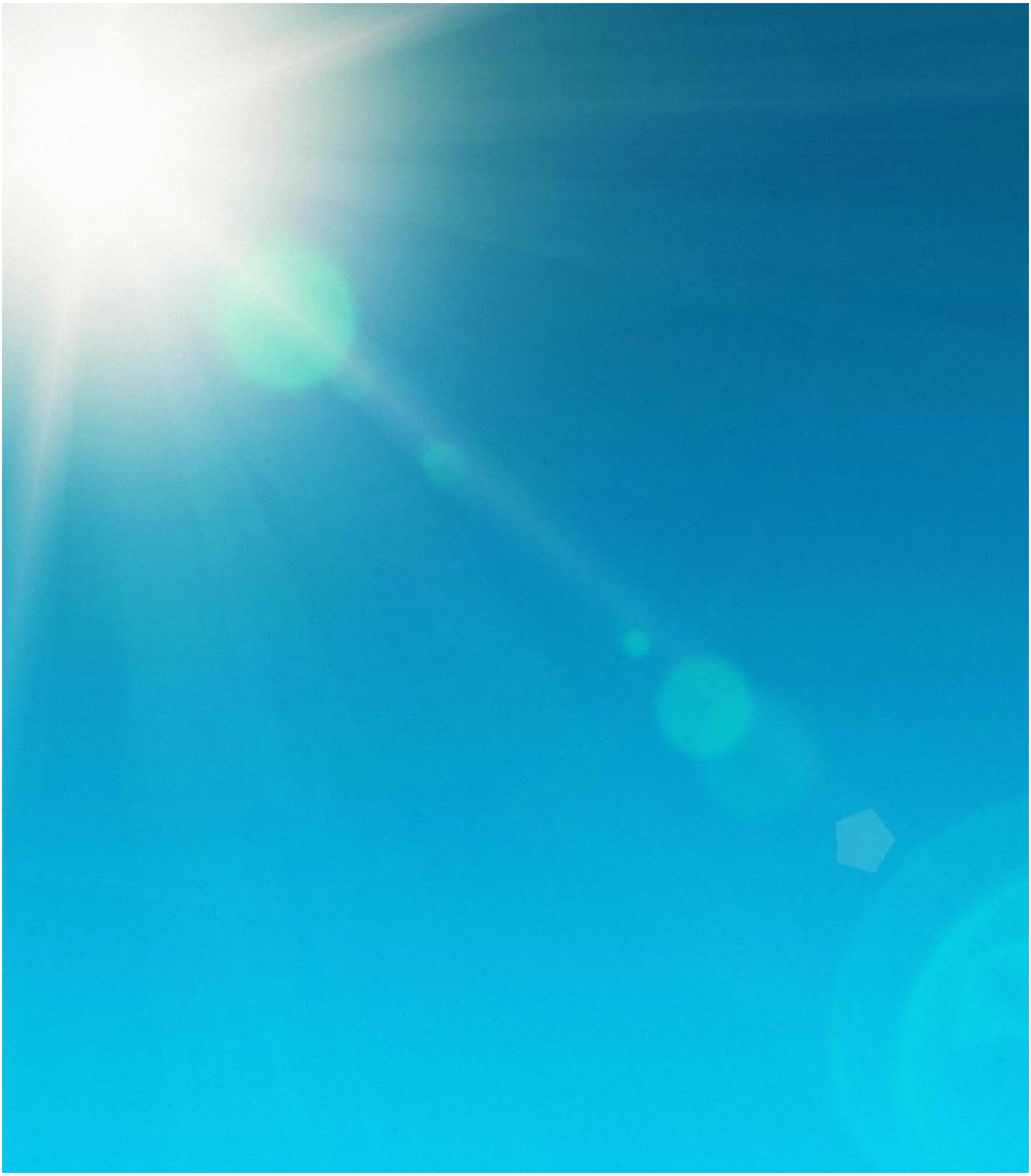
LEX 77989 DOCUMENT 1

March 2022

Chapter 2 – Proposal Description

Australia-Asia PowerLink Environmental Impact Statement



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Chapter 2 – Project Description

Document ID: 200050

Revision history

Revision	Date	Purpose	Reviewed by	Approved by
0	25/03/2022	Draft EIS Submission	Joe Sheridan	Mark Branson

Contents

Tables

Figures

2 Proposal description

2.1 Overview

The Australia-Asia PowerLink (AAPowerLink) comprises the following six key components:

- Powell Creek Solar Precinct in the Barkly Region of the NT where electricity will be generated, stored, and transmitted
- Overhead Transmission Line (OHTL) to transmit electricity from the Solar Precinct to Darwin
- Darwin Converter Site including Voltage Source Converters (VSCs), energy storage and network connection to supply electricity to the Darwin region
- Cable Transition Facilities at Murrumujuk and Gunn Point Beach to transition power cables between land and sea
- Subsea Cable System extending from the Cable Transition Facilities to Singapore
- Singapore Converter Station to receive electricity and supply the Singapore electrical network.

The Solar Precinct will have a peak generation capacity of approximately 17-20 GW, subject to final modelling. The proposed transmission system rating is approximately 6.4 GW for the OHTL and 4 GW for the Subsea Cable System. The AAPowerLink is scheduled to be operational in the NT by 2026, with supply to Singapore by 2028. The project design life is 70 years.

Generation and transmission capacity will be built in stages in response to market demand, with the solar, batteries, OHTL, VSCs and Subsea Cable Systems to be installed progressively and operated as two or more independent power systems dispatching power offshore.

The onshore project proposal components are located within the Northern Territory of Australia. The offshore components, comprised of the Subsea Cable System, extends to approximately 748 km within the Australian Exclusive Economic Zone (AEEZ) and then approximately 147 km on the Continental Shelf up to the boundary of the Seabed Treaty with Indonesia. Components beyond that limit fall within the jurisdictions of Indonesia and Singapore respectively.

Construction of the AAPowerLink will take approximately four years and is proposed to start in early 2024. Network connection availability for the NT is planned for 2026, with supply to Singapore by 2027-2028. The project is forecast to directly employ approximately 1,750 people over the construction phase and approximately 350 people during operations.

This chapter provides an overview of each project component and the activities associated with construction, operation and decommissioning of the infrastructure, including criteria used to assess alternative options.

The key aspects of the project are summarised in Table 2-1 and Table 2-2. Locations are shown in Figure 2-1, Figure 2-2, Figure 2-3, Figure 2-4.

Table 2-1. Key aspects of the AAPowerLink project proposal located in Australia

Project element	Component	Location	Details
Infrastructure	Powell Creek Solar Precinct Section 2.4	Powell Creek Station, 70km south-west of Elliott and 30km west of the Stuart Highway	A 12,000-ha precinct comprising multiple large-scale solar and storage fields, Battery Energy Storage Systems, Voltage Source Converters, and supporting infrastructure. The Solar Precinct is designed to generate up to 20 GW of renewable electricity for storage and transmission to Darwin and Singapore.
	Overhead Transmission Line (OHTL) Section 2.5	Powell Creek Station to Murrumujuk, 31 km north-east of Darwin	The OHTL will transfer electricity over 788 km from the Solar Precinct to the Darwin Converter Site. The OHTL will require up to a 22 m wide cleared corridor for construction that will accommodate power poles and towers, conductors (powerlines) and a maintenance access track. A 6m wide access track will be established for the operational period. The OHTL corridor is predominantly located within the existing Railway Corridor for 722 km and a NT Government Utilities Corridor for the final 66 km into Murrumujuk. A fibre optic cable will also be installed within the cleared footprint for the length of the OHTL. This may be buried in the OHTL corridor to a depth of up 1.2 m or strung with the powerline.
	Darwin Converter Site Section 2.6	Murrumujuk, 31km north-east of Darwin	The Darwin Converter Site is located on 124 ha of land of which 55 ha will be developed. The site is the terminal location for the OHTL and will contain Voltage Source Converters to convert electricity from High Voltage Direct Current (HVDC) to High Voltage Alternating Current (HVAC) to enable connection to the Darwin electricity system before being converted back to HVDC for transmission to Singapore. Approximately 800 MW will be made available for connection to the local Darwin electrical system and for private offtake by industry.
	Cable Transition Facilities Section 2.7	Murrumujuk-Gunn Point Beach, 31 km north-east of Darwin	Facilities to connect the onshore and offshore components of the AAPowerLink, including 2.7 km underground HVDC cables, a Land Sea Joint Station where the onshore and offshore cables are connected and a Shore Crossing Site where the offshore cables are laid across and then buried through the intertidal zone and beach.
	Subsea Cable System	Shoal Bay, Beagle Gulf and Timor Sea	Up to six power cables and laid parallel over 4,200 km to transfer electricity from Darwin to Singapore. Length of the Subsea Cable

Project element	Component	Location	Details
	Section 2.8	NT Coastal Waters and Commonwealth Waters	System in the AEEZ and within the Commonwealth marine area is approximately 895 km.
Indicative Execution Schedule 2.10	Project Financial Close	All	Late 2023
	Early works	Solar Precinct	Late 2023
	Onshore facilities construction	Powell Creek Station to Murrumujuk	Early 2024, 60 months
	Offshore cable laying	Murrumujuk to AEEZ	Mid 2024, 48 months
	Darwin power supply online	Darwin	Mid 2026
	Singapore power supply online	Singapore	Mid 2027
	Full commercial operations	All	Supply to Singapore by 2028
	Design life of facilities	Whole of project	70 years
Workforce (construction) 2.10.1	Construction workforce	Powell Creek Solar Precinct	Approximately 1,000
	Construction workforce	OHTL	Approximately 460
	Construction workforce	Darwin Converter Site and Cable Transition Facilities	Approximately 230
	Construction workforce	Subsea cables	Approximately 60
Workforce (operations) 2.11.1	Operations workforce	Powell Creek Solar Precinct	Approximately 200 personnel
	Operations workforce	Darwin (inclusive of OHTL maintenance)	Approximately 150 personnel

Table 2-2. Location and disturbance footprint of AAPowerLink project components in Australia

Project element & location	Component	Size/capacity (approximate)	Footprint (approximate)
Powell Creek Solar Precinct and ancillary infrastructure, Powell Creek Station	Solar arrays, battery energy storage systems, electrical infrastructure and ancillary infrastructure including pioneer camp, construction accommodation facility, intermodal logistics facility, internal roads, construction waste disposal area.	12 km x 10 km	12,000 ha
	Main access road to Stuart Highway (sealed) and fibre optic link	42 km x 20m	84 ha (12 ha of the road is within the Solar Precinct footprint)
	All-weather unsealed access road	30 km x 10m	30 ha
	Airstrip and associated infrastructure	2,500m x 500m	125 ha
	Rail sidings	2.5 km x 50m	12.5 ha (within the Solar Precinct footprint)
			Total 12,269 ha
Overhead Transmission Line, Powell Creek Solar Precinct to Murrumujuk	OHTL easement corridor	788 km x 60 m (22 m wide temporary disturbance) Note: While the designated easement is 60m wide, the cleared disturbance corridor for construction will be 22 m or less in width.	Easement area 4,728 ha Temporary disturbance footprint 1,734 ha Permanent access track (within temporary disturbance footprint) 479 ha
	Tower/pole structures every 300m-450m 27.2m – 30m in width	Up to 2,500 structures, approx. 48-56 m height – Metallic Earth Return (MER) worst case.	Within corridor
	Overhead powerlines (conductors)	Four circuits of 4-bundled wires, plus two metallic earth returns capable of transmitting approx. 6.4 GW of electricity.	Within corridor

Project element & location	Component	Size/capacity (approximate)	Footprint (approximate)
	Construction access and laydown areas	Up to 2,500 sites, 100 m x 60 m pad per pole	1,500 ha temporary (for construction only). Reinstated to 12 m x 6 m (18 ha) post construction.
	Mobile accommodation camps	Approximately six camps, 100 m x 100 m each	6 ha temporary. Reinstated post construction.
			Total 1,734 ha
Darwin Converter Site, Murrumujuk	Up to 4 x Voltage Source Converters, batteries, AC substation, site offices, parking and laydowns, warehousing, and ancillary infrastructure	124 ha site	55 ha disturbed for construction and operations
			Total 55 ha
Cable Transition Facilities, Murrumujuk	Underground Cable Corridor for up to six cables plus fibre optics connecting from the converter site to Land Sea Joint Station	2.7 km x 70 m	19 ha
	Land Sea Joint Station	Six bays located in fenced compound	1.5 ha
	Shore Crossing Site involving open trenching of up to six cables plus fibre optics from Land Sea Joint Station to offshore	500 m x 500 m area within which cables will be laid in open trenches crossing the intertidal zone and beach, and then back filled	Temporary only. Reinstated post construction.
			Total 20.5 ha
Subsea Cable System Two route options under consideration (options A & B shown in Figure 2-4). Both traverse Shoal Bay, Beagle Gulf, Timor Sea.	Subsea HVDC cable corridor for up to six power cables laid parallel over 4,200 km from Darwin to Singapore. Length up to the Commonwealth marine area boundary is approximately 895 km.	Up to 6 cables installed over approximately 895 km, spaced 50-200 m apart. Cable installation will disturb a 12 m wide area of seabed around each cable	1,074 ha per cable
			Total 6,444 ha

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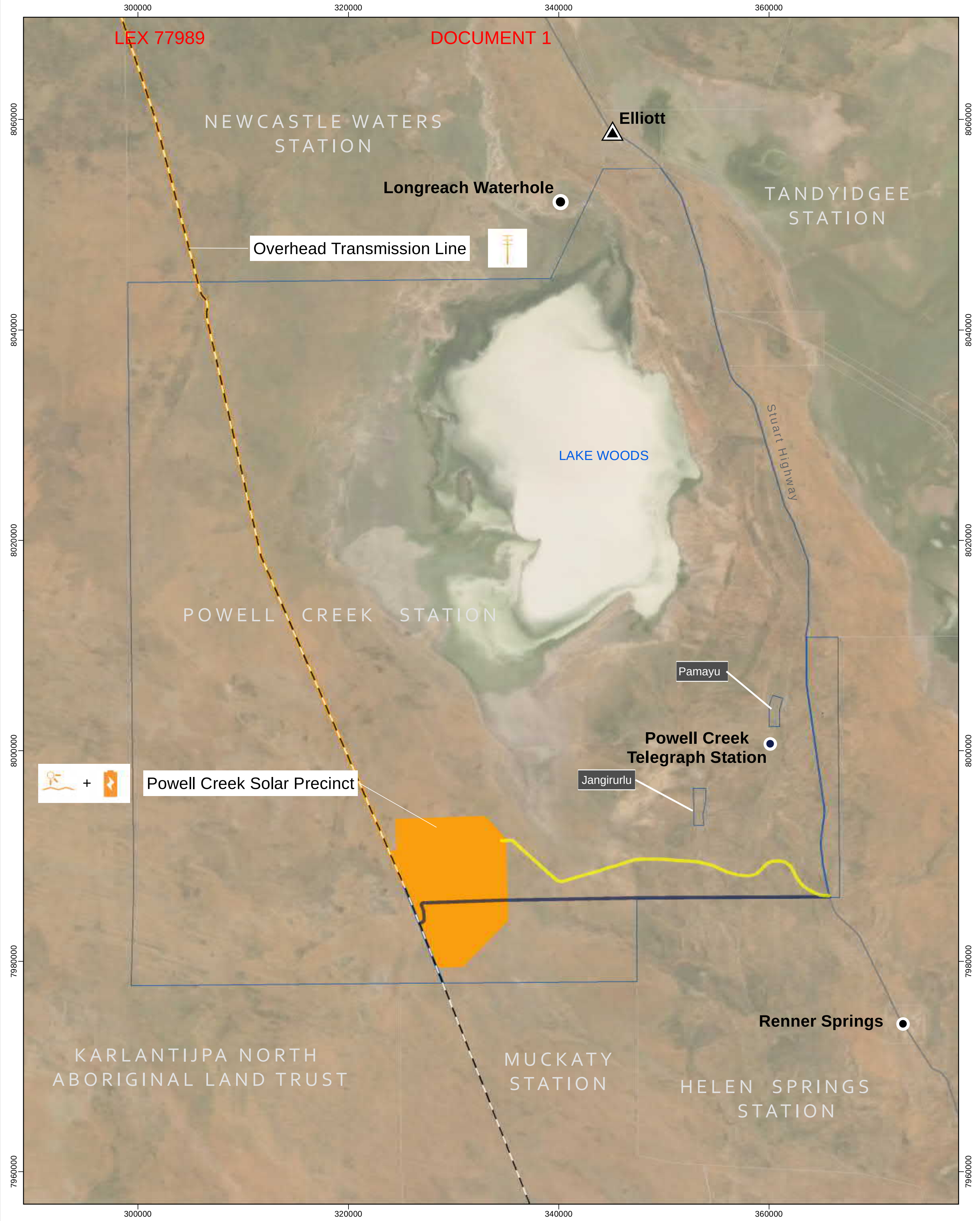

Legend

- Town
- Stuart Highway
- Alice Springs to Darwin Railway
- All weather access road (unsealed)
- Main access road (sealed)
- Powell Creek Station
- Cadastre
- AAPowerLink Infrastructure

Source: NTG data - Cadastre and conservation areas. Australian Government data - Ralway and roads

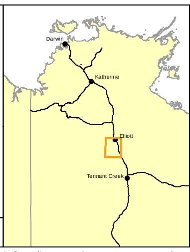

Figure 2-1: Powell Creek Solar Precinct

Project: Australia-Asia PowerLink

0 4 8 12 16 Kilometers

Scale: 1:450,000 | Datum: GDA2020

Coordinate System: MGA 53 | A4

Reference #: AAPL_GNR_CTA_GEN_MAP_0082

Date: 07/03/2022 | Figure: 1 of 1 | Revision: A

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Legend

- Town
- Highway
- Alice Springs to Darwin Railway
- AAPowerLink Infrastructure
- Powell Creek Station

Note: There are 2 separate options for the Subsea Cable Corridor transitioning from Sun Cable's Cable Transition Facility

Source: NTG data - Parks and reserves. Australian Government data - Railway, roads, coastal waters and marine parks

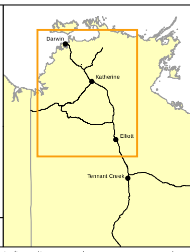

Figure 2-2: Overhead Transmission Line (OHTL)

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Project: Australia-Asia PowerLink

0 25 50 75 100 Kilometers

Reference #: AAPL_GNR_CTA_GEN_MAP_0083

Date: 07/03/2022	Figure: 1 of 1	Revision: A

Scale: 1:3,000,000

Datum: GDA2020

Coordinate System: -

A4

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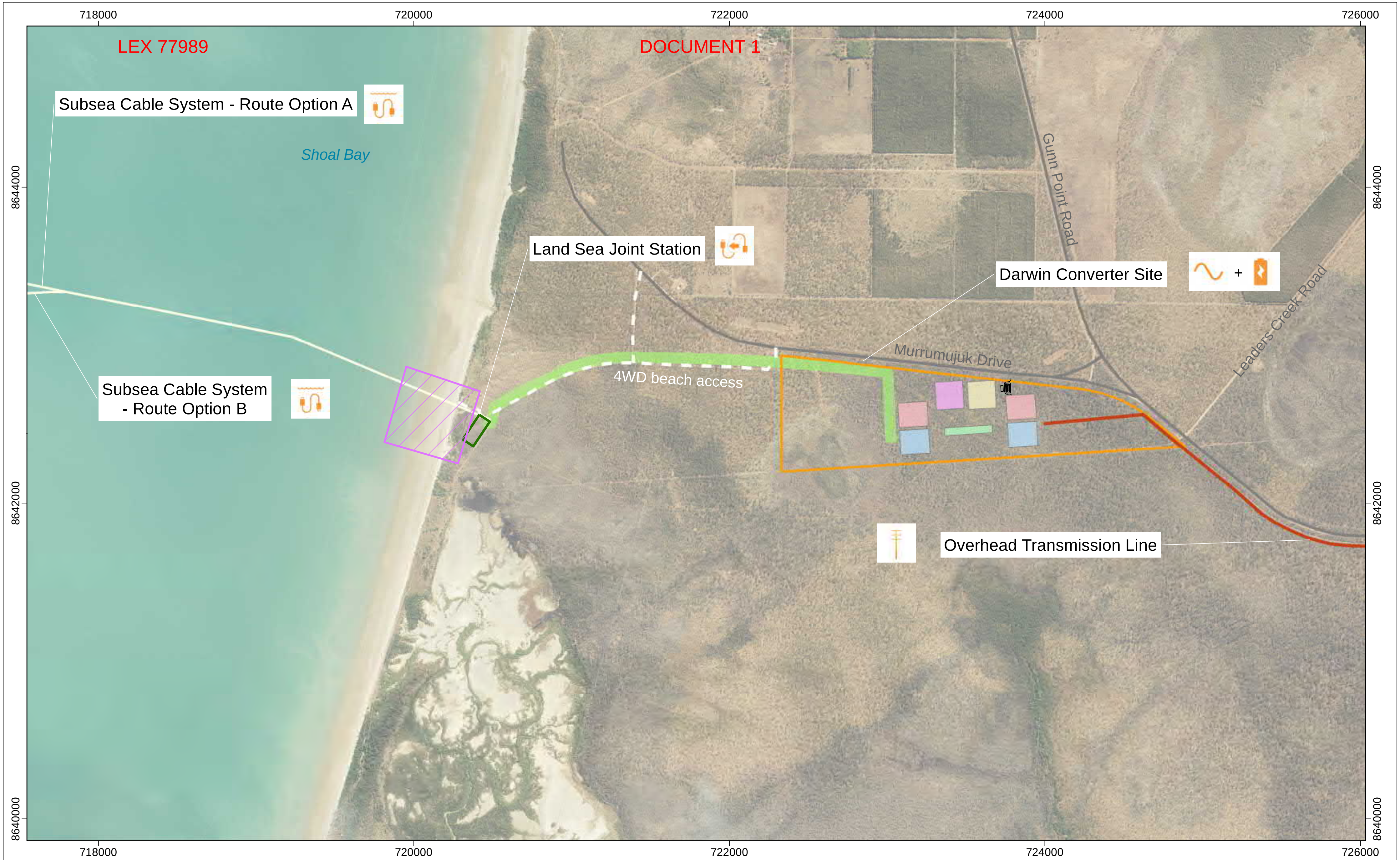
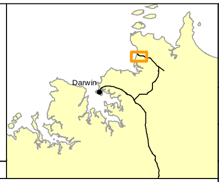


Legend

- Overhead Transmission Line
- Carpark and vehicle access
- Subsea Cables
- Cadastre
- Shore crossing
- Land Sea Joint Station
- Underground cable corridor
- Darwin Converter Site - Part NT Por 2626
- Battery Hall 1
- Battery Hall 2
- Voltage Source Converters 1
- Voltage Source Converters 2
- Switchyard, filters and substation



Source: NTG data - Cadastre and roads. Imagery: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 2-3: Darwin Converter Site and Cable Transition Facilities

Project: Australia-Asia PowerLink	Reference #: AAPL_GNR_CTA_GEN_MAP_0073	Figure: 1 of 1	Revision: B
Coordinate System: MGA 52	Datum: GDA2020	Date: 07/03/2022	
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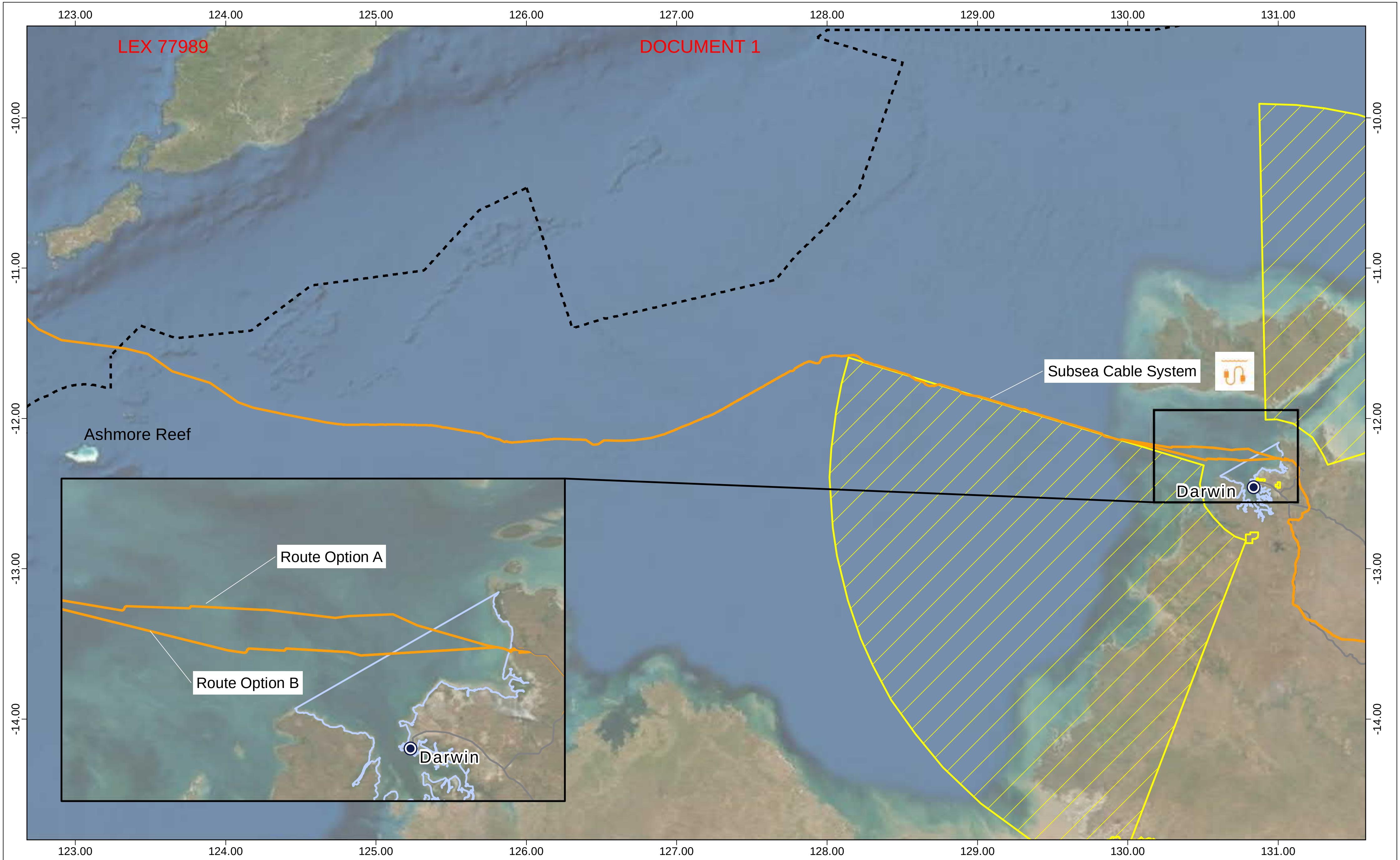

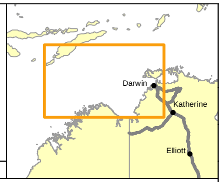

Legend

- Australia-Asia Powerlink Infrastructure
- Commonwealth Marine Area Boundary
- Defence training area
- Darwin harbour boundary

Source: NTG data - Cadastre and roads. Imagery: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 2-4: Subsea Cable System

Project: Australia-Asia PowerLink	Reference #: AAPL_GNR_CTA_GEN_MAP_0077	Figure: 1 of 1	Revision: C
Coordinate System: -	Datum: WGS 1984	Date: 22/03/2022	

0 50 100 150 Kilometers | Scale: 1:3,500,000 | A4

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2.2 Land information

2.2.1 Local Government Areas

The AAPowerLink will operate across seven Local Government Areas (LGAs) in the Northern Territory: Barkly Region, Roper Gulf Region, Katherine Municipality, Victoria Daly Region, Unincorporated (Marrakai-Douglas Daly) Area, Coomalie Shire and Litchfield Municipality. The Solar Precinct site is in the Barkly Region. The Darwin Converter Site is in the Litchfield Shire. All of the above-mentioned LGAs are traversed by the OHTL. The local government authorities are key project stakeholders that will be engaged through-out the Project's life cycle.

2.2.2 Land tenure, ownership, and interests

The Solar Precinct is located on Pastoral Lease 948 (part of NT Portion 2094) Powell Creek Station, which is held by Consolidated Pastoral Company Pty Ltd and operated for cattle production. Native Title was determined over the site on 28 October 2020 (National Native Title Tribunal Number: DCD2020/007), in favour of the applicants and Top End Aboriginal Corporation Registered Native Title Body Corporate (Default Prescribed Body Corporate). Sun Cable will operate the Solar Precinct under a lease arrangement with the Consolidated Pastoral Company. An Indigenous Land Use Agreement (ILUA) is also under negotiation with the native title holders through the Northern Land Council.

The OHTL is predominantly within the AustralAsia Rail Corporation (AARC) railway easement which is operated under a lease and sub-lease arrangement over Crown Land and Aboriginal Freehold Land. AARC retains proprietary rights to land contained within the railway easement but has granted possession to One Rail Australia. For the OHTL within the railway easement, AAPowerLink will establish a Transmission easement with AARC in consultation with One Rail Australia. An ILUA is also under negotiation with the native title holders through the Northern Land Council and Central Land Council.

Some sections of the OHTL may need to be diverted outside the rail corridor due to a range of constraints. Options for these diversions are currently under discussion and will likely be operated under a lease and easement arrangement with the relevant landholders.

The northern 66 km from Livingstone through to the Darwin Converter Site follows a NTG designated future Utilities Corridor. This section of the OHTL will likely be operated under lease and easement arrangements negotiated with the NT Government.

The Darwin Converter Site and Cable Transition Facilities are located on Crown Land, which is subject to a Crown Lease in Perpetuity in favour of the NT Land Corporation. The land is zoned for Future Development.

The Subsea Cable System will be operated under easement and licence arrangements with the Northern Territory Government to the extent it is on Crown land.

Native title and traditional land ownership matters relating to the proposed tenure across the project area are being addressed in consultation with the Northern Land Council and Traditional Owners.

2.2.3 Current land uses

2.2.3.1 Solar Precinct

The Solar Precinct site on Powell Creek Station has a history of pastoral land use and features access tracks, fence lines and groundwater bores. Currently, pastoral activities on Powell Creek Station are concentrated in the north of the property, which is one of the reasons why the Solar Precinct has been sited toward the southern boundary of the property to mitigate the potential for land-use conflicts. Further detail in relation to site selection is provided in section 2.4.2.

Aboriginal access and land use

Powell Creek Station is used by local Aboriginal people, particularly to the north-east of the proposed Solar Precinct. Native title rights on Powell Creek Station are recognised for six estate groups. These rights extend to possession, occupation, use and enjoyment to the exclusion of all others, including the right to access and take for any purpose the resources of those areas. Sun Cable acknowledges these rights and is in the process of negotiating ILUA's with the native title holders and the Northern Land Council. This is outlined in Chapter 13 – Community and economy.

2.2.3.2 Overhead Transmission Line

The OHTL within the Railway Corridor traverses remote, sparsely populated areas where the main surrounding land use is broad-scale pastoral operations for cattle grazing. North of Katherine, the OHTL remains in the Railway Corridor and passes through areas where there are smaller land holdings that support agriculture and horticulture activities, and rural living. From Livingstone, the final 66 km of the OHTL is within a Utilities Corridor designated in the NTG's Litchfield Sub-Regional Land Use Plan (LSLUP). The OHTL will span across public roads and watercourse as well as existing infrastructure at a number of locations.

There are also several locations where the OHTL may deviate from the designated Railway corridor which are currently being assessed. These potential deviations are likely to be at Katherine, Pine Creek and Adelaide River. Details of sensitive receptors and land uses proximate to the OHTL corridor are provided in section 2.2.4 below. Route deviations will consider environmental, cultural, and social constraints as well as land access.

2.2.3.3 Darwin Converter Site and Cable Transition Facilities

The Darwin Converter Site and Cable Transition Facilities are located at Murrumujuk on the corner of Gunn Point Road and Murrumujuk Drive which connects with the Gunn Point Beach Access Road. There is no current formal land use, and the site is zoned for Future Development by the LSLUP. The site is located adjacent to Seafarms' proposed Project Sea Dragon aquaculture facility. To the west, Gunn Point Beach is a beach recreation and camping area, and the land to the south-west and south of the site comprised of the Tree Point Conservation Reserve and Shoal Bay Coastal Reserve.

The NTG's Mapping the Future Project identified the Gunn Point region as an area of high development potential due to its proximity to Darwin, its status as a Priority Development Zone under the Economic Development Framework (Cruickshank 2020) and the availability of Crown land. The Gunn Point peninsula is identified as having land suitable for development as a rural centre – with rural lots, tourism, and horticulture land uses. The future town of Murrumujuk is proposed to be located immediately north of the Darwin Converter Site.

Aboriginal access and land use

Murrumujuk is considered Larrakia country and a popular hunting area for Larrakia, Wulna and Tiwi people, all of whom maintain customary connections to the shared areas on Gunn Point Peninsula.

