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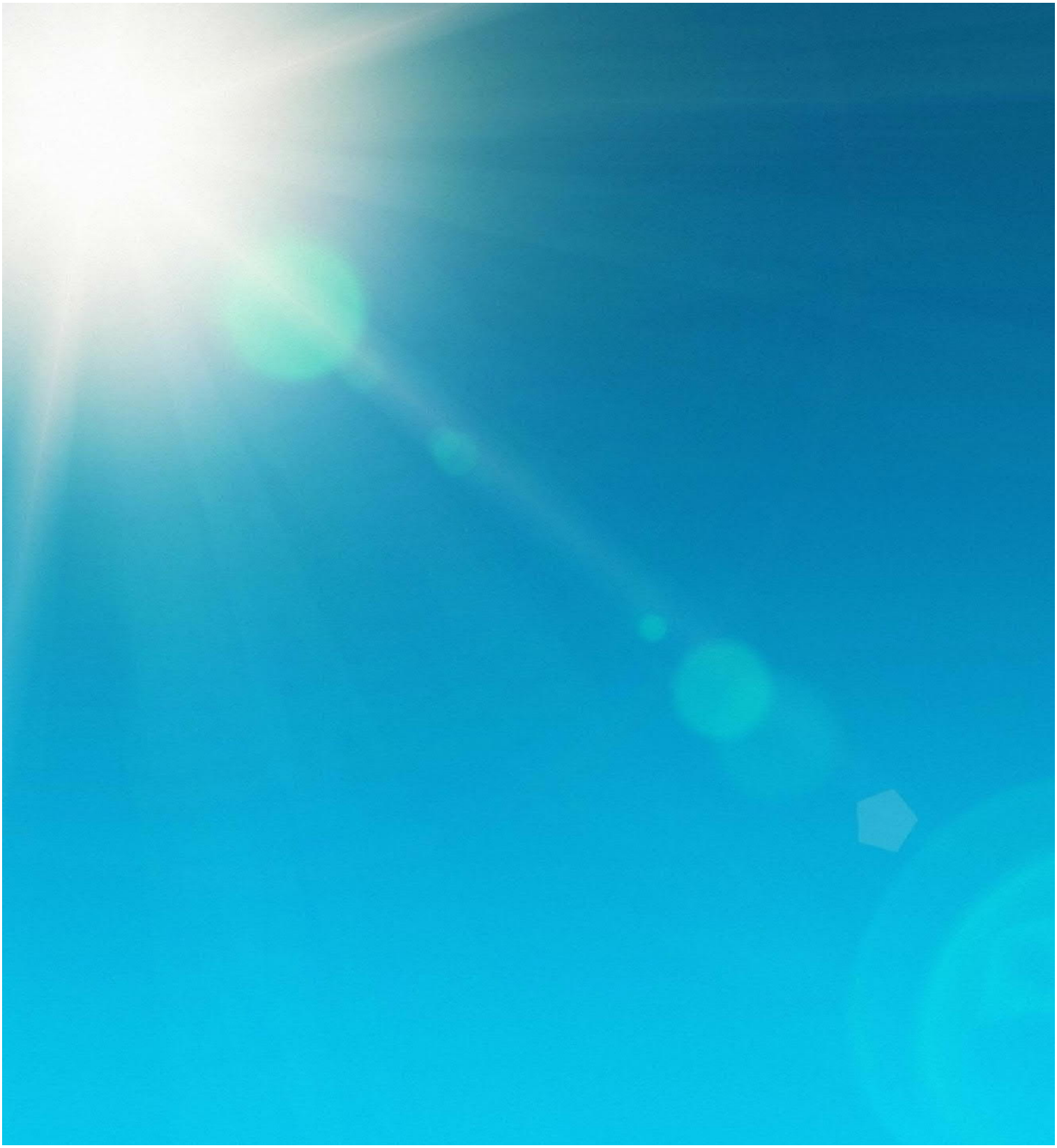
Chapter 15 – Human Health

Australia-Asia PowerLink Environmental Impact Statement



Chapter 15 – Human Health

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Revision history

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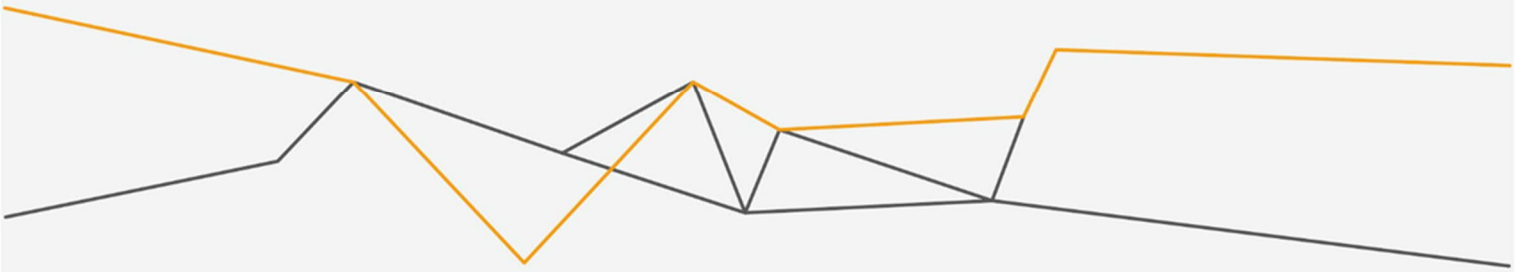

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15 Human Health

The NT EPA's objective for the Human health factor is to:

"*Protect the health of the Northern Territory population.*"

This chapter describes and assesses the significance of potential impacts to human health associated with the Australia-Asia PowerLink (AAPowerLink) proposal. Human health impacts from electromagnetic fields (EMF), air emissions, and noise were identified for assessment because AAPowerLink activities will be a source of these pollutants and risks which can impact human health if present at elevated levels. Human health impacts from biting insects and communicable disease were also identified for assessment because AAPowerLink activities have the potential to increase the risk of biting insects due to standing water and the camp workforce may also be exposed to an increased risk of disease transmission (e.g. COVID-19).

Key chapters that inform this chapter include Chapter 7 Inland Water Environmental Quality, Chapter 12 Air Quality, Chapter 13 Community and Economy and Appendix L Noise Technical Memo. Short-term nuisance impacts to people who live and work close to the Overhead Transmission Line (OHTL) corridor as a result of construction traffic, air emissions, and noise are discussed in Chapter 13 Communities and Economy. This chapter does not address workplace health and safety, aside from biting insects and communicable disease. General workplace health and safety matters are governed by the *Work Health and Safety (National Uniform Legislation) Act 2011* and *Electricity Reform Act*. Sun Cable will implement a workplace health and safety (WHS) management system that complies with all legislative requirements, codes of practice and standards. Biting insects was also identified as a requirement to be assessed in the AAPowerLink EIS Terms of Reference.

Chapter 7 Inland Water Environmental Quality concluded that assuming effective implementation of standard controls, any potential contamination of surface water or groundwater by spills/leaks from storage and handling of fuels and hazardous materials, waste storage and disposal, or sewage from camps and ablutions during construction phase are unlikely to occur. During operations, the likelihood of impacts to water quality is further reduced. Additionally, surface water is not used as a potable water source. Therefore, contaminated surface water or groundwater is not considered further as a pathway for human health impacts, for example through drinking of being exposed to contaminated water.

15.1 Information sources

The information presented in this chapter in relation to electromagnetic fields (EMF) is taken from proposal details and specifications provided by Sun Cable, based on technical review of literature pertaining to relevant engineering specifications. The relevant EMF guideline has been provided by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA 2015) and the International Commission for Non-ionizing Protection (ICNIRP 2003) in relation to EMF management and acceptable exposure levels in Australia and internationally.

Biting insects relevant to the proposal and their potential impacts were determined from information and guidelines developed by the NT Centre for Disease Control and the NT Department of Health Medical Entomology branch, and are referenced throughout.

Modelled predicted changes in pathway environmental factors (e.g., air quality and noise) were also considered for their potential to cause impacts to human health as a result of the proposal. Refer to Appendix U Air Quality Impact Assessment and Appendix L Noise Technical Memo.

15.2 Relevant policies and guidelines

The following guidelines have been referred to when assessing and managing potential impacts to human health:

- *Guidelines for Limiting Exposure to Time-Varying Electric and Magnetic Fields (1Hz – 100kHz)* – International Commission on Non-Ionizing Radiation Protection (ICNIRP 2009b)
- *Guidelines for Preventing Mosquito Breeding Sites Associated with Mining Sites* – Northern Territory Centre for Disease Control (Whelan 2005b)
- *Guidelines for Preventing Mosquito Breeding Associated with Construction Practice near Tidal Areas in the NT* (Department of Health 2017).
- *National Environment Protection (Ambient Air Quality) Measure (Air NEPM 1998)* and the *National Environment Protection (Air Toxics) Measure (Air Toxics NEPM 2004)*
- Ambient air quality guidelines per *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (2016)* (NSW EPA, 2016).
- *Northern Territory Noise Management Guideline* (NT EPA, 2018)

15.3 Sensitive receptors

Sensitive receptors are locations where people are regularly present, such as homes, workplaces, schools, care facilities and recreation sites, and therefore are sensitive to exposure to emissions or contaminants. Sensitive receptors within specific areas of influence have been identified when assessing potential human health impacts, including:

- EMF – Community receptors and workers in close proximity to OHTL with the potential to that may experience EMF impacts.
- Biting Insects – Community receptors and workers that could experience an increase in biting insects as a result of proposal components and activities.
- Communicable Disease – Workers, and community receptors in close proximity to construction camps or areas where workers may interact with community residents, visitors, and businesses.
- Air Quality – Community receptors within modelled area of influence from incremental impact of AAPowerLink construction air emissions (generally 500-950 m from construction activities).
- Noise – Community receptors (residents, businesses, and users of community amenities) within the assessed area of influence from incremental impact of AAPowerLink construction noise emissions.

