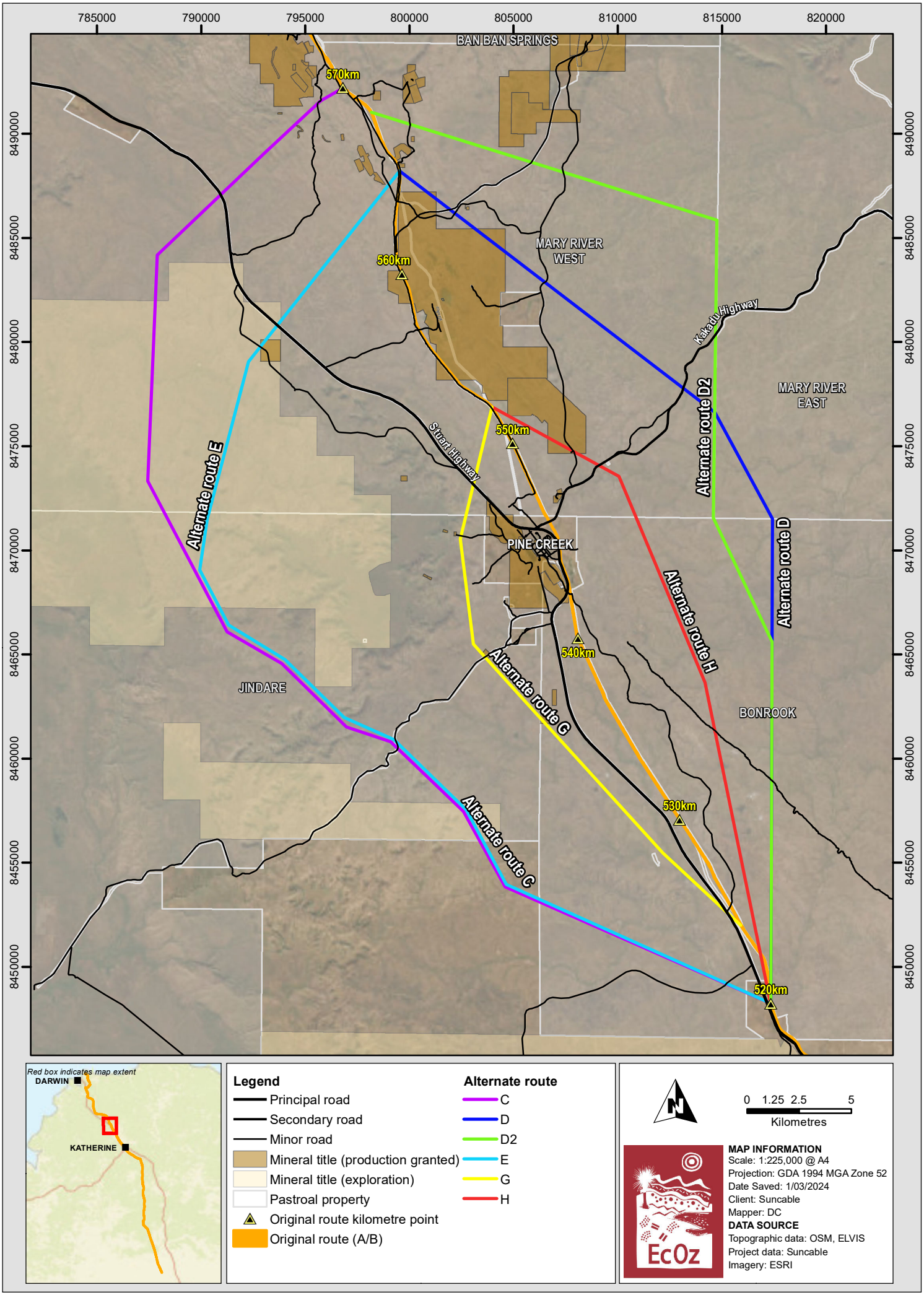

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Figure 5. Property boundaries and mineral titles within the Pine Creek area

3.11 Human health

The alternative routes are unlikely to alter the level of impact human health. Potential impacts were assessed in Chapter 15 of the DEIS and Chapter 14 of the SEIS, which conclude that the OHTL routes will have a moderate level of residual impact.

The alternative routes deviate around Pine Creek and sensitive human receptors within and surrounding the town. As described in Chapter 15 Section 15.4 of the DEIS and Chapter 14 Section 14.4 of the SEIS, the key potential impacts to human health associated with constructing and operating the OHTL are:

- Increase in communicable disease
- Exposure to air emissions of particulate matter (PM10, PM2.5) and Nitrogen Oxide (NOx)
- Exposure to noise emissions
- Exposure to EMF
- Increased pressure on emergency services
- Physical obstacle to aircrafts
- Damage to physical OHTL structures posing a human health and public safety risk.

While the alternative routes avoid some impacts on human health in the Pine Creek region, there is no significant change to potential impacts on sensitive receptors along the other sections of the OHTL corridor.

Impacts from exposure to noise emissions, air emissions of particulate matter and EMF, and damage to the OHTL posing a human health risk are considered unlikely from the alternative routes due to the increased separation distance from Pine Creek town. However, the risk of increased communicable disease still exists because it is possible the construction workforce will use services within Pine Creek. Moreover, the OHTL may continue to act as a physical obstacle to aircrafts and the concern that will be increased pressure on emergency services remains. The DEIS and SEIS concluded the residual impact to human health from these aspects is minor to moderate.

The potential impacts are proposed to be mitigated by a suite of measures detailed in the EIS and SEIS. The proposed mitigation measures are considered equally relevant to the alternative routes, and there is a high level of confidence these measures will minimise impacts on human health to as low as reasonably practicable. Impacts to human health from the alternative routes are similar or reduced compared to the impacts from the current proposed route – namely minor to moderate.

3.12 Conclusion

The desktop constraints assessment, for most of the proposed alternative OHTL routes near Pine Creek (C, E, D and D2) shows that the routes are unlikely to result in significant impacts to environmental values that have not been considered in the EIS process to date. However, consultation with the Department of Environment, Parks and Water Security (DEPWS) suggests that routes G and H do not provide an acceptable separation distance from the Kohinoor adit, and therefore are not considered feasible due to ecological constraints.

By deviating from the rail corridor, all alternative routes intercept more environmental values than the original route, except for the Kohinoor adit which the alternative routes avoid. However, potential impacts to these values from the alternative routes can be avoided and mitigated by measures outlined in the DEIS and SEIS, so that the overall residual impact rating of the alternative routes is similar to that assessed in the DEIS and SEIS.

When comparing routes deviating to the west (C and E) and routes to the east (D and D2), generally, routes to the west of the rail corridor traverse land that has:

- a higher risk of erosion
- more major watercourses
- more significant vegetation and Gouldian Finch habitat
- areas that are more likely to contain higher value Aboriginal heritage features
- are in proximity to declared heritage sites.

All alternative routes introduce impacts regarding land use and social impacts compared to the original route, by deviating from existing infrastructure corridors; however, route H follows the DKIS and existing gas pipeline, co-locating the OHTL with existing linear infrastructure corridors. The further from the original route each of the alternatives are, the more land clearing and disturbance is required due to an increase in the length of the route, and through areas that are largely undisturbed.

Assuming effective implementation of avoidance and mitigation measures provided in the DEIS and SEIS, the alternative routes (C, E, D and D2) would not result in significant impacts to any environmental value.