2.2.3.4 Subsea Cable System

The Subsea Cable System corridor extends from the Shore Crossing Site at Gunn Point Beach to approximately 895 km to the edge of Commonwealth Waters on the Continental shelf as defined by the Seabed Treaty 1972. Currently there are two route options which are being assessed for suitability. Both options traverse the shallow waters of Shoal Bay and proceed through the outer areas of Darwin Harbour (remaining outside the Darwin Port boundary) prior to entering the Beagle Gulf and Timor Sea.

The southern cable corridor option (cable route A) lies approximately 7 km offshore of Lee Point and approximately 15 km offshore of Charles Point. The northern cable corridor option (cable route B) lies further offshore, approximately 18.5 km from Lee Point and approximately 22 km from Charles Point. Beyond the NT Coastal Waters limit1 the corridor traverses Commonwealth marine waters.

2.2.4 Sensitive receptors and land uses

The location of populated places, areas of interest and potentially sensitive land uses are summarised in Table 2-3 and shown on Figure 2-5a, Figure 2-5b, Figure 2-5c, and Figure 2-5d. The term Kilometre Point (KP) is used to indicate the location along the OHTL services corridor, where KP0 is at the Solar Precinct and KP788 is at the Darwin Converter Site at Murrumujuk. The term Chainage (CH) is used to indicate locations along the Subsea Cable System route where CH0 is at the Shore Crossing Site and CH895 is at the edge of the Commonwealth marine area, 895 km from the Shore Crossing Site.

Table 2-3. Populated places, areas of interest and public infrastructure proximate to AAPowerLink

Component Location	Receptors from south to north	Distance from project footprint
Solar Precinct	Renner Springs Roadhouse	36 km south-east
Solar Precinct	Powell Creek telegraph station	25 km north-east
Solar Precinct	Jangirulu Family Outstation	17 km north-east
Solar Precinct	Lake Woods Site of Conservation Significance	10 km north-east
Overhead Transmission Line KP = Kilometre Point - KP0 is at Solar Precinct and KP788 is at Murrumujuk		
KP153	Murranji Family Outstation	3.5 km
KP265	Farmhouse	1.6 km
KP358	Farmhouse	1.5 km
KP373 to KP446	Threatened ecological community - Arnhem Plateau Sandstone Shrubland Complex	0 km
KP463	Katherine rail siding	0 km
KP464	Principal road (Victoria Highway overpass)	0 km
KP465	Industrial buildings	1 km
KP466	Rural housing (multiple buildings)	0.6 km
KP467	Rural housing (multiple buildings)	1 km
KP473	Rural housing (multiple buildings)	0.6 km
KP474	Rural housing (multiple buildings)	0.4 km
KP477	Principal road (Stuart Highway overpass)	0 km

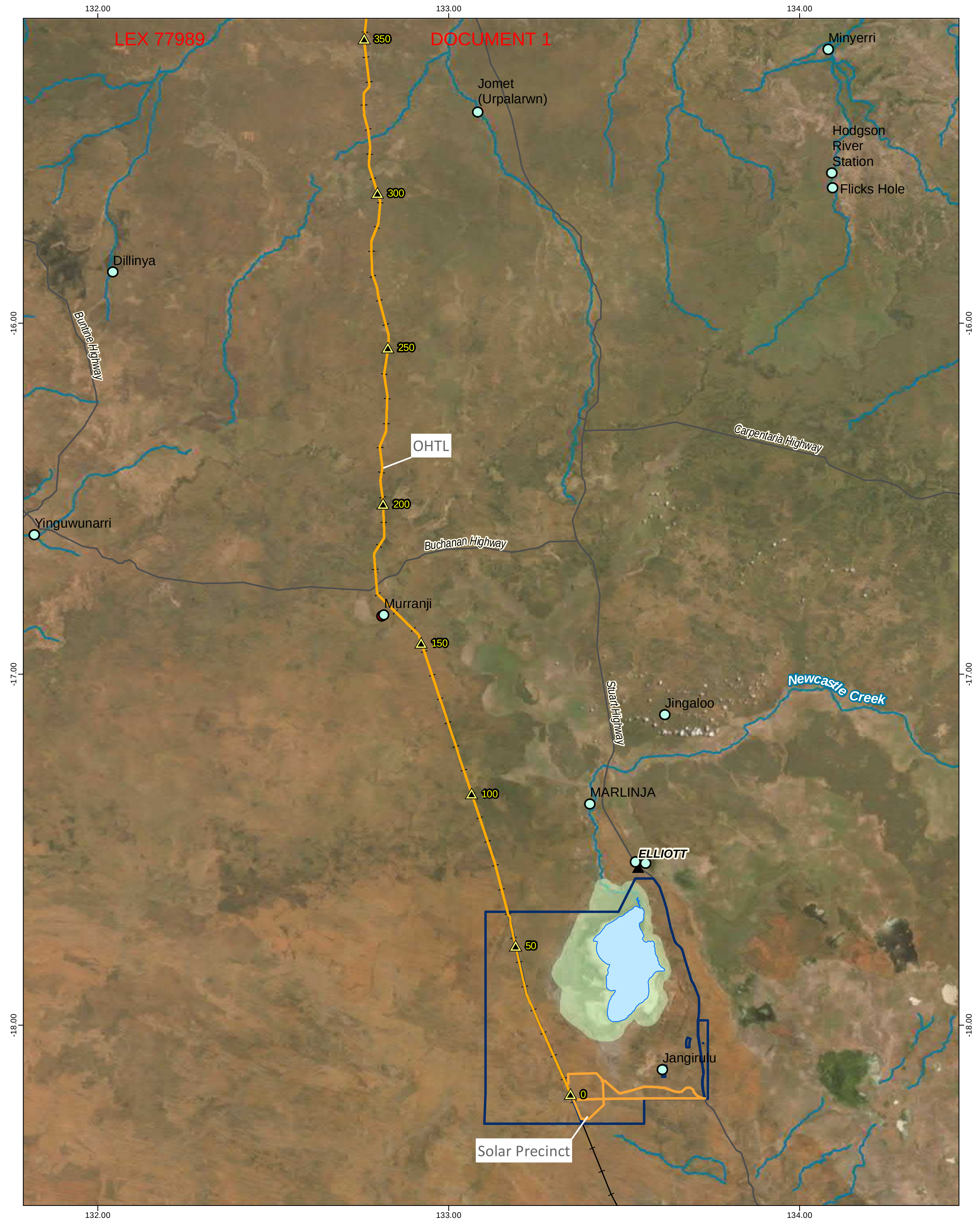
[1] NT coastal waters consist of the waters from the lowest astronomical tide (LAT) outwards by 3 nautical miles (5.55 km).

Component Location	Receptors from south to north	Distance from project footprint
KP492 to 527	Site of Conservation Significance - Yinberrie Hills	0 km
KP550	Bonrook homestead	2.6 km
KP552	Kybrook Farm Aboriginal Community	3.4 km
KP554	Farmhouse	0.4 km
KP555	Pine Creek	1 km
KP556	Pine Creek Aboriginal Community	0.6 km
KP557	Pine Creek golf course and track	0.2 km
KP557	House	0.8 km
KP572	Rail siding	0 km
KP596	The Banyans homestead	1.3 km
KP608.5	House	0.1 km
KP623	Work area	0.5 km
KP665	House	1.2 km
KP666	Burnside Farm homestead	2.6 km
KP667	Racecourse - Adelaide River	0.2 km
KP667	Amangal Indigenous Village	0.8 km
KP667	Adelaide River township	0.11 km
KP671.5	House	0.6 km
KP672	Litchfield National Park boundary	0.4 km
KP673	House	0.45 km
KP675	House	0.2 km
KP679	Small rural blocks	0.1 km
KP680	Gulngarring Family Outstation	2.45 km
KP680	Small rural blocks	0.1 km
KP681	Small rural blocks	0.1 km
KP690	Albany Park	1.21 km
KP691	Small rural blocks	1.1 km
KP692	Small rural blocks	1.1 km
KP715	Acacia Larrakia family Outstation	4.5 km
KP723 to KP788	Darwin rural areas; Noonamah, Wak Wak, Lambells Lagoon, Herbert and Koolpinyah	0.2 – 0.3 km east and west

Component Location	Receptors from south to north	Distance from project footprint
KP736.8	Major road (Stuart highway)	0 km
KP752-755	Black Jungle Conservation Reserve	0 km
KP776.5	Major road (Gunn Point Road)	0 km
Darwin Converter Site	Tree Point Aboriginal Community	5 km south
Darwin Converter Site	Sea Dragon aquaculture facility (proposed)	Adjoins west of site
Cable Transition Facilities	Gunn Point beach access and recreational area	Adjacent north of site
Subsea Cable System CH = Chainage – CH0 is Shore Crossing Site and CH886 is edge of AEEZ[2]		
CH0-5	Seagrass habitat potential occurrence	0 km
CH0-5	Seaweed habitat potential occurrence	0 km
CH82 (Route A) CH56 (Route B)	Bayu Undan gas pipeline crossing	0 km
TBC	Northwest telecommunication cable crossing	0 km
CH43	Fenton Patches – recreational fishing area	3.5 km north of Route A 10 km north of Route B
CH36	INPEX dredge spoil disposal area	1.6 km north of Route A 8 km north of Route B
CH56-325	North Australian Exercise Area (NAXA) – Defence	Cable route partially enters NAXA
CH259-560	Oceanic Shoals Marine Reserve	0 km

It should be noted that sensitive receptors located near potential OHTL deviations have not been listed, as the route is currently being confirmed.

[2] Note chainage is indicative until route surveys are completed in early 2022



Legend

- AAPowerLink infrastructure
- OHTL Kilometre Points
- Towns
- Railway
- Roads
- Homesteads
- Aboriginal communities
- Powell Creek Station
- Lake Woods
- Major Drainage
- Minor Drainage

Sites of Conservation Significance

- Lake Woods

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

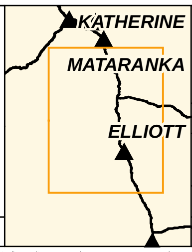


Figure 2-5a: Map of sensitive receptors proximate to the AAPowerLink

Project: Australia-Asia PowerLink

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0 15 30 45 Kilometres

Scale: 1:1,500,000

Coordinate System: GDA2020

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Reference: M-Files ID 200050

Date: 07/03/2022

Revision: 0

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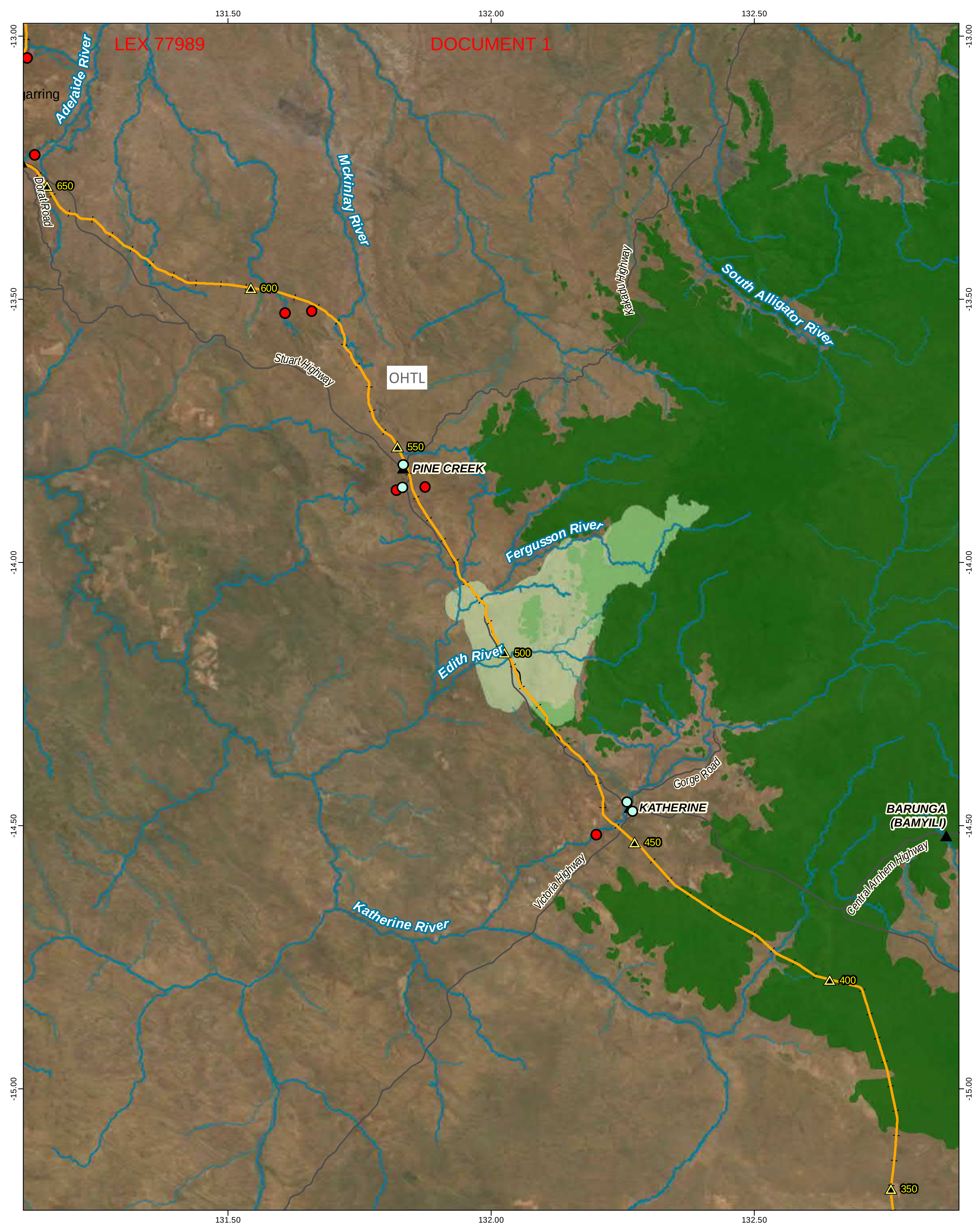

Legend

- AAPowerLink infrastructure
- OHTL Kilometre Points
- Towns
- Homesteads
- Aboriginal Communities
- Major Drainage
- Minor Drainage
- Railway
- Roads

Sites of Conservation Significance

- Yinberrie Hills

Threatened ecological communities

- Arnhem Plateau Sandstone Shrubland Complex

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

Figure 2-5b: Map of sensitive receptors proximate to the AAPowerLink

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Project: Australia-Asia PowerLink

0 10 20 30 Kilometres

Scale: 1:1,000,000

Coordinate System: GDA2020

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Reference: M-Files ID 200050

Date: 07/03/2022

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Legend

- AAPowerLink infrastructure
- OHTL Kilometre Points
- Towns
- Homesteads
- Aboriginal communities
- Major Drainage
- Minor Drainage
- Railway
- Roads
- Sea Dragon aquaculture facility
- NT Parks and reserves

Sites of Conservation Significance

- Shoal Bay

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

Figure 2-5c: Map of sensitive receptors proximate to the AAPowerLink

Project: Australia-Asia PowerLink

0 5 10 15 Kilometres

Scale: 1:500,000

Coordinate System: GDA2020

A4

Reference: M-Files ID 200050

Date: 08/03/2022

Revision: 0

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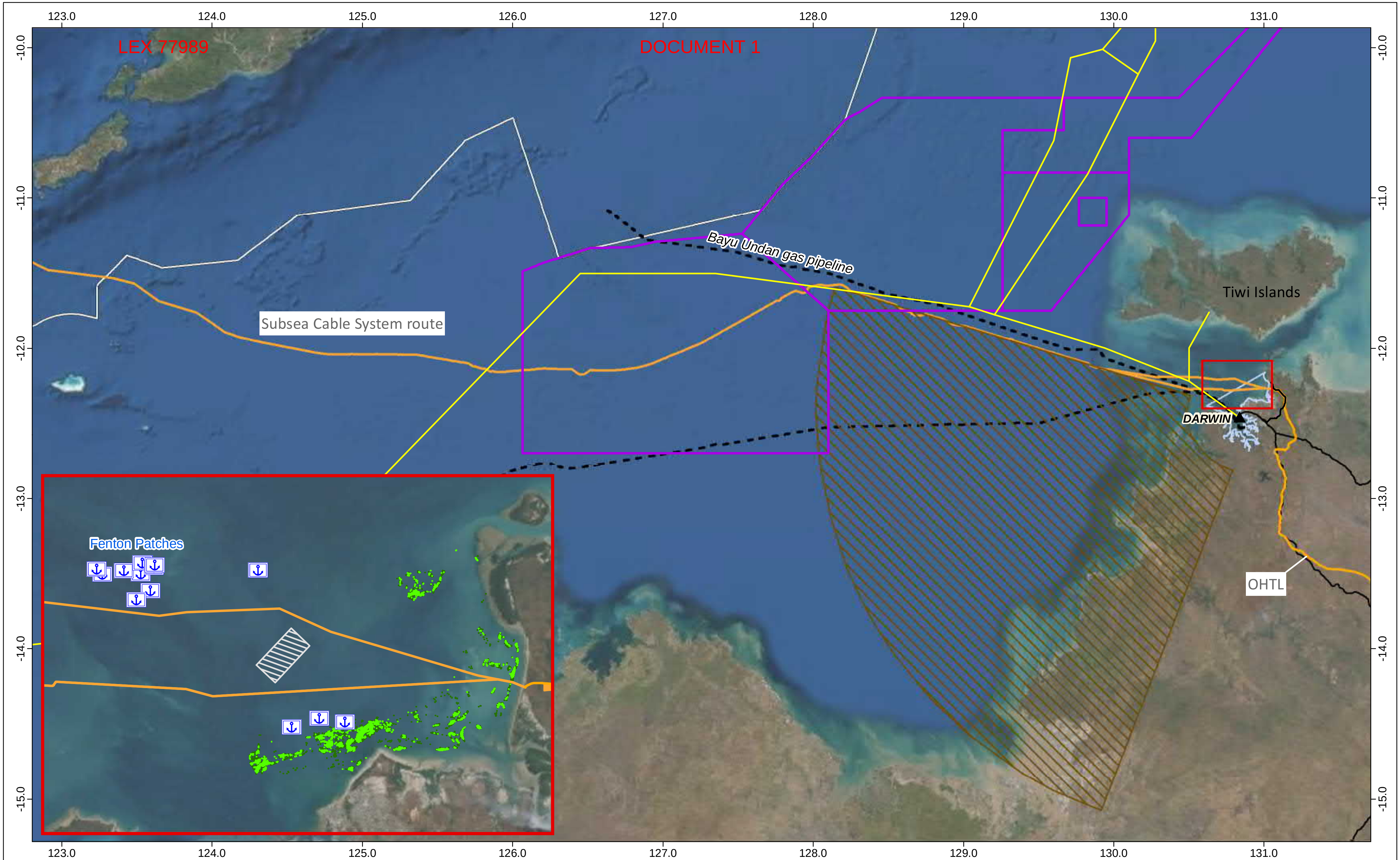

Legend

- AAPowerLink Infrastructure
- Commonwealth marine environment
- Oceanic Shoals Marine Park
- NAXA Defence training area
- Pipelines
- North West Telecommunications Cable
- INPEX dredge disposal area
- Artificial reefs
- Darwin Harbour boundary

Probability of occurence

- Seagrass 80% - 100%
- Seagrass 60% - 80%

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

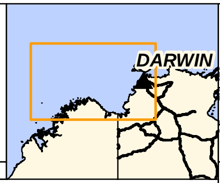

Figure 2-5d: Sensitive receptors proximate to the AAPowerLink

Project: Australia-Asia PowerLink | Reference: M-Files ID 200050 | Revision: 0

Coordinate System: GDA2020 | Date: 08/03/2022

0 50 100 150 Kilometres | Scale: 1:3,500,000 | A4

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2.3 Climate and weather

Climate and weather are important considerations in the site selection and infrastructure design for the AAPowerLink project to protect the infrastructure and the environment. The project footprint occurs across semi-arid and humid climatic zones, with varying levels of risk associated with extreme weather events including flooding, cyclones, and storm surge. Climatic conditions experienced across the areas where project infrastructure will be located are summarised below.

2.3.1 Semi-arid zone

The Solar Precinct and southern part of the OHTL are in an area that experiences a semi-arid climate, which is characterised by hot dry summers and cool dry winters, with low average annual rainfall. The closest long-term Bureau of Meteorology (BoM) weather station is Elliott (station number 015131) approximately 70 km north-east of the Solar Precinct.

Rainfall

The mean average annual rainfall is 587.2 mm, with higher rainfall typically occurring in the summer months due to influences from the northern monsoon – see Figure 2-6 (data from BoM 2021a). Annual rainfall can be highly variable from year to year – for example, 2019 experienced 97.6 mm of rain, while 2014 experienced in excess of 800mm rain (see Figure 2-7).

Temperature

Temperatures follow the seasonal patterns typical of central Australia, with the hottest daily maximums occurring in January. Evapo-transpiration is high – approximately 2,800 mm based on records from 1975-2005 (BOM 2021a) – with the annual evaporation rate greatly exceeding annual rainfall. Surface water bodies are mostly seasonal or ephemeral, and flow/hold water only after rainfall events.

Severe weather events

Significant rainfall events can cause widespread flooding across the Barkly Region. The Flood modelling extent in extreme 1 in 1000 events and climate change flood projections are included in Appendix N. The vast majority of the footprint is outside of any mapped flood extents, including in extreme 1 in 1,000-year events.

The likelihood of cyclones within the semi-arid zone is low because the proposal is many hundred kilometres inland (Geoscience Australia 2018). Information from BOM (2021c) indicates that since 1906, four cyclones have come within the proximity of the Solar Precinct.

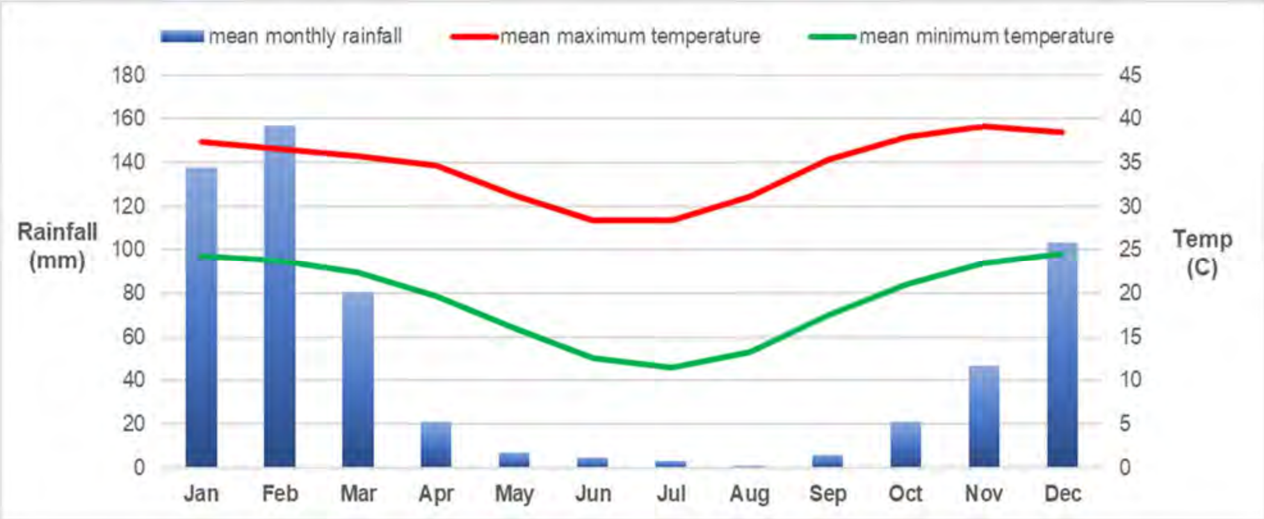


Figure 2-6. Long term monthly rainfall and temperature statistics at Elliott (station 015131)

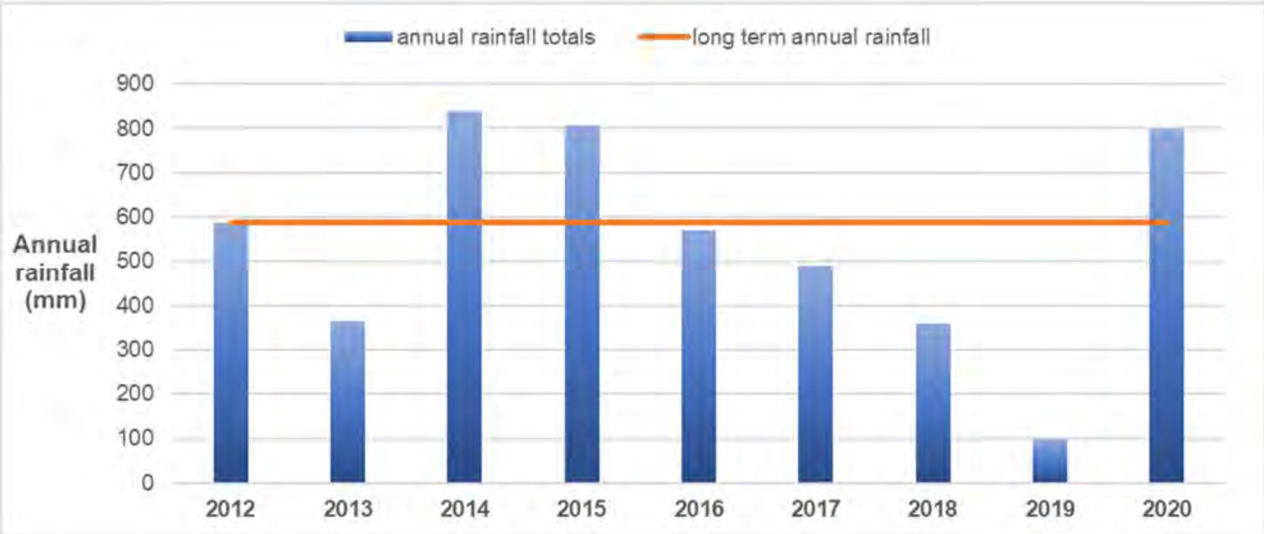


Figure 2-7. Annual rainfall at Elliott (station 015131) between 2012 and 2021

2.3.2 Humid zone

The OHTL from approximately KP170 to the Darwin Converter Site and Cable Transition Facilities at Murrumujuk, is within the humid zone. The climate varies within this zone, but is distinctly dominated by a wet season, from November to April, and dry season, from May to October. The climate of the mid-region of the OHTL corridor is represented by the long-term climate data from the BOM Katherine weather station (Tindal RAAF station number 014932). The climate of the northern portion of the OHTL, and the Darwin Converter Site and Cable Transition Facilities, is represented by the Darwin Airport weather station (number 014015).

Katherine

Rainfall mostly occurs in the wet season months of November to April. The annual average rainfall is ~975 mm, the majority of which falls in December, January, and February. Annual rainfall is variable however, with the lowest annual rainfall, 439.5 mm, recorded in 1952, and the highest annual rainfall, 1,575.4 mm, recorded in 1984. Annual evaporation is high; approximately 2,300 mm per year (NRETAS, 2010).

Katherine experiences hot summer months during the wet season, when mean maximum temperatures range from ~35°C to ~38°C (BoM 2021a). The hottest month on average is November when the mean maximum temperatures is 38°C and the mean minimum temperatures is 24.7°C (see Figure 2-8). The coolest months of the year are the dry season months of June and July.

Darwin

The mean annual rainfall is 1,723.1 mm, with most rainfall typically occurring in the wet season months associated with the northern monsoon – see Figure 2-9. Annual rainfall can vary from year to year – for example, 2019 experienced 1,074 mm of rain, while 2017 experienced 2,197 mm of rain (see Figure 2-9) (BOM 2021a). The highest annual rainfall recorded was 2,776.6 mm, in 1998.

Temperatures follow the seasonal patterns typical of northern Australia, with the hottest daily maximums occurring in November. Evapo-transpiration is high – approximately 2,400 mm based on records from 1975-2005 (BoM 2021a) – with the annual evaporation rate exceeding annual rainfall.

Severe weather events

Severe thunderstorms and cyclones occur more frequently in the north of the NT and could affect the northern portion of the OHTL corridor and the Darwin Converter Site and Cable Transition Facilities at Murrumujuk. The likelihood of being affected by cyclones is relatively high, with numerous cyclones forming each year in the region (Geoscience Australia 2018).

Flood extent maps are available for some rivers in the NT near populated places, including the Katherine River (NRETAS 2006), and the Elizabeth and Blackmore River Catchments (DLPE 2014), which are both crossed by the OHTL. The maps indicate that the OHTL is outside of the mapped flood extent for the Elizabeth and Blackmore Rivers but does cross the 1% AEP flood extent of the Katherine River.

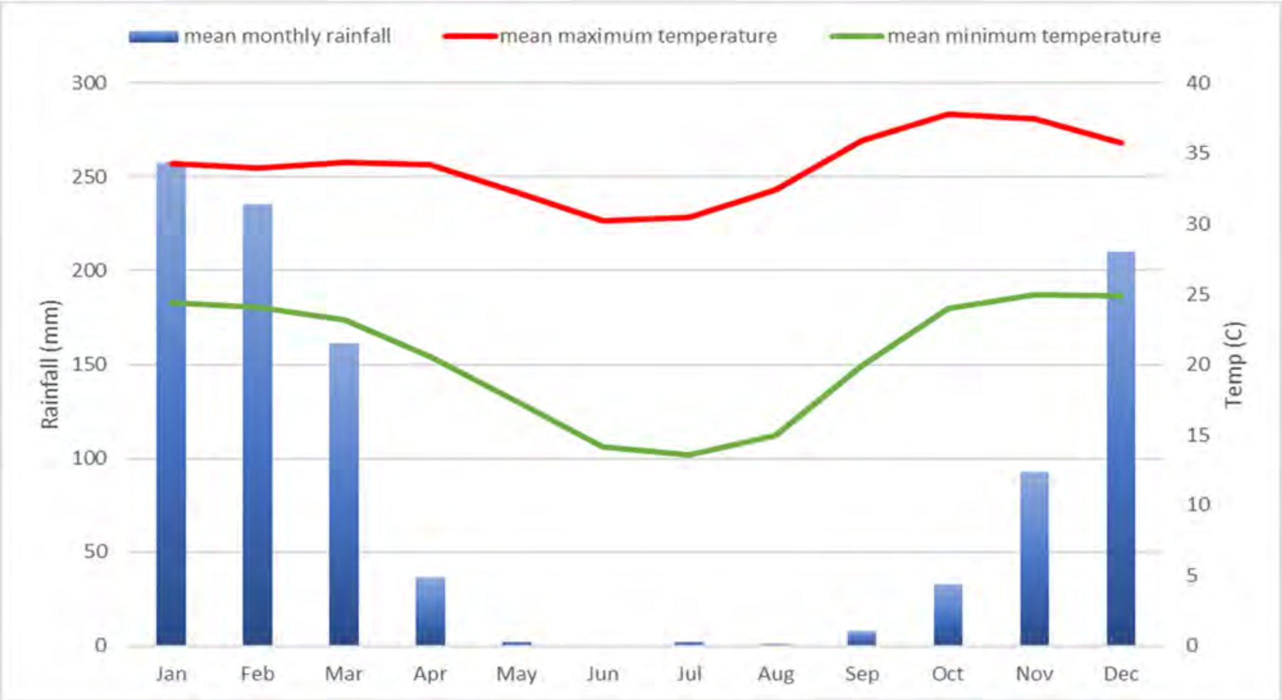


Figure 2-8. Long term monthly rainfall and temperature statistics for Katherine RAAF Tindal (station number 014932)

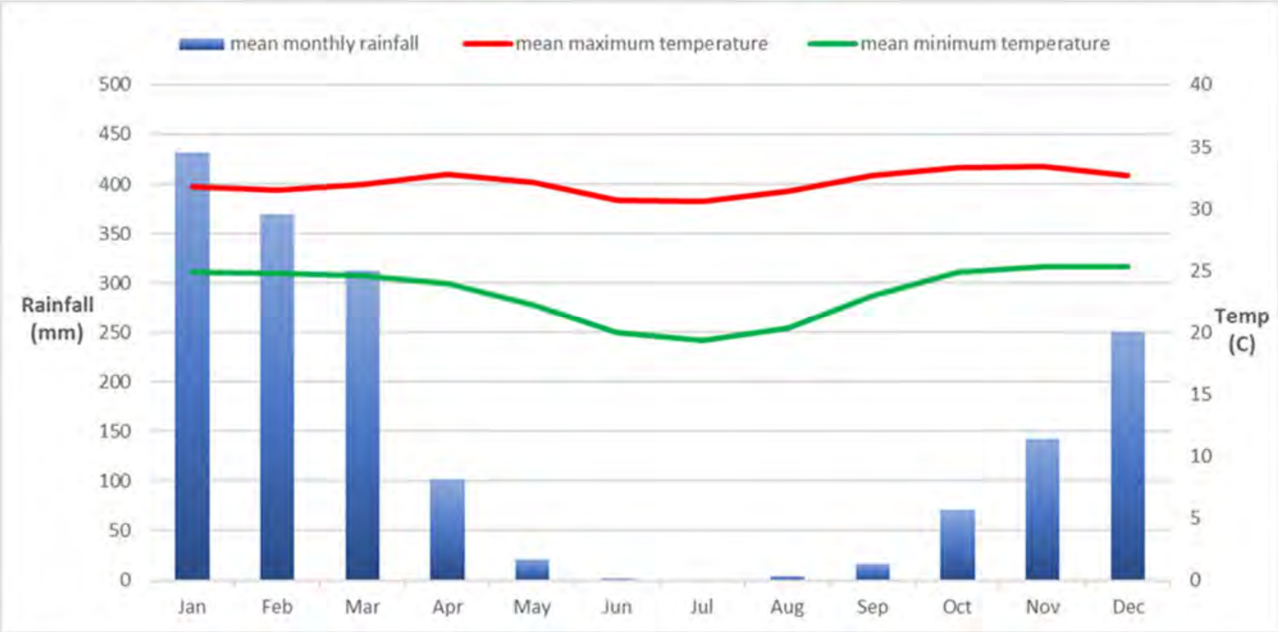


Figure 2-9. Long-term monthly rainfall and temperature statistics at Darwin Airport (station 014015)

2.4 Powell Creek Solar Precinct

The Powell Creek Solar Precinct (the Solar Precinct) is proposed to have a peak generation capacity of approximately 17-20 GW. The Solar Precinct will be comprised of multiple large-scale solar and storage fields, comprising photovoltaic (PV) solar arrays and battery storage, developed in a modular arrangement (see Figure 2-18 below). The arrays will be connected to medium and high voltage transmission infrastructure within the Solar Precinct using underground and overhead reticulation.