The locations of sensitive receptors in proximity to the AAPowerLink proposal footprint are detailed in Chapter 2, Figure 2-5a, Figure 2-5b, Figure 2-5c, and Figure 2-5d, and distances from proposal footprint are provided below.

15.3.1 Solar Precinct

The closest residential areas to the Solar Precinct are the occasionally occupied Aboriginal family outstations at Jangirulu (17 km to the east) and Powell Creek outstation (25 km north-east). Renner Springs Roadhouse on the Stuart Highway is located 36 km from the Solar Precinct site and provides overnight accommodation and meals for tourists and workers. The nearest town is Elliott, approximately 70 km to the north, which has a population of approximately 330 people, most of whom are Aboriginal people who live in two camps at either end of the town, Gurungu and Wilyugu (Bushtel 2020a & 2020b).

Aboriginal people continue to access Powell Creek Station for hunting and fishing, particularly in the Lake Woods Conservation Area to the north-east of the proposed Solar Precinct. The Solar Precinct was sited

towards the southern border of Powell Creek Station to reduce interference with/from pastoral operations. The site is remote and not readily accessible to the general public.

Key sensitive receptors near the Solar Precinct, and distance from proposal footprint, are listed in Table 15-1, and shown in Chapter 2 Figure 2-5a.

Table 15-1. Populated places, areas of interest and public infrastructure proximate to Solar Precinct

Receptors from south to north	Type of Receptor	Distance from Solar Precinct footprint
Renner Springs Roadhouse	Outstation	36 km south-east
Powell Creek telegraph station	Outstation	25 km north-east
Jangirulu Family Outstation	Outstation	17 km north-east
Lake Woods Site of Conservation Significance	Site of Conservation Significance / Recreational	10 km north-east

15.3.2 Overhead Transmission Line

The first 465 km of the OHTL corridor from the Solar Precinct, north to near Katherine, traverses' remote areas where there are no permanent residences. Review of aerial imagery indicates there are no dwellings or buildings within 1 km of the corridor through this area. Between Katherine and Darwin, the OHTL corridor traverses close to several rural dwellings, buildings and land holdings, where people are likely to live and/or work. Some of the dwellings and buildings are located within 100 m of the corridor (Chapter 2, Figure 2-5a, Figure 2-5b, Figure 2-5c).

Through Pine Creek, the OHTL corridor traverses within 600 m of the Pine Creek Compound and within 200 m of buildings at the golf course. The OHTL corridor traverses through Adelaide River township where the railway runs alongside the Stuart Highway. On the outskirts of the Darwin rural area, the OHTL corridor traverses within a few hundred metres of rural dwellings through Livingstone and Noonamah.

Key sensitive receptors near the OHTL, and distance from proposal footprint, are listed in Table 15-2, and shown in Chapter 2 Figure 2-5b and Figure 2-5c.

Table 15-2. Populated places, areas of interest and public infrastructure proximate to OHTL

Receptors from south to north	Type of Receptor	Distance from OHTL footprint
Murranji Family Outstation	Outstation	3.5 km
Farmhouse	Residence	1.6 km
Farmhouse	Residence	1.5 km
Industrial buildings	Business	1 km
Rural housing (multiple buildings)	Residence	0.6 km
Rural housing (multiple buildings)	Residence	1 km
Rural housing (multiple buildings)	Residence	0.6 km
Rural housing (multiple buildings)	Residence	0.4 km
Site of Conservation Significance - Yinberrie Hills	Site of Conservation Significance / Recreational	0 km
Bonrook homestead	Outstation	2.6 km
Kybrook Farm Aboriginal Community	Aboriginal Community	3.4 km

Receptors from south to north	Type of Receptor	Distance from OHTL footprint
Farmhouse	Residence	0.4 km
Pine Creek	Residence	1 km
Pine Creek Aboriginal Community	Aboriginal Community	0.6 km
Pine Creek golf course and track	Business	0.2 km
House	Residence	0.8 km
The Banyans homestead	Outstation	1.3 km
House	Residence	0.1 km
Work area	Business	0.5 km
House	Residence	1.2 km
Burnside Farm homestead	Outstation	2.6 km
Racecourse - Adelaide River	Business / Recreation	0.2 km
Amangal Indigenous Village	Aboriginal Community	0.8 km
Adelaide River township	Residence	0.11 km
House	Residence	0.6 km
Litchfield National Park boundary	Recreational	0.4 km
House	Residence	0.45 km
House	Residence	0.2 km
Small rural blocks	Residence	0.1 km
Gulngarring Family Outstation	Outstation	2.45 km
Small rural blocks	Residence	0.1 km
Small rural blocks	Residence	0.1 km
Albany Park	Recreational	1.21 km
Small rural blocks	Residence	1.1 km
Small rural blocks	Residence	1.1 km
Acacia Larrakia family Outstation	Outstation	4.5 km
Darwin rural areas; Noonamah, Wak Wak, Lambells Lagoon, Herbert and Koolpinyah	Residence	0.2 – 0.3 km east and west
Black Jungle Conservation Reserve	Site of Conservation Significance / Recreational	0 km

15.3.3 Darwin Converter Site and Cable Transition Facilities

The Darwin Converter Site and Cable Transition Facilities are located at Murrumujuk (on Gunn Point) approximately 31 km north-east of Darwin. The closest residences are located approximately 5 km south at the Tree Point Community and the access road to this community passes through the area where the facilities will be located. The facilities are located adjacent to the Gunn Point Beach access track and the area experiences a low level of use for camping and other recreational activities on weekends and holidays due to its accessibility and proximity to Darwin.

Key sensitive receptors near the Darwin Converter Site and Cable Transition Facilities, and distance from proposal footprint, are listed in Table 15-3, and shown in Chapter 2 Figure 2-5b and Figure 2-5c.

Table 15-3. Populated places, areas of interest and public infrastructure proximate to Darwin Converter Site and Cable Transition Facilities

Receptors	Type of Receptor	Distance from
Tree Point Aboriginal Community	Aboriginal community	5 km south
Gunn Point beach access and recreational area	Recreational	Adjacent north of site

15.4 Potential impacts

The potential impacts to human health associated with the AAPowerLink have been assessed using the EIA methodology described in Chapter 3 Impact Assessment. The EIA identified and assessed the following impacts that could occur during construction and/or operations:

- Exposure to Electric and Magnetic Fields (EMF)
- Increase in biting insects
- Increase in communicable disease
- Exposure to air emissions of particulate matter (PM10, PM2.5) and Nitrogen Oxide (NOx)
- Exposure to noise emissions

The EIA considered the impact avoidance and mitigation measures detailed in Section 15.6 below and assessed the residual impacts to human health assuming these measures are effectively implemented. A residual impact rating was then assigned taking into consideration the scale, magnitude and duration of the impacts, the presence/absence of environmental values and/or sensitive receptors and the level of certainty with respect to the intensity of the impact and the effectiveness of the mitigation measures. The residual impact ratings adopted in the assessment are provided in Table 15-4.

The outcomes of the EIA are summarized in Table 15-5 and Table 15-6 from the *Impact Assessment Register* provided at Appendix E and discussed in the subsequent sections.

Table 15-4. Residual impact ratings adopted for the AAPowerLink EIA

Ratings and Description
Minor: A minor residual impact is unlikely to be significant.
A minor impact generally has two or more of the following characteristics: Scale: Limited/Localised Magnitude: Negligible/Minor Duration: Short-term/ Medium-term/Reversible. **OR** There are no sensitive receptors or land uses present, and the environment does not contain any aspects that are valuable or otherwise important or unique (i.e., Very Low/Low rating), and there is moderate to high degree of certainty about the likelihood and intensity of the impact, and the effectiveness of proposed mitigation measures.
Moderate: A moderate residual impact has potential to be significant. The significance depends on the acceptability of the impacts and the effectiveness of mitigation measures.
A moderate impact generally has two or more of the following characteristics: Scale: Localised/Regional Magnitude: Moderate Duration: Medium-term/Long-term **AND/OR** There are sensitive receptors or land uses present, or environmental aspects that are valuable or otherwise important or unique (i.e., Medium-High value rating), and there is a low degree of certainty about the impact, and the effectiveness of proposed mitigation measures.

Ratings and Description
Major: A major residual impact is likely to be significant. The level of acceptability will depend on offsets or benefits compensating for the impact.
Impact generally has two or more of the following characteristics: Scale: Regional/ Widespread Magnitude: Moderate/Major Duration: Long-term/Permanent **AND** There are sensitive receptors or land uses present, or environmental aspects that are valuable or otherwise important or unique (i.e., Medium-High value rating).

Table 15-5. Summary of EIA results – Human health factor – Construction

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty	Residual Impact
Exposure to EMF Sections 15.4.1-15.4.5	All Sites	**Unlikely**	Not assessed as impact unlikely to occur. No construction activities predicted to create EMF exposures.					**None**
Increase in Biting Insects Section 15.4.6	All Sites	**Unlikely**	Construction activities unlikely to create biting insect breeding habitat.					**None**
Increase in communicable disease Section 15.4.7	All Sites	**Possible** Camp living arrangements and worker interactions with communities could increase communicable disease transmission.	**Regional** Could impact nearby communities.	**Medium-term** Impacts could occur over several years during construction.	**Minor** Minor increase in communicable disease predicted; mitigation measures expected to reduce magnitude of risk.	**High** Nearby communities could experience increased communicable disease transmission with could add stress to local health care provision.	**Low** Unpredictable nature of COVID-19 and other communicable diseases.	**Moderate**
Exposure to air emissions of particulate matter (PM10, PM2.5) and Nitrogen Oxide (NOx) Section 15.4.8	Solar Precinct	**Unlikely**	Not assessed as impact is unlikely to occur. No sensitive receptors are within area of predicted air quality area of influence (~250-500 m from site boundary).				**High** Atmospheric dispersion modelling undertaken (Appendix U).	**None**
	OHTL	**Possible** Air emissions likely as a result of land clearing, site preparation, pole installation, and stringing of conductors.	**Localised** Air quality assessment criteria could be exceeded between 283-468 m from the construction activities.	**Short-term** Impacts will occur for a few weeks to months at each location along the OHTL.	**Minor** Emissions are likely to exceed health criteria with no mitigation. Mitigation measures expected to	**Medium** There are residences and buildings present in areas where air quality criteria are predicted to be exceeded.	**High** Atmospheric dispersion modelling undertaken (Appendix U). Understanding of construction activities, and	**Minor**

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty	Residual Impact
					reduce the magnitude of this risk.		mitigation measures.	
	Darwin Converter Site	**Possible** $PM_{2.5}$ and NO_2 pollutants decrease rapidly outside construction site boundary and are unlikely to be at levels that cause health effects outside of the site.	**Localised** PM_{10} could exceed criteria up to 2km (annual) and 3.5km (daily) from site boundary.	**Medium-term** Impacts will occur over several years during construction.	**Minor** Emissions are likely to exceed health criteria with no mitigation. Mitigation measures expected to reduce the magnitude of this risk.	**Medium** People frequent areas where air quality criteria are predicted to be exceeded.	**High** Atmospheric dispersion modelling undertaken (Appendix U). Understanding of construction activities, and mitigation measures.	**Minor**
	Cable Transition Facilities	**Possible** Air emissions likely as a result of land clearing, trenching, and cable burial activities.	**Localised** Air quality assessment criteria could be exceeded between 48-370 m from the construction activities.	**Medium-term** Impacts will occur over months during construction.	**Minor** Emissions are likely to exceed health criteria with no mitigation. Mitigation measures expected to reduce the magnitude of this risk.	**Medium** People frequent areas where air quality criteria are predicted to be exceeded.	**High** Atmospheric dispersion modelling undertaken (Appendix U). Understanding of construction activities, and mitigation measures.	**Minor**

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty	Residual Impact
Exposure to noise emissions Section 15.4.9	Solar Precinct	**Unlikely**	Not assessed as impact and is unlikely to occur. No sensitive receptors are within predicted screening distance.				**High** High confidence in noise screening assessment.	**None**
	OHTL	**Possible** Pole installation activities likely to produce noise emissions experienced by local receptors.	**Localised** Health criteria predicted to be exceeded within 116-620 m from source activity.	**Short-term** Impacts will occur for a few weeks to months at each location along the OHTL.	**Moderate** Noise is precited to exceed health criteria at sensitive receptors in several locations along OHTL.	**Medium** Sensitive receptors present but impacts will be short-term.	**High** High confidence in understanding of construction activities contributing to noise.	**Moderate**
	Darwin Converter Site	**Unlikely**	Not assessed as impact is unlikely to occur. No sensitive receptors are within predicted area of influence.				**High** High confidence in noise screening assessment.	**None**
	Cable Transition Facilities	**Possible** Cable installation and backfilling activities likely to produce noise emissions experienced by local receptors.	**Localised** Health criteria predicted to be exceeded within 92 m from source activity.	**Medium-term** Impacts will occur over months during construction.	**Moderate** Noise is precited to exceed health criteria at Gunn Point Beach.	**Low** NT EPA noise guideline (NTEPA 2018) does not identify recreational beaches (Gunn Point Beach) as a noise sensitive land use. Any people within area of influence would be transient.	**High** High confidence in understanding of construction activities contributing to noise, and effective mitigation.	**Minor**

Table 15-6. Summary of EIA results – Human health factor – Operations

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty	Residual Impact
Exposure to EMF Sections 15.4.1-15.4.5	All sites	**Unlikely** Exposure to low frequency fields and static electricity and magnetic fields unlikely to cause health effects.	**Limited** Very short distance from emissions source.	**Long-term** Continuous during operations.	**Negligible** Negligible risk associated with low frequency fields; below ICNIRP occupational exposure criteria. Research to date shows no detrimental health effect from exposure to low-level static electric and magnetic fields	**Low-Medium** There are no sensitive receptors in areas where EMF exposure could occur; no public access near and under facilities.	**High** Acceptable level of confidence in EMF research to date.	**None**
Increase in Biting Insects Section 15.4.6	All sites	**Unlikely**	Not assessed as impact is unlikely to occur. Operational footprints will be managed to avoid creation of biting insect breeding habitat.					**None**
Increase in communicable disease Section 15.4.7	All sites	**Unlikely**	Not assessed as impact is unlikely to occur. Reduced size of operations workforce and reduction in camp living accommodation reduces risk of increase in communicable disease during operations phase.					**None**
Exposure to air emissions of particulate matter (PM10, PM2.5) and Nitrogen Oxide (NOx) Section 15.4.8	All sites	**Unlikely** Diesel emissions from vehicles and dust emissions from operational activities could potentially expose human receptors to air emissions.	**Limited** Diesel emissions from operational activities will affect a small area around activities. Vehicle numbers required during operations are	**Short-term** Emissions could cause elevated concentrations of NO_2 or TSP for short periods of time as vehicles drive by or during maintenance activities, or	**Negligible** Health criteria are unlikely to be exceeded.	**Low-Medium** There are no sensitive receptors in areas where air emissions will occur i.e. they are limited to within operational areas.	**High** The only sources of N02 during operations will be some vehicles and maintenance equipment. Operational activities will not involve major	**Minor**

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty	Residual Impact
			limited. Dust emissions from operational activities will affect a small area around activities. Most of the footprint will be under infrastructure and vegetation management will be used to control dust at the Solar Precinct.	ground disturbance.			ground disturbance works. Most ground surfaces will be covered.	
Exposure to noise emissions Section 15.4.9	Solar Precinct	**Unlikely**	Not assessed as impact is unlikely to occur. No sensitive receptors are within predicted screening distance.				**High** High confidence in noise screening assessment.	**None**
	OHTL	**Possible** OHTL operation will produce continuous noise.	**Localised** Health criteria predicted to be exceeded within 101 m from source activity.	**Long-term** Impact to occur continuously during operations.	**Moderate** Noise will likely exceed health criteria at sensitive receptors in several locations along OHTL.	**Medium** Some sensitive receptors within area of influence.	**High** High confidence in noise screening assessment, understanding of operations activities.	**Moderate**
	Darwin Converter Site	**Unlikely**	No operational noise is anticipated for any potential sensitive receptors near the Darwin Converter Site				**High** High confidence in noise screening assessment.	**None**
	Cable Transition Facilities	**Unlikely**	No operational noise is anticipated for the Cable Transition Facilities as the cabling will be buried underground. No sensitive receptors.				**High**	**None**

Impact	Location	Likelihood	Scale	Duration	Magnitude	Value rating	Certainty	Residual Impact
							High confidence in noise screening assessment.	

15.4.1 Electromagnetic Fields

It is unlikely that sensitive receptors will be impacted by exposure from EMF as a result of the proposal. EMFs are physical fields produced by electricity or electrically charged objects that can be emitted from a range of natural sources (such as thunderstorms or from the earth's magnetic field) and human-made sources including powerlines and other electrical infrastructure. The proposal will transmit electricity from the Solar Precinct to Darwin using high-voltage direct current (HVDC) which is a digitised form of alternating current (AC). HVDC is recognised as having a significantly lower level of electromagnetic field (EMF) and significantly lower ionisation than AC lines.

There is growing public concern globally about exposure to EMFs, especially near powerlines and phone towers. The WHO reports that members of the general public exposed to low levels of electromagnetic fields at home have described symptoms including headaches, anxiety, suicide and depression, nausea, fatigue, hypersensitivity, and loss of libido (WHO, 2016). During consultation for AAPowerLink, stakeholders have raised concerns about exposure to EMFs.

In response to community concerns globally, the impacts of EMF on human health have been subject to extensive research around the world[1] and an extensive literature database with an inventory of 34,609 publications and 6,940 summaries of individual scientific studies compiled. EMF around power lines have been studied in cities and towns throughout Australia.

Leading agencies Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) and the World Health Organisation (WHO) have reviewed available research and published information and guidelines. ARPANSA (2019) finds that most of the research indicates that extremely low frequency (1 Hz to 100 Hz) EMF exposure normally encountered in the environment, including in the vicinity of transmission lines, does not pose a risk to human health. The World Health Organisation (WHO, 2016) conclude that current evidence does not confirm the existence of any health consequences, including chronic or delayed impacts from exposure to low level electromagnetic fields (<100 kHz) associated with electrical power infrastructure. The WHO also states "there appears to be little benefit in continuing research into the impacts that static electric fields have on health. None of the studies conducted to date suggest any untoward health impacts, except for possible stress resulting from prolonged exposure to microshocks" such as those experienced when walking on non-conductive carpet (EHC232 2006).