The Solar Precinct is comprised of the following infrastructure:

- Distributed battery energy storage systems (BESS)
- Medium and high voltage transmission lines - internal transmission reticulation system
- Voltage Source Converters (VSC) and associated switch yard
- Access and transport infrastructure including
    - Intermodal Logistics Facility inclusive of up to two rail sidings
    - an airstrip with terminal and helipad (adjacent the Solar Precinct)
- Services and utilities such as water, wastewater, electricity, and communications infrastructure
- Hazardous material storage areas
- Temporary Landfill during construction (to be confirmed)
- Ancillary facilities
    - Operation, accommodation, and maintenance facilities
    - Internal access roads and drainage infrastructure
    - Weather monitoring equipment inc. wind monitoring masts, weather monitoring stations, sky camera monitoring and forecasting equipment
    - Security system, fencing, signage, lighting and cleared firebreaks
    - Communications infrastructure (inc. Satellite, fibre optic and Microwave communications tower)
    - Underground or overhead fibre optic cable network
    - Water and wastewater treatment
- Temporary construction accommodation and associated facilities
- Borrow Pits for construction only – located outside the Solar Precinct footprint.

2.4.1 Location and footprint

The site chosen for the Solar Precinct is located on Powell Creek Station approximately 70 km south-west of Elliott and 30 km west of the Stuart Highway, adjacent to the Adelaide-Darwin railway line. The Solar Precinct will occupy up to 12,000 ha of land for all solar fields, and associated infrastructure. Access roads from Stuart Highway and an airstrip will occupy a further 269 ha. Photos illustrating the characteristics of the land within the footprint are provided in Figure 2-10, Figure 2-11, Figure 2-12, and Figure 2-13.

Figure 2-10. Solar Precinct footprint – Land type A - Sandplain

Figure 2-11. Solar Precinct footprint - Land type B - Sandy loam plain

Figure 2-12. Solar Precinct footprint – Land type C Alluvial flats

Figure 2-13. Solar Precinct footprint – Land Type D – Drainage depression

2.4.2 Site selection and design

The selection of the preferred site follows an extensive review of land opportunities in the Barkly region, using a range of project success metrics developed by Sun Cable. In broad terms, the Newcastle Waters and Powell Creek Station area was selected using the following criteria for engineering and constructability:

- Area of very high solar irradiance and low cloud cover
- Open expanse of relatively flat land suitable for large field solar infrastructure
- Proximity to the Alice Springs to Darwin Railway corridor as the preferred route for the OHTL to Darwin and opportunity for a rail siding to provide access for construction logistics
- Ability to access the site from the Stuart Highway
- Potential to access or develop an airstrip
- Suitability of ground conditions, soil type and hydrology.

Four site options, shown in Figure 2-14, were identified as the best candidate sites based on a desktop analysis and were subject to further on-ground assessment and evaluation, in consultation with the landowners and native title holders. Prior to selecting the preferred location, Sun Cable engaged with the Northern Land Council to meet with native title holders of Powell Creek Station and surrounding Traditional Owners. Two sites were proposed in the meetings and discussions were held with the Traditional Owners including meetings on Country, to explain the proposal in detail and seek feedback on the options. Following these meetings, Site 4 was identified as the preferred location for the Solar Precinct for the following environmental, social and heritage reasons:

- There was a consensus at the meetings that Site 4 was a suitable location for such a development.
- Aboriginal Areas Protection Authority abstract of records indicates no registered or recorded sacred sites over the area, which was subsequently validated through Traditional Owner consultation.
- Located towards the southern border of Powell Creek Station reducing interference with/from pastoral operations.
- Ecological surveys indicated few significant ecological values with potential to occur in the area. Specifically, the area was verified to not contain Bilby habitat.
- Located adjacent to the railway line providing direct access for improved construction logistics for both the Solar Precinct and OHTL.
- Located east of the rail line, allowing construction of the main access road direct to the Stuart Highway, reducing the risks associated with crossing an operational rail line.
- Located south-west of Lake Woods thereby avoiding a crossing of Newcastle Creek, which generates the largest overland river flows in the area and is often impassable during the wet season.
- Dominated by level and open terrain, red sand country, which is well-drained and not subject to inundation.

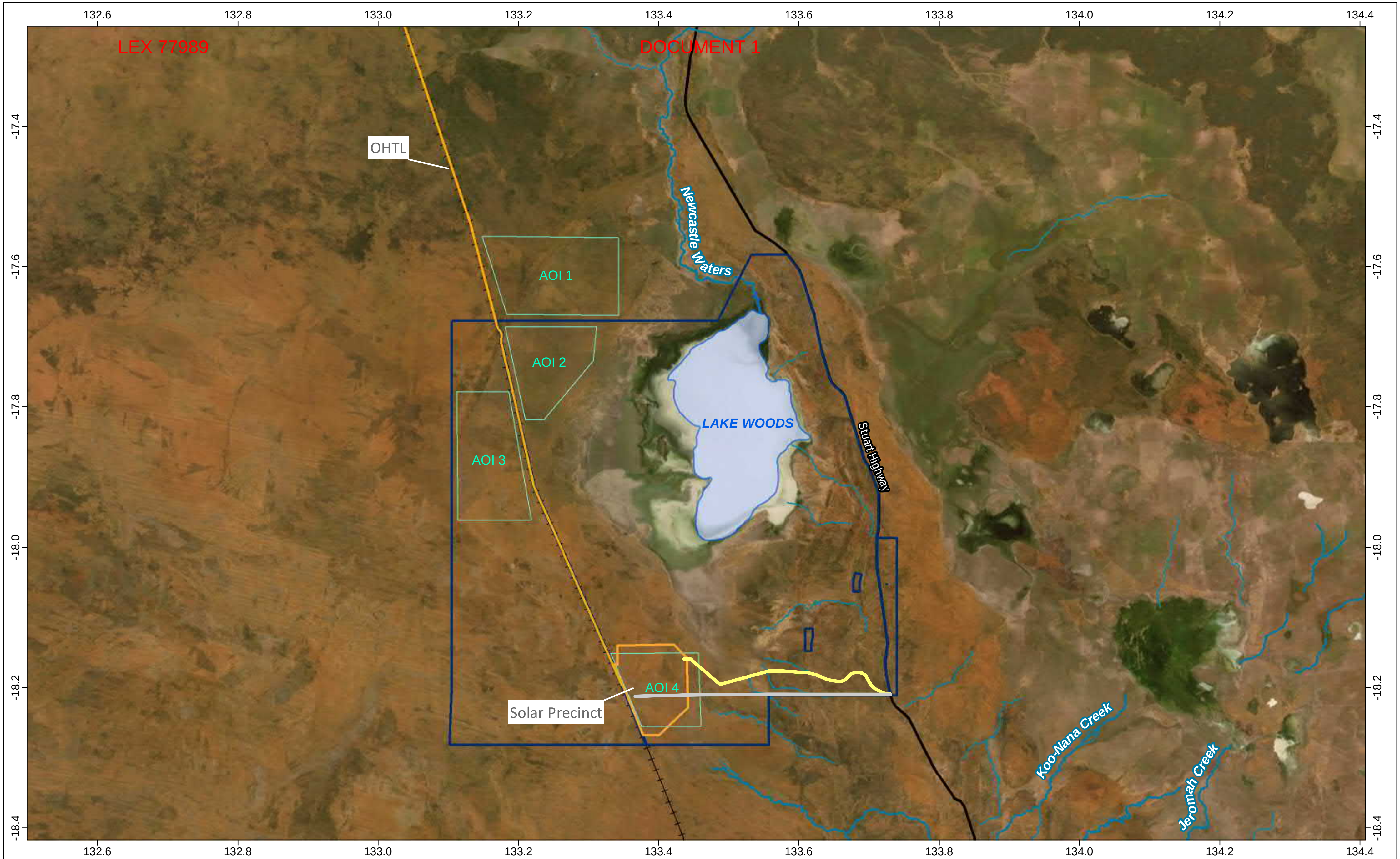
Within Site 4, detailed site investigations, including ecological and heritage assessments, preliminary hydrological modelling, and geotechnical assessments, were undertaken to establish an indicative development footprint for the Solar Precinct and access roads, which is shown in Figure 2-15.

2.4.3 Key components

Key physical components of the Solar Precinct are described below, and a conceptual site layout is shown in Figure 2-16. The site design will be refined through the detailed engineering design process.

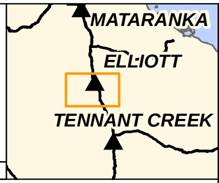
LEX 77989

DOCUMENT 1



Legend

- AAPowerLink infrastructure
- Powell Creek Station boundary
- Solar Precint Areas of Interest
- Main access road (sealed)
- All-weather access road (unsealed)
- Railway
- Principal road
- Lake Woods
- Major Drainage
- Minor Drainage



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

Figure 2-14: Map of Solar Precinct site selection options

Project: Australia-Asia PowerLink | Reference: M-Files ID 200050 | Revision: 0

Coordinate System: GDA2020 | Date: 08/03/2022

0 10 20 30 Kilometres | Scale: 1:750,000 | A4

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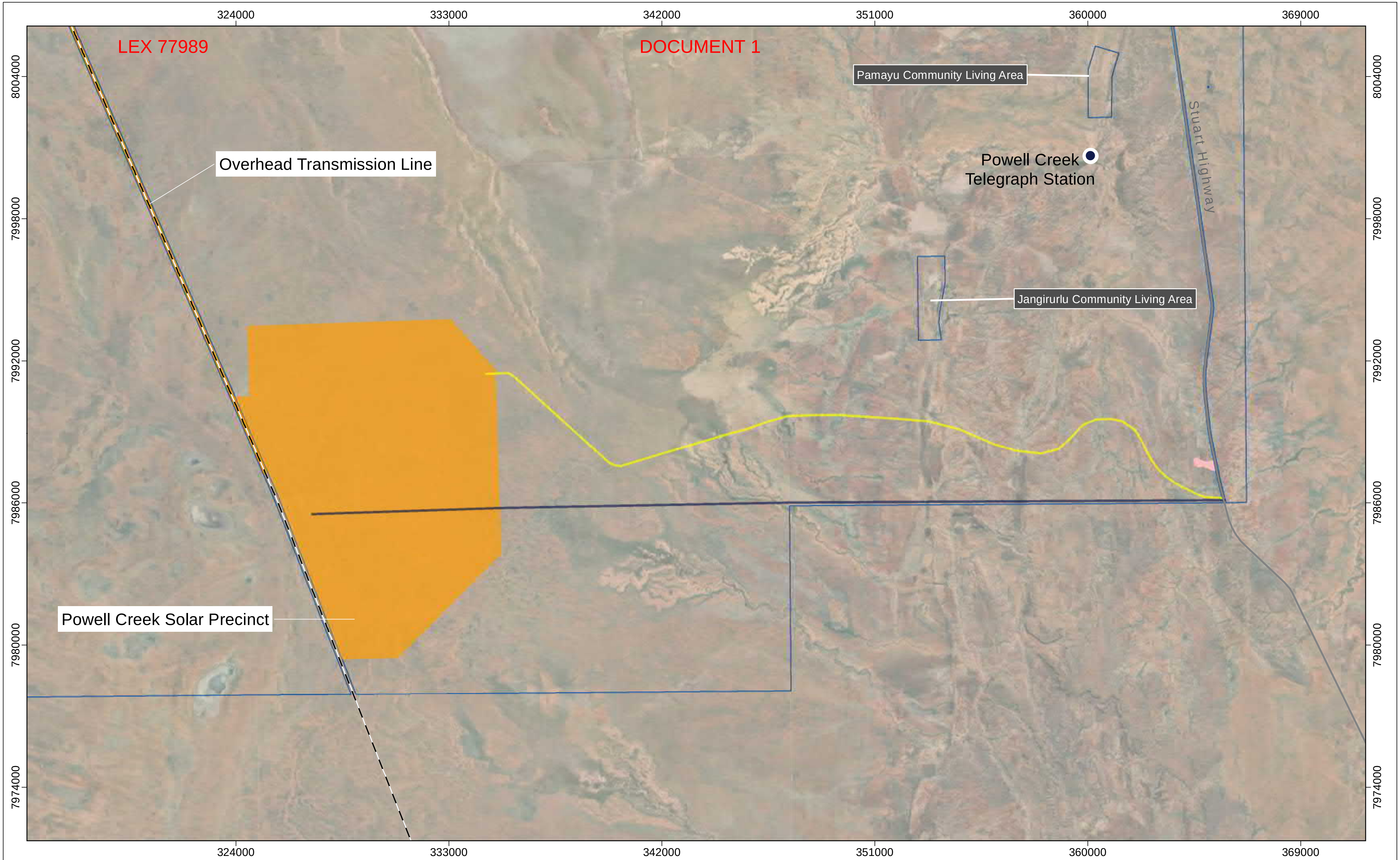

Legend

- Alice Springs to Darwin railway
- AAPowerLink Infrastructure
- All weather access road (unsealed)
- Main access road (sealed)
- Powell Creek Station
- Cadastre
- Indicative borrow pit

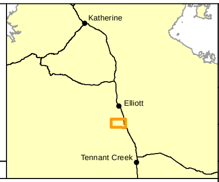

Figure 2-15: Solar Precinct, indicative access roads and borrow pit

Project: Australia-Asia PowerLink	Reference #: AAPL_GNR_CTA_GEN_MAP_0084	Figure: 1 of 1	Revision: A
Coordinate System: MGA 53	Datum: GDA2020	Date: 08/03/2022	
0 2 4 6 8 Kilometers		Scale: 1:200,000	A4

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Source: NTG data - Cadastre and roads. Australian Government data - Railway

175-2-0200-GE-DRG-0003

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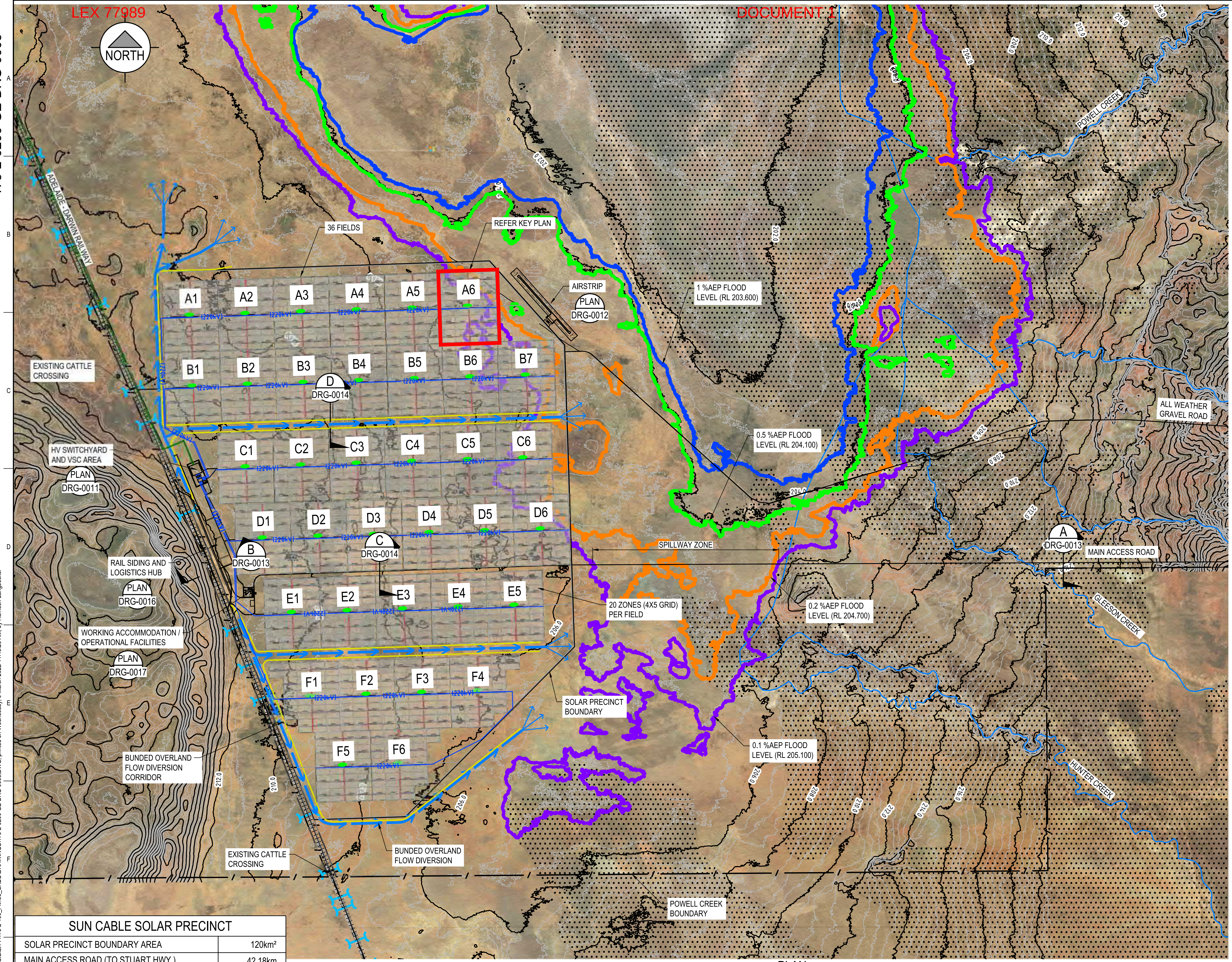
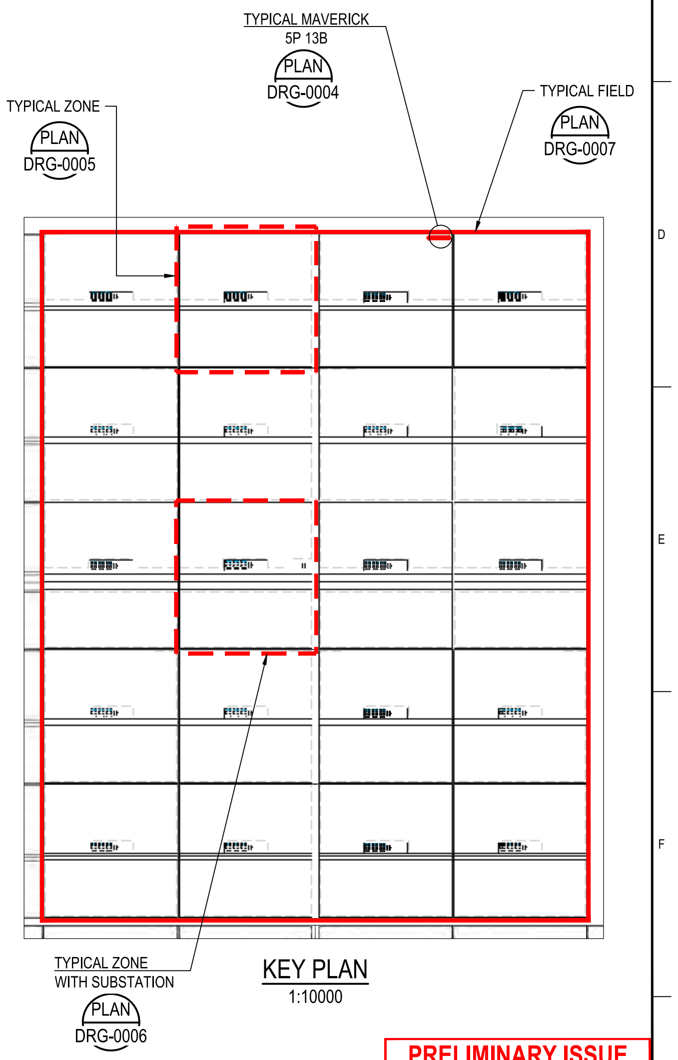
DOCUMENT 2



PLAN
1:50000

LEGEND

- ACCESS ROAD
- AAPL HVDC OHTL
- 220kV OVERHEAD TRANSMISSION LINE
- 0.1% AEP FLOOD LEVEL (RL 205.100)
- 0.2% AEP FLOOD LEVEL (RL 204.700)
- 0.5% AEP FLOOD LEVEL (RL 204.100)
- 1% AEP FLOOD LEVEL (RL 203.600)
- DIVERSION BUND
- BUNDED CHANNEL SHEET FLOW
- RAIL SIDING / LOGISTICS HUB
- POWELL CREEK BOUNDARY
- SWITCHYARD
- EXISTING CULVERTS
- QUATERNARY ALLUVIAL SEDIMENTS EXTENT
- MINOR CREEKS



KEY PLAN
1:10000

SUN CABLE SOLAR PRECINCT	
SOLAR PRECINCT BOUNDARY AREA	120km²
MAIN ACCESS ROAD (TO STUART HWY.)	42.18km
GRAVEL ROAD	35.170km

PRELIMINARY ISSUE
NOT FOR CONSTRUCTION

REV	DATE	REVISION DESCRIPTION	DRAWN	CHECKED	APPROVED
A	09.09.21	PRELIMINARY ISSUE	VA	KH	RH
B	22.09.21	PRELIMINARY ISSUE	VA	KH	RH
C	09.03.22	PRELIMINARY ISSUE	HL	KS	SN

REFERENCE DRAWINGS

SCALES
0 500 1000 2000 3000
Full Size 1:50000 ; Half Reduction 1:100000
SCALE (m)

H DATUM	V DATUM
MGA2020 ZONE 53	AHD

CLIENT
SUN CABLE AUSTRALIA-ASIA PowerLink
SUN CABLE

PROJECT NUMBER	
PROJECT NUMBER: 175-2	
DRAWN	VA 09.09.21
DESIGNED	
VERIFIED	
APPROVED	
DESIGN CERTIFICATION	
SIGNED	RPEQ No. DATE

PROJECT NAME
AAPOWERLINK
SOLAR PRECINCT PRE-FEASIBILITY CONCEPT DESIGN

TITLE
Figure 2-16. Conceptual Solar Precinct layout
Note: Modelling is at concept level only.

SHEET SIZE	DRAWING NUMBER	REVISION
A1	175-2-0200-GE-DRG-0003	C

File name P:\CLIENTS\SUN-CABLE\175-2_PRE-FEASIBILITY\175-2-100_PM\03_CAD\DRAWINGS\175-2-0200-GE-DRG-0003.DWG, printed on Wednesday, 9 March 2022 11:46:26 AM, by Harrison Langbecker

2.4.3.1 Electrical infrastructure

The electrical infrastructure installed at the site will comprise a range of generation, conversion, transmission, and energy storage equipment. The sections below summarise the key components.

Generation and Storage Equipment

The Solar Precinct will have a capacity of up to 20 GW and up to 40 GWh of storage to manage transmission between the solar fields and the VSC. Solar panels are designed to absorb light and convert the photons into electrons. They are designed to minimise reflection and heat in order to increase electrical production. This technology is the same that is used for residential solar production.

The conceptual generation and storage design involves modular arrangement of components which are:

- **Solar Arrays** will be made up of PV modules mounted on a Maverick (MAV) structure or tracker rows connected to inverters. Each array will produce power at low voltage in the range of 1500 V.
- **Solar Zones** will aggregate the arrays into blocks of approximately 23 to 28 MW DC peak capacity tied into approximately 60 MWh of energy storage, connected to a step-up transformer.
- **Solar Fields** will aggregate Zones collecting into high voltage AC collector circuits, each field having a peak capacity of approximately 400 to 560 MW DC and 1.2 GWh of storage.

The design is arranged in a fixed east-west facing array. An example of a prefabricated Maverick Solar Array is shown in Figure 2-17 and conceptual arrangement is shown in Figure 2-18.

The PV modules produce direct current (DC) power, which is converted to alternating current (AC) through inverters.

Figure 2-17. Example of a pre-fabricated (Maverick units) solar array, Port Bonython, SA (Source: 5B, 2020).

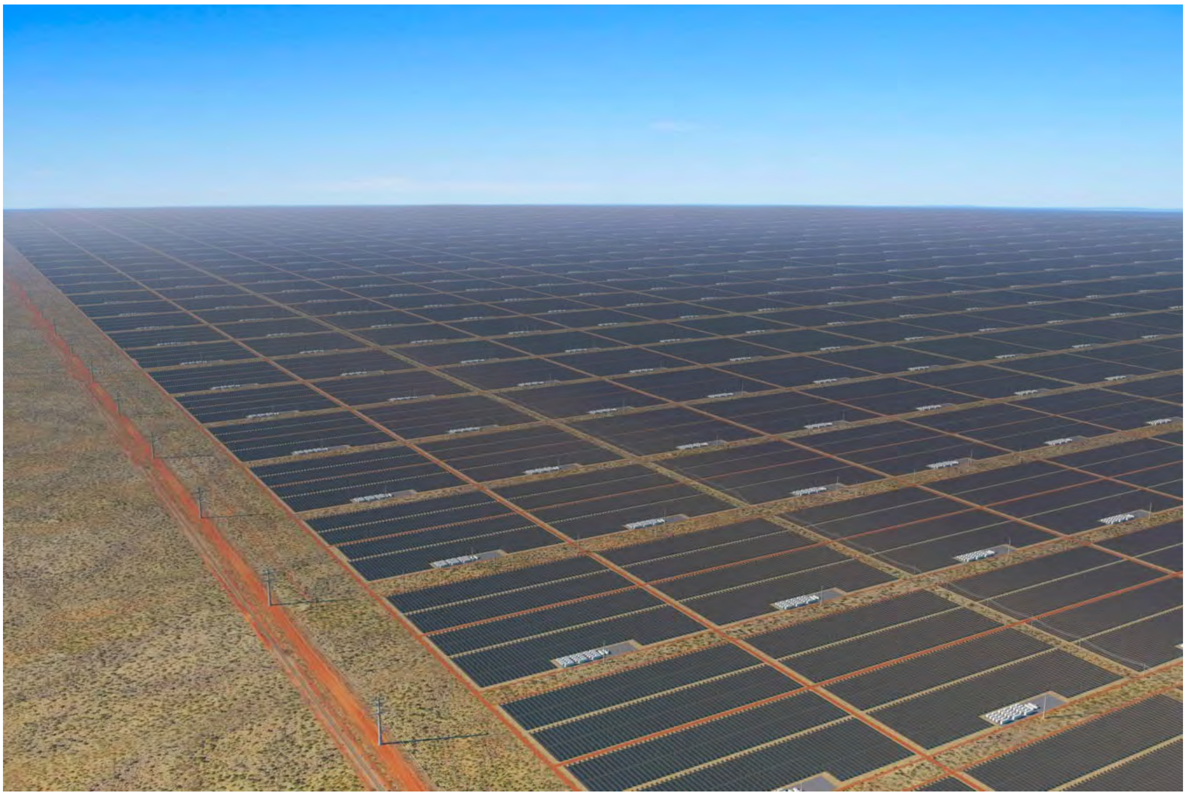


Figure 2-18. Conceptual render of large field solar array at Power Creek Solar Precinct.

Battery Energy Storage Systems

Battery Energy Storage Systems (BESS) will be incorporated into the Solar Precinct to regulate electricity discharge from the site. The total size of the BESS will be approximately 40 GWh. The technology adopted may include steady state battery or flow battery. The selection of technology for the BESS will be based on technology risk assessment, cost, and efficiency of the system. The three main functions of a BESS are summarised below.

Energy shifting

The BESS will store excess solar power generated during high irradiance periods (day) and release it during periods of low irradiance (night or cloudy days). The Solar Precinct will be specifically designed to generate more than the required load during high irradiance periods to ensure that the transmission of electricity is constant to sufficiently service the load.

Energy Backup

Energy backup is similar to energy shifting in that the batteries will store excess power for dispatch if and when required. The main difference with an energy backup function is that it will only be called upon in the event of a system fault preventing the transmission of the required load. Energy backup provision is typically placed close to loads to streamline transmission.

Grid stability

Another important application of a BESS is to provide grid stability which balances the demands of loads and generators. For example, if a major load in a grid faulted then it would create a scenario where excess power is not used and unless an adequate absorption system is in place, widespread grid disturbance would result. Conversely, if a major generator faults, then a lack of power to service the load can have the same effect. A

BESS offers the ability to absorb and generate power to ensure grid stability is retained and the likelihood of faults is lessened.

Internal Electrical Reticulation

The Solar Fields will be connected by a range of underground and overhead internal electrical reticulation operating at voltages between 33 kV and 275 kV. The internal reticulation network will connect the Solar Fields to the VSC and central battery.

Voltage Source Converter

The Solar Precinct will include up to two Voltage Source Converters (VSC). The VSC will convert the AC power, sourced from the solar array and batteries, into DC for transmission to the Darwin Converter Site. The VSC infrastructure is comprised of an AC switchyard, capacitors and filters, internal valve hall, converter transformers (including oil/water separation unit), DC switchyard, earthing mat, drainage, lightning protection and ancillary infrastructure. Each VSC footprint is approximately 200 m x 200 m with the valve hall representing the tallest structure at approximately 25 m in height. A representation of a comparable VSC and an example of VSC site layout is shown in Figure 2-19 and Figure 2-20.

A central battery will be co-located with the VSC to regulate power input to the VSC and provide frequency control and fault protection services. The VSC will be located at the perimeter of the Solar Precinct to enable transmission of the power from the site via the HVDC OHTL. Electricity will be evacuated from the AC switchyard at 275 kV into the VSC and stepped up to the transmission voltage of 525 – 600 kV for transmission to Darwin via the OHTL.

Figure 2-19. An indicative layout of a single VSC (Source: Siemens)

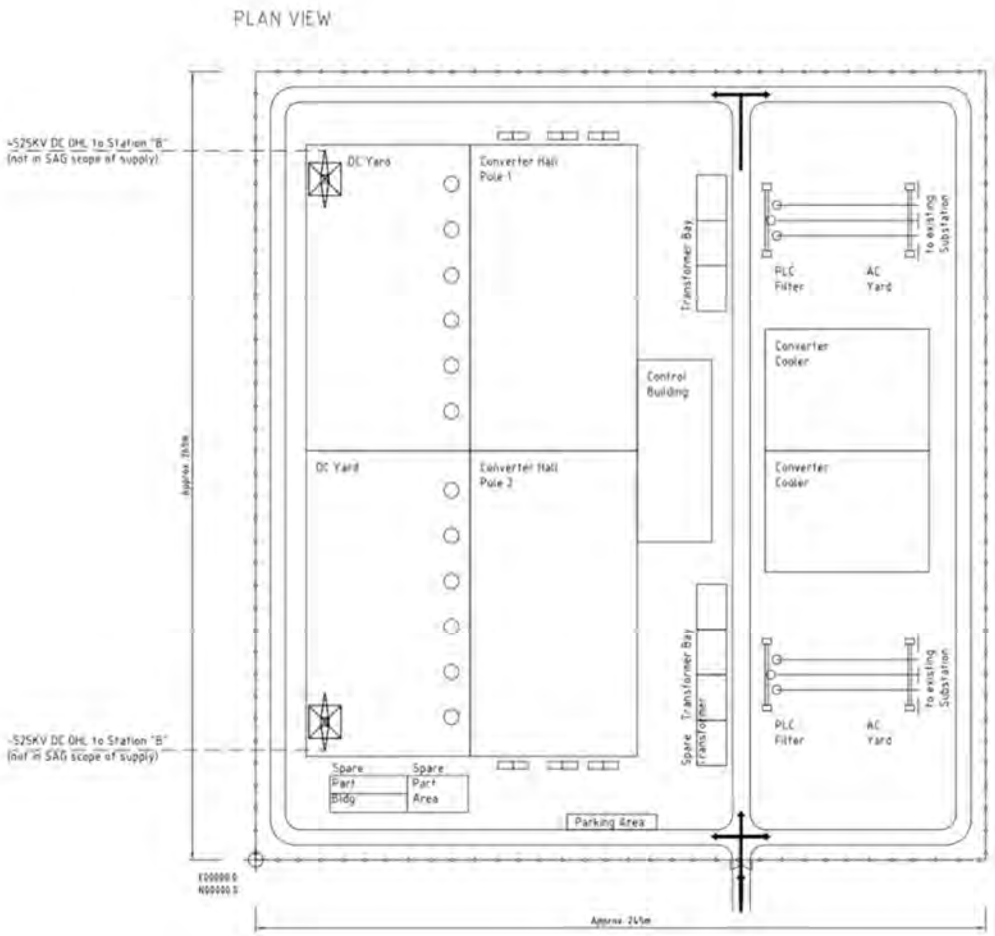


Figure 2-20. Example of Voltage Source Converter site layout

2.4.3.2 Access and transport infrastructure

Access to the site for delivery of equipment, materials and personnel will be via a combination of road, rail, and air. This section outlines the elements which will be installed as a part of the project. It also describes the use of these elements through the different stages of the project.