15.4.2 Low frequency fields

There will be low frequency EMF emitted from the alternating current (AC) transmission lines within the Solar Precinct and Darwin Converter Site, which will reflect a typical suburban street powerline[2], propagating over a very short distance and that will comply with health standards and exposure guidelines. EMF levels will be below the ICNIRP occupational exposure criteria, and the facilities are fenced to prevent public access. There is a negligible level of risk to the community associated with the low frequency fields associated with the AAPowerLink infrastructure.

15.4.3 Static electric and magnetic fields

The OHTL and Subsea Cable System will transmit high voltage direct current (HVDC) electricity, which emits low-level static electric and magnetic fields, that differ from the low frequency fields emitted by AC powerlines. Overall research to date has not shown that exposure to low-level static electric and magnetic fields have detrimental impacts on health (ICNIRP 2019).

[1] EMF Portal - https://www.emf-portal.org/en/cms/page/home/objectives
[2] Most powerlines in Australia, transport electricity as alternating current (AC) (at 50 or 60 Hz).

Static electric fields

Static electric fields are measured in volts per metre (V/m). Table 15-7 lists typical *static electric field* levels for both naturally occurring fields and HVDC overhead lines. The table is comprised of values from EHC232 (2006) and ICNIRP (2003) guidelines.

Table 15-7: Static Electric Field Levels [kV/m]

Typical Static Electric Field Levels [kV/m]		
Natural Static Electric Fields		**[kV/m]**
	Earth's Surface (fair weather)	0.13
	Approaching Storm	0.1-3
	Walking on Carpet	10-500
500 kV HVDC line		
	Directly Below	20
	400 m	2
	800 m	1
ICNIRP Continuous Exposure Limit		
	No limits provided for Static Electric fields	N/A

Static electric fields are a natural phenomenon producing field strengths up to 3 kV/m under thunderclouds, and up to 500 kV/m when walking on non-conducting carpets. This can result in a surface electric charge which, if high enough, can cause a spark discharge felt on a person's skin (static shocks or micro-shocks) (ICNIRP 2003). HVDC power transmission can produce fields up to 20 kV/m underneath the lines, which is about the same strength as a visual display unit from 30 cm away (EHC232, p. 216). This field quickly reduces to 2 kV/m and 1KV/m at a distance from DC lines of 400m and 800m respectively.

Static electric fields are unable to penetrate the human body (WHO 2006) but may be perceived by people through interaction with body hair and other impacts such as spark discharges (micro-shocks) (Petri et al. 2017). Typically, people experience this impact in the range of 10 – 45 kV/m.

WHO notes that "there are no studies on exposure to static electric fields from which to make any conclusion on chronic or delayed effects," and that "IARC (2002) noted there was insufficient evidence to determine the carcinogenicity of static electric fields" (EHC232 2006).

No guidelines or exposure criteria have been developed for static electric fields by ICNIRP as they do not pose any significant health effects (Petri et al. 2017). AAPowerLink's subsea and underground cables design includes lead sheathing and armoured cores which further prevents electric fields from entering the surrounding environment.

Static magnetic fields

Table 15-8 lists typical static magnetic field levels as well as the ICNIRP continuous exposure limits. The values are taken from the EHC232 (2006), and ICNIRP (2009) guidelines.

Table 15-8 demonstrates that standing directly under a 500 kV HVDC transmission line would expose an individual to static magnetic fields on the order of 10-20 µT, which is less than the lowest end of the range of the earth's naturally occurring magnetic field, and ~18,000 times lower than the 2009 ICNIRP continuous exposure limits for the general public and ~23 times lower for people who have pacemakers and other similar devices.

Table 15-8: Static Magnetic Field Levels [µT]

Typical Static Magnetic Field Levels [µT]		
Static Magnetic Fields		**[µT]**
Earth's Magnetic Field		30-70
HVDC Line	500 kV Overhead Transmission Line	22
	Underground line buried 1.4 m carrying 1 kA	10
ICNIRP Continuous Exposure Limit		
General Public	1994 Report	40,000
	2009 Report	400,000
Pacemakers, etc.	2009 & 2014 Reports	500

ICNIRP (2009a) states that in laboratory studies of humans, no pronounced impacts on physiological parameters have been found from exposure to fields of up to 8,000µT, except for a small increase in systolic blood pressure. It is only when exposed to very strong magnetic fields, such as MRI machines, that perceptible impacts on humans occur. Above 2,000µT, transient effects such as vertigo, nausea and phosphenes have been occasionally observed in some people, but no evidence has been found for any irreversible or serious adverse health impacts. General public exposure limits should not exceed 400 µT to any part of the body (ICNIRP 2009b).

Magnetic fields will be emitted by the AAPowerLink OHTL in the order of 20 µT. For underground cables and the Subsea Cable System, magnetic fields will be in the order of 10 µT. For both proposal components, these magnetic fields will rapidly decrease with distance. Tricas and Gill (2011) found that magnetic fields from a buried cable decreased rapidly and within 6 m were equal to the earth geomagnetic fields. Magnetic field values from the AAPowerLink infrastructure are significantly lower than the levels that are perceptible to humans and there are no known long-term health impacts from exposure. Moreover, AAPowerLink electromagnetic fields will be managed in accordance with the applicable standards and regulations to ensure safety for all persons is maintained just as any other transmission network. For this reason, noticeable electromagnetic fields associated with the OHTL that could impact human health are not expected. No human health residual impacts related to exposure to EMFs are predicted.

Nevertheless, the WHO recommends as precautionary measures to follow the ICNIRP guidelines and engage the public prior to constructing transmission lines. Effective communication of accurate information will assist the community in understanding that no adverse health risks form HVDC transmission lines have been determined through extensive research, especially when the ICNIRP guidelines are followed. AAPowerLink will deploy community engagement techniques to proactively provide accurate information to address any community anxiety. This method was used in the development of Manitoba Hydro in Canada, whereby three brochures were created for the HVDC proposal, including Alternating Current Electric and Magnetic Fields (2009), Direct Current Electric and Magnetic Fields (2009), and DC Lines and Electronic Devices (2010).

15.4.4 Biting insects

It is unlikely that construction activities at the Solar Precinct and Darwin Converter Site could create biting insect breeding habitat as mitigation measures and design criteria will be implemented in accordance with NT guidelines. The NT, and particularly the Top End, is home to a wide range of biting insects – including mosquitoes, midges, ticks, and mites, which can cause discomfort and can transmit viruses. Construction sites can create artificial breeding habitats for biting insects, as well as be exposed to biting insects if they are in areas with naturally occurring biting insect populations. This is particularly true for mosquitoes, which can breed in ponding water in wheel ruts, exposed tires, building materials and anywhere that can collect water (Wilke et al. 2019).

Activities that have potential to create biting insect breeding habitat include construction of stormwater drainage systems, sediment ponds, access roads/tracks, excavation activities, onsite landfill and wastewater

disposal. These activities will mainly occur at the Solar Precinct and Darwin Converter Site and could create conditions where pooling or ponding of water occurs for extended periods, but will not involve any dry season flows or discharges which are most typically responsible for creating mosquito breeding habitat.

The design criteria and control measures adopted at these locations to avoid the creation of mosquito breeding habitat are described in Table 15-9. The measures proposed will aim to ensure that facilities are designed, constructed, and maintained to be free draining and free from accumulated sediments and vegetation to prevent pooling of water for periods greater than five days, which is recommended by the Centre for Disease Control (NT Department of Health 2017) Guidelines. Subject to effective implementation of these controls, the proposal is unlikely to create significant new mosquito breeding habitats that would cause detrimental impacts to nearby community receptors.

Construction materials imported from Northern Queensland have the potential to bring with it the Dengue Mosquito (*Aedes aegypti*) currently not resident in the NT. Materials imported from overseas arriving at Darwin Port are subject to quarantine inspections and treatments, and pest monitoring and control programs are implemented around the Port area by Commonwealth and NT Government agencies. Materials arriving at the works areas from elsewhere in Australia, will be subject to inspections for weed and pest species as detailed in Chapter 17.

There is also potential for the AAPowerLink workforce to be exposed to biting insects, with the main exposure risk being during construction when there will be larger numbers of people accommodated at the construction camp located at the Solar Precinct and fly camps along the OHTL route, and people are more likely to be working at times when mosquitoes are active at dusk and dawn. The distribution of many mosquito species in the NT does not reach as far south as the Solar Precinct and there is a lack of suitable breeding sites in the area, but the main mosquito pest for the NT (Common Banded Mosquito) does occur in the area (Whelan 2010). Around the Darwin Converter Site there are extensive saltwater and freshwater mosquito breeding habitats and significant numbers of mosquitos and midges are present.

The risk to the workforce will be managed by routine measures including education on the risks, the use of long sleeves and pants, screening, repellents, lighting diversion and adult insect control (Whelan 2011). Because the proposal is unlikely to cause new biting insect breeding habitats, the risk of worker exposure to biting insects is considered an occupational health and safety risk that will be governed by the *Work Health and Safety (National Uniform Legislation) Act 2011* and *Electricity Reform Act.* Sun Cable will implement a workplace health and safety (WHS) management system that complies with all legislative requirements, codes of practice and standards.

15.4.5 Communicable Disease

It is possible that the construction accommodation facilities could increase the risk of introduction or spread of communicable diseases. Onsite accommodation will be established at the Powell Creek Solar Precinct with capacity of up to 1,100 beds during peak construction periods. Facilities in this precinct include modular accommodation units, a dining hall, and a recreation hall. It is assumed that workers staying at this camp may periodically visit and interact with individuals, businesses, and facilities in nearby communities, such as Jangirulu, Powell Creek, Elliott, and Renner Springs Roadhouse. Additional 'fly camps' will be built for the Overhead Transmission Line where existing commercial town accommodation is not possible. These 100 m x 100 m mobile fly camps will be used for a period of approximately six months, and each camp will provide temporary transportable accommodation and amenities for approximately 20 people.

During the construction phase, camp living arrangements may pose a health risk to both workers and locals living in surrounding communities. Workers living in close quarters are more likely to transmit communicable disease as facilities and appliances are shared, and physical distancing is not possible. Workers living in camps and interacting with the public (going to restaurants, malls, grocery stores, etc.) increase the risk of COVID 19 transmission within the community, which may add stress to local hospitals and healthcare providers.

It is difficult to predict the COVID 19 health and safety risks in the future when construction commences in 2024 and beyond. Nonetheless this assessment is prepared on the basis of the pandemic situation still being in effect.

Given the ongoing concern of the COVID 19 pandemic, COVID 19 health and safety measures will be implemented to minimise the risk of communicable disease transmission and impact on local healthcare systems. Sun Cable's Health and Safety Management Plan will require key measures to mitigate risk of transmission of communicable disease, including:

- Compliance with all federal (Australian Government Department of Health), state (Northern Territory Government Health), and local requirements set out for COVID 19 health measures, as well as guidelines set out by the World Health Organization (WHO).
- Practices to minimize the risk of COVID 19 infection while living in camps include washing hands, wearing masks while in common areas where physical distancing is not possible, and avoiding touching one's eyes, nose, and mouth without properly cleaning hands first.
- To prevent and control the spread of COVID 19, no guests will be allowed in the camps, and all camps with be equipped with readily available PPE, including hand soap, sanitizer, face masks, disinfectant wipes, over the counter medicines, thermometers, and rapid COVID 19 antigen tests.
- Workers will be required to be fully vaccinated.
- If any worker exhibits cold or flu like symptoms, immediately notify a Construction Supervisor. The individual must, if possible, evacuate the camp to a hotel for a minimum of five days or until symptoms improve, or self-isolate away from other workers.
- 14 days prior to moving into the camp, it will be recommended that workers avoid large gatherings, wear masks in public spaces and where physical distancing is not possible, avoid being near people who are sick, and wash their hands.

Sun Cable acknowledges the unpredictable nature of the COVID 19 pandemic and will implement public health measures as required.

15.4.6 Air Quality

Chapter 11 Air Quality and Appendix U assessed air quality impacts associated with emissions of particulate matter (PM_{10}, $PM_{2.5}$) from site ground preparation, infrastructure construction and heavy diesel non-road construction equipment, and nitrogen oxide (NOx) emissions from heavy diesel non-road construction equipment. These air pollutants have the potential to affect human health through inhalation. PM_{10} and $PM_{2.5}$ are of concern to human health as these particles can enter the lower airways of humans and cause negative health impacts. Build-up of dust in lungs can cause lung inflammation and eventually scar tissue (fibrosis), leading to breathing impairment. Elevated levels of NO_2 can also cause damage to the human respiratory tract, and may also affect the senses, for example, by reducing a person's ability to smell an odour.

It is possible that construction activities along the OHTL and at the Murrumujuk facilities could produce air emissions which would exceed air quality guidelines. AAPowerLink construction activities will produce dust and diesel exhaust emissions that will cause air quality exceedances beyond the proposal footprint and into some surrounding areas that human receptors frequent during the construction phase. It is anticipated the impacts would be experienced for a duration of several weeks to several months. Sensitive receptors within the air quality area of influence include nearby residents and businesses, and periodic users and visitors as described above in Section 15.3 and shown in Chapter 2, Figures 2-5a-d. Construction workers are not considered a sensitive receptor because specific measures will be required to protect worker health and safety in accordance with the *Work Health and Safety (National Uniform Legislation) Act 2011*.

Chapter 11 Air Quality concluded that, after mitigation, the AAPowerLink is predicted to have a minor residual impact to sensitive receptors due to air emissions during both construction and operations, when modelled against ambient air quality criteria established by NSW EPA 2016.

At the Solar Precinct, the atmospheric dispersion modelling predicted that the AAPowerLink emissions could exceed relevant air quality assessment criteria for protection of human health at distances up to 501 m from construction activities. However, there are no sensitive receptors proximate to the Solar Precinct that are likely to experience any health or amenity impacts from air emissions associated with AAPowerLink construction activities. The nearest residences are located at Jangirulu Family Outstation, which is 17 km north-east of the Solar Precinct and 5.5 km from the gravel access road into the site.

Along the OHTL corridor, modelling results indicate it is possible that air quality assessment criteria for NO_2 could be exceeded between 307-468 m from the construction activities and PM criteria could be exceeded up to 283 m from construction activities. There are several locations where sensitive community receptors, including local residents, businesses, and recreational venues, could experience exceedances in air quality criteria. Exceedances would be experienced for a duration of several weeks to several months along each section of the OHTL.

At the Darwin Converter Site, $PM_{2.5}$ and NO_2 pollutants are unlikely to be at levels that cause health effects outside of the site. The assessment criterion for PM_{10} is predicted to be exceeded 170-950 m from the site boundary, with the impact affecting a larger area when background concentrations are elevated during the dry season. Parts of Gunn Point Road and Murrumujuk Drive are within the predicted exceedance area for PM_{10}, but human health impacts are considered unlikely to occur as exposure will be transient, largely limited to people driving through the area in vehicles.

At the Cable Transition Facilities, air emissions from the AAPowerLink construction activities could exceed air quality assessment criteria up to approximately 370 m from the construction activities. The pollutant that is likely to affect the largest area is NO_2. $PM_{2.5}$ and PM_{10} are predicted to meet the assessment criteria within 48 m and 175 m from the construction activities. Gunn Point Beach users may experience air quality exceedances for short periods of time during construction, but human health impacts are considered unlikely to occur as exposure will be transient.

15.4.7 Noise

AAPowerLink construction and operations activities will produce noise that could potentially impact the health of human receptors in the vicinity of these activities. Exposure to elevated environmental noise has been shown to cause human health impacts including sleep disturbance, cardiovascular disease, and reduced mental wellbeing. Excessive exposure to elevated noise levels can cause hearing impairment, though the thresholds for noise induced hearing loss is at least 80 dB(A) over a long period of time (NTEPA, 2018). Activities associated with construction and operations of the AAPowerLink will not produce noise at sufficient levels to impact on hearing at sensitive receptors.

A screening-level AAPowerLink Noise Technical Memo (Appendix L) concluded that several human receptors are located within areas where construction noise levels are expected to exceed recommended construction noise levels as set by *Northern Territory Noise Management Framework Guideline* (NT EPA, 2018). As the construction noise assessment was carried out to identify potential areas of influence only, the actual maximum noise levels experienced at specific receptor locations was not quantified.

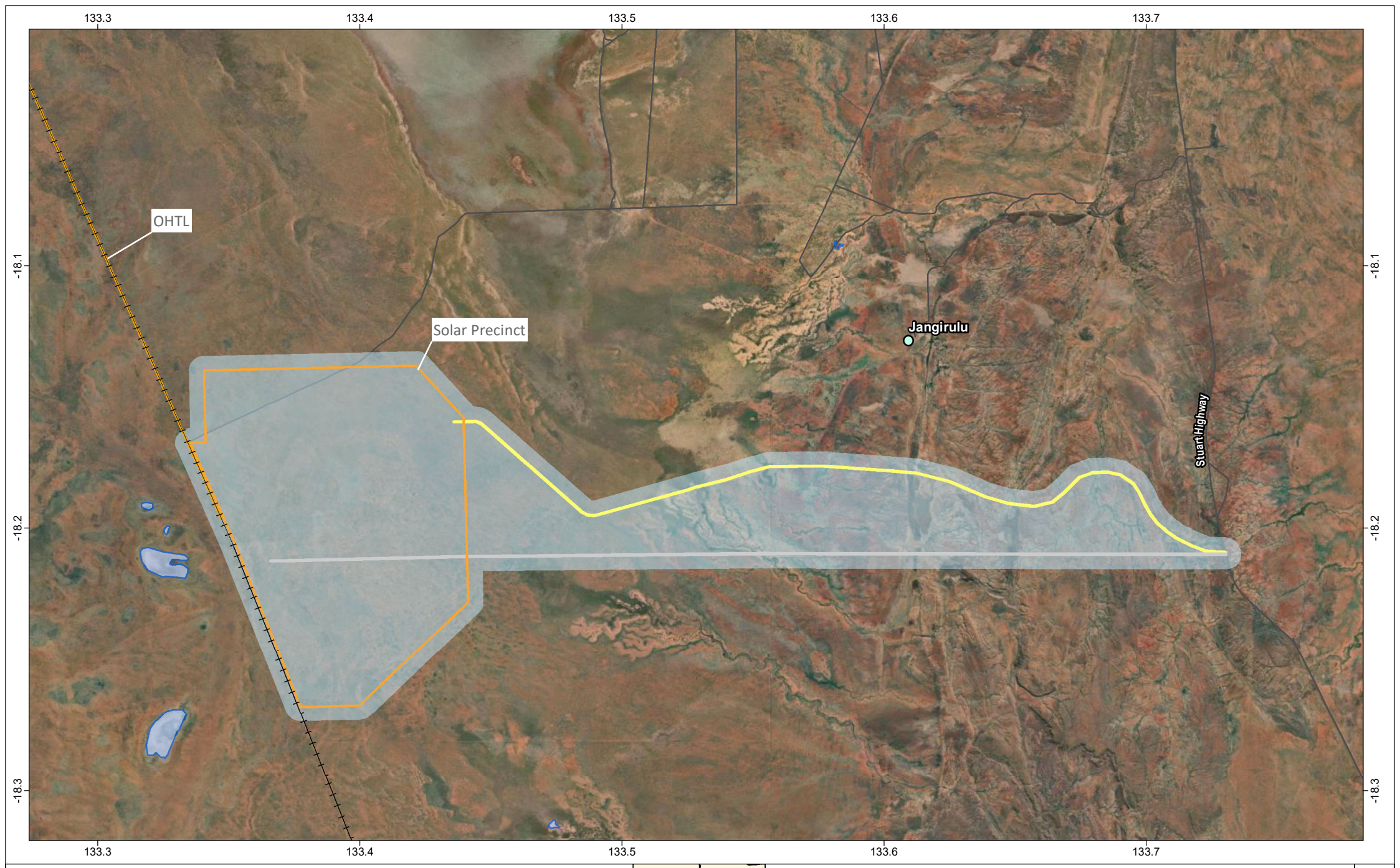
Figure 15-1 shows predicted distances from construction activities to meet noise criteria at the Solar Precinct. Figure 15-2 shows the area of influence from construction noise along the OHTL railway corridor. Figure 15-3 shows the area of influence from construction noise along the OHTL utilities corridor, and Figure 15-4 shows the area of influence from construction noise at Darwin Converter Site.