Roads

Two separate access roads will be constructed from the Stuart Highway and will provide all-weather access to the Solar Precinct site. The proposed routes are shown on Figure 2-15.

The first road is an unsealed gravel access road approximately 30 km long established to provide access for early site investigation activities and construction activities. This access route has been selected to avoid major drainage lines by following higher ground. The route will be retained into operations as a secondary access for use if and when required.

A second all-weather bitumen access road approximately 42 km long, approximately 12 km of which is within the Solar Precinct footprint, will be constructed as the primary access road during operations.

Additional small internal unsealed access roads ranging from 5 m to 8 m in width will be established within the disturbance footprint to provide access within site.

There will be a requirement to move a considerable quantity of materials and equipment via road. Most of the road freight will be via the Stuart Highway utilising Double and Triple Road Trains. Out-of-Gauge and Over-dimensional freight will be transported via Heavy Haulage under the NT Government permitted system for over-dimensional / oversize freight.

It is estimated that approximately 3,000 to 5,000 full-trailer loads will be transported by road to Powell Creek in Double and Triple Road Train configurations, consisting of general cargo and skid-mounted equipment not suitable to be transported via rail. An estimated 1,600 extendable trailer loads, transporting overhead power poles for the on-site transmission infrastructure at Powell Creek, will be transported to site.

Approximately 150 Out-of-Gauge and Over-dimensional road movements will be required in support of the construction phase, ranging in size, and consisting of:

- Heavy Plant & Construction equipment, including:
  - Graders, Scrapers, Bulldozers, Excavators, Loaders, Rollers and Articulated Dump Trucks
  - Drill Rigs, Piling Rigs and Trenching Equipment
  - Mobile Cranes and Forklifts up to 100 Tonne
  - 150 Tonne Transformers: Qty x 36
- 300 Tonne Transformers: Qty x 6
- Switch rooms, Metering Skids and Electrical Management Equipment

Loads may be transported from either Darwin or Adelaide, depending on the intended international shipping route, the relevant Port capacity, and the suitable road transport envelope for each route.

A Transport Route Survey will be undertaken to identify road and bridge limits along the route and identify any constraints to the movement of over-dimensional loads. The result of this study will identify the maximum Transport Envelope for Out-of-Gauge equipment and the recommended route to use.

To manage the trans-shipment of freight between rail and road at Powell Creek, a dedicated Intermodal Logistics Terminal will be constructed at the Powell Creek Solar Precinct to act as a centralised point for the consolidation and management of all inbound and outbound freight, materials, and equipment.

Sea

It is estimated that up to 5,000 Containers per month will be imported through Darwin Port throughout the construction phase. It is intended to use dedicated shipping charter vessels for freight, scheduled on a fortnightly basis into Darwin Port. Containers and Project Cargo will be cleared from the Port via road transport to the Pre-assembly and distribution centre, which is co-located with the logistics facility at East Arm, or direct to the works areas via rail or road transport.

Rail

Rail transport has been identified as the primary delivery method for infrastructure and materials during the life of the proposal. A network of rail infrastructure including a passing lane within the rail corridor is envisaged for locomotive trains to access the site with minimal obstructions to the existing main line.

The Intermodal Logistics Facility will include a dedicated rail logistics yard including several parallel rail sidings which are approximately 2.5 km in length. Multiple temporary offloading locations are being considered within the Solar Precinct. The sidings will be used to offload materials and equipment to site during construction and retained for operational purposes throughout the life of the project. Provisional rail siding locations are shown in Figure 2-16.

It is estimated that up to 150,000 Twenty Foot Equivalent (TEU) Container units will be transported to Powell Creek via rail transport over the construction phase. This is equivalent to 75,000 Road Transport Trailers being taken off the road.

It is expected that approximately 1,100 train movements, the equivalent of 5 – 6 trains per week, will operate in support of the construction phase. Most of the rail freight will originate from Darwin utilising a combination of trains dedicated to the project and utilising available space on the daily freight service operating between Darwin to Adelaide, hence the need to construct two parallel rail sidings at Powell Creek to accommodate and facilitate the safe movement of two trains concurrently. Some rail freight may originate from Adelaide as required.

Materials and Equipment planned to be transported via Rail Transport include approximately:

- 55,000 Containers (TEU) of solar panels
- 9,000 Containers (40') of Batteries and Power Storage Equipment
- 300 Flat Racks (40') of Cable Drums
- 20' Tank-tainers of bulk dry and liquid materials such as cement
- Additional 20' and 40' Flat Racks and Skids holding construction materials and electrical equipment.

Air

It is planned to construct an all-weather sealed airstrip, and associated terminal, at Powell Creek. This will be used during construction and operations, as well as for use by emergency services. The layout of the runway will meet the minimum requirements for a Code 4C aerodrome facility. A taxiway and aircraft parking apron will be linked to the runway, together with a passenger terminal, car parking facility and perimeter security fence.

The airstrip will also be made available for use where possible. The proposed airstrip location is shown in Figure 2-16, noting that the final location will be subject to agreement with the Civil Aviation Safety Authority, pastoralists, and other relevant parties. It will be accessed via the perimeter gravel road. The terminal will be likely to include:

- Combined check-in, baggage handling and storage zone
- Passenger seating area
- Utilities, reticulated from an external water tank
- Secure storage areas for pilot-activated airstrip and windsock, fuel storage and firefighting.

It is expected the airport will be serviced by a dash 8 (turbo prop) or fokker 100 (f100) with daily flights operating in and out of Powell Creek during the construction period, with a decrease in flights during operations.

A helicopter landing area (helipad) will be established in proximity to a first aid facility to support emergency evacuations of personnel. The helipad is proposed to be located on the eastern side of the main access road to the airstrip.

2.4.3.3 Services

Power will be supplied by connection to the onsite solar generation and batteries during operations, with some requirement for temporary diesel power generation during construction.

Water supply to the Solar precinct and the associated infrastructure is planned to be sourced from the local groundwater supply. Groundwater bores will be installed by a licenced installer in accordance with a bore permit and an extraction licence will be obtained in accordance with NT Legislation. Water will be required during construction for dust suppression, wash down, concrete batching and to service the construction camps. At this time, the concept level forecast for construction water demand is up to 1500 ML per annum. Detailed engineering and construction planning will allow for refinement of this volume and potential areas where water efficiency measures can be installed.

Options for water supply are currently being assessed, and finalisation of the sourcing of this supply will be reliant on the completion of a detailed water balance, which will be used to confirm this volume, and the associated supply.

2.4.3.4 Dangerous goods and hazardous chemicals storages

This project does not require large volumes of chemicals to be stored for electricity generation. Hazardous chemicals storage areas will be established for storage of minor quantities of fuels, oils/lubricants, chlorine for water treatment, glycol, cleaning chemicals, herbicides and pesticides where required.

The VSC transformers at the Solar Precinct will house synthetic ester. Insulating oils used in the electrical infrastructure will be biodegradable varieties. Across the site, there will be approximately 40 large transformers and 35 small transformers which contain this oil in sealed sections.

Bulk storage tanks will be installed at the airstrip for storage of aviation fuel. There is limited requirement for bulk storage of dangerous goods or hazardous chemicals during operations, because power requirements will be supplied by the solar array and battery system. Further investigation into the potential to use electric vehicles for the site fleet will be undertaken, with the potential for recharging facilities to be powered by on site solar generation.

During construction, temporary self-bunded fuel storages will be established for diesel, unleaded petrol (ULP), aviation turbine fuel (AVTUR) and oils & lubricants.

2.4.3.5 Landfill

A landfill may be established for disposal of putrescible wastes from the accommodation camp and inert solid wastes that cannot be reused or recycled. The location, design and management of the onsite landfill will consider environment and cultural constraints of the area. The facility will comply with the *Guidelines for Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory 2003.* All other waste will be transferred to a licensed facility in accordance with the applicable regulations. This option is subject to further studies and may not be required.

2.4.3.6 Other ancillary facilities

The Solar Precinct will contain a range of other ancillary infrastructure, including:

- Operation and maintenance buildings
- Internal access roads and drainage infrastructure
- Weather stations, sky camera monitoring and forecasting equipment
- Security system, fencing, signage, lighting and cleared firebreaks
- Microwave communications tower
- Underground or overhead fibre optic cable network
- Satellite communications
- Secure compounds set aside for future small-scale energy usage applications
- Hardstands, laydowns, warehousing, and storage areas.

2.4.4 Construction

The Solar Precinct is planned to be constructed and commissioned over a period of approximately 2.5 years commencing in early 2024. Workforce and scheduling for construction is discussed in Section 2.10.

2.4.4.1 Construction Accommodation

A pioneer camp of appropriate size will be established at the Powell Creek Solar Precinct to support the mobilisation of personnel to complete early works and enabling activities. This will include the workforce required to construct a full construction accommodation facility. At this stage of Project definition, it is anticipated that this facility will require approximately 200 to 250 beds.

It is expected that a construction accommodation facility in the range of 1,100 beds will be required during peak construction periods. Actual requirement will be determined following a review of field direct, field indirect, field non-manual and support services personnel requirements.

The accommodation facility will be constructed using portable / demountable modular buildings and will be decommissioned and removed at the conclusion of implementation activities. Accommodation capacity shall be developed in stages so that room availability is established incrementally in line with construction stage workforce requirements.

Onsite accommodation will be established at the Solar Precinct with the following facilities to be included:

- Dining Hall
- Administration building and drop off zones
- Modular accommodation units including a dining hall, and recreation hall
- An onsite wastewater management system designed in compliance with the *NT Code of Practice for Wastewater Management, November 2020*.

2.4.4.2 Site establishment

Site establishment works will be undertaken concurrently and will involve the following key activities and stages:

- Pioneering works and access road construction for site investigations

- Temporary site demarcation and security established
- Water supply, water treatment and power supply established
- Rail sidings established and rail works completed
- Borrow pits and gravel supplies developed
- Airstrip and aerodrome (including helipad) facilities established
- Temporary site camps and support facilities installed
- Site drainage installed.

2.4.4.3 Land clearing

Clearing of vegetation across the large Solar Precinct footprint will occur in a progressive manner to establish the work area required for each stage of site establishment. Methods and procedures that will be adopted for vegetation clearing in line with best practices. Cleared vegetation may be mulched for use in landscaping, and erosion and sediment control.

2.4.4.4 Equipment and machinery

The equipment and machinery required to construct the Solar Precinct is typical of that used in large-scale land development and construction activities. The following activities are indicative of the preparatory works which may be undertaken as a part of construction, including the types of equipment that would be used for these activities:

- Clear and grab – Slashers, dozers, watercarts
- Bulk earthworks – Graders, scrapers, compactors, excavator/loaders, haul, and tipper trucks
- Roads and paving – Graders, rollers, bitumen sprayers
- Concrete structures – Agitator trucks, pump trucks, cranes
- Trenching – Trencher, excavators, graders, compactors
- Equipment installation – Cranes, telehandlers
- Borrow Pits – Excavator/loaders, mobile crusher, and mobile screening plant
- Concrete batching plant
- Personnel transport – Light vehicles
- Dust suppression – Water carts

At peak construction when multiple activities are happening concurrently, there will be hundreds of civil plant, equipment and vehicles operating across the broader 12,100 ha Solar Precinct footprint.

2.4.4.5 Construction materials

To facilitate the construction of this project, materials will need to be sourced from various locations. At this time the following materials will be required:

- Various borrow material for micro piling and fill
- Concrete
- Gravel

- Aggregate
- Concrete and cement

Borrow materials required for construction of the Solar Precinct are planned to be extracted from borrow pits to be developed on the Ashburton Range within the southern parts of Powell Creek Station. This area has been previously disturbed for borrow materials for road construction and existing pits shows evidence of suitable borrow materials for road and hardstand construction (see Figure 2-15).

These borrow pit operations would be completed using earthmoving equipment only, and the exact siting of these locations has not been finalised. Factors which will be considered in the siting analysis will include:

- Sufficient material for construction use,
- Consideration of environmental and cultural constraints such as cultural and sacred sites, waterways, sensitive environmental receptors including threatened species and land use conditions
- Landform stability and disturbance
- Management of operations
- Distance to works
- Rehabilitation and closure requirements

It is envisaged that each borrow pit will provide approximately 1.5 million cubic metres of crushed rock material to use in construction.

Alternate gravel and aggregate supply may be sourced from local licenced quarries near to the Solar Precinct under commercial arrangements. Concrete batching plant/s will be established on site to supply the concrete requirements of the Solar Precinct construction.

2.4.4.6 Installation of electrical infrastructure

Deployment of the solar modules and electrical reticulation will occur in stages, with Zones being deployed, connected, and commissioned sequentially. The prefabricated solar and battery units will be unloaded at the rail siding/s and stored in stockpiles near the siding to facilitate deployment logistics. The systems will be delivered to Solar Zones using haul trucks and deployed throughout each Zone using telehandlers to form a Solar Field. In the event that MAVs are installed, each array will be laid and anchored to the pre-established foundation piles/blocks as shown in Figure 2-21 using a small team of 2-3 personnel.

Construction of other electrical infrastructure such as the transformer, cable gantries and walkways will run in parallel. Temporary concrete batching plants may be established to supply the materials required to construct concrete foundations for these facilities. Materials and components will be assembled and connected by work teams progressing on multiple zones in parallel. Underground and overhead cabling will be installed to progressively connect the arrays, zones, and fields within the Solar Precinct to the central battery and VSC.

Depending on the type of solar panels selected for the project, the solar arrays may be installed on micro piles, driven up to 3 m into the ground, to account for uplift effects, or use short piles as anchors.

Figure 2-21. Deployment of a pre-fabricated MAV solar unit (Source: 5B, 2020)

The modules are arranged in a 5 x 24 sheet which folds for transport into a regular 20 ft shipping container. The PV modules are mounted to hinges and beams in the factory with inter-module wiring completed prior to shipping. The Maverick Solar Arrays are proposed to be prefabricated in Darwin at Sun Cable's Solar Array Assembly Facility, before being transported to site via rail. The Solar Arrays can be rapidly deployed on site using a telehandler forklift (see Section 2.4.4).

Other solar technologies are also being investigated and the final design may include a combination of Maverick Solar Arrays and Single Access Trackers (SATs) to allow optimal solar output.

Additional areas of land disturbed during construction but not required during operations, will be reinstated to stabilise the soils and native vegetation will be encouraged to regenerate.

2.4.5 Operation

At the Solar Precinct the electrical infrastructure will require constant monitoring and maintenance to maintain system performance. The solar arrays may require infrequent cleaning using air pressure from ground mounted booms or aerial pressure cleaning and monitoring; however, testing at Powell Creek Station has indicated that cleaning may not be required.

Vegetation management will be an ongoing operations activity within the Solar Precinct to prevent shading of the panels and/or fire risk. Trials are underway at the Solar Precinct to determine the best vegetation management regime for the site.

The components may need to be replaced or repowered with the solar panels having an optimal design life of approximately 40 years and the batteries approximately 15 years. These replacement campaigns will require a temporary increase in the operational workforce, which may require some use of commercial accommodation.

While electrical componentry that will be replaced during this campaign may no longer be suitable to sustain a utility scale commercial export operation, the solar arrays are anticipated to be fit for re-purposing in a range of scenarios including small scale and domestic applications. Recycling of componentry, particularly solar arrays, is also expected to develop throughout the project life and present opportunities to re-purpose materials that are currently difficult to dispose of and/or recycle. A detailed strategy will be developed prior to the first replacement campaign.

The forecast operational water demand at the Solar Precinct is approximately 10 ML per annum. This calculation will be refined during detailed design. Operational water requirements will generally be limited to maintenance of the solar panels (i.e., cleaning if required), road maintenance and dust suppression. Potable water will be required for personnel camp operations (drinking water, cooking, showers, and toilets), and supply to the operations and maintenance facility. Water for fire-fighting purposes will be stored in tanks at the Solar Precinct, in line with the requirements under the *Bushfire Management Act* (NT).

Other operational activities that will occur at all sites will include road maintenance, maintaining site security and access, site drainage, erosion and sediment controls, land management and bushfire prevention.

2.5 Overhead Transmission Line

A new High Voltage Direct Current (HVDC) Overhead Transmission Line (OHTL) will be constructed over 788 km to transmit electricity from the Solar Precinct to the Darwin Converter Site. The OHTL will have a rated capacity of approximately 6.4 GW operating at a voltage of 525 – 600 kV, subject to detailed engineering. A fibre optic cable may also be laid within the easement for communications and monitoring purposes.

2.5.1 Location and footprint

The proposed OHTL route is shown on Figure 2-2 above. The route is predominantly located within the existing Railway Corridor over the first 722 km from the Solar Precinct north to Livingstone. The OHTL will maintain separation distance from the railway according to specifications agreed with the Railway Operator and in accordance with Australian Standards. The OHTL may divert to/from the Rail Corridor in sections in response to local conditions, community concerns and technical constraints, which are uncovered through the detailed design phase. Potential areas and route options where deviations are expected are described in Section 2.5.2.1.

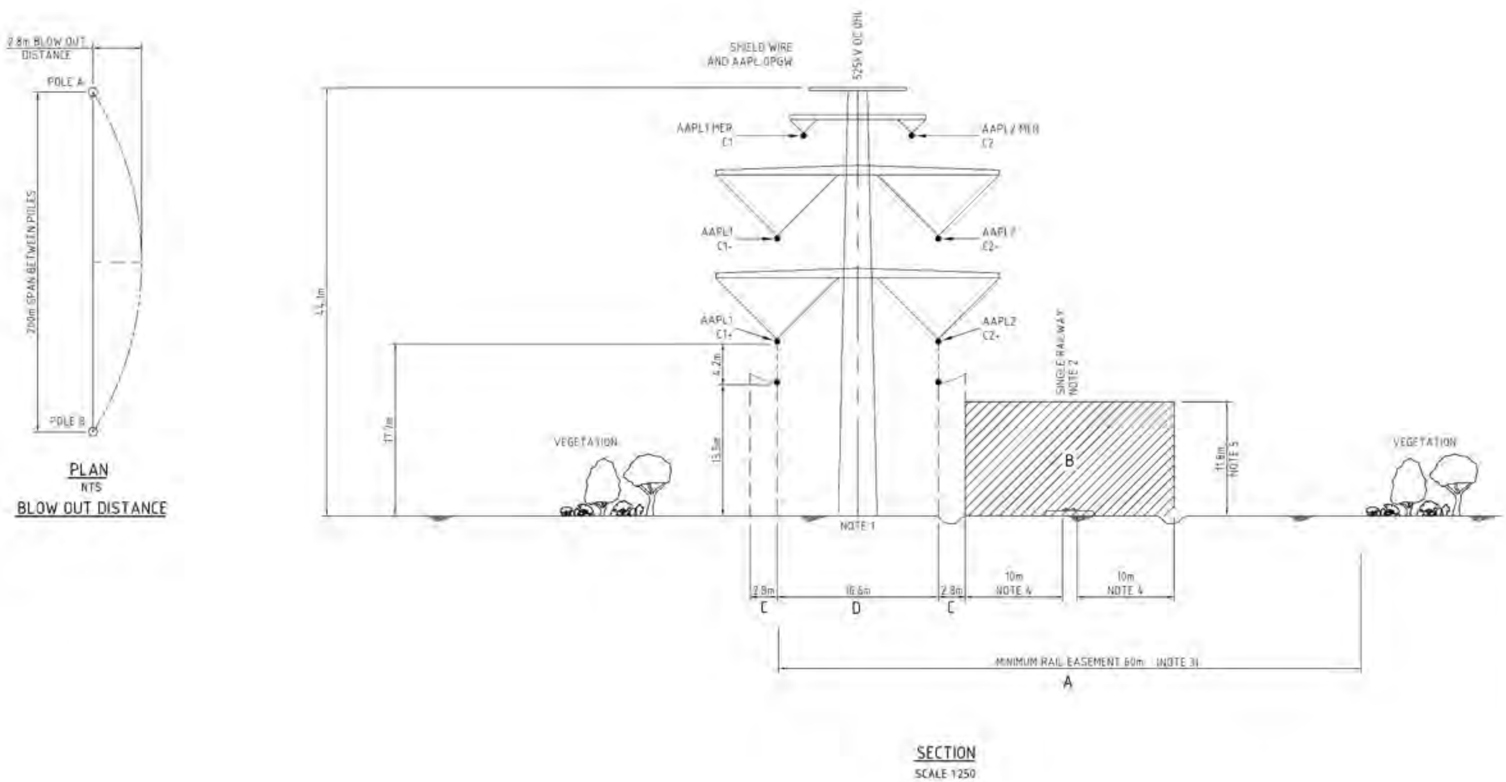
The OHTL exits the Railway Corridor at Livingstone, heads east across the Stuart Highway and north-east towards the Arnhem Highway, before heading north to intersect Gunn Point Road. The section of the OHTL from Livingstone to Gunn Point Road is approximately 66 km and follows a NTG designated future Utilities Corridor that traverses the eastern outskirts of Darwin's rural area. The final 19 km of the OHTL corridor from the intersect of Gunn Point Road to the Darwin Converter Site at Murrumujuk runs parallel immediately west of the Gunn Point Road corridor.

The proposed construction disturbance width of the OHTL is up to 22 m. The easement width is required to accommodate the infrastructure and conductor line sway distance[3]. Line sway is dependent on three key aspects: span length (distance between poles), cable tension (which determines the depth of sag), and local wind conditions (which dictate the lateral line sway distance of conductors). The built infrastructure will occupy only part of this easement, allowing for micro-siting of poles and foundations and design flexibility to avoid local features and infrastructure (i.e., roads, railway, fibre optic cables and utilities).

[3] Conductor line sway distance is the distance that each conductor moves when wind acts to move it to one side.

The proposed OHTL corridor width will be cleared up to 22 m wide depending on the height of vegetation and potential for interference with the conductors.

The corridor will house the OHTL pole foundations but will be re-instated with only a 6 m wide permanently cleared area retained for an access track to aid inspection and maintenance activities through the life of the asset. A concept design is presented in Figure 2 showing the minimum width of the conductors for pole spans of 200 m using a fibre reinforced conductor at high tension.



HVDC CONSTRUCTION (CONCEPT ONLY)	
CIRCUIT	DESCRIPTION
AAPL1 (SINGAPORE) C1	CIRCUIT DESIGN LOAD 3200 MW CONDUCTOR 4 x ACRF - 665 - 71 - FA - TTT 1996A@180°C PER CONDUCTOR
AAPL2 C2	CIRCUIT DESIGN LOAD 3200 MW CONDUCTOR 4 x ACRF - 665 - 71 - FA -TTT 1996A@180°C PER CONDUCTOR

CLEARANCES	
A	MINIMUM EXISTING RAIL EASEMENT
B	MINIMUM CLEARANCE FOR NON-RAIL INFRASTRUCTURE
C	BLOWOUT DISTANCE
D	POLE CONDUCTOR WIDTH

NOTES

1. CONCEPT DRAWING ONLY, LAYOUT OF INFRASTRUCTURE AND SEPARATION DISTANCES ARE INDICATIVE ONLY AND SUBJECT TO CHANGE DURING DETAILED DESIGN. THIS CASE ASSUMES POLE SPAN OF 200m. REFER AAPL-ETD-TRM-ELC-SKE-0007 FOR DETAILS.
2. ASSUMES STANDARD GAUGE SINGLE TRACK.
3. WORST CASE EXISTING RAIL EASEMENT WIDTH OF 60 m USED FOR THIS CONCEPT.
4. SEPARATION REQUIREMENTS AS PER AS 4799 SECTION 3.2.3.2 ACTUAL SEPARATION DISTANCE SUBJECT TO RAIL AND PIPELINE OWNER REQUIREMENTS.
5. CLEARANCE TO RAILWAYS - VERTICAL CLEARANCE ABOVE NON-ENERGIZED RAILS = 11.8m FROM NSW RAIL T-HREL-10005ST
6. ALL CLEARANCES BASED ON 600kV DC.

CONCEPT DESIGN ONLY

NOT FOR CONSTRUCTION

ISSUED FOR REVIEW

0 5 10 15 20 25
SCALE 1:250 METRES

SUN CABLE

No	DATE	DRN	CHK	ENG	Q.A	PROJECT	DESCRIPTION	NUMBER	TITLE
B	21/07/21	GPA	ER	BB	RHL	210444	RE-ISSUED FOR CONCEPT REVIEW	210444-SK-002	PREVIOUS REVISION
A	07/07/21	GPA	ER	BB	RHL	210444	ISSUED FOR CONCEPT REVIEW	AAPL-ETD-TRM-ELC-MEM-0001	TECHNICAL MEMORANDUM
REVISION								REFERENCE DRAWINGS	

Figure 2-22. Overhead Transmission Line concept design

DATE: 23/04/21 | DRN: GPA | CHK: SLH | ENG: BB | Q.A: RHL | SCALE: 1:250

PROJ No 210444 | DRG No AAPL-ETD-TRM-ELC-SKE-0006 | REV B

AUTOCAD A1SHEET

2.5.2 Site selection and design

The Railway Corridor has been identified as the preferred location for the majority of the OHTL route. This route was selected because it provides an existing negotiated corridor with a nominal width of 200 m, held by the Railway Operator. The Railway Corridor provides an existing developed corridor with reasonable access, minimising the amount of clearing required for the OHTL.

From a logistics' perspective, the railway is proposed to serve as the primary material delivery mode for construction equipment and materials, including the solar arrays and battery units. The easement also has existing road access points connecting to the Stuart Highway from lateral roads such as the Victoria Highway and Buchanan Highway as well as multiple smaller roads. Sun Cable are progressing route surveys, stakeholder engagement and technical assessments, to model the construction staging of the OHTL within the Railway Corridor. This will allow for further clarification in areas where a deviation outside the Corridor is required.

The OHTL infrastructure design in the coastal wind zone (where cyclones occur) incorporates deeper pole foundations and a wider easement that allows for sideways movement of the conductors (powerlines) caused by the wind.

2.5.2.1 Route options

Work undertaken to date has determined that deviations from the Railway Corridor may be required to address route obstacles and constraints at the following locations:

- Katherine – The Railway Corridor passes to the west of Katherine by around 3 km and approximately 8 to 10 km west of the Tindall RAAF base. There are a number of OHTL route obstacles from south to north, including the Victoria Highway and Stuart Highway overpasses, existing Darwin-Katherine powerline, and the Katherine River crossing.
- Pine Creek – The railway corridor and the existing Darwin-Katherine powerline pass east of the Stuart Highway and bypass the town. Either the railway corridor or powerline corridor could be used through this area. There is an old racecourse and caravan park and golf course, which may present a constraint to the route.
- Adelaide River – The railway corridor passes through the centre of town in a narrow alignment adjacent to Stuart Highway, where multiple services are in a narrow strip between the highway and railway including telecommunications, power, water, and drainage. Adelaide River Channel, south of the town, presents a crossing obstacle, where trenching may not be suitable.

Alternate route alignments are under investigation and potential deviations are being explored. If required, alternate route alignments will be selected through a consideration of technical (e.g., constructability, cost), environmental, and social factors, and informed from consultation with relevant stakeholders.

A micro-siting process will be implemented to ensure that the hierarchy for environmental decision making is applied in the final route selection, with the aim to avoid and minimise associated impacts.

2.5.2.2 Design options

The OHTL will be constructed using two types of structures for the transmission structures. A preliminary concept design study for the OHTL was prepared comparing configurations for two design options:

- Option 1 – Steel Monopole (Bi-pole with two sets of 2 x 525 kV high voltage DC and 1 x metallic earth return conductors)
- Option 2 - Double Symmetric Monopole (2 x pairs of 525 kV high voltage DC conductors).

For each design option, the study identified different configurations of structure types (i.e., towers and poles), structure locations, foundations, and conductors as a basis for assessing the feasibility and cost of construction. For each configuration, the assessment determined whether the OHTL, including conductor line sway, can be accommodated within the Railway Corridor and the Utilities Corridor.

Further work has subsequently been undertaken to develop a preliminary design of the OHTL based on updated specifications for the pole structures and conductors, described further below.

Through this options analysis, the use of pole structures, instead of towers, will be installed for much of the route. Lattice towers may be required where there are notable changes in direction of the line because they provide greater tensioning, but poles will be adopted for most of the route. In constrained areas, poles will be located closer together to reduce line sway distance, and fibre-reinforced cables may also be used to reduce conductor line sway and therefore easement width. Where these options are not feasible, an engineering design exercise will be employed to identify an acceptable solution.

2.5.2.3 Micro-Siting Approach

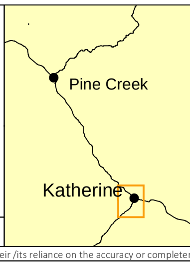
At this time, the exact location of each (transmission) pole installation, constructions camps, laydowns and electrode are under review and assessment. A micro-siting process will be implemented to ensure that the following components are placed in locations which aim to minimise associated impacts. 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 groundtruthing 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 will consider further overall studies which are underway and will require further groundtruthing prior to construction of the key elements.