Fourteen community human receptors, including rural residents, the Pine Creek Aboriginal Community, Adelaide River township, and several Darwin rural areas, are estimated to experience noise levels at or above recommended thresholds during OHTL construction. The highest noise levels in the vicinity of the OHTL will come from pole installation activities, which will produce 125 dBA sound power per Octave dB. Community receptors will experience noise levels above recommended thresholds within 620 m of these source activities. Between Katherine and Darwin, some dwellings and buildings are located within 100 m of the OHTL corridor. Each receptor may hear pole installation activities over the course of several days or weeks as the OHTL is

being constructed and work fronts progressively advance, and so health impacts are unlikely to occur from short term exposure to construction noise.

Users of Gunn Point Beach access and recreational area may experience noise levels that exceed recommended thresholds as a result of construction (cable installation and backfilling activities) at the Cable Transition Facilities Site, which could produce noise levels up to 125 dBA. The estimated area of influence (area within which noise levels will exceed recommended thresholds) is 92 m from construction activities. Any visitors to Gunn Point beach may be exposed to elevated noise levels close to the construction activities, however health impacts are unlikely to occur as visitors would be transient and would only be exposed for a short period of time

During operations, no sensitive receptors will be expected to experience noise levels that exceed residential amenity limits near the Solar Precinct or at the Darwin Converter Site. Four sensitive receptors along the OHTL are expected to experience low noise levels at or above residential amenity limits, which are modelled at 40dBA. These receptors are located approximately 100m from the OHTL and may experience these above-threshold noise levels continuously if micro-siting of project infrastructure is constrained in such a manner that limits flexibility of individual pole locations. It should be noted that the potential exceedance at receptor locations have been identified through a desktop study and the associated modelling does not factor in site specific conditions or existing noise sources in the vicinity of each potentially impacted receptor. Sun Cable will consider the NT EPA noise management guidelines when undertaking detailed design and engineering activities and will consider micro-siting of project infrastructure to minimise potential for operational noise impacts to residential receptors.



Legend

- AAPowerLink infrastructure
- Main access road (sealed)
- All-weather access road (unsealed)
- Railway
- Outstations
- Daytime noise screening distance (45 dBA)
- Lakes
- Roads

ELLIOTT

Source:Sun Cable, EcOz, NTG (NR Maps)

Figure 15-1: Map of predicted distances from construction activities to meet noise criteria at the Solar Precinct

Project: Australia-Asia PowerLink	Reference: M-Files ID 202374		Revision: 0
Coordinate System: GDA2020	Date: 09/02/2022		
0 5 Kilometers	Scale: 1:200,000	A4	

N

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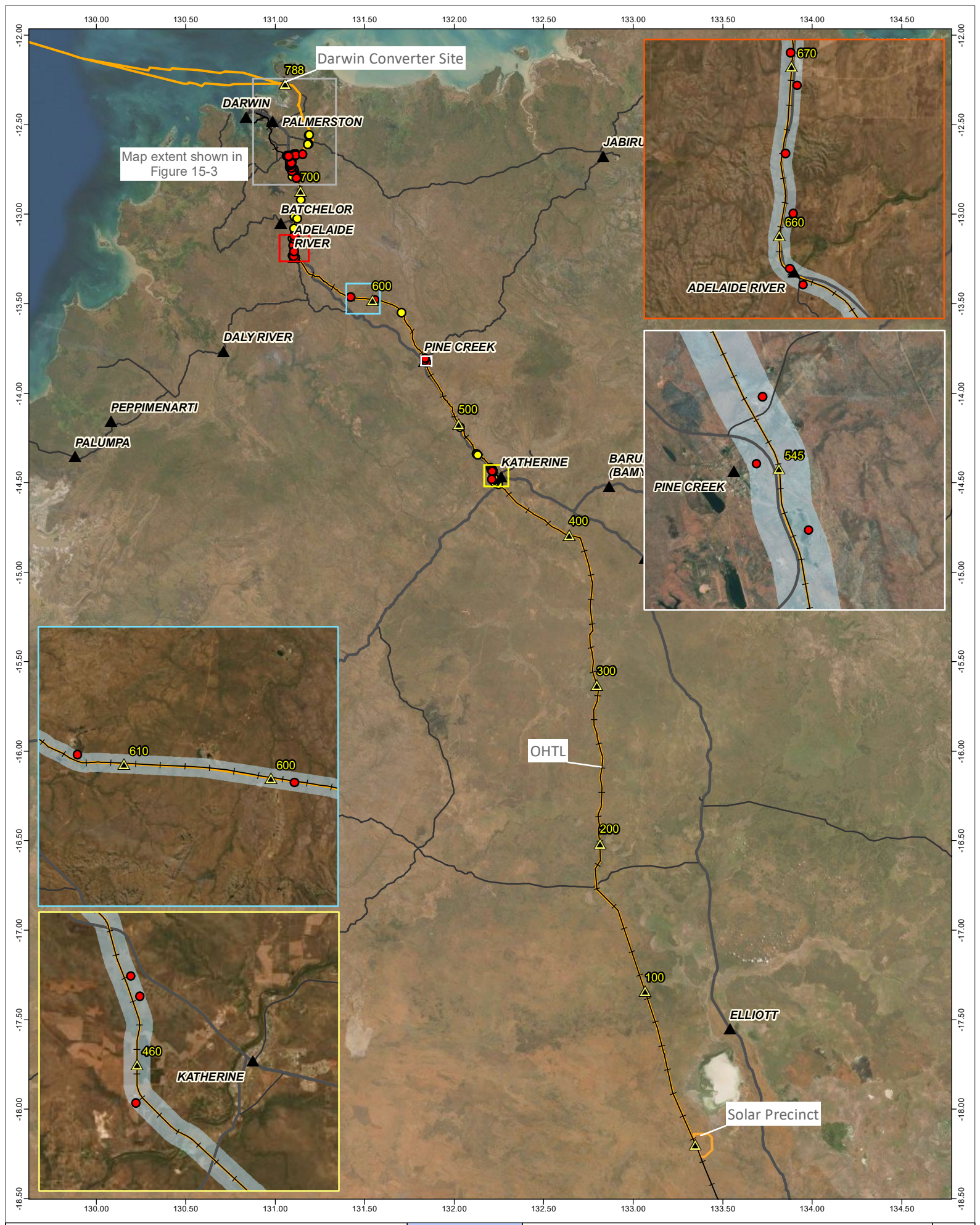

Legend

- AAPowerLink infrastructure
- Railway
- Principal road
- Secondary road
- OHTL Kilometre Points
- Daytime noise screening distance (45 dBA)
- Potential receptors within the noise zone of impact

Source: Sun Cable, EcOz, NTG (NR Maps)

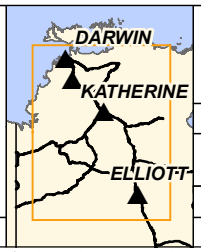

Figure 15-2: Map of zone of influence from construction noise along the OHTL Railway Corridor

Project: Australia-Asia PowerLink

0 30 60 90 Kilometers

Reference: M-Files ID 202374

Date: 08/03/2022 | Revision: 0

Scale: 1:2,900,000

Coordinate System: GDA2020 | A4

N

SUN CABLE

Legend

- AAPowerLink infrastructure
- Railway
- Roads
- OHTL Kilometre Points
- Daytime noise screening distance (45 dBA)
- Potential receptors within the noise zone of impact

Source: Sun Cable, EcOz, NTG (NR Maps)

Figure 15-3: Map of zone of influence from construction noise along OHTL Utilities Corridor