Legend

- Railway
- Road
- Cadastre
- Potential areas of OHTL route deviation



Source: NTG data - Cadastre and conservation areas. Australian Government data - Ralway and roads

Figure 2-23. Katherine Area of Interest for potential OHTL route deviation

N

Project: Australia-Asia PowerLink

0 750 1,500 2,250 3,000
Meters

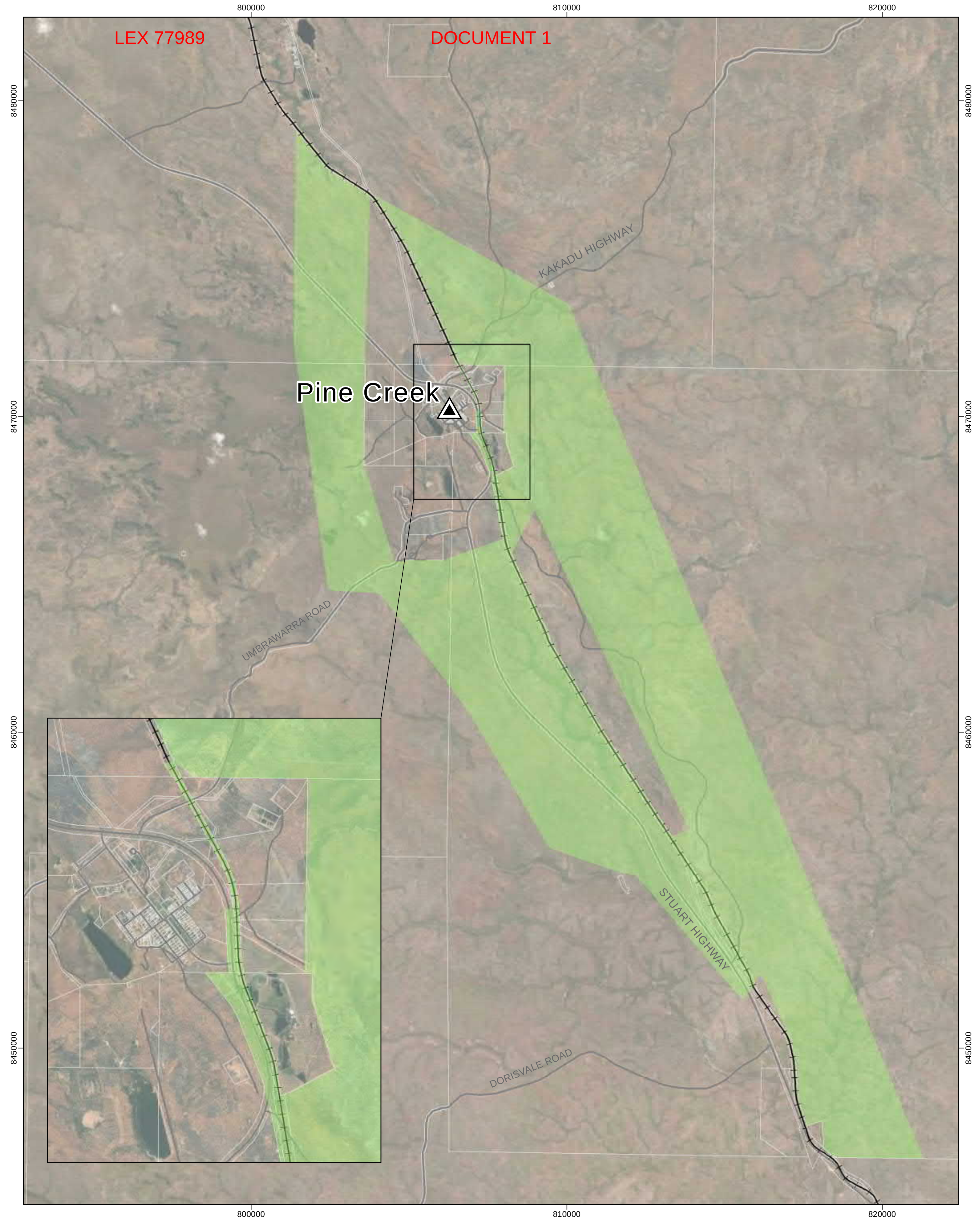
Reference #: AAPL_GNR_CTA_GEN_MAP_0071

Date: 08/03/2022 | Figure: 3 of 3 | Revision: A

Scale: 1:75,000 | Datum: GDA2020

Coordinate System: MGA 52 | A4

SUN CABLE



Legend

- Railway
- Road
- Cadastre
- Potential areas of OHTL route deviation

Figure 2-24. Pine Creek Area of Interest for potential OHTL route deviation

N

Project: Australia-Asia PowerLink

0 1 2 3 4 5
Kilometers

Scale: 1:150,000 | Datum: GDA2020

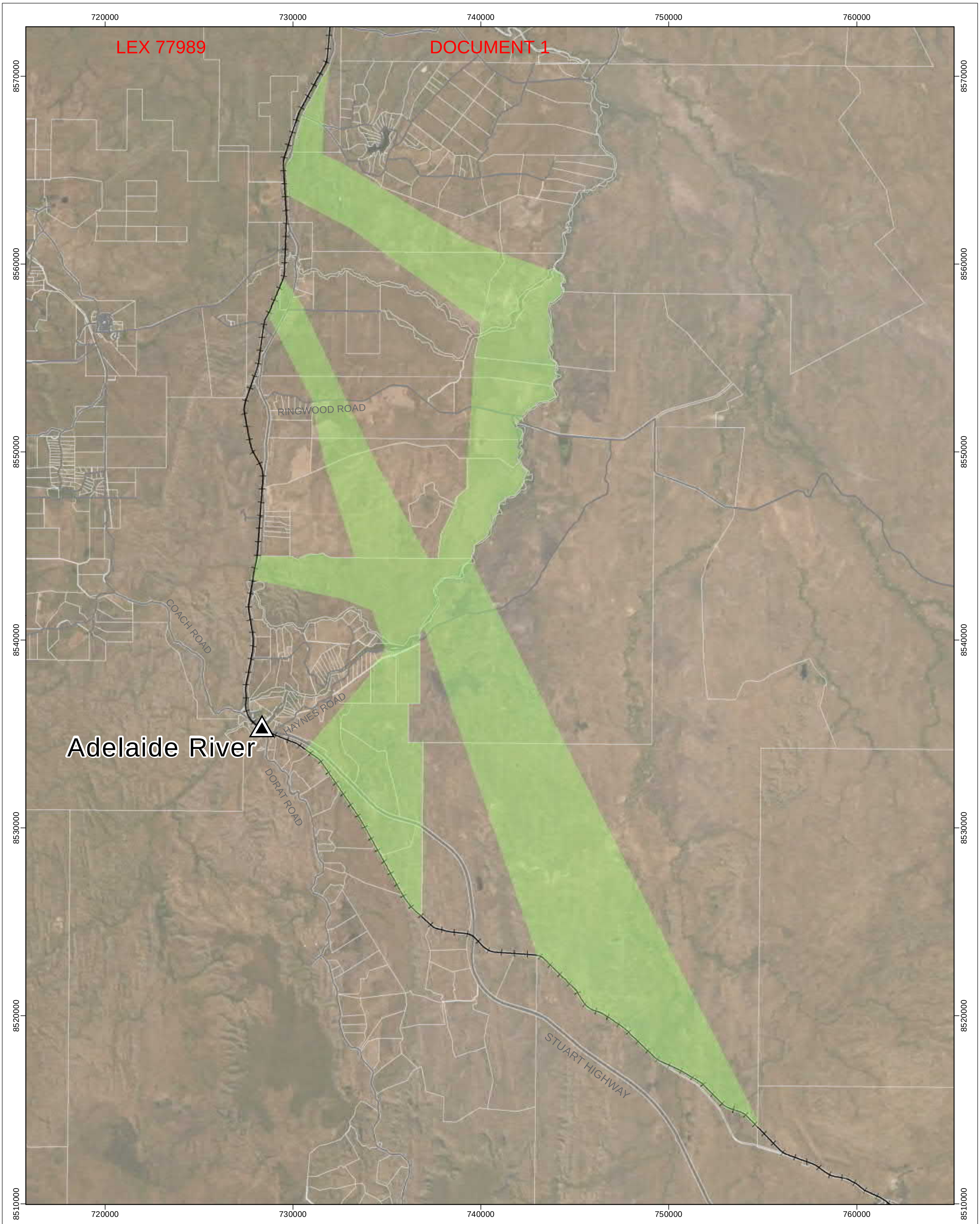
Coordinate System: MGA 52 | A4

Reference #: AAPL_GNR_CTA_GEN_MAP_0070

Date: 08/03/2022 | Figure: 2 of 3 | Revision: A

SUN CABLE

Source: NTG data - Cadastre and conservation areas. Australian Government data - Ralway and roads



Legend

- Railway
- Road
- Cadastre
- Potential areas of OHTL route deviation

Figure 2-25: Adelaide River Area of Interest for potential OHTL route deviation

N

Project: Australia-Asia PowerLink

0 2 4 6 8 10
Kilometers

Reference #: AAPL_GNR_CTA_GEN_MAP_0069

Date: 08/03/2022 | Figure: 1 of 3 | Revision: A

Scale: 1:250,000 | Datum: GDA2020

Coordinate System: MGA 52 | A4

SUN CABLE

Source: NTG data - Cadastre and conservation areas. Australian Government data - Ralway and roads

2.5.3 Key components

The key components of the OHTL services corridor are described below.

2.5.3.1 Structures

Segmented steel poles 44 m to 56 m in height will be used for most structures along the route. Steel monopoles minimise visual impact and have a more simplistic foundation arrangement to minimise construction logistics and clearing requirements. Steel lattice structures of similar dimensions may be used where tensioning is required, such as a change in direction of the OHTL. The different structures under consideration are illustrated in Figure 2-26.

Two preliminary structure designs are shown below which maintain the 13.5 m conductor ground-clearance heights. The taller structures (up to 56 m) allow for longer spans between poles (up to 450 m) and will be used along the majority of the OHTL where the route is not constrained. Shorter span poles approximately 46 m in height can be used in areas where the corridor is constrained, and line sway needs to be minimised.

The spacing will be adjusted as required to address easement and other constraints. For example, the structure spacing may be increased or decreased to avoid disturbance to watercourses or heritage sites identified during site survey activities. Approximately 2,500 structures will be installed along the route.

2.5.3.2 Conductors (powerlines)

Multiple conductors will be strung between each structure, typically in a 4-wire bundled arrangement with capacity to add additional conductors in the future. The OHTL will utilise either a MER (metallic earth return) or electrode (earth return) arrangement for each circuit. The conductor types considered are from the ACSR (aluminium conductor steel-reinforced) and AAAC (all aluminium alloy conductor) family of high-strength, high-capacity stranded high voltage transmission conductors which meet AS/NZS Standards and are available, and in-use by other high voltage transmission utilities within Australia. Different conductor types may also be selected to reduce conductor line sway distances where there are easement constraints, including fibre reinforced conductors. Conductors may be installed in a single construction campaign, or in separate stages, subject to market demand for electricity and engineering.

2.5.3.3 Services corridor

A construction disturbance of up to 22 m will be established for the majority of the OHTL. Where constrained sections of the OHTL exist such that a width of up to 22 m is not feasible, a narrower easement width and commensurate design solution will be explored. In the most constrained scenarios, a route deviation may be required as described in Section 2.5.2.1. A services corridor will incorporate the OHTL structures along with a permanently cleared 6 m wide access track to provide access for inspection and maintenance activities. The remaining width of the corridor beneath the transmission lines, will be allowed to regrow up to a height of 6 m following completion of construction. As most of the vegetation types along the route generally have tree heights less than 6 m, the requirement for ongoing pruning or removal of vegetation will be limited to specific locations along the northern section of the OHTL route.

LEX 77989 DOCUMENT 1

CONCEPT DESIGN ONLY

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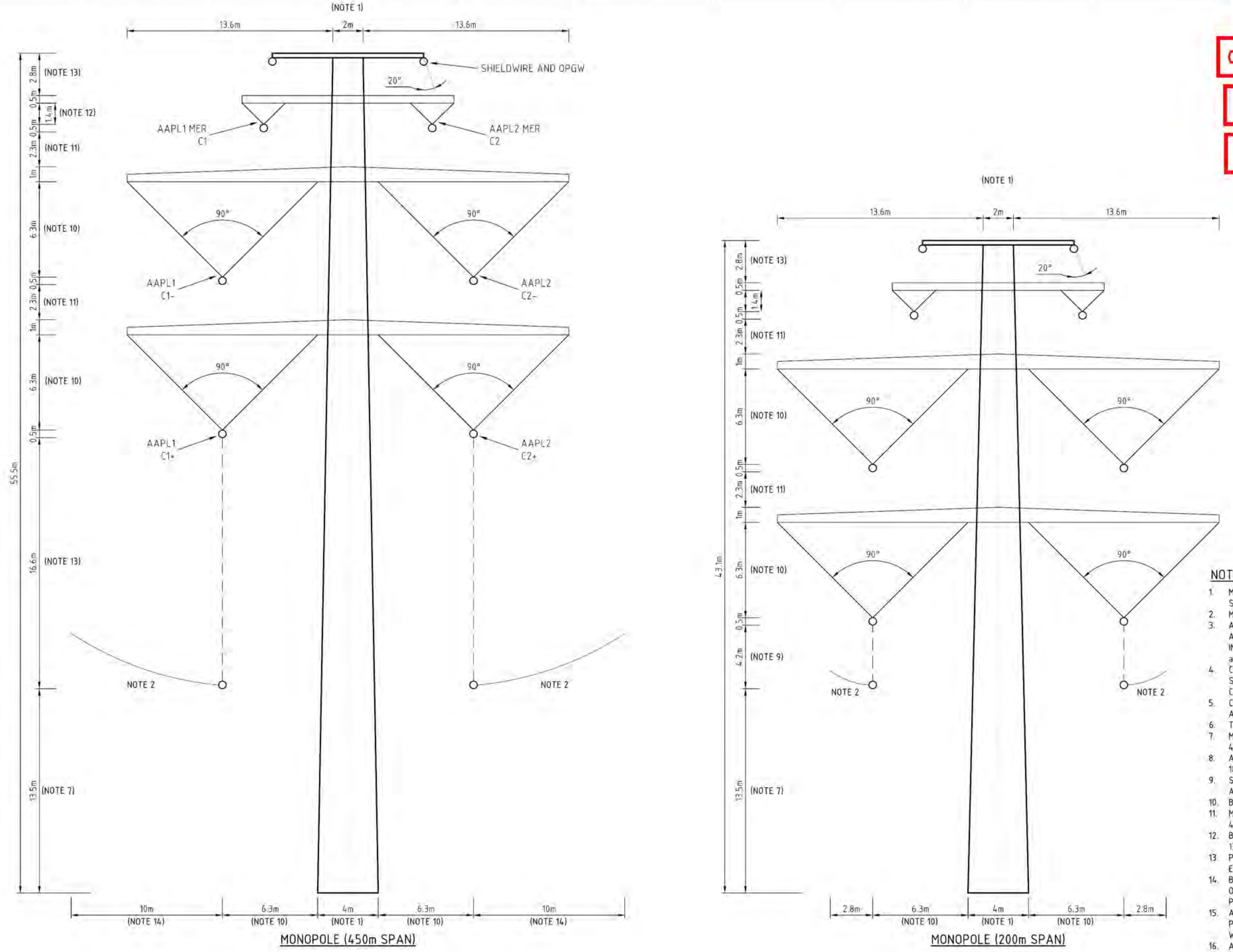
ISSUED FOR REVIEW



NOTES:

1. MONOPOLE STRUCTURE CONCEPT ONLY SUBJECT TO STRUCTURAL REVIEW AND FOOTING ACCESSMENT.
2. MID SPAN CONDUCTOR BLOWOUT ARC.
3. AAPL C1 RATED TO 3200MW FOR CONNECTION TO SINGAPORE, AAPL CIRCUIT 2 RATED TO 3200MW AS PER SUN CABLE INSTRUCTION ON 20181-R82: RE: 20181-S97: OHTL Datasheet and Pole Arrangement.
4. CONDUCTOR BUNDLE ASSUMED TO BE 3X ACFR 665 sqmm, SEPARATED 0.4mTO BE CONFIRMED BY RIV AND CORONA CALCULATIONS DURING DETAILED DESIGN.
5. CLEARANCES BASED IN CIGRE 388, REFER TO AAPL-ETD-TRM-ELC-MEM-0001.
6. THIS STRUCTURE IS FOR SUSPENSION STRUCTURES ONLY.
7. MINIMUM CLEARANCE TO GROUND AS PER CIGRE388 TABLE 4.28 FOR 600 kV DC SYSTEMS.
8. ACFR CONDUCTOR SAG OF16.6m FOR SPANS OF 450m AT 180°C.
9. SAG WILL BE 4.2m FOR ACFR 665-H-FAIT CONDUCTOR ASSUMING A POLE SPAN OF 200m AND OPERATED AT 180°C.
10. BASE ON ESTIMATE INSULATOR/LENGTH USING 45mm/kV
11. MINIMUM CLEARANCE TO CROSS ARM FROM CIGRE388 FIGURE 4.10
12. BASED ON ESTIMATED INSULATOR LENGTH EQUIVALENT TO 132k VOLTAGE FOR MER.
13. POSITION OF SHIELD WIRE TO ACHIEVE 20° ANGLE OF SHIELD ENVELOP.
14. BLOW OUT OF ACFR 665-71-FATT CONDUCTOR FOR OPERATION AT 180°C AND 500 PA WINDS IS 10m FOR A 450m POLE SPAN.
15. ACFR CONDUCTOR BLOW OUT DISTANCE IS 2.8m ASSUMING A POLE SPAN OF 200m FOR OPERATION AT 180°C AND 500 Pa WIND PRESSURE.
16. ALL CLEARANCES BASED ON 600kV DC.

SUN CABLE

No	DATE	DRN	CHK	ENG	Q.A.	PROJECT	DESCRIPTION
B	21/07/21	GPA	ER	BB	RHL	20181	RE-ISSUED FOR CONCEPT REVIEW
A	07/07/21	GPA	ER	BB	RHL	20181	ISSUED FOR CONCEPT REVIEW

REVISION

NUMBER	TITLE
20181-SK-001	PREVIOUS REVISION

REFERENCE DRAWINGS

GPA

www.gpaeng.com.au

Figure 2-26 Two preliminary OHTL pole structure designs (Source: GPA 2021)

DATE: 23/06/21 | DRN: GPA | CHK: BB | ENG: BB | Q.A: RHL | SCALE: NTS

PROJ No 20181 | DRG No AAPL-ETD-TRM-ELC-SKE-0002 | REV B

AUTOCAD A1SHEET

2.5.3.4 Electrodes

A bipole HVDC system, such as the Powell Creek–Murrumujuk HVDC link, requires a grounded electrical current return path for proper operation. This return path can be realized by using either (a) a dedicated metallic earth return (MER) (as shown in Figure 2-26) or by (b) a ground electrode at each converter location.

The project is currently evaluating MER and ground electrode options. Each option has its pros and cons, but in most cases a ground electrode is preferred from both technical and economical perspectives. The ground electrode option has the potential to significantly reduce capital expenditure by omitting ~788 km of conductor wire required for the MER. Furthermore, without MER conductors on the OHTL the tower size could be reduced by up to 8 m in height which improves visual amenity, the size of foundations could be reduced, and construction vehicle traffic movements could be reduced.

Electrodes have been used since 1965 in HVDC systems globally and improve the reliability of the entire system by providing an earth return for the power current which is generally only utilized during HVDC faults or outages. The longest utilisation of a ground electrode would be during an extended partial OHTL repair. Total ground electrode utilisation is typically less than 500 hours per year based on existing installations around the world.

Electrodes are static infrastructure with little activity in their footprint. Of the three types of ground electrodes considered during conceptual design (land, sea, and shore types), the land electrode is preferred for its simplicity in design where land is not in short supply. Shallow horizontal ground electrodes are the most typical design in remote areas which involve earthing rods installed in a back-filled trench below or near the ground water table, with the rods surrounded by coke breeze. Images in Figure 2-29 and Figure 2-30 show examples of an electrode site without a fence and an image of Dorsey electrode site, part of the Nelson River DC Transmission System in Manitoba, Canada.

The project may install up to two electrodes each near the Solar Precinct site and the Darwin Converter Site to accommodate earthing for the two circuits on the OHTL system. The electrode will be connected to the VSC via a medium voltage overhead distribution line. These electrode lines require minimal easement width since they do not need a high voltage rating and are comparable in scale, height, and appearance to conventional domestic overhead distribution poles.

The areas of interest identified for the electrode locations are approximately 8 km away from each of the Powell Creek Solar Precinct and the Darwin Converter Site VSCs. This separation is required to ensure electrical system safety during earthing events. Each site will have a footprint of approximately 2 ha each (see Figure 2-27 and Figure 2-28 below).

Subject to confirmation of the electrodes as a component in the OHTL design, selection of suitable sites for the electrodes will consider the following environmental and social attributes:

- Sacred site and cultural heritage areas
- Environmental values and constraints
- Geological and hydrogeological data
- Hydrology, inundation, and flooding
- Geoscientific data
- Land tenure, land uses and zoning
- Other notable features

Legend

- Electrode areas of interest
- AAPowerLink Infrastructure
- Cadastre

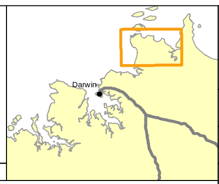


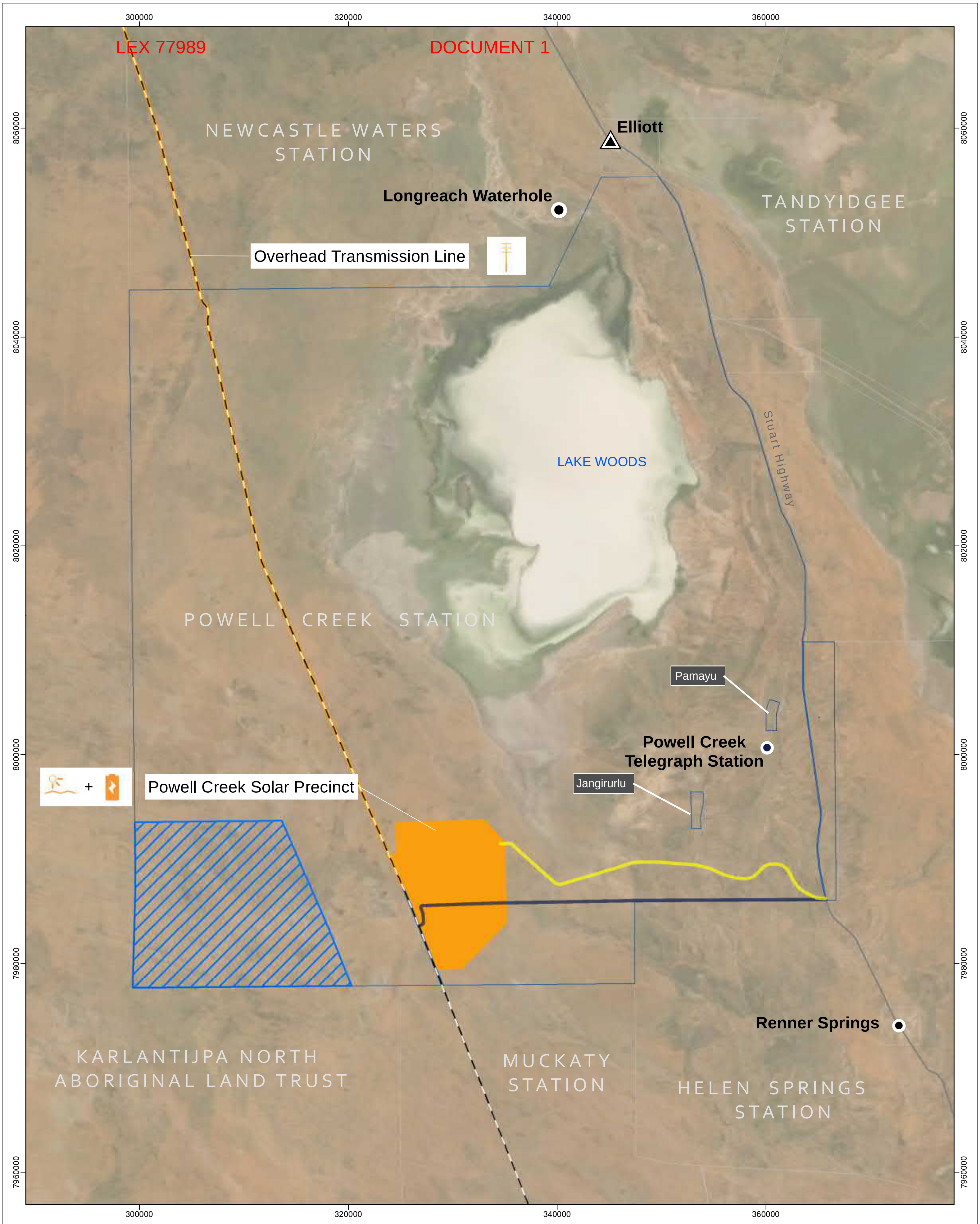
Figure 2-27: Murrumujuk Electrode areas of interest

Project: Australia-Asia PowerLink	Reference #: AAPL_GNR_CTA_GEN_MAP_0079	Figure: 1 of 1	Revision: B
Coordinate System: MGA 52	Datum: GDA2020	Date: 23/02/2022	
0 1 2 3 4 5 Kilometers	Scale: 1:120,000	A4	

N

SUN CABLE

Source: NTG data - Cadastre and roads. Imagery: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Legend

- Town
- Stuart Highway
- Alice Springs to Darwin Railway
- All weather access road (unsealed)
- Main access road (sealed)
- Powell Creek Station
- Cadastre
- AAPowerLink Infrastructure
- Electrode area of interest

Source: NTG data - Cadastre and conservation areas. Australian Government data - Ralway and roads

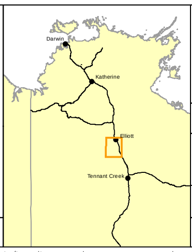


Figure 2-28: Powell Creek Electrode Area of Interest

N

Project: Australia-Asia PowerLink

0 4 8 12 16 Kilometers

Scale: 1:450,000 | Datum: GDA2020

Coordinate System: MGA 53 | A4

Reference #: AAPL_GNR_CTA_GEN_MAP_0080

Date: 07/03/2022 | Figure: 1 of 1 | Revision: B

SUN CABLE

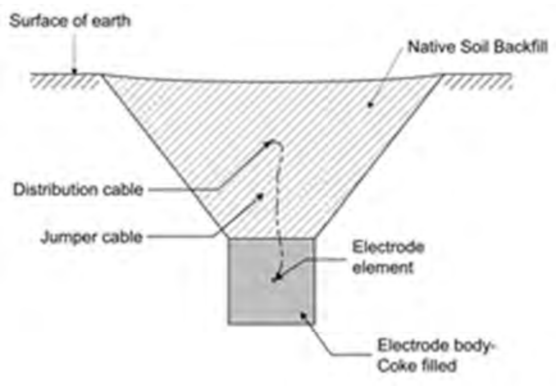


Figure 2-29 Shallow Horizontal Land Electrode [CIGRE TB 675 Figure 2.1]

Figure 2-30. An Electrode Site Without a fence and electrode switches mounted on poles [CIGRE TB 675 Figure 7.4]

2.5.4 Construction

The OHTL is planned to be constructed and commissioned over a period of approximately 2 to 3 years commencing in early 2024. The construction will occur on a rolling basis using a series of mobile work fronts across the length of the corridor. Key construction stages, equipment and activities are summarised below. Section 2.10 provides details of the overarching AAPowerLink construction programme.

2.5.4.1 Intermediate work bases/fly camps

Construction of the OHTL will be operated out of intermediate work bases in the relevant locations and temporary site camps will be established at key access points. These will be in a mobile 'fly camp' configuration – subject to detailed logistics arrangements. It is estimated that six fly camp locations will be used at intervals of approximately 100 km. Where possible these camps will utilise existing town accommodation (if available) and services (i.e., Daly Waters, Dunmarra, Larrimah, Katherine, Adelaide River, Pine Creek etc.). Where towns have limited commercial accommodation available for the duration of the construction effort, alternative arrangements will be explored. In more remote sections of the OHTL, the fly camp location will be selected through consultation with landholders and centred around existing Railway Corridor access points.

Camps are expected to be in use at each location for a period of approximately six months.

Remote fly camps will provide temporary transportable accommodation and amenities for approximately 20 personnel. The camps will be self-supporting in terms of water, power, sewerage, and waste management as follows:

- Water supply is planned to be trucked in to site tanks or sourced from existing bores (if potable), under agreement with licensed landowners.
- Power will be supplied by mobile solar and/or small diesel-powered generators.
- An onsite wastewater management system will be installed, the design, installation, and operation of which will to comply with *NT Code of Practice for Wastewater Management*.
- All wastes will be removed from site and disposed of at licensed facilities.

A cleared levelled pad approximately 100 x 100 m will be established for each camp. The cleared vegetation and topsoil will be stored in windrows along the site boundary, for later use in reinstatement of the site. Following removal of the camp infrastructure, each site will be reinstated by re-spreading cleared vegetation to promote natural regeneration.

2.5.4.2 Access tracks and temporary works areas

Existing access tracks will be used to gain access to the construction corridor from the Stuart Highway, including those used for construction and operation of the railway. Some new access tracks may be developed as required to facilitate construction. The following will be considered in the access track selection process:

- Existing public roads will be used to access the Railway Corridor, including the Buchanan Highway, Larrimah, Victoria Highway, Stuart Highway, Arnhem Highway, Alverly Road, Gunn Point Road and Murrumujuk drive.
- Existing access tracks (including widening if necessary) within the corridor will be used where possible, under agreement with the Railway Operator or relevant road authority and relevant stakeholders, to minimise clearing.
- If required, new access tracks will be selected in consultation with landowners.
- Tracks will be developed in locations to minimise the distance travelled on public roads.
- The OHTL access corridor will be used in preference to a track in areas where high road maintenance is expected, such as sand and soft soil.
- Access will be provided to either side of a watercourse where practical, to enable construction traffic to reach both sides whilst avoiding the need for installing crossings.
- Additional rail level crossings may be required within the easement to enable the OHTL construction and operations crews to gain access to both sides of the track; crossing agreements will be negotiated with the Rail Operator and all technical safety requirements will be met.
- There are frequent locations along the length of the corridor where pastoral station access gates involve railway crossings and access roads which are suitable for turning bays.

All access tracks and turnaround bays that are proposed for use, will be subject to environmental clearances and management, and landowner approvals.

A construction pad of approximately 100 m x 60 m will be established for the installations of the towers, which will include the laydown needs, and any top/tail lifting activities.

2.5.4.3 Equipment and machinery

Early civil fleet assumptions adopted for project planning indicate the following equipment types will be used to construct the OHTL:

- Clear and grab – Grader, dozer, watercart
- Pole installation – Excavator, boring machine, piling rig, concrete agitator truck, concrete pumping truck,
- Several 65 tonne cranes.
- Approximately 2,500 Overhead Transmission poles
- 7,300 km of conductors

Each work front is expected to comprise in the order of 10-20 pieces of heavy plant/equipment over the period of construction, plus light vehicles for personnel transport.it is expected that there will be a number of work fronts operating at any one time.

2.5.4.4 Construction materials

Materials required to construct each pole include the following:

- Drilling muds for use in piling operations
- Aggregate
- Cement stabilised or concrete backfill
- water

It is possible that mobile Concrete batching plant/s will be established at intermediate work bases to supply concrete for the pole foundations, however the construction methodology and sequencing will be developed as a part planning for project delivery.

2.5.4.5 Land clearing

Construction of the OHTL will require the use of up to a 22 m wide cleared construction corridor along the entire OHTL route, and for each pole, a temporary construction pad of up to 100 x 60 m. This pad will be cleared to provide an area for assembly of the pole components and for operation of the equipment required to erect the pole. The construction corridor and pads will be progressively cleared using bulldozers and graders. Cleared vegetation will be temporarily stored along the edge of the corridor for later use in reinstatement of the construction pads and areas beneath the transmission lines with only a 6 m wide permanently cleared access track retained.

2.5.4.6 Pole foundations

The pole foundations will be deep piles – either steel or concrete – combined in a pile cap with embedded bolt assemblies for the pole connection. For lattice towers, four piles will be installed (one per leg of the tower); for poles, one pile will be installed. The piles are installed to depths ranging between 6 m and 13 m depending on the suspension and strain requirements and wind zone location (coastal or inland). Pole foundations will be established with foundation caps installed as a single work front, prior to the installation of pole structures in a separate work front. A 12 m x 6 m cleared pad will be retained around each structure for operational access and maintenance.

2.5.4.7 Structure installation

The poles will be transported to site via road train or rail to tagging areas for laydown and distribution to the work fronts. Pole sections will be delivered to pad locations using road trains and small haul trucks where required. The pole sections will be assembled in a vertical manner using cranes. Each section will be approximately 10 m in length and will weigh 3 – 4 tonnes. Mobile all-terrain cranes shall be used to lift the sections with elevated work platforms (EWPs) used to bolt the sections together. Insulators and cross arms will be installed by the same crane and EWP. No welding/hot works are anticipated, and if required will be managed in accordance with detailed safe working procedures developed in accordance with Australian Standards.

2.5.4.8 Stringing of conductors

The primary means of stringing conductors will be ground based using spools and cable drums located at the crane pads and laydown areas. The conductors will be strung using lead lines and pulleys located downstream from the cable drums. Conductors will be pulled down the line and secured to the cross arms and insulators by mobile work crews. Helicopters may be used where extra-long spans are required to address easement constraints, for example at major river crossing such as the Katherine River, or for aerial works including final checks and commissioning.

2.5.4.9 Logistics

Logistics support and transport of materials and equipment for the construction of the OHTL will be by road transport from Darwin. It is expected that a series of Staging Areas / Laydowns will be established along the route from Darwin to Powell Creek at approximately 100 km intervals, to act as laydown areas for OHTL materials. Identification of areas to use for staging is underway, with efforts to locate staging areas in previously disturbed location, which may have been used for laydown previously. The sizing of these laydown areas will be dependant of the locations available for use.

Where the OHTL exits the Railway Corridor and enters the Utilities corridor, a construction approach that mitigates the impact to the rural residential areas will be developed accordingly, which may include a staging and laydown area proximate to Gunn Point Road.

It is envisaged that there will be approximately 4 work fronts operating at any one time. Several construction work crews may operate concurrently along the length of the OHTL corridor. On-site plant and equipment will be minimal, consisting of graders, medium earth-moving equipment, and two 65 Tonne cranes to erect each of the transmission poles. It is envisaged that the work crews and accompanying plant and equipment will remain in the corridor for most of the time, with minimal requirement to exit the corridor and travel on public roads on a frequent basis. The Stuart Highway and Gunn Point Road will be used to transport the OHTL materials and equipment to the Staging Areas / Laydowns and to access to the lateral roads into the OHTL corridor as required.

Materials and equipment to be transported for the OHTL from Darwin (other areas may also be drawn upon as required) include:

- Approximately 2,500 Overhead Transmission Poles
- 5,000 Cable Drums providing 7,300 km of overhead transmission line
- Plant and equipment to prepare the Transmission Pole pads
- Several 65 Tonne Cranes.

The approximate number of road transport movements along the Stuart Highway in support of the OHTL construction include:

- Extendable Trailer Movements: 8,000 for overhead transmission poles
- Full-Trailer Loads: 6,000 for Cable Drums, poles, and transmission equipment.

2.5.5 Reinstatement

Areas of land disturbed during construction but not required during operations, will be reinstated to stabilise the ground, native vegetation will be encouraged to regenerate and weed control measures will be implemented. Along the OHTL, areas to be reinstated will include the pole construction pads, partial reinstatement of the construction access track (from areas required for construction back to 6 m wide required for ongoing maintenance access), laydown areas, temporary access tracks and fly camps. Reinstatement will occur progressively as construction activities are completed in each area.

2.5.6 Operations

During the operation of the OHTL, the main activity that will occur along the OHTL is small scale maintenance of the track to allow for regular inspections via the access road.

Scheduled large scale maintenance programs will be carried out during the operational life of the OHTL. These will be carefully planned and will involve a dedicated team who will have a specific period to complete these activities.

2.6 Darwin Converter Site

The Darwin Converter Site (DCS) is the terminal location for the OHTL and will convert electricity from High Voltage Direct Current (HVDC) to High Voltage Alternating Current (HVAC) to enable connection to the Darwin electricity system[4] before being converted back to HVDC for transmission to Singapore. The site will serve as the junction point between two independent power networks within the AAPowerLink (onshore and offshore). Approximately 800 MW will be made available for connection to the local Darwin Katherine Electrical System. Most of the power supply will be converted back to HVDC for transmission to Singapore via the Subsea Cable System.

2.6.1 Location and footprint

The Darwin Converter Site is proposed to be situated on a 124-ha site located at Murrumujuk, approximately 31 km north-east of Darwin. The site is bound by Murrumujuk Road to the north and eastern boundary, and the Project Sea Dragon hatchery site (proposed) on the western boundary. The Shoal Bay Conservation Area is over 1.5 km from the southern boundary. The locality also provides a suitable area in which to accommodate the Cable Transition Facilities without compromising the future development of adjoining land or recreational values associated with the area. Within the site, approximately 55 ha of land will be developed. The location and layout concept are shown in Figure 2-3.

[4] Powerlines required to export electricity from the Darwin Converter Site into the Darwin electricity system are the responsibility of NT Government and are not within the scope of this EIS.

2.6.2 Site selection and design

The Darwin Converter Site was selected following a thorough planning and consultation process undertaken with key NT Government agencies and other stakeholders. The original proposed location for the Darwin Converter Site was at Middle Arm, adjacent to the Weddell Power Station. However, due to reasons stated in a Notice of Variation lodged in August 2021 (Available here), the revised location was selected for the following principal reasons:

- Sub-sea congestion due to existing and planned infrastructure in Middle Arm and the inner Darwin Harbour with the potential to compromise the AAPL Subsea Cable System.
- Potential terrestrial constraints associated with the future development plans for Middle Arm as an industrial precinct.
- Identification of an alternative Darwin Converter Site at Murrumujuk with proximity to the coastline, suitable topography, and soil conditions.
- The existence of a NT Government utilities corridor providing a viable route for the OHTL from the Railway corridor to Murrumujuk.
- A suitable strategic land use planning framework under the Litchfield Sub-Regional Land Use Plan which identifies both the OHTL route and the Darwin Converter Site as suitable for project infrastructure.

An area of approximately 55 ha is required to accommodate the AAPowerLink infrastructure. To reduce the impact of the linear infrastructure on surrounding and future developments, project infrastructure is located centrally within the development footprint to the extent possible. The infrastructure will be sited to avoid direct impacts to the seasonal wetland (swamp) located in the south-west corner of the site.

2.6.3 Key components

The Darwin Converter Site will comprise up to four Voltage Source Converters (VSC), a BESS, substation and switchyard, an Operations and Maintenance Facility and ancillary infrastructure, including but not limited to parking, laydown, warehousing, staff offices, communications tower, and ablutions. The facilities will be in a fenced compound with 24-hr lighting and surveillance. The key components of the Darwin Converter Site are described below.

2.6.3.1 Access

Access to the Darwin Converter Site for delivery of equipment, materials and personnel will be via Gunn Point Road and Murrumujuk Drive, both of which are sealed public roads. Internal sealed and unsealed access roads will provide access within the Darwin Converter Site.

2.6.3.2 Site foundations and drainage

Within the Darwin Converter Site, raised compacted earth and concrete building pads will be established for critical infrastructure components that require protection from localised flooding during extreme rainfall events. Due to the low relief at the site, there will be minimal requirements for cut and fill.

The site drainage concept involves open drainage channels that route flows received from the surrounding areas, around the infrastructure. The drainage design will minimise the risk of localised flooding by managing overland flows within a drainage system, with open drains and basins designed to deal with peak rainfall events, such that surface water discharges from the site will be at rates similar to pre-development conditions.

2.6.3.3 Electrical infrastructure

The electrical infrastructure installed at the site will comprise a range of conversion, transmission and energy storage equipment as described below.

Voltage Source Converters

The Darwin Converter Site will operate with up to four VSCs. Two receiving VSCs will accept power supplied from the OHTL and convert the electricity to HVAC. A portion of that power (nominally 800 MW) will be delivered to the onsite substation, stepped down to the local transmission voltage (275 kV to be determined with the network service provider), and evacuated through the switchyard to the local Darwin electrical network. Most of the electricity will be re-converted to HVDC by a pair of export VSCs, then exported from the Darwin Converter Site via the Underground Cable Corridor to the Land Sea Joint Station before transmission to Singapore.

Each VSC is comprised of an AC switchyard, internal valve hall, converter transformers, DC switchyard, earthing mat, drainage, lightning protection and ancillary infrastructure. Each VSC footprint is approximately 260 x 260 m with the valve hall representing the tallest structure at approximately 25 m in height. The valve hall will be housed in a steel framed structure and built to Australian standards for the local wind region and other regulatory requirements. An example of VSC internal view is provided in Figure 2-31.

Figure 2-31. Internal view of a Voltage Source Converter (Source ABB Power Grids Pty Limited)

Battery Energy Storage System

A BESS will be located within the Darwin Converter Site to provide backup, fault protection and ancillary services to the Darwin electricity system and the operation of the VSCs. The Darwin BESS has two main functions, firstly to add reliability to the system by responding to grid frequency changes during abnormal situations such as an HVDC system fault, and secondly to provide extra grid services during normal operation. Capacity of the BESS will be scaled to meet demand and network service provider requirements, with a nominal capacity of 800 – 2,000 MW. As this station will enable connection to the local electricity network, it will be designed to meet the local network requirements and the grid code as specified by the network service provider.

2.6.3.4 Operations and Maintenance Facility

An Operations and Maintenance (O&M) Facility will be constructed at the site that will service the associated AAPowerLink infrastructure. The facility will include site offices and administration, parking and laydown areas, warehousing and spares storage, water storage and firefighting equipment, communications tower, utilities, security systems, fuel storage, chemicals storage, electric vehicle charging station, on site solar power and battery demonstration units, an information and education centre and other ancillary facilities. The O&M Facility will be constructed within the fenced perimeter of the Darwin Converter Site.

2.6.3.5 Services

The Darwin Converter Site will be connected to mains power and will source potable and firefighting water supply from an onsite bore or the nearby water tower under agreement with Power and Water Corporation.

2.6.3.6 Dangerous goods and hazardous chemicals storage

Hazardous chemicals storage areas will be established at the Darwin Converter Site for minor quantities of hazardous chemicals such as cleaning chemicals, herbicides (for vegetation management and weed control) and pesticides. There is no requirement for bulk storage of any dangerous goods or hazardous chemicals because power requirements during operations will be supplied by connection to mains power. Further investigation into the potential to use electric vehicles for the site fleet will be undertaken, with the potential for recharging facilities to be powered by on site solar generation. Any refuelling of vehicles will occur in Darwin and not with the facility.

The VSC transformers at the Darwin Converter Site will house synthetic ester, which is the same as the units at the Solar Precinct. This will be contained in sealed sections of the transformers.

2.6.3.7 Waste management facilities

Waste storage and transfer facilities will be established for temporary storage of wastes prior to collection and transport offsite by a licenced contractor. There is no requirement for onsite waste disposal.

2.6.4 Construction

The Darwin Converter Site will be constructed and commissioned in stages to meet the electricity demand requirements of the system. Initially two VSCs will be constructed as well as the first stage of the BESS at approximately 400 MW and the associated substation and switchyard components. Key construction stages, equipment and activities are summarised below.

2.6.4.1 Equipment and machinery

Early civil fleet assumptions adopted for project planning and the EIA indicate the following heavy equipment types will be used across different construction stages and activities at the Darwin Converter Site:

- Clear and grab – Graders, dozers, watercarts
- Formation – Graders, rollers, bitumen sprayers, haul, and tipper trucks
- Concrete structures – Agitator trucks, pump trucks, cranes
- Equipment installation – Cranes
- Personnel transport – Light vehicles

- Dust suppression – Water carts

At peak construction when multiple activities are happening concurrently, there will be in the order of 50 pieces of mobile equipment including civil plant, equipment, and vehicles, operating across the 55-ha footprint.

2.6.4.2 Construction materials

Construction materials such as cement, concrete, aggregate and others will be sourced locally where possible. Equipment and componentry that is not available in Australia, will be sourced from overseas. A concrete batching plant may be required during construction, however at this time construction planning indicates that it will be sourced from external suppliers.

2.6.4.3 Land clearing

Clearing of vegetation across the footprint will occur in a progressive manner to establish the work area required for each stage. Cleared vegetation will be mulched for use in landscaping, and erosion and sediment control. Any vegetation clearing will be completed in accordance with best practice.

2.6.4.4 Site establishment

Site establishment works will involve the following key activities and stages:

- Temporary site demarcation and security established
- Marking of sensitive areas including wetlands in accordance with site clearance procedures
- Pioneering works and construction of a new site entry from Murrumujuk Road
- Water supply, water treatment and power supply established
- Foundations for VSC's laid down
- Laydown areas for construction equipment and materials established
- Temporary site offices and amenities installed
- Site drainage installed.

2.6.4.5 Installation of infrastructure

The initial two buildings for the first VSC will be constructed in back-to-back arrangement, including the switchyards, valve halls and common busbar, after which the 275 kV substation, switchyard and first stage of the BESS will be built. The connection point to the Darwin electricity system will be constructed at the switchyard on the eastern side of the site. On the western end of the site, the jointing pits and service ducts will be installed ready for installation of the underground export cables. The O&M Facility will be constructed at the latter end of the construction campaign, utilising the laydown areas created during the initial construction effort.

The additional two buildings for the second VSC and BESS capacity will likely be constructed into the future consistent with the above methods to meet the future demand requirements of the system.

2.6.5 Reinstatement

Additional areas of land disturbed during construction but not required during operations, will be reinstated to stabilise the soils and native vegetation will be encouraged to regenerate.

2.6.6 Operations

During operations, there will be a small crew who operate and maintain the facility. Minor maintenance will be conducted withing the facility.

Water demand at the Darwin facilities will be limited to water required for potable needs and office ablutions. Water will be supplied from onsite groundwater bore subject to permit and licencing under the *Water Act*, or piped in from offsite sources under agreement with PowerWater or the relevant landowner

2.7 Cable Transition Facilities

The Cable Transition Facilities comprise three separate components to transfer power from onshore to offshore: Underground Cable Corridor, Land Sea Joint Station and Shore Crossing Site. Power leaving the Darwin Converter Site enroute to Singapore, will be transferred by underground HVDC cables laid over 2.7 km in an Underground Cable Corridor, to the Land Sea Joint Station where the onshore and offshore cables will be connected. The Shore Crossing Site is where the subsea cables will be winched from a barge located offshore across the intertidal zone and beach to the Land Sea Joint Station.

2.7.1 Location and footprint

The Cable Transition Facilities are located at Murrumujuk and extend from the Darwin Converter Site to the Shore Crossing Site at the southern end of Gunn Point Beach. The combined footprint of the facilities is approximately 19 ha. The location and site layout concept are shown in Figure 2-3.

Underground Cable Corridor

The Underground Cable Corridor is approximately 2.7 km and up to 70 m wide and is proposed to run parallel to the south of Murrumujuk Drive and north of the Gunn Point Beach access track, which will be rerouted during construction to maintain public access to the area however efforts will be made to minimise the need for this, and it will only be rerouted if no other solutions are available. The proposed corridor will be subject to geotechnical testing and assessment of Acid Sulfate Soils (ASS) risk to confirm suitability of the soils and determine whether any specific treatments are required to protect the buried cables. The corridor will be partially cleared for construction purposes and reinstated once construction is complete.

Land Sea Joint Station

The Land Sea Joint Station will be a fenced 1.5 ha site located approximately 300 m inland from the beach, near the junction of the access tracks to Gunn Point Beach and Tree Point Road. A photo taken at the site is shown in Figure 2-32.

The station will house six bays (one for each cable) excavated to dimensions of approximately 20 x 5 m, to house the physical connection between the onshore and offshore cables. The site includes provision for a temporary construction area to accommodate excavators, generators, pumps, winches, surge arrestors, joint workshop, pipe storage, and ancillary infrastructure – including construction site offices, lighting, fuel storage and amenities. On completion of construction the land surrounding the bays will be reinstated with native vegetation where possible and have signage identifying the electrical hazards within the compound. There will be no restrictions on public use or access outside of the 1.5 ha fenced area.

Figure 2-32. Photo taken at Land Sea Joint Station location (looking west towards Shoal Bay)

Shore Crossing Site

The Shore Crossing Site is located immediately to the south of the current Gunn Point Beach access track. A photo taken at the site is shown in Figure 2-33. A temporary construction corridor approximately 500 m wide and 500 m long will be established from the Land Sea Joint Station, out to the low water mark in Shoal Bay to accommodate the cable trenches and construction machinery and equipment.

Figure 2-33. Photo taken at Shore Crossing Site looking west towards Shoal Bay (top) and east toward the Land Sea Joint Station (bottom)

2.7.2 Site selection and design

The Cable Transition Facilities location was selected following consultation and planning with the NT Government and key stakeholders in the Darwin region. The original proposal identified four possible locations on the Middle Arm peninsula which were assessed for their viability.

However, due to reasons stated in a Notice of Variation lodged in August 2021 (Available here), the revised location was required to avoid potential conflicts within Darwin Harbour. Murrumujuk was identified as a suitable cable landing location for several reasons including:

- Few offshore seabed constraints identified for Subsea Cable Corridor options
- Navigable bathymetry and suitable onshore topography for cable trenching at the Shore Crossing Site
- A relatively short distance between the Darwin Converter Site and the Shore Crossing Site
- Availability of land identified for future development at Murrumujuk and proximity to the utilities corridor identified in the NTG's Litchfield Sub-Regional Land Use Plan (LSLUP)
- Absence of mangrove habitat in development footprint, thus reducing the potential for environmental impacts

The design of the facilities has considered a range of other inputs including proximity to the Tree Point Aboriginal Community, maintaining recreational access to Gunn Point Beach for fishing, camping and 4WDing, avoiding registered and recorded sacred sites including middens and burial sites, minimising impacts to cultural heritage, sensitive ecological communities and minimising other impacts to the environment.

2.7.3 Construction

The Cable Transition Facilities will be constructed in stages, initially to accommodate three cables, with subsequent cables installed in separate campaigns to meet future growth in energy demand. Key construction stages, equipment and activities are summarised below. Section 2.10 provides details of the overarching AAPowerLink construction programme.

2.7.3.1 Equipment and machinery

Early assumptions adopted for project planning and the EIA indicate the following equipment and machinery types will be used in the installation of the terrestrial cables:

- Light commercial vehicles
- Aggregates wagons
- Flat back wagons
- Crane
- Low Loader
- Escort Vehicle
- Crane support vehicle
- Excavators.

2.7.3.2 Construction materials

Construction materials requirements and sources will be determined following survey and geotechnical assessment of the Underground Cable Corridor. The surveys will assess whether the subsoil material excavated from the trench will be suitable for use in cable burial. Early assumptions adopted for the EIA are that the majority (if not all) of the subsoils will be suitable and therefore importation of fill materials will be limited to minor quantities that can be sourced from existing commercial quarries. Bedding sand required to line the trench to a depth of 15 cm will be sourced from commercial suppliers.

2.7.3.3 Site survey

A terrestrial survey will be carried out during the Underground Cable Corridor route selection. The aim of the survey is:

- Identification of detailed ground levels through LIDAR (topography)
- Identification of any additional terrestrial activities and hazards that are presently unknown
- Identification and confirmation of existing utilities that cross the route or are proximate to cable corridor
- Ensure appropriate separation distances to planned infrastructure on adjacent land and the broader locality
- Landowner delimitations, restrictions, permits and regulations
- Nature of the geo-technical conditions in each section
- Road crossing characteristics.

A system of control stations will be set out along the proposed cable route using a GPS system. The initial setting out will be conducted during route selection, with the centreline pegged out at boundaries and intersection points.

Prior to commencing construction, a routing line walk will be undertaken to review the route centreline, in order that the cable installation can be constructed in a safe, environmentally acceptable, economical, and timely fashion. The surveyor will walk the centreline and carefully examine the route together with any salient features which may cause problems during construction. Route development / re-routes may be proposed in response to factors such as:

- Landowner / tenant disturbance
- Health and safety issues
- Environmental disturbance
- Construction-associated problems

The Underground Cable Corridor and works areas associated with the Land Sea Joint Station and Shore Crossing will be flagged and/or fenced to demarcate and secure the works areas.

2.7.3.4 Land clearing

The Underground Cable Corridor will initially be cleared to 35 m wide and stripped of topsoil. The cleared vegetation and topsoil will be stockpiled along the edge of the corridor to be mulched and used in reinstating the area post-construction. A construction access track will be established along the corridor. This access track will be maintained and used to facilitate the duplication of the cable system when additional clearing of the residual 35 m width will be required. A conceptual arrangement of the 35 m wide Underground Cable Corridor construction is illustrated in Figure 2-34.

The 1.5ha Land Sea Joint Station footprint will be cleared and stripped of topsoil. The cleared vegetation and topsoil will be stockpiled along the site boundaries to be used to reinstate the construction works area post-construction.

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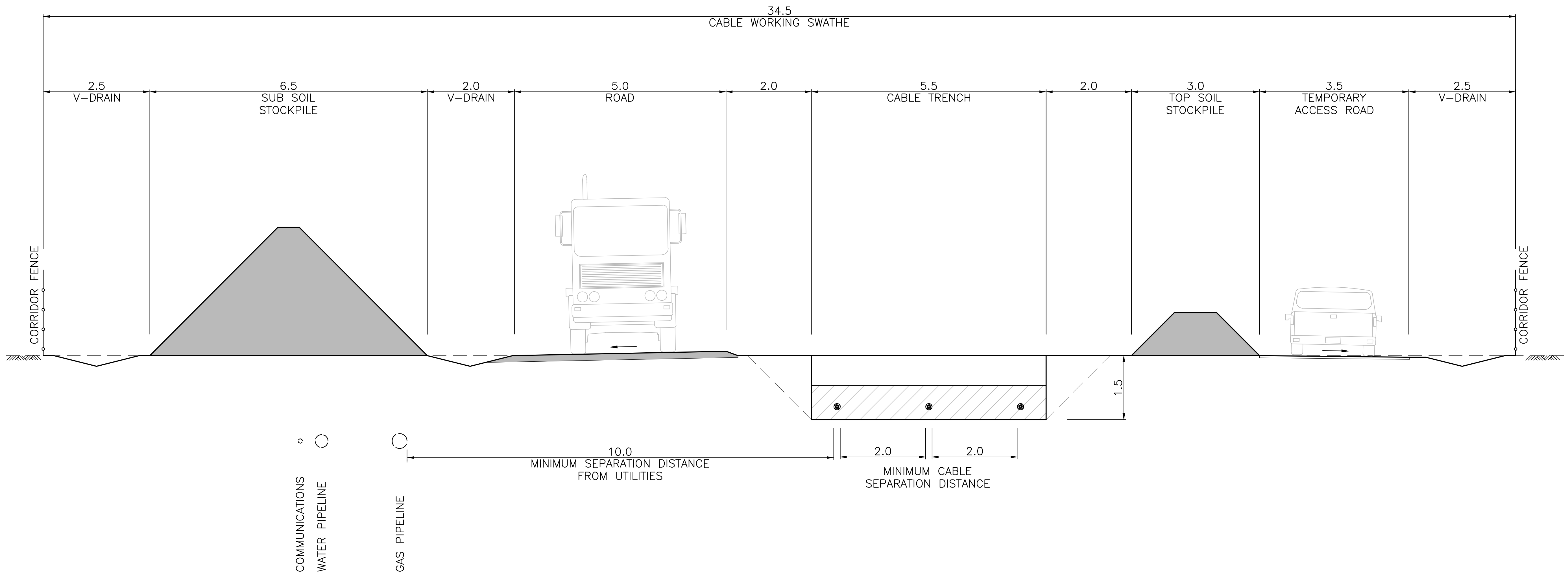

NOTES

1. CONCEPT DRAWING ONLY, LAYOUT OF INFRASTRUCTURE AND SPACING SUBJECT TO CHANGE DURING DETAILED DESIGN.
2. DRAWINGS OF INFRASTRUCTURE ARE INDICATIVE ONLY.
3. MINIMUM 10m SEPARATION DISTANCE BETWEEN HVDC CABLE AND ADJACENT UTILITIES TO MAINTAIN THERMAL INDEPENDENCE.
4. BURIED UTILITIES WITHIN CABLE CORRIDOR MUST BE INSTALLED TO WITHSTAND LOW LOADER AND CABLE DRUM CONSTRUCTION LOADS.

PRELIMINARY ISSUE
NOT FOR CONSTRUCTION

SCALES	CLIENT	PROJECT NUMBER	PROJECT NAME
0 20 40 60 80 Full Size 1:1500 ; Half Reduction 1:3000 SCALE (m)	SUN CABLE	PROJECT NUMBER: 175-2 DRAWN V. ALONSO 12.04.21 DESIGNED K. HOLDER 12.04.21 VERIFIED APPROVED	SUNCABLE CONCEPT LAYOUT
H DATUM / V DATUM			TITLE: Figure 2-34. Indicative cross section of working swathe (units in m)

SHEET SIZE	DRAWING NUMBER	REVISION
A1	175-2-CI-SK-0050	B

2.7.3.5 Cable loading and transportation

The terrestrial cables will be wound onto drums at the designated cable factory overseas and will be shipped to Darwin Port. Each drum has a capacity of approximately 1,000 m of cable, hence approximately nine cable drums for the initial 3 underground cables will be shipped from overseas and transported by low loader trailers Figure 2-35 to a cable storage area located at the Darwin Converter Site. A typical storage area for nine drums would be approximately 70 x 130 m. From the storage area the drums will be transported to the pulling positions along the Underground Cable Corridor.

Figure 2-35. Examples of low loader trailers used to transport cable drums (Source: Prysmian)

2.7.3.6 Trenching and excavation

The onshore and offshore cables will be buried. Trenching and excavation activities that will occur in preparation for cable laying are described below.

Underground Cable Corridor

Temporary trenches will be excavated in segments along the Underground Cable Corridor with sub-soil stockpiles established adjacent to the trench for use as backfilling once the cables are laid. If required due to ground conditions, and in case it is not possible to execute a trench with side slopes, the trench will be built with sheeting, especially if there is the need to excavate at extra depth to cross existing services. Examples of sub soil excavation and a sheeted trench are shown below in Figure 2-36 and Figure 2-37.

Excavation will be carried out by hydraulic excavators and where necessary water pumps will be used to keep the trench clear of water. Indicative trench design parameters for the Underground Cable Corridor are provided in Table 2-4 with detailed design pending further studies and site survey.

Table 2-4. Preliminary trench design parameters

Parameter	Preliminary details
Depth of cable	1.5 m
Depth of bedding sand	15 cm
Fill type above bedding sand / cable marker type	Natural soil backfill
Lateral spacing between multiple cables	2 m
Total trench width	Approximately 9.5 m

Figure 2-36 – Photo of sub soil excavation in a trench with side slopes (Source: Prysmian)

Figure 2-37. Photo of a sheeted trench (Source: Prysmian)

Shore Crossing Site

Open trenches will be excavated from the Land Sea Joint Station bays across the beach and intertidal zone using conventional excavators. There will be one trench for each cable (i.e., total of three trenches for the initial system). It is estimated each trench will be approximately 500 m long, up to 2 m deep and 2 m wide. Within the beach and intertidal area, a tracked excavator (either on the shore or mounted on a shallow barge) will dig a V-shaped trench. Alternatively, temporary trench support may be installed, particularly on the sandy beach, usually in the form of steel sheet piling as illustrated in the photos above. The trenches will be excavated progressively to account for tidal differences, approximately one to two weeks. Cables will take two to three days to pull in. Once cables are winched into place, the trenches will be back filled with the excavated material.

Land Sea Joint Station

At the Land Sea Joint Station, three bays (jointing pits) (one for each cable) will be excavated to dimensions of approximately 20 x 2 m and 2 m deep. The jointing pits may be bunded with formed concrete or steel covers, subject to the local geotechnical conditions. The excavated material will be subject to geotechnical testing and assessed for the presence of PASS or ASS, to determine suitability for reuse as fill, or will be disposed of at an approved location.

2.7.3.7 Cable installation

Onshore the cables will be laid using specifically designed cable laying trailers and cable spools. Offshore, a Cable Lay Barge (CLB) will be used.

Onshore

The onshore cables will be laid using a system of winches and rollers to pull the cable off the cable drums and ensure correct placement in the trench without damage. An example of a motorised stand and roller placement used to install onshore cables is shown below in Figure 2-38. The cables will be laid on a bed of clean sand, joined together and covered by the subsoil materials excavated from the trench.

Each 1 km section of the trench, which is the length of cable each drum can carry, will be prepared by placing rollers along the trench and positioning the winch at one end and the cable drum at the other. The pulling wire from the winch is pulled out and connected to the cable, and the cable is winched through the trench on the rollers. Pulling operations will be controlled and coordinated through continuous communication between pulling crew members using radio communication equipment. When the cable length has been completely pulled in, the cable is lifted off using slings and positioned into the trench to allow the repositioning of the rollers for the next cable.

Jointing areas will be established at the locations where each of the 1 km cable lengths meet. An indicative layout of a jointing area is shown below in Figure 2-39. During jointing operations, the jointing position will be covered by a series of specialist containers in which the jointing activities will take place to connect the cables. A photo example of a jointing site is shown in Figure 2-40.

Once the cable is laid and joined, all the construction equipment is removed from the Underground Cable Corridor. The backfill will then take place using first the stockpile of subsoil, selected and sieved by removing stones and objects not applicable for backfill. All backfill will be placed in layers with each layer being compacted. The compaction will ensure level ground and to prevent any subsidence of the soil at ground level. Finally, the topsoil will be restored using the topsoil stockpiled and grasses/shrubs will be left to naturally regrow over the corridor.

Figure 2-38. Photo example of motorised stand and roller placement used to install onshore cables (Source: Prysmian)

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F233 **Indicative land sea jointing layout**

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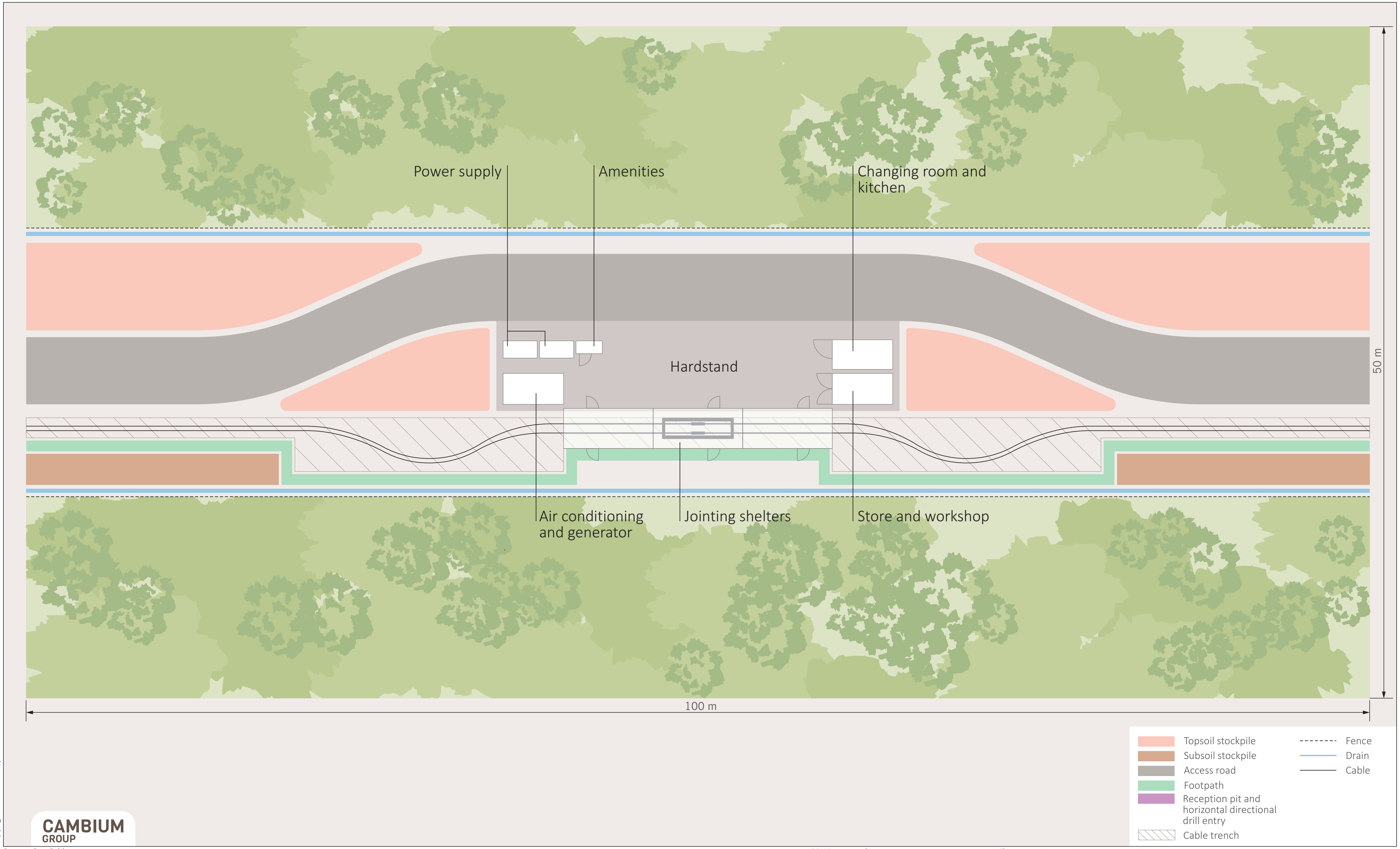


Source: Sun Cable

Sun Cable drawing ref: AAPL-GEN-CTA-GN-MAP-0001-A.pdf

Cambium ref: 031186_Sun_Cable_AAPL_EIS_F233_Indicative_land_sea_jointing_layout_220302_v01

Figure 2-39. Indicative jointing area layout

Figure 2-40. Photo of typical jointing containers (Source: Prysmian)

Offshore cable laying

The offshore cable will be installed from a CLB situated in shallow water offshore from the Land Sea Joint Station. The cable will be laid by a combination of floating and pulling the cable ashore using a winch anchored behind the Land Sea Joint Station. The CLB will approach the Shore Crossing Site trench as close as possible, and the cables will be floated to the start of the trench, and then winched through the open trench over the beach and secured at the Land Sea Joint Station. The floats are then deflated, and the cables will settle into the trench. A photo example of an open trench cable installation is shown in Figure 2-41.

Figure 2-41. Photo example of open cut trench at landfall (Source: Sun Cable)

2.7.4 Reinstatement

The Underground Cable Corridor and Land Sea Joint Station construction areas will be reinstated by respreading the stockpiled topsoil and mulched vegetation. Surplus soil will be either be used as fill material, respread over the disturbed areas (minor quantities), or will be removed from site and transported to suitably approved and licensed waste facility. Drainage and erosion and sediment controls will be installed, and grasses and shrubs will be allowed to regrow; however, trees will be excluded due to potential impacts on the buried cables.

The trenches at the Shore Crossing Site will be backfilled using the excavated material and will be returned to the pre-existing surface topography. In the areas above the high-water mark, vegetation will be re-established to protect the dune and hind dune areas. Below the high-water mark, through the intertidal area, reinstatement of the natural substrates is expected to allow for rapid recolonisation of benthic habitats and fauna; shoreline erosion protection measures will be implemented as needed.