Project: Australia-Asia PowerLink

0 5 Kilometers

Reference: M-Files ID 202374

Date: 09/03/2022 | Revision: 0

Scale: 1:250,000

Coordinate System: GDA2020 | A4

N

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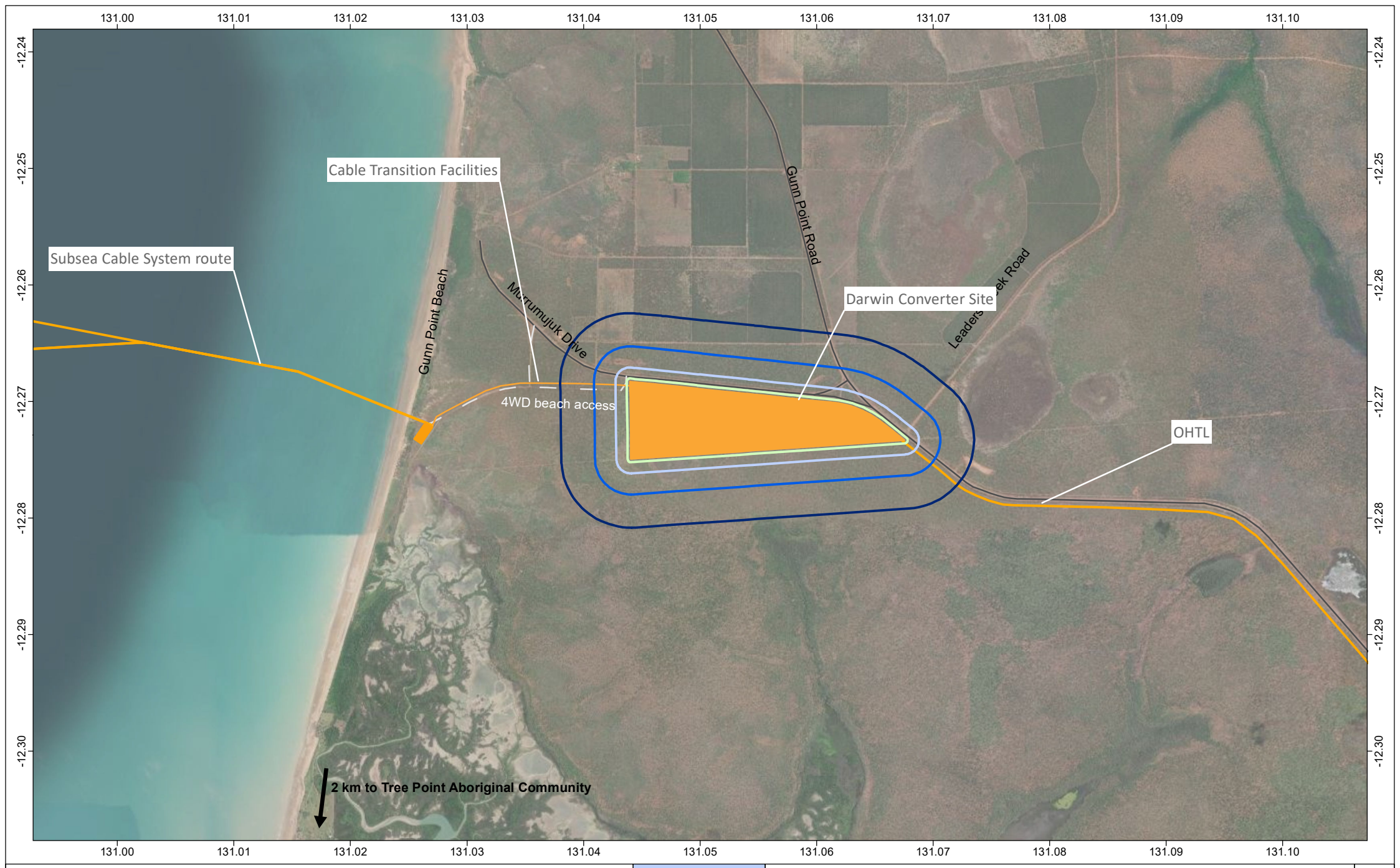

Legend

- AAPowerLink infrastructure
- 4WD beach access
- Road

Daytime noise screening distances

- 45 dBA
- 50 dBA
- 55 dBA
- 60 dBA

Source: Sun Cable, EcOz, NTG (NR Maps), Air Environment 2021

Figure 15-4: Map of zone of influence from construction noise at Darwin Converter Site

Project: Australia-Asia PowerLink	Reference: M-Files ID 202374	Revision: 0
Coordinate System: GDA2020	Date: 08/03/2022	
0 2 Kilometers	Scale: 1:45,000	A4

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15.5 Avoidance, mitigation and monitoring

Sun Cable is committed to applying the environmental decision-making hierarchy. Consistent with section 26 of the *EP Act* this involves applying the following approaches in order of priority:

1. Avoid – Ensure that actions are designed to avoid adverse impacts.
2. Mitigate – Identify management options to mitigate adverse impacts to the greatest extent practicable.
3. Offset – if appropriate, provide for environmental offsets for residual adverse impacts that cannot be avoided or mitigated.

The environmental management framework that will be adopted for the construction and operation of the AAPowerLink is detailed in Chapter 17 Environmental Management. The framework comprises a Construction Environmental Management Plan (CEMP) and Operations Environmental Management Plan (OEMP) that sit within an overarching Environmental Management System (EMS).

For each of the impacts to human health discussed in this chapter, Table 15-9 summarises the actions that will be taken to avoid environmental impacts (through site selection and design) and actions proposed to minimise impacts during construction, operation and decommissioning of the proposal. Relevant measures have been referred to in the above discussion of the potential impacts at each component. The proposed controls are routine for land development and industrial operations and, assuming proper implementation and adaptive management, should be effective in minimising human health impacts as a result of the AAPowerLink proposal. The measures provided in this chapter, along with any additional measures required to address conditions of approvals, permits and licences, will be integrated into the CEMP and OEMP prepared for the AAPowerLink.

Table 15-9. Human health – Avoidance, mitigation, monitoring and reporting commitments

Impact	Avoidance	Mitigation	Monitoring	Reporting requirements
Health impacts as a result of exposure to EMF	HVAC cables at Solar Precinct and Darwin Converter Site emit low level EMF that does not pose a risk to human health. Subsea and underground cables design includes lead sheathing and armoured cores minimises electric fields.	Nil	Nil	Nil
Increase in Biting Insects	Construction camps will be adequately insect screened. Locations for OHTL fly camps will be selected to be as far as possible away from significant mosquito breeding habitats i.e. watercourses and wetlands that retain water during the dry season. Landfill will comply with the *Guidelines for Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory 2003*. Materials arriving from overseas at Darwin Port are subject to quarantine inspections and treatment.	Implement NT Department of Health Guidelines for *Preventing Biting Insect Problems* where required. Inspection of imported materials, equipment and plant for pests on arrival at works areas. Treat any pest species detected in accordance with advice from NT Medical Entomology branch.	Reports/complaints from workers.	Incident reporting in the event a worker requires treatment or becomes ill from exposure to biting insect bites or disease. Internal inspection records. Notify NT Medical Entomology branch in the event a pest species is detected.

Impact	Avoidance	Mitigation	Monitoring	Reporting requirements
Transmission of Communicable Disease	Compliance with all federal (Australian Government Department of Health), state (Northern Territory Government Health), and local requirements set out for COVID 19 health measures, as well as guidelines set out by the World Health Organization (WHO). Practices to minimize the risk of COVID 19 infection while living in camps include washing hands, wearing masks while in common areas where physical distancing is not possible, and avoiding touching one's eyes, nose, and mouth without properly cleaning hands first. No unauthorised guests will be allowed in the camps. Workers will be required to be fully vaccinated.	Camps to be equipped with medical centre with health support and supplies for workers. If any worker exhibits cold or flu like symptoms, report to the medical centre.	Records of communicable diseases relevant to proposal personnel.	Internal incident reporting of any communicable disease outbreaks resulting from proposal activities. Reporting to Department of Health if required.
Exposure to air emissions of particulate matter (PM10, PM2.5) and nitrogen oxide (NOx).	Whenever possible, plan haul routes to avoid residential areas. Efficient staging and layout of construction facilities to minimize haulage, avoid double handling of materials and other excessive equipment operations. Use grid or solar power whenever practical over stationary combustion generated power.	NO_x emissions will be minimised by using electric vehicles and equipment where practicable, and ensuring all machinery, plant and equipment complies with minimum emissions standards.		Reporting will be carried out per the requirements of the CEMP described in Chapter 17. External reporting in accordance with environmental approval conditions.

Impact	Avoidance	Mitigation	Monitoring	Reporting requirements
Exposure to noise emissions	Whenever possible, schedule high noise works in areas of sensitive receptors during the NT EPA prescribed acceptable construction times (Monday to Saturday 7am to 7pm and between 9am and 6pm Sundays or public holidays). Work outside the NT EPA construction times may be needed if it is not possible to work within these times. Locate site access roads, laydown areas and stationary equipment (e.g., generators) as far away as possible from sensitive receptors.	Adopt construction noise minimisation measures appropriate for each work front or activity location based on an assessment of risk to surrounding receptors. Notify local communities of the construction activities, especially if overnight construction is required. Notifications should include the location, extent, and duration of construction activities. Establish a complaint procedure, including any notification requirements.		Complaint investigation and response documentation. Reporting will be carried out per the requirements of the CEMP described in Chapter 17 External reporting in accordance with environmental approval conditions.

15.6 Residual impacts

As stated at the start of this chapter, the NT EPA's objective for the Human Health factor is to:

'*Protect the health of the NT population*'.

The residual impacts of the AAPowerLink to human health are summarized below, assuming the adoption of the impact avoidance, mitigation, and monitoring measures described in this chapter.

Each impact to human health was assigned a residual impact rating taking into consideration the scale, magnitude and duration of the impacts, the presence/absence of environmental values and/or sensitive receptors and the level of certainty with respect to the intensity of the impact and the effectiveness of the mitigation measures. The residual impact ratings adopted in the assessment were provided earlier in Table 15-4. The combined residual impact to human health from all components of the AAPowerLink construction and operations is summarised in Table 15-10.