2.8 Subsea Cable System

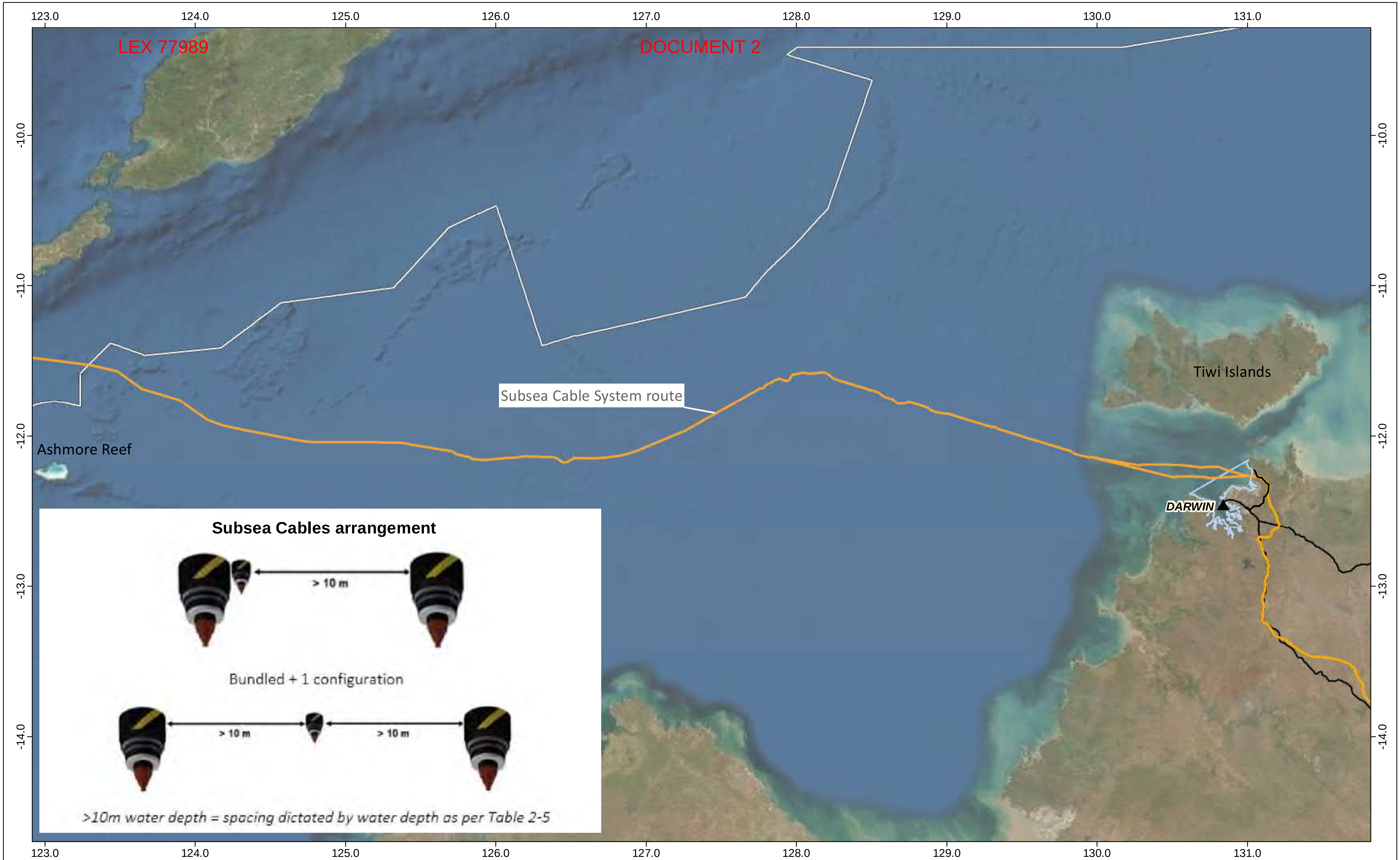
A High Voltage Direct Current (HVDC) Subsea Cable System will be installed to transfer electricity over approximately 4,200 km from Darwin to Singapore. The length of the Subsea Cable System within the AEEZ and to the limit of the Commonwealth marine area is approximately 895 km. The proposal includes an initial three cable system, and a further three cables to be installed a later date, to meet future energy demands. The proposed transmission system rating is 5.4 GW.

2.8.1 Location and footprint

The Subsea Cable System will be laid from the Land Sea Joint Station extending through outer Shoal Bay, through the outer Darwin Harbour into the Beagle Gulf within NT coastal waters and continue through the Timor Sea to the Continental Shelf (including the Perth Treaty Area) before entering the Indonesian Archipelagic Waters, enroute to Singapore. There are two route options (Route A and Route B) under consideration in the nearshore part of the footprint from the Shore Crossing Site out to a common point of convergence approximately 45 km northwest of Darwin. Both options have been selected to avoid known areas of environmental sensitivity and recreational fishing values such as artificial reefs and wrecks. The routes will be subject to further engineering studies and marine survey.

Both routes traverse the shallow waters of Shoal Bay and the outer areas of Darwin Harbour, remaining outside the Darwin Port boundary. Route B is the closest to land and lies approximately 7 km offshore of Lee Point and 15 km offshore of Charles Point. Both routes cross the existing Bayu Undan gas pipeline. A small portion of the cable route enters the periphery of the NAXA at several locations (See Figure 2-43). Sun Cable will continue to engage with the Department of Defence to ensure NAXA activities and cable infrastructure can co-exist. The route enters the Oceanic Shoals Marine Park at approximately 270 km from the shore and traverses through the marine park for approximately 300 km, before continuing west towards Indonesian waters. The proposed Subsea Cable System route is shown on Figure 2-4.

The Subsea Cable System will comprise up to six cables to accommodate peak supply requirements and future growth in demand. Cables could be installed individually or in a bundled configuration. The spacing between the cables, will be between 50 - 200 m depending on specific sea floor features, with actual spacing requirements to be determined in detailed design. The cables will either be laid on the seafloor or trenched into the seabed generally to a depth between 0.3 – 1 m (in certain circumstances it may be necessary to bury to 3 m depth), or protected with armouring as required, subject to various hazards and sea floor conditions along the route. A conceptual layout is shown in Figure 2-42.



Legend

- AAPowerLink Infrastructure
- Towns
- Darwin Harbour boundary
- Commonwealth Marine Area

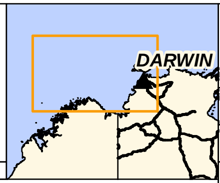


Figure 2-42: Map of Subsea Cable System conceptual layout

Project: Australia-Asia PowerLink	Reference: M-Files ID 200050	Revision: 0
Coordinate System: GDA2020	Date: 08/03/2022	
0 50 100 150 Kilometers	Scale: 1:3,500,000	A4

N

SUN CABLE

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

2.8.2 Route selection and design

A range of route alternatives, design options and installation methods have been evaluated by Sun Cable in consultation with stakeholders including NT Government agencies, Commonwealth Government departments including Defence and Parks Australia, Darwin Harbourmaster, shipping authorities, Aboriginal Land Councils, gas pipeline operators and other interested parties. The sections below outline the key activities and alternatives considered for the Subsea Cable System.

2.8.2.1 Route selection

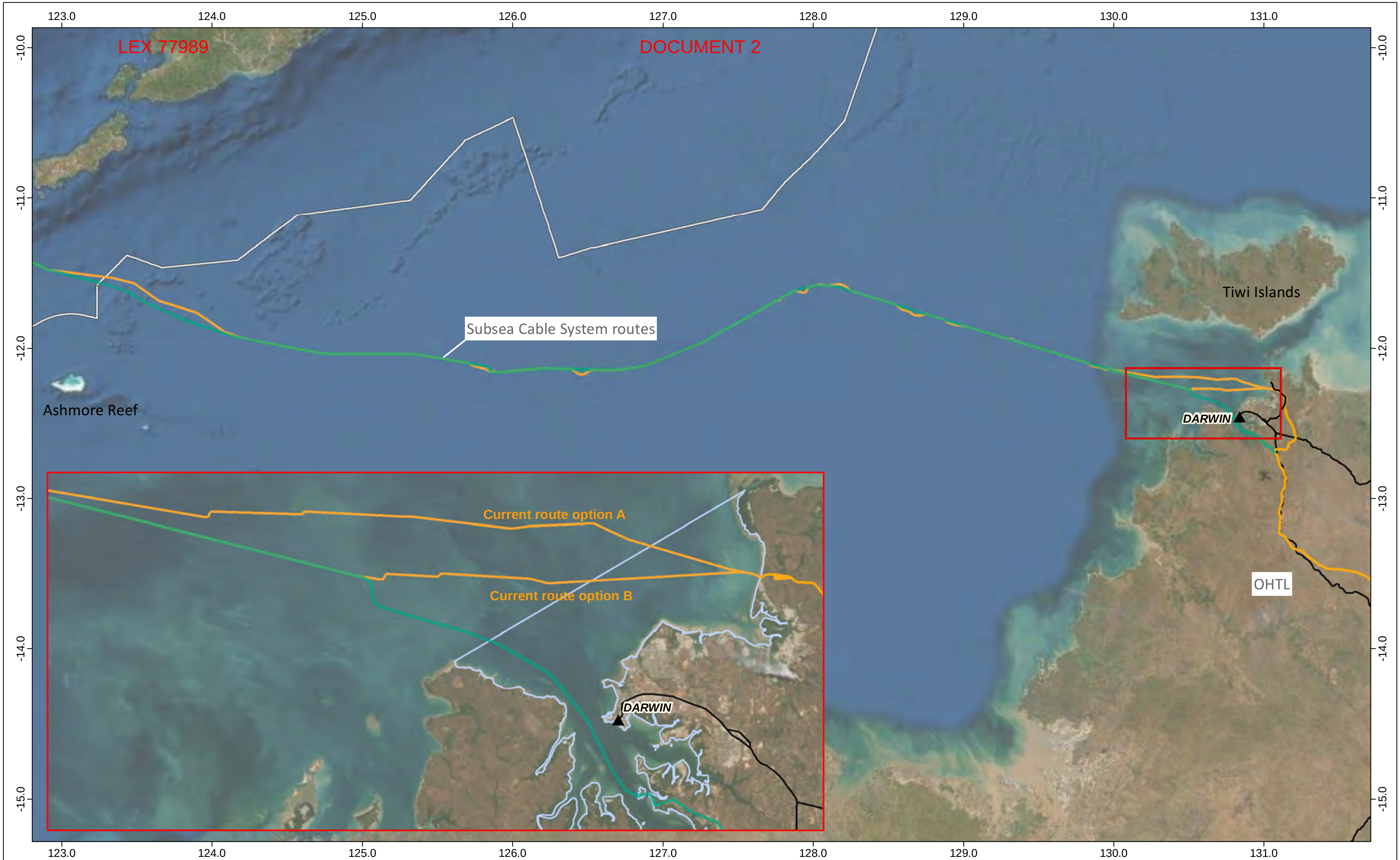
A comprehensive geophysical survey and geotechnical sampling program was undertaken from 25th August 2020 to 20th November 2020 to inform selection of the Subsea Cable System route (Guardian Geomatics, 2021[5]). A total length of approximately 748 km was surveyed. The geophysical survey consisted of multibeam echosounder, side scan sonar and sub-bottom profiler along a 500 m wide swath, while the geotechnical survey involved cone penetrometer testing and vibro coring every 10 km along the route centreline. The available survey data covers most of the route, excluding the first 45 km, which has changed due to the relocation of the Darwin Converter Site and Shore Crossing Site to Gunn Point Beach from Middle Arm in Darwin Harbour. A portion of the Commonwealth marine area is also beyond the initial survey scope.

The geophysical survey and geotechnical sampling surveys also collected information and data to inform the selection of installation methods suitable for route sections, including:

- Bathymetry and water depth
- Seabed features, such as seabed depressions, seafloor scarps/escarpments, pockmarks (isolated and clustered – low and high density), area of boulders, channels, mega ripples and sand wave crests, debris, wrecks, and unknown hard sonar contacts
- Geology and sediment characteristics
- Locations of existing cables and pipelines.

The current Subsea Cable System route, including two inshore route options, was selected based on review of available geophysical data. Further surveys of the near-shore Route options A and B are planned for early 2022 to confirm this approach, which has been amended from the original route as per the submitted variation. The preferred Subsea Cable System route option will be finalised following the surveys. The original surveyed route (through Darwin Harbour) and the new route/s under investigation are shown on Figure 2-43.

[5] Guardian Geomatics (2021) Preliminary survey report – Work Package 1.2 (Australia – Shallow/Offshore Survey)



Legend

- Current AAPowerLink infrastructure route
- Darwin Harbour boundary
- Commonwealth marine environment
- Original AAPowerLink infrastructure route

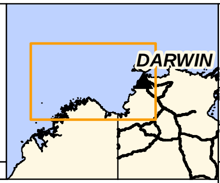


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Figure 2-43: Map of Subsea Cable System routes

Project: Australia-Asia PowerLink | Reference: M-Files ID 200050 | Revision: 0

Coordinate System: GDA2020 | Date: 08/03/2022

0 50 100 150 Kilometres | Scale: 1:3,500,000 | A4

SUN CABLE

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

2.8.3 Key components

The key components of the Subsea Cable System are described below.

2.8.3.1 Cables

The preferred configuration for each of the two cable systems is a Bipole with Metallic Return, which involves three cables laid parallel:

- Positive pole (Pole 1)
- Negative pole (Pole 2)
- Metallic return.

Pole 1 and Pole 2 cables are each approximately 161 – 176 mm in diameter and weigh approximately 66 – 85 kg/m, while the Metallic return is approximately 120 mm in diameter and weighs approximately 36 kg/m.

The cables will be of Cross-Linked Polyethylene (XLPE) insulation and use either copper or aluminium conductors, or possibly a combination of both. The cables will have a lead sheath to ensure no moisture can penetrate the insulation, and heavy steel wire armour will protect the cables from external damage during installation and burial/protection. An example of a cross-section of the cable is provided in Figure 2-44.

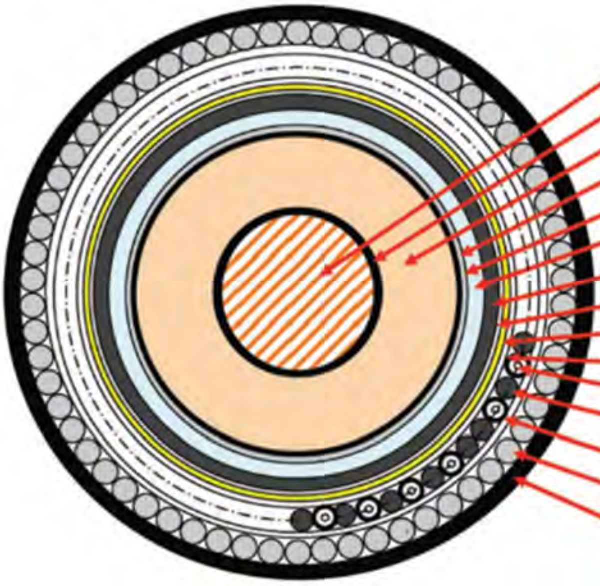

Figure 2-44. Example Cable Diagram

2.8.3.2 Configuration

The cables are planned to be laid individually. The installation footprint of each individual cable is approximately 12 m wide and is determined by the width of the machinery used to bury the cable. The cables and bundles will be spaced from 50 – 200 m apart. Cable spacing is dependent on several factors, the main being:

- Thermal spacing between adjacent cables to avoid overheating (generally minimum 10 m apart).
- Footprint of seabed installation / equipment – Where burial is required, the largest footprint of burial machinery is approximately 12 m wide. A working corridor width of approximately 50 m between each cable is required to alleviate any risk to adjacent cables during installation.

- Crossing of third-party assets (e.g., pipelines or telecommunication cables) – non-bundled cables can converge locally to a single crossing point to minimise the impact to the crossed asset.
- Access for maintenance and repair – Should there be a fault in the cable, there will be a need to locate the fault, cut and retrieve the faulty cable for forensic examination, conduct repairs and lay out the repaired cable and joint safely. The area required for the repair, and therefore the spacing of the cables, is dependent on water depth as shown in Table 2-5. Cables in deep water need to be more widely spaced to provide enough space to repair a cable without impacting the adjacent cables.

As landfall is approached, the cables will converge and the spacing is then driven by the thermal spacing or footprint of the seabed installation equipment (i.e., 10 m thermal spacing or 50 m spacing if burial is required).

Table 2-5. Cable spacing required to accommodate cable joints at different water depths

Water depth (m)	Cable spacing for omega joint (m)
0-20	50
20-50	100
50-100	150
100 -150	200

2.8.3.3 Protection

Once laid on the seabed, the cables need to either be buried or otherwise protected from the threat of external damage such as anchors or fishing activity. Where possible, the cables will be buried in the seabed as this provides the best protection for the cable and minimises potential for interference with fishing activity. The depth of burial will vary from 0.5 – 3 m and is dependent on the outcome of the Cable Burial Risk Assessment, which considers the sea floor properties and the risk of cable damage from anchoring and fishing gear. A typical trench profile showing a buried cable is shown in Figure 2-45

Where the seabed composition is not suitable for burial, or where the cable crosses other infrastructure such as the Bayu Undan pipeline and other cables, external mechanical protection will be provided through either rock placement, application of concrete mattresses and/or installation of cast iron shells (Table 2-6).

Fx Subsea cable burial

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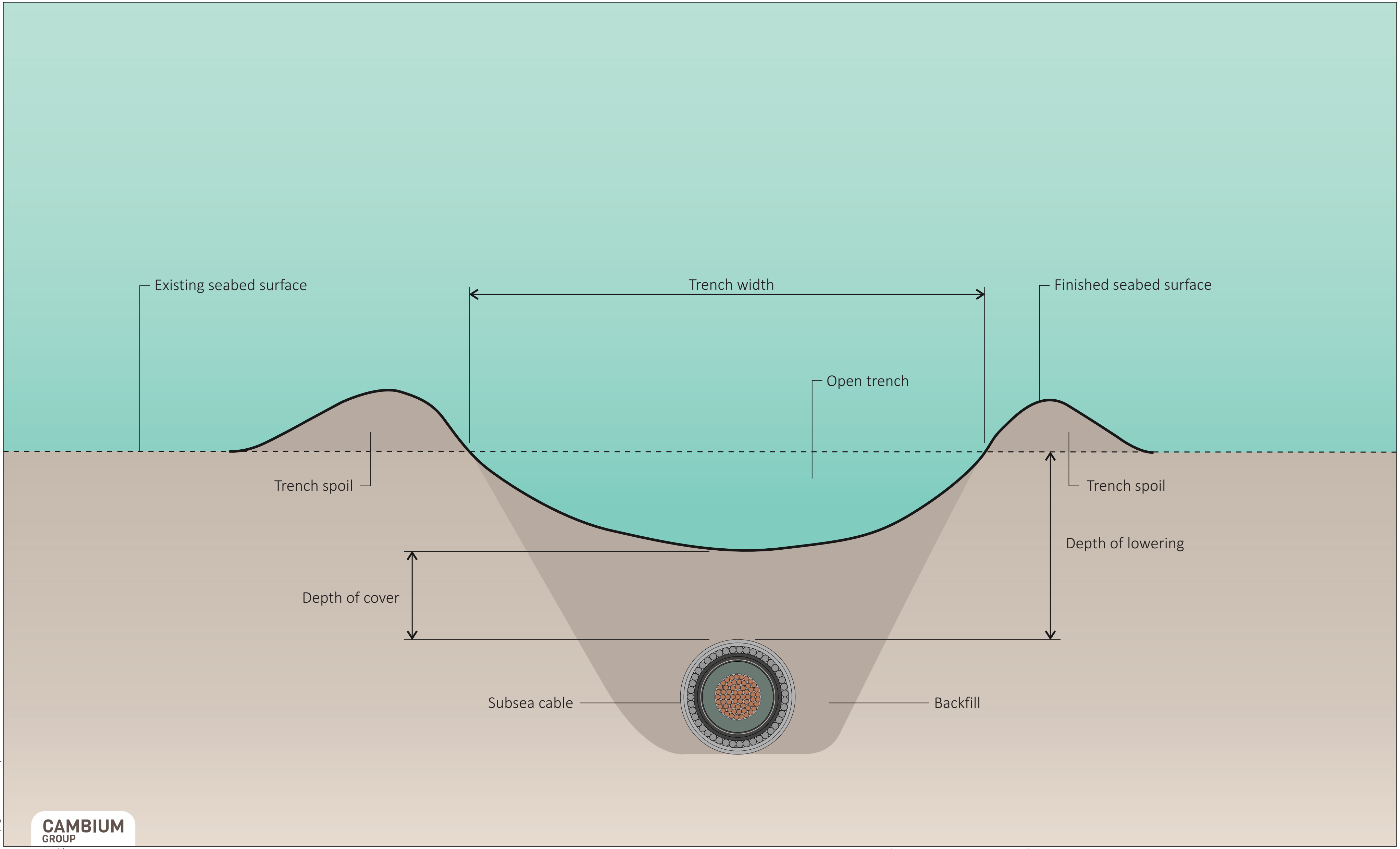

CAMBIUM GROUP

Source: Sun Cable

Sun Cable drawing ref: AAPL-GEN-CTA-GN-MAP-0001-A.pdf

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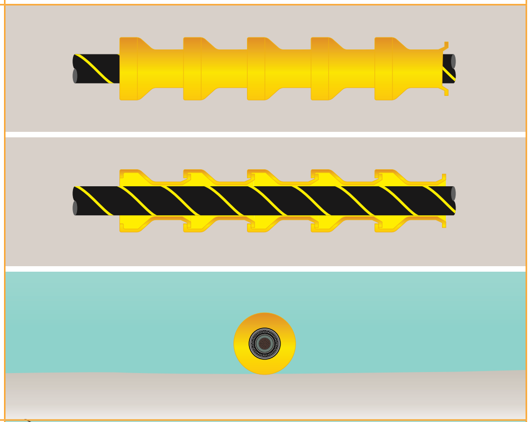
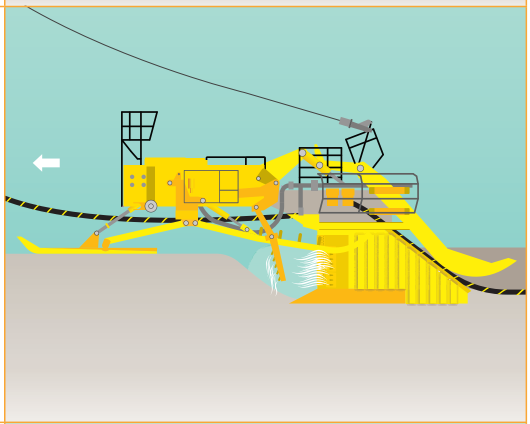
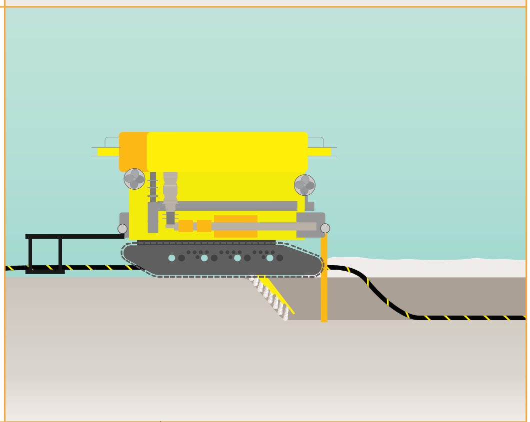
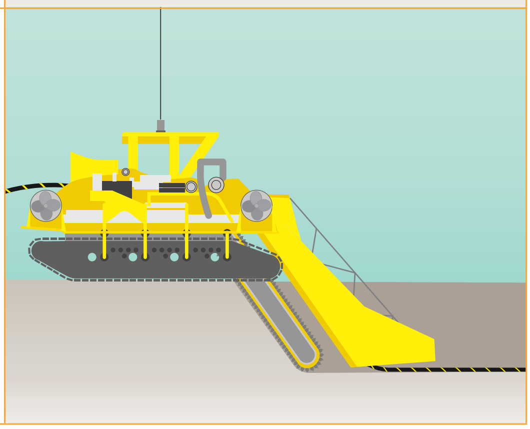
Figure 2-45. Typical cable trench profile and definitions of terminology

Method	Description	Applicable Seabed Type	Typical Equipment
Polyurethane shells	Applied to the cable as it is over boarded from the cable laying vessel to provide mechanical protection over uneven seabed and increase stability of cables in high energy areas. May also be used for crossing protection together with concrete mattresses and / or rock placement	Rock and hard sediments	
Plough	Burial by plough towed either by the cable lay vessel (simultaneous lay and burial) or by a separate vessel (post lay burial)	Sand, mud, silt, soft clay, gravel	
Jet trenching	Powerful water jetting tool used to fluidise seabed and allow surface laid cables to sink	Sand, mud, silt, soft clay	
Mechanical trenching	Cutting of a trench by a wheel or chain cutter, either pre-lay (so the cable can be laid into the trench) or post lay	Hard clay, limestone, calcarenite	

2.8.3.4 Crossings

The AAPowerLink cables will cross the Bayu Undan gas pipeline and the Northwest telecommunications cable and an out-of-service cables along the route through Australian waters.

Out-of-service cables

Disused cables will be severed with the permission of the cable owner. The cables are typically de-buried, cut and folded back on the seabed and stabilised by concrete weights or mattresses. The removal of out-of-service cables will be carried out according to the *International Cable Protection Committee (ICPC)* recommendations. Depending on burial depth of the out of service cable and local soil conditions, the cable will be exposed to the seabed surface by using jetting tools and/or a grappling hook dragged perpendicularly across the cable. One out-of-service cable is expected to be crossed in Australian waters.

Live cables and pipelines

For live cable and pipeline crossings, formal agreements will be entered into with the asset owner. The detailed methodology for crossing arrangements will be subject to the conditions of the agreement. The design of the crossing needs to protect both the cables and the third-party asset and address other aspects such as crossing angle and vertical separation.

The crossing physical design will vary according to, among other things, the size, type, location, and burial state of the crossed asset. Generally, the cables will cross over the asset on a 'bridge' comprised of either rock placement or concrete mattresses. This section will subsequently be covered over with a protective layer of either rock berm or concrete mattresses.

The minimum vertical separation between an existing cable / pipeline and the cables, typically 300 mm, will be agreed with the cable owners; and the crossing engineered to achieve the agreed vertical separation distance. The crossing design for each asset crossed will indicate the footprint of the impact to the seabed. The industry standard is a 7 m wide bridge over an existing cable.

During the operation of HVDC subsea cables, heat losses occur as a consequence of the resistance in the cable/conductor. AAPowerLink is likely to install XPLE insulated cables. These cables have maximum design operating conductor temperatures of 70°C. When the cables are in operation there will be localised heating of the environment surrounding the cables (i.e., sediment for buried cable or water in the interstitial spaces of rock armouring). The rate of heat dissipation, and magnitude of environmental heating, will be determined by a number of factors; most notably: the amount of power passing through the cables, the design of the cables and the thermal properties of the surrounding media.

2.8.4 Construction

Installation of the first Subsea Cable System (comprised of three cables) is planned to take place over 4.5 years commencing in 2024. Key construction stages, equipment and activities are summarised below. Section 2.10 provides details of the overarching AAPowerLink construction programme, including how Sun Cable will address environmental management requirements across the whole project area.

2.8.4.1 Pre-installation work

Pre-installation works are required to prepare the cable route and will comprise the following key activities:

- Marine survey
- Pre-sweeping
- Boulder clearance

- UXO (Unexploded Ordnance) clearance
- Route clearance and Pre-Lay Grapnel Run (PLGR).

Marine survey

Detailed marine surveys will be undertaken by Sun Cable to further investigate and select the preferred route option. A further survey will be undertaken by the cable installation contractor prior to commencement of installation. This typically takes place 6 to 12 months ahead of installation. The primary objective of these surveys is to obtain more detailed and current information on the seabed and complete a UXO (Unexploded Ordnance) survey. The survey will involve a range of standard geophysical survey techniques such as multi-beam echo sounder, side scan sonar, sub-bottom profiler and magnetometer; and geotechnical survey techniques such as cone penetrometer test, vibro core and piston core sampling.

Pre sweeping

Pre-sweeping will be required in areas where there are sand waves that are elevated above 1 m to prepare a flat working profile for the cable burial machine. The selected route of the Subsea Cable System will avoid areas of sand waves where possible; however, it is expected that pre-sweeping works will be required at locations along the route. The requirement for use of pre-sweeping methods will be confirmed during detailed design.

Where pre sweeping is required, a Mass Flow Excavator (MFE) or cutter-suction dredger (Figure 2-46) will be deployed in advance of the main cable lay spread to remove the tops off the sand waves to create the necessary seabed profile based on bathymetry. A MFE produces a downwards flow of water from a nozzle suspended 1 m above the seabed that pushes sediment to either side of the cable trench. Alternatively, a trailing suction hopper dredger can be used to collect the sand using suction pressure, for disposal at an approved location. If required, the aim will be to use current spoil disposal locations where possible in lieu of setting up a new disposal area; this construction methodology will be confirmed during detailed design.

F240 Mass flow excavator

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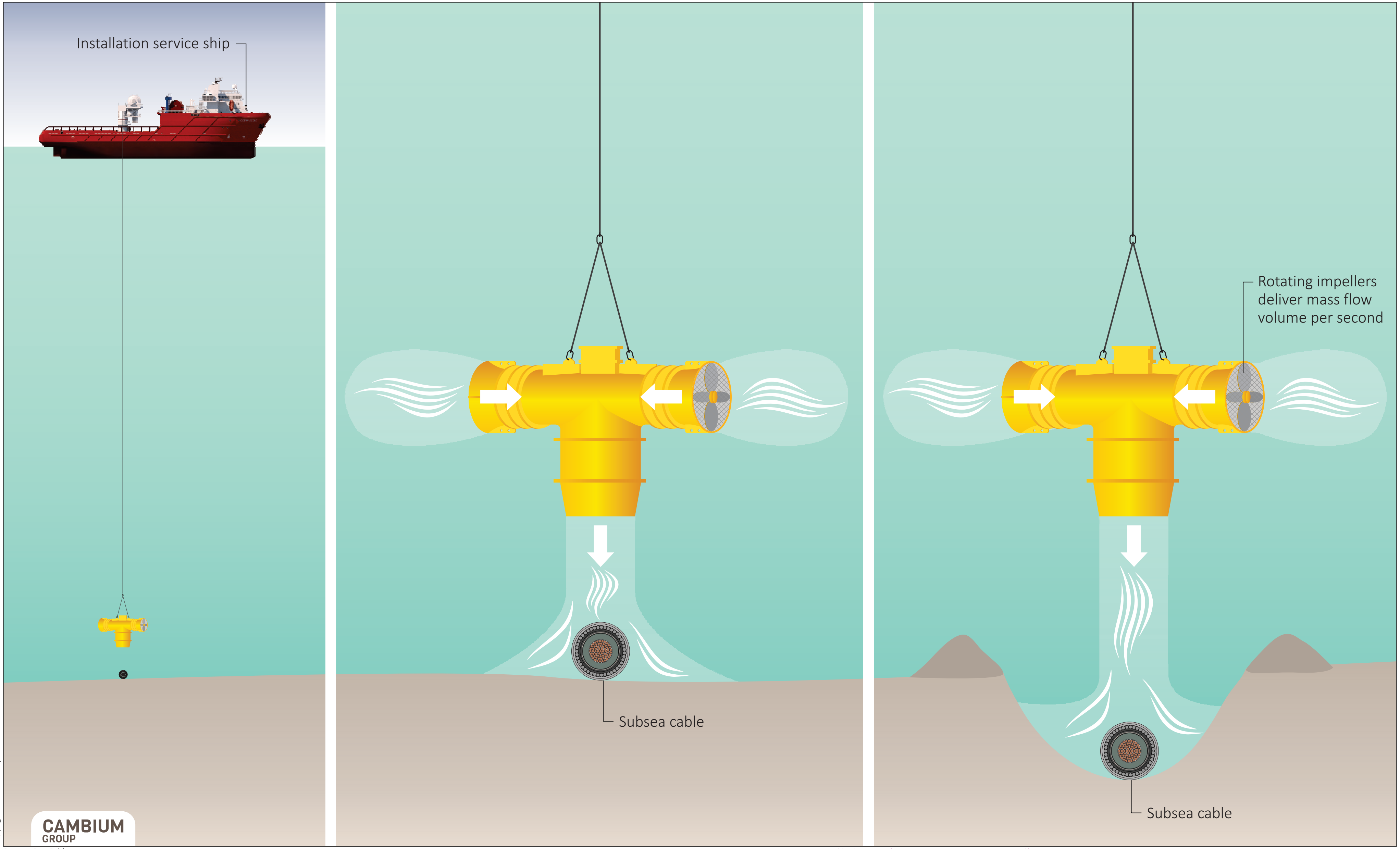

Source: Sun Cable

Sun Cable drawing ref: AAPL-GEN-CTA-GN-MAP-0001-A.pdf

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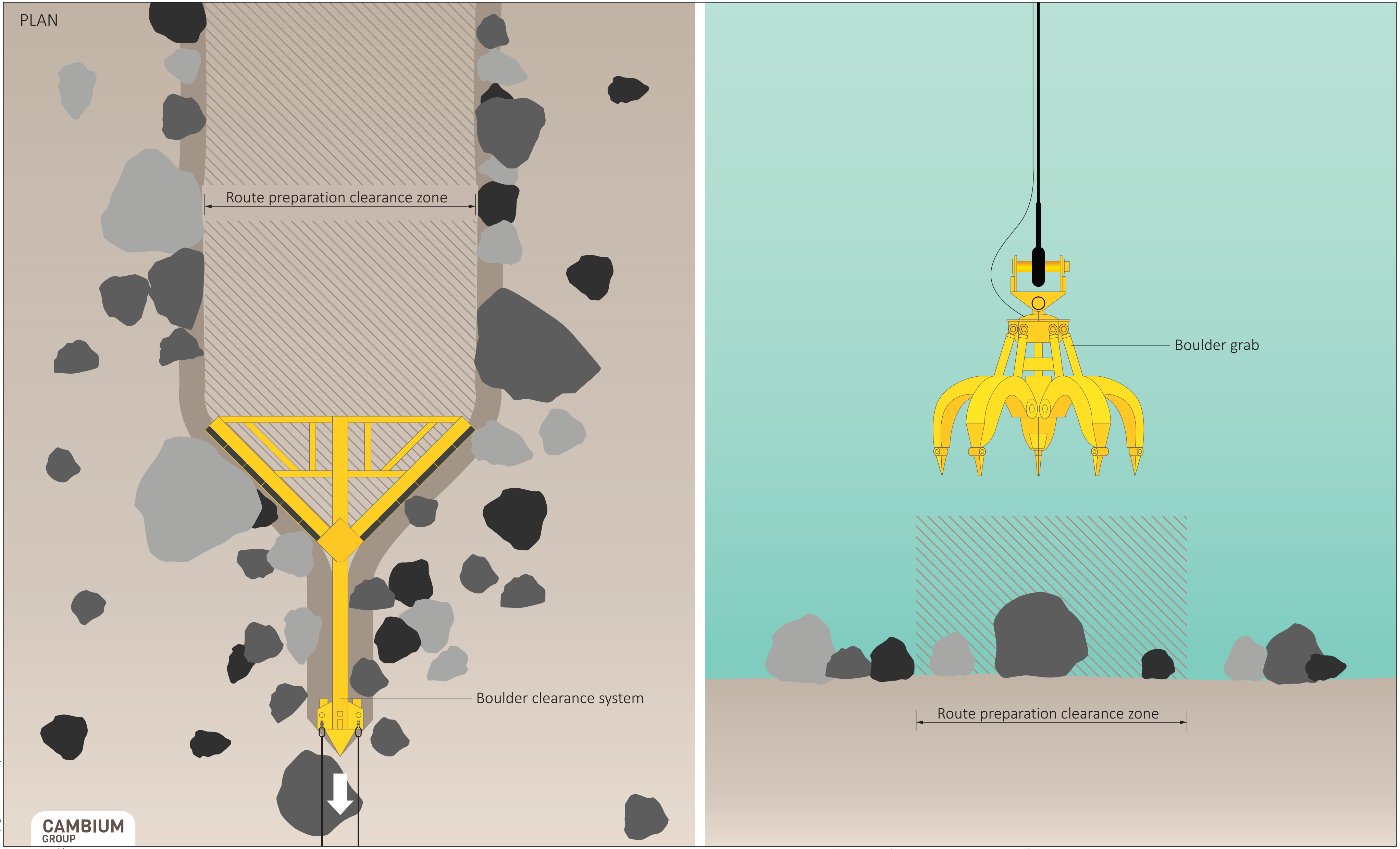
Figure 2-46. Illustrations of a Mass Flow Excavator (MFE)

Boulder clearance

To prepare a clear path for the cable to be laid and buried, in the event that there are boulders across the route, a boulder clearance operation will be undertaken. The locations will be determined during the detailed pre-construction survey. A boulder clearance plough or grab (Figure 2-47) will be used to clear a swathe between 10 m and 20 m wide. The plough method involves towing the plough across the seabed, pushing the boulders to one side. The grab method involves grabbing the boulders and moving them off the route.