Table 15-10: Residual impact ratings for impacts to human health

Impacts	Residual Impact Rating
Construction	
Exposure to EMF	**Unlikely**
Increase in biting insects	**Unlikely**
Increase in communicable disease	**Moderate**
Exposure to air emissions of particulate matter (PM10, PM2.5) and Nitrogen Oxide (NOx)	**Minor**
Exposure to noise emissions	**Minor-Moderate**
Operations	
Exposure to EMF	**Unlikely**
Increase in biting insects	**Unlikely**
Increase in communicable disease	**Unlikely**
Exposure to air emissions of particulate matter (PM10, PM2.5) and Nitrogen Oxide (NOx)	**Unlikely**
Exposure to noise emissions	**Minor-Moderate**

Numerous studies have been undertaken on potential human health impacts from EMF, and current evidence suggests no impacts to human health from low-level exposure to EMF, as would be experienced in the vicinity of the AAPowerLink infrastructure (see ARPANSA 2019 and WHO 2016). The OHTL will transmit electricity via high-voltage direct current (HVDC), which is recognised as having a significantly lower level of EMF and significantly lower ionisation than alternating current (AC) lines). Relevant EMF guidelines will be complied with including the *Australian Radiation Protection and Nuclear Safety Agency* (ARPANSA 2015) and the *International Commission for Non-ionizing Protection* (ICNIRP 2003). There is no residual impact associated with exposure to EMF as a result of construction or operation of the AAPowerLink proposal.

The construction and operational footprints will be designed and managed in accordance with relevant guidelines to avoid the creation of biting insect habitat, and to protect AAPowerLink personnel (see Department of Health 2017 and Whelan 2005b). Adherence to these guidelines is effective in avoiding the

creation of biting insect habitat and protecting people, including AAPowerLink personnel. With mitigation, the residual impact to human health from biting insects is Unlikely during construction and operations.

It is likely that at some point during construction, communicable disease (COVID 19 outbreak) will occur in the camps, as it has routinely occurred in other development activities where workers are living in close quarters. An outbreak may affect the local communities and healthcare systems in surrounding towns. Construction camps will be located at the Solar Precinct and along the OHTL, and so communities could be impacted in a number of locations across the NT. Avoidance and mitigation measures will be implemented, including development and implementation of a Health and Safety Management Plan and adherence to NT and Australian Covid-19 policies and requirements, including the requirement for workers to be fully vaccinated. However, due to the unpredictable nature of COVID 19 (e.g. possible variants may require further mitigation measures) the residual impact is Moderate for construction. The workforce will be significantly smaller during the operational phase, and the only camp accommodation will be at the Solar Precinct, and so no residual impact is predicted during operations.

With the implementation of mitigation, there is potential for a Minor level of residual impacts to human health from air emissions (particulate matter and N02) at specific locations along the OHTL corridor and at Murrumujuk and Gunn Point Beach associated with construction of the Darwin Converter Site and Cable Transition Facilities. There is a Minor residual impact to human health from air emissions during the operational phase, and the scale, duration and magnitude of potential impacts are lower than during construction.

There is no residual impact for noise emissions impacting on human health at the Solar Precinct, due to its remote location and therefore lack of sensitive receptors within the area of influence. There are sensitive receptors within the predicted area of influence along the OHTL, who may be impacted by noise during both construction and operations (based on exceedance of assigned noise levels from NT EPA 2018). As such, the residual impact along the OHTL is Moderate. It should be noted that the potential exceedance at receptor locations have been identified through a desktop study and the associated modelling which does not factor in site specific conditions or other existing noise sources in the vicinity of each potentially impacted receptor. Sun Cable will consider the NT EPA noise management guidelines throughout the design process, ensure micro-siting of infrastructure prioritises minimal impacts on environmental factors including noise, and review if further assessment and associated mitigation measures are required.

The residual impact for noise at the Darwin Converter Site and Cable Transition facilities is Low to None as, during construction, emissions will be short-term, and receptors will be transient (e.g., recreational users of Gunn Point Beach), and during operations there are no receptors within the area of influence. Impacts on potential future land use is discussed in Section 15.7 below.

15.7 Cumulative impacts

The framework used to assess cumulative impacts from the AAPowerLink and other existing and future developments is described in Chapter 3. The process involves considering the cumulative or combined impacts to human health associated with the residual impacts from the AAPowerLink proposal, and existing or reasonably foreseeable developments that described in Chapter 3. The following identified residual impacts to human health are carried forward for consideration in this cumulative impact assessment:

- Transmission of Communicable Disease
- Exposure to air emissions of particulate matter (PM10, PM2.5) and nitrogen oxide (NOx)
- Noise impacts from construction and operation of the proposal.

Future mining activities that could create additional vectors for transmission of communicable disease in communities in proximity to the Solar Precinct are considered too far in the future and too geographically distant to cause a cumulative impact regarding transmission of communicable disease.

As described in Chapter 11 Air Quality, the *Air Quality Impact Assessment* (Appendix U) assessed cumulative impacts by deriving background air quality concentrations and taking these into consideration when determining the distance from the AAPowerLink construction activities that air quality criteria are likely to be exceeded for key pollutants. For most pollutants the background air quality in the NT is good and the air quality impact assessment found there is limited potential for cumulative impact from the combined effects of existing emissions and AAPowerLink construction emissions. For $PM_{2.5}$ and PM_{10}, background concentrations (derived from the monitoring stations in the Darwin region) either exceed or make up a substantial portion of the assessment criteria for these pollutants. As a result, the cumulative dust impact assessment is dominated by existing background emissions from natural sources of particulate matter ($PM_{2.5}$ and PM_{10}) and, when AAPowerLink activities coincide with periods of increased natural particulate matter emissions, emissions are predicted to exceed the air quality assessment criteria over a wider area than would otherwise occur. These cumulative impacts have been taken into consideration in the air quality impact assessment.

Reasonably foreseeable projects that could further contribute to cumulative impacts from air quality emissions are the proposed Project Sea Dragon prawn hatchery, which is located directly west of the Darwin Converter Site. Construction dust and diesel exhaust emissions from these proposals could result in cumulative impacts to air quality with exceedance of air quality assessment criteria over wider areas than would otherwise occur if the construction phases occurred at different times. Air quality impacts are mainly associated with the construction phase of the AAPowerLink proposal and are predicted to be localised, which limits the potential for cumulative impacts to air quality.

In the Solar Precinct footprint, there are no other current land uses which contribute to noise impacts. Within the OHTL, the only existing noise impact is from trains. Train movements generate noise along the OHTL, but these are generally short-term (i.e. minutes) at any point along the OHTL. Therefore, cumulative noise impacts from train movements and the OHTL construction and operation are unlikely to occur. At the Darwin Converter Site, cumulative noise impacts could occur if the Sea Dragon aquaculture project was constructed at the same time as AAPowerLink infrastructure. As discussed in Section 15.4.7, noise impacts are not expected to occur as any people within the area of influence would be transient visitors to Gunn Point Beach

Gunn Point is flagged for future development, and cumulative operational noise impacts of the Darwin Converter Site and Sea Dragon aquaculture project could potentially impact future land uses. The Sea Dragon hatchery facility has been designed to account for required buffers from infrastructure which will generate noise (power generation), and noise impacts are expected to be minor. Construction noise emissions are expected to meet industrial land use assessment criteria within 50 m of infrastructure, and residential amenity assessment criteria for night-time within 1930 m of infrastructure (see C02 Australia 2017). Operational Noise emissions from the Darwin Converter Site are expected to meet industrial land use assessment criteria adjacent to the site, and residential amenity assessment criteria for night-time within 350 m of infrastructure. The land immediately north of Murrumujuk Drive is planned for future residential development in the *Litchfield Subregional Land Use Plan 2016* (as amended 2021; see NT Planning Commission 2021). A vast majority of land proposed to be zoned for future residential development will be outside of the area impacted by operational noise (i.e. 350 m from Darwin Converter Site).

15.8 Offsets

The EIA did not identify any significant residual impacts to human health that require offsets.

15.9 References

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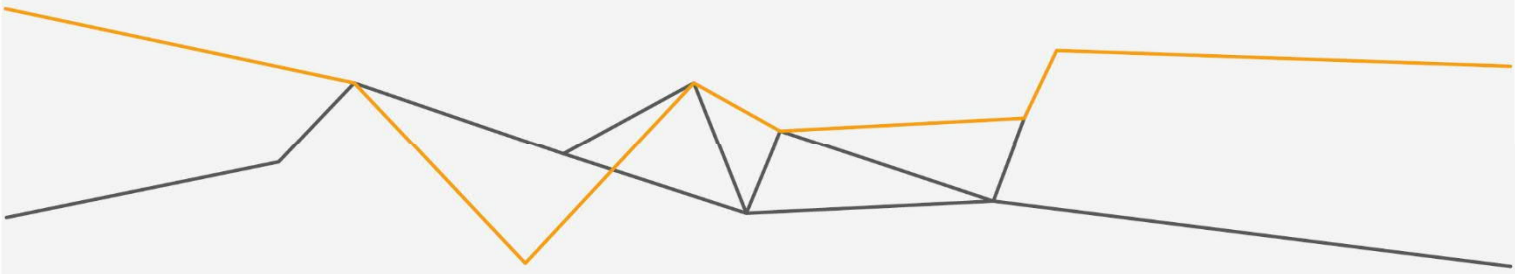

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