Source: Sun Cable

Sun Cable drawing ref: AAPL-GEN-CTA-GN-MAP-0001-A.pdf

Cambium ref: 031186_Sun_Cable_AAPL_EIS_F241_Boulder_clearance_220304_v01

Figure 2-47. Photo of a typical boulder clearance plough (left) and boulder grab (right)

UXO (Unexploded Ordnance) clearance

Any UXOs that are identified/located using a magnetometer during the marine survey, will be avoided by a minimum clearance distance where possible, or alternatively will be removed by a specialist sub-contractor. The minimum clearance distance is determined by a risk assessment that considers the UXO type and the nature of the construction activity.

Pre-Lay Grapnel Run (PLGR)

The purpose of the PLGR is to clear any debris from the cable route, such as lost fishing gear, that could impact on the cable laying and burial operations. Most old cable and scrap wire is normally found at, or just below, the seabed. To remove this debris, a heavy grapnel with a series of specially designed hooks, or grapnels – approximately 1 m in width and with 0.5 – 1 m penetration depth (Figure 2-48) will be towed along the cable route by either a work boat or the cable lay vessel.

The grapnel will not be deployed within 100 m of any live cables and will only be used following close consultation with infrastructure owners and relevant authorities, and the PLGR operation may be phased to ensure that the route is clear of any recently dumped debris before each cable laying campaign. Debris retained by the grapnel will be collected on board and disposed of appropriately through licensed onshore facilities.

F242 Typical grapnel chain assembly

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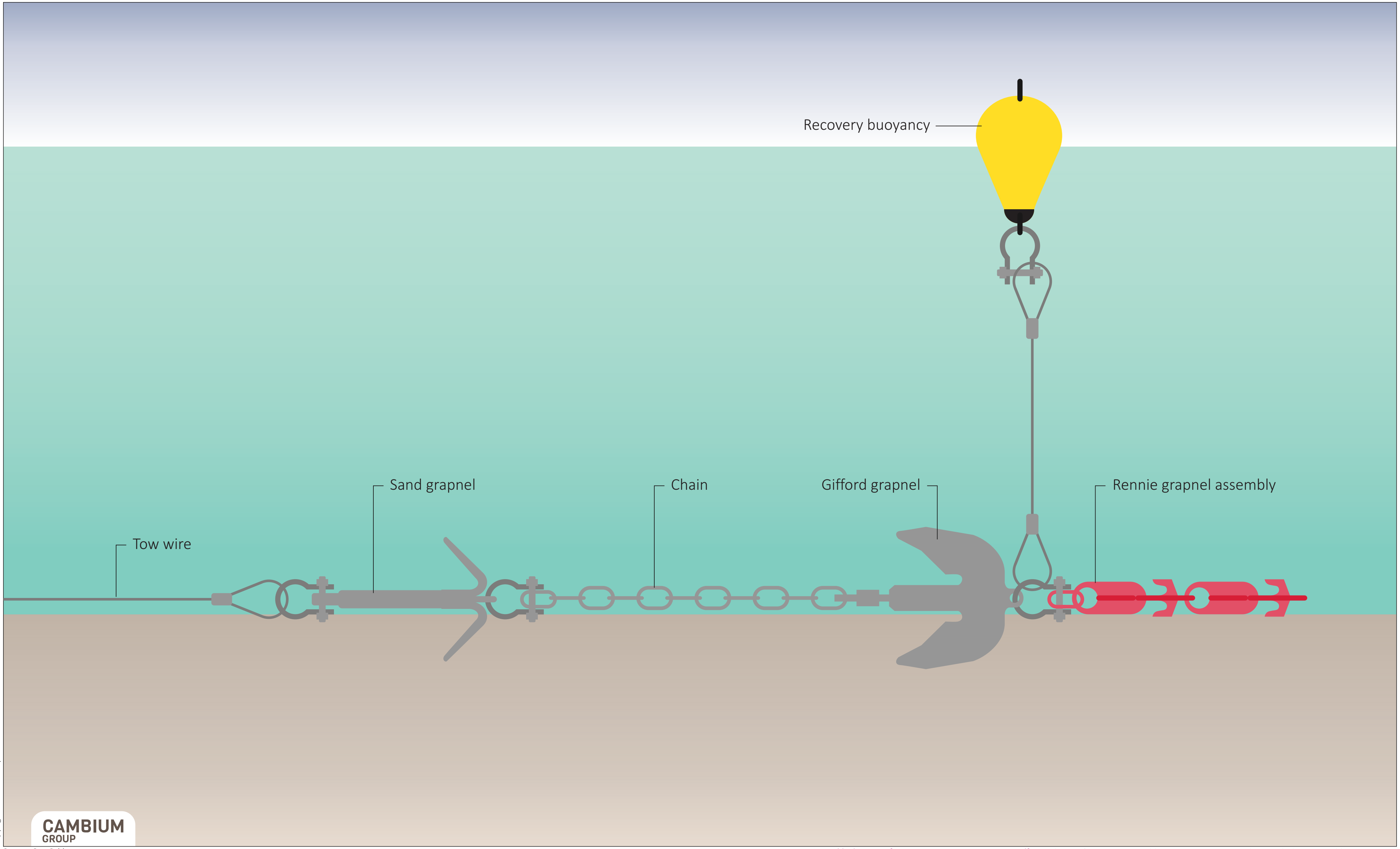

Source: Sun Cable

Sun Cable drawing ref: AAPL-GEN-CTA-GN-MAP-0001-A.pdf Cambium ref: 031186_Sun_Cable_AAPL_EIS_F242_Typical_grapnel_chain_assembly_220304_v01

Figure 2-48. Typical grapnel chain assembly

2.8.4.2 Installation works

The proposed cable installation method involves post-lay burial, whereby the cable will be first laid on the seafloor by a cable lay vessel or barge, and then buried in a separate operation involving a cable burial vessel. The layout of a typical cable laying operation is show in Figure 2-49 and the stages and activities are described in the sections below.

Fx Subsea cable laying

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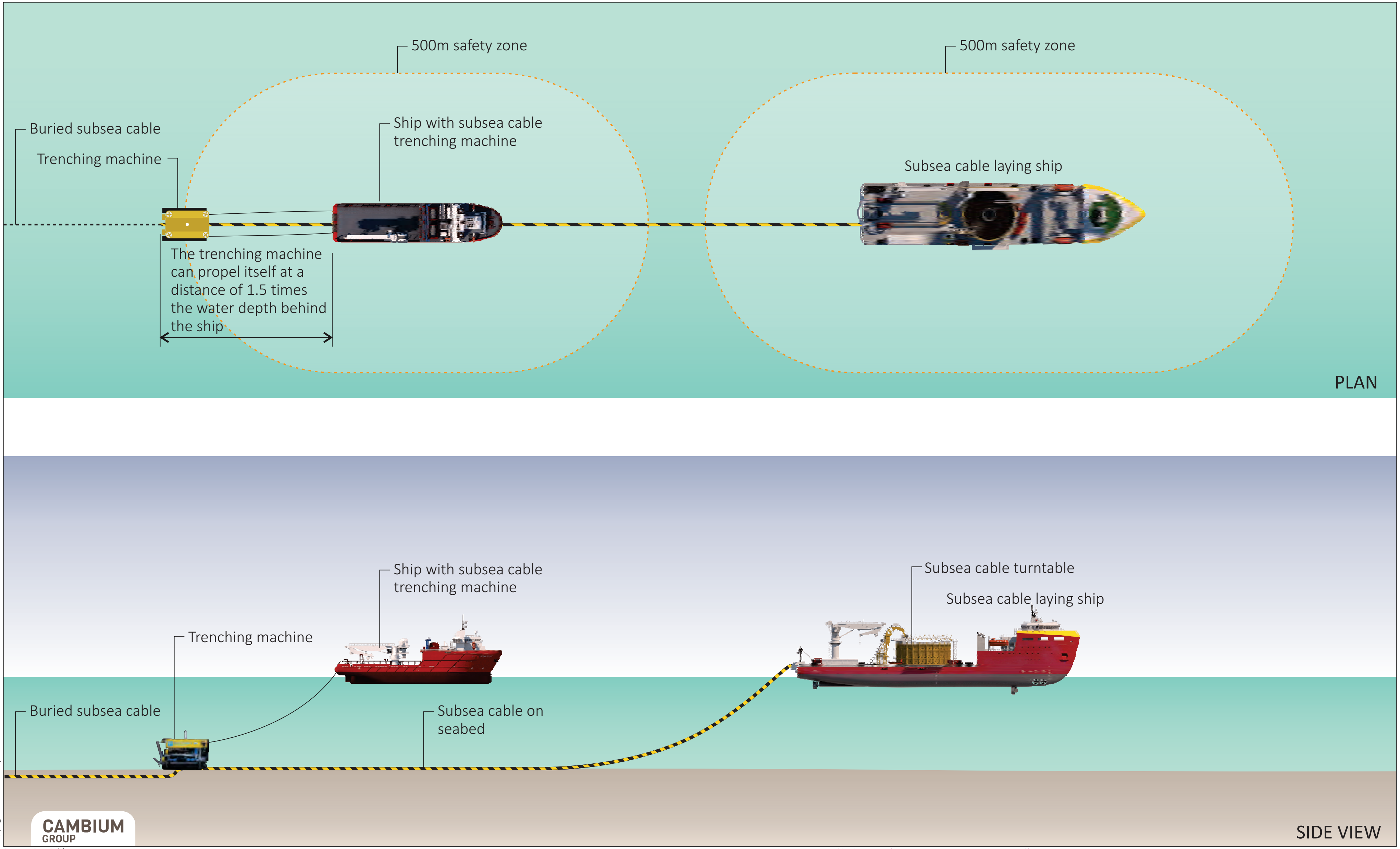

Source: Sun Cable

Sun Cable drawing ref: AAPL-GEN-CTA-GN-MAP-0001-A.pdf

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Figure 2-49. Illustration of layout of typical cable laying operation

Cable lay

The cables will first be laid out on the seafloor by a specialist cable lay vessel (CLV) or cable lay barge (CLB). CLVs are typically used in water depths of 10 m or more. For shallower waters, a CLB is used, which has the same cable lay equipment as a CLV (i.e., carousels, tensioners, winches) but is not equipped with engines or thrusters, hence minimising the draft to allow works in shallow waters. Photo examples of a CLV and CLB are shown in Figure 2-50 and Figure 2-51.

The cables will be loaded onto the CLV or CLB ship at the cable factory located overseas (location yet to be determined). Once loaded, the vessel will transit to a port close to the worksite for final mobilisation of cable handling crew, staff, and equipment, prior to heading to the work site. The vessels can carry long lengths of cable, more than 100 km, depending on the vessel used and the final design of the cable. Once the section of cable on board is laid, the ship will return to the cable factory to refill. When the CLV/CLB returns to the site of completion of the previous section of cable, the new cable section is joined to the already laid section as described in the relevant section below.

It is planned to start cable laying at the Shore Crossing Site in Shoal Bay. As described earlier in Section 2.7.3.7, the CLB will approach the Shore Crossing Site trench, and the cables would be floated to the start of the trench, winched in, and secured at the Land Sea Joint Station. The CLB would then commence laying the cable on the seafloor along the offshore route.

Cable laying can progress at speeds of up to around 500 m per hour and will be performed on a 24-hour basis to ensure minimal navigational impact on other users and to maximise efficient use of applicable weather conditions and vessel and equipment time. At this rate, laying of the Subsea Cable System within the AEEZ is anticipated to take about 2 months per cable/cable bundle, excluding any time for loading, unloading and offshore jointing.

Notifications will be issued in accordance with statutory procedures to ensure navigational and operational safety. In addition to the installation vessel(s), additional vessels (i.e., guard vessels) will be involved with the operation. This operation can continue in heavy weather. In the most severe weather, the vessel may have to cut and cap the cable and leave the worksite. In this case, the vessel will return when the weather has subsided, recover the end of the cable, make a joint and continue the laying operations.

The CLVs will be equipped with a remotely operated vehicle (ROV) and supporting camera equipment. In selected areas, such as at cable crossings and close to any sand waves/boulder areas, the ROV will be used to check the cable touch-down position to ensure correct positioning.

Figure 2-50. Examples of cable lay vessels (Source: Left: NKT, Right: Nexans)

Figure 2-51. Example of cable lay barge (Source: Geomares)

Cable jointing works

Between each cable section laid by the CLV/CLB, a joint will be required. There are two jointing methods that could be used as follows:

- Inline joints
- Omega joints.

Inline joints are carried out between a new cable section on the vessel and a cable section already deployed. The end of the deployed cable is brought up from the seabed to the vessel's deck and jointed to the end of the new cable section on board the vessel. Once jointing works are complete, cable lay resumes and the joint is deployed in line with the cable. The footprint occupied on the seabed for inline joints is the same as the cable.

Omega joints (otherwise known as hairpin joints or final joints) are carried out between two cable sections which are already deployed on the seabed and overlap one another. This scenario will occur when a separate vessel is used to conduct the jointing works or where a cable repair needs to be carried out. In this case, the joints need to be on board the vessel, which means extra cable equal to twice the depth of water is introduced into each of the two cable sections to allow for the jointing operation to take place.

The jointing process is illustrated in Figure 2-52. One of the cable ends is first brought up to the vessel, followed by the other cable end. Jointing works between both cable ends are carried out on the vessel. Once complete, the joint and the cables are paid out onto the seabed, forming an omega shape due to the excess cable lengths. The footprint occupied on the seabed for omega joints is much bigger compared to inline joints; 50 m to 200 m is required for joints in the water depths encountered along the route and as explained earlier in Section 2.8.3.2, is one of the key factors that determines the spacing required between each of the cables.

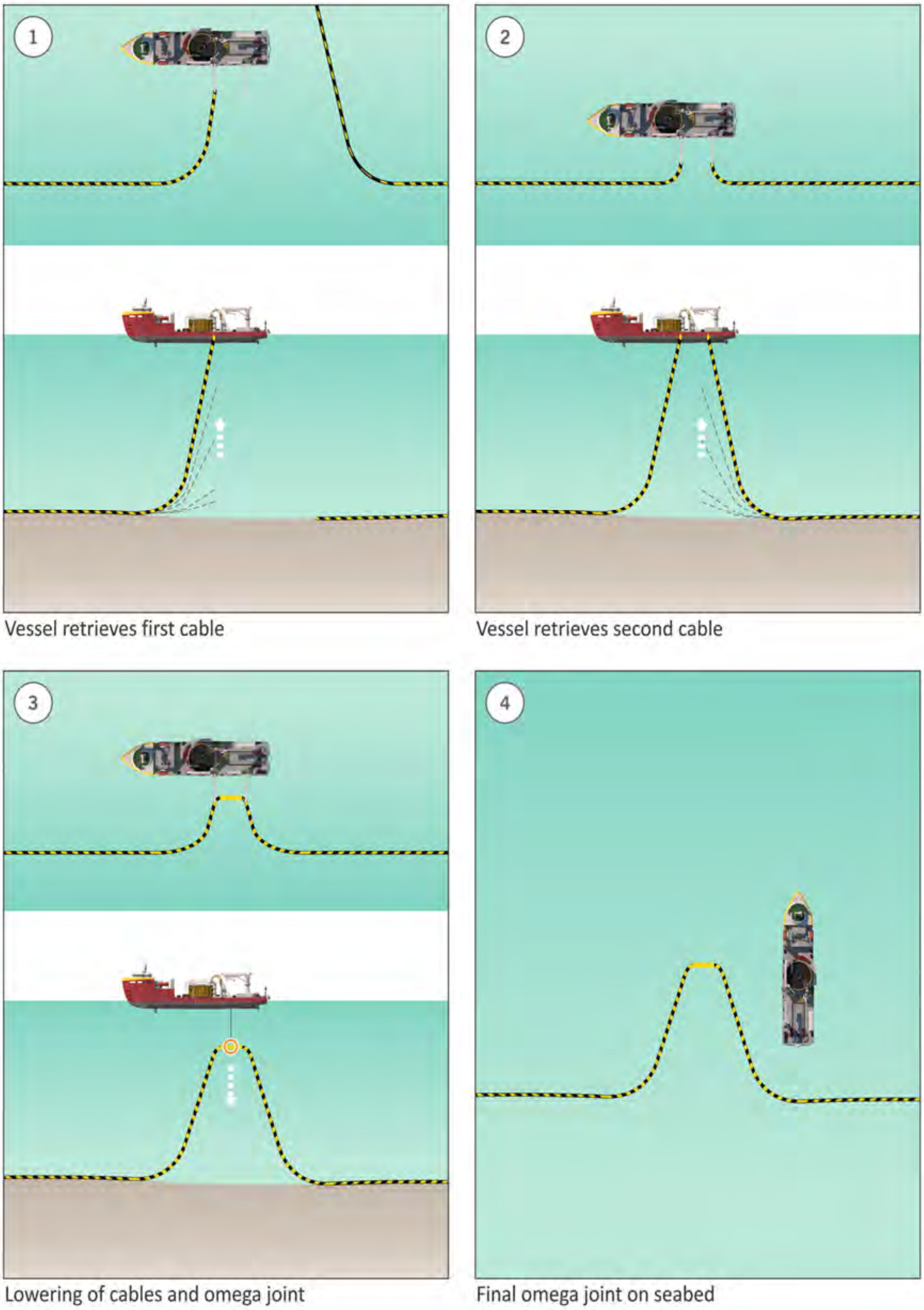


Figure 2-52. Illustration of process for installation of omega joints (Source: Cambium)

Cable burial

Over most of the route, the cables will be buried approximately 0.5 to 2 m. In areas where cable burial is not possible (e.g., at cable/pipeline crossings and areas of bedrock), or where the cable was inadequately buried during installation, the cable will be protected by installation of rock (gravel) or mattress armouring as previously described in section 2.8.3.3. The burial techniques being considered are outlined in the **Error! Reference source not found.**.

Jetting is the preferred burial method although this method may need to be augmented by mechanical trenching along short sections of the route. The choice of burial technique will vary along the route depending upon the seabed conditions in each section. This will be confirmed prior to construction.

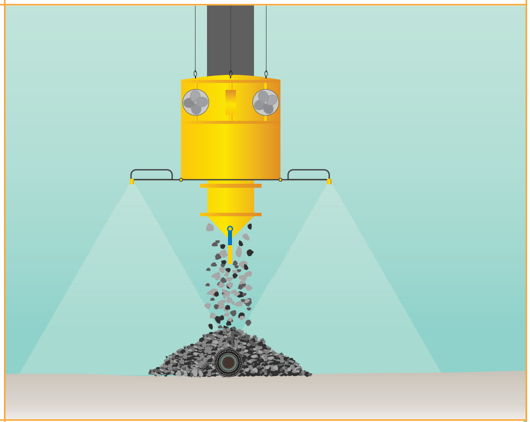
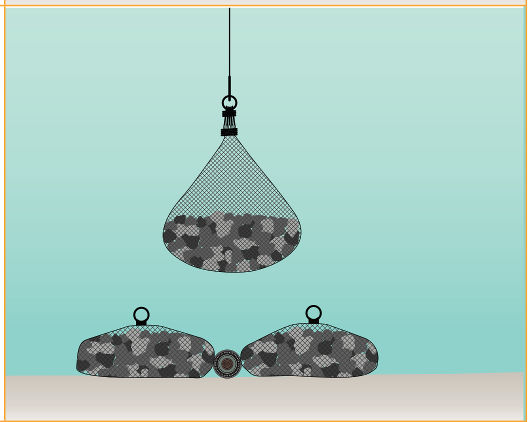
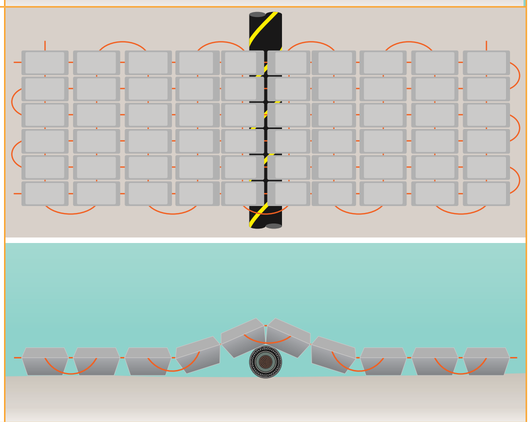
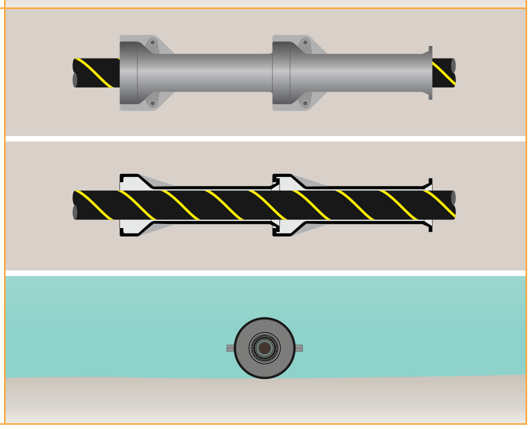
Jetting machines can be sled mounted and towed by the cable laying vessel or an auxiliary vessel, mounted on free swimming remotely operated vehicles, or mounted on self-propelled tracked vehicles. A specialised jet trencher may be used to cover the intertidal and shallow water sections of the route. Machine function is remotely controlled from the surface vessel via an umbilical cable. Examples of jetting machines are shown in Figure 2-53.

Jet trenchers sit on the seabed and follow the cable whilst employing high powered pumps to inject sea water either side of the cable which fluidises the seabed. The footprint of the trenching machine on the seabed is approximately 12 m wide, centred on the cable. As the sediments around the cable are fluidised, the cable naturally sinks between the jetting ‘swords’ and the trench left behind backfills from the natural movement of sediment on the seabed.

Post-lay survey

To ensure cables are adequately buried and to prevent navigational risk, a post-installation geophysical survey will be undertaken to demonstrate the successful burial and depth of the cables.

LEX 77989 DOCUMENT 2

Method	Description	Applicable Seabed Type	Typical Equipment
Rock Placement	Construction of rock berms over laid cables by specialist contractors using dedicated vessels and equipment. Rock berms are sometimes used to stabilised a seabed prior to cable laying and are also used for crossing protection with existing cables and pipelines.	Rock and hard sediments	
Rock Bags	Placement of rock bags over laid cables by crane and from a general marine installation vessel. Rock bags are sometimes used to stabilise the seabed prior to cable lay	All	
Concrete Mattresses	Usually used for protection at specific points such as crossing of existing cable. Laid by crane from a general marine installation vessel	All	
Cast Iron Shells	Applied to the cable as it is over boarded from the cable laying vessel to provide mechanical protection over uneven seabed and increase stability of cables in high energy areas. May also be used for crossing protection together with concrete mattresses and / or rock placement	Rock and hard sediments	

LEX 77989 DOCUMENT 2

Fx **Deep water and shallow water jet trenchers**

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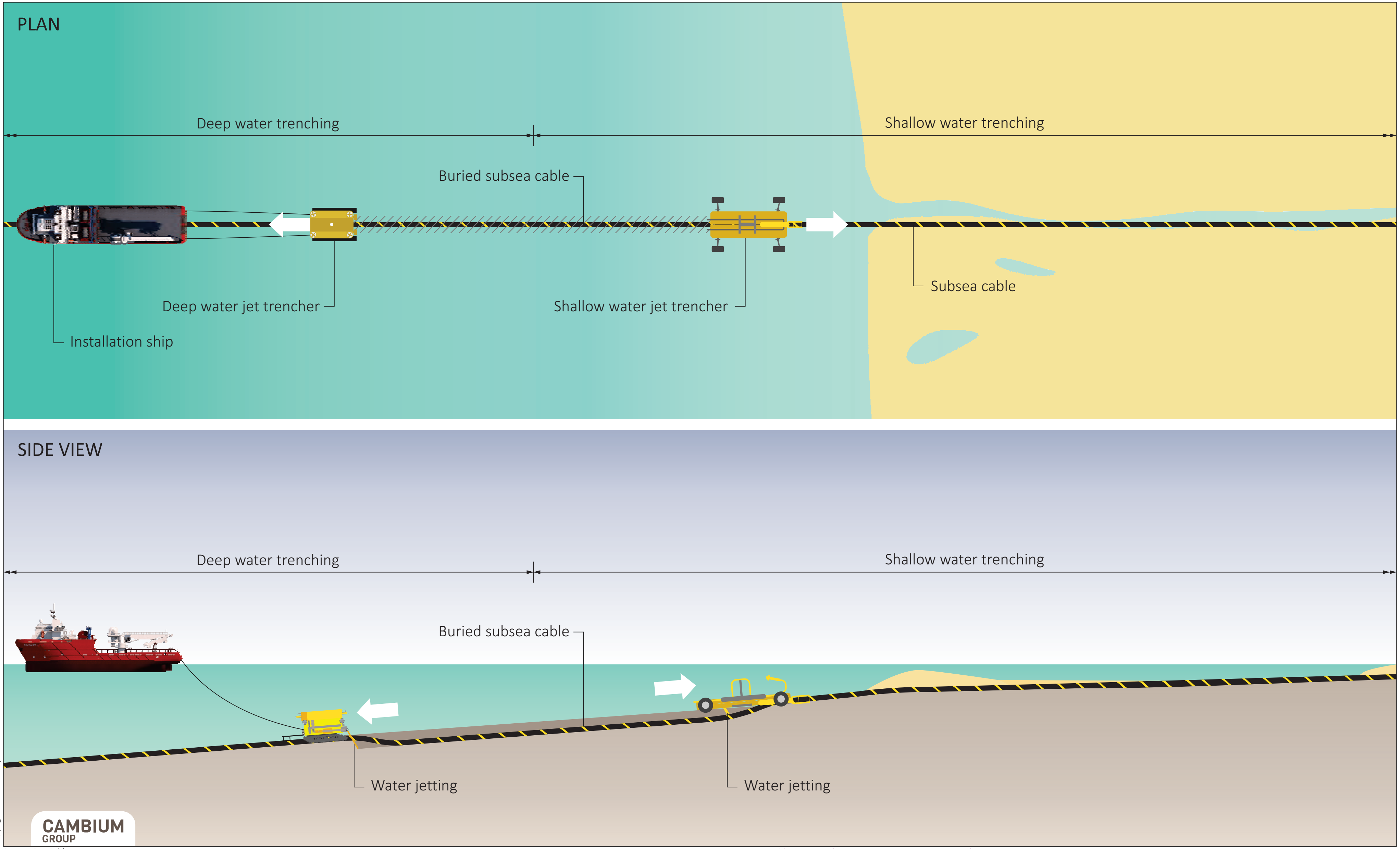

Source: Sun Cable

Sun Cable drawing ref: AAPL-GEN-CTA-GN-MAP-0001-A.pdf

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Figure 2-53. Illustrations of a ROV jet trencher (left) and shallow water jet trencher (right)

2.8.5 Operation and Reinstatement

The shallow trench that is left following cable burial will be left to backfill naturally in accordance with industry standard. Time-series observations of surface laid, and buried cables show that the seabed typically returns to its natural state within months to years, with the rate of recovery depending upon (i) the mode of cable deployment, (ii) wave and current regimes, (iii) rates of sediment supply to the ocean, (iv) seabed topography and geology and (v) biological activity (Clare, 2021[6]).

2.9 Climate Change Considerations

Climate change is predicted to have a substantial impact on infrastructure into the future, which makes it particularly important that climate change risks are considered when siting and designing long-term infrastructure, such as the AAPowerLink with an operational life of 70 years. The NT *Environment Protection Act 2019* Section 42 requires that activities are assessed, planned, and carried out considering the impacts of a changing climate. Climate change predictions for the NT[7] include:

- An increase in mean temperatures across the NT; the range of temperature increase varies depending on the emissions scenarios, but by 2090 will be ~0.6-1.9 °C under a low emissions scenario, and 2.8-5.6 °C under a high emissions scenario (this range represents projected temperature increases across both northern and southern NT).
- An increase in extreme heat, with a doubling of the number of days over 35 °C by mid-century (2036-2065).
- Both wetter and drier rainfall conditions could occur, depending on the emissions scenarios, and natural variability will have a greater impact in the near future. Rainfall changes toward the end of the century are unclear, with a 45% reduction and a 44% increase in annual rainfall both possible.
- The intensity of heavy rainfall events, including cyclones, is likely to increase. Tropical cyclones are likely to become less frequent but more intense.
- Time spent in drought conditions will likely increase in central and southern NT (i.e., around the Solar Precinct).
- Fire weather will become harsher and more frequent, particularly in the southern and central parts of the NT (i.e., around the Solar Precinct).
- Sea level rise is occurring; with sea levels projected to rise by 0.28 - 0.64 m by the end of the century, and up to 0.85 m under a high emissions scenario. Rising sea levels will exacerbate the impacts of storm surges and other extreme sea levels. These sea level rises are modelled into the NT Government storm surge mapping for 2100.

Flood modelling has been prepared for the Solar Precinct for several Annual Exceedance Probability (AEP) events, including extreme events - 0.1% (1 in 1,000 year), 0.2% (1 in 500 year) and 0.5% (1 in 200 year) events (Appendix N). Included is a climate change assessment of flood inundation modelling using the midpoint of the percentage rainfall increase of the RCP 4.5 and RCP 8.5 climate models. The BOM and SILO rainfall record from the Lake Woods area from the past 120 years was projected for the future 120 years and increased relative to the climate change model in accordance with the percentages provided by the ARR Data Hub (Babister, Trim, Testoni, & Retallic, 2016).

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[6] International Cable Protection Committee Environment Update, Issue 220, December 2021.

[7] From *Climate change in the Northern Territory: state of the science and climate change impacts*, National Environmental Science Program (NESP) Earth Systems and Climate Change Hub (2020)

Results of the climate change modelling estimate that all Annual Exceedance Probability (AEP) levels increase by approximately 1.5mAHD[8] by 2140. Modelling also showed that when the lake exceeds 204mAHD, the lake outflows to a creek proximate to Newcastle Waters. This indicates that flood attenuation northward may reduce any potential impacts from flood inundation on the Solar Precinct. These results should be considered in light of climate change modellings inherent a level of uncertainty due to Australia's variable rainfall patterns and projections.

The Solar Precinct boundaries were established with reference to the climate change flood modelling with the objective of ensuring that most of the site is outside of all mapped flood extents. Within the site boundaries, infrastructure that is flood sensitive will be located outside of the mapped flood extents, and/or constructed on raised pads, ensuring climate change resilience for the Solar Precinct infrastructure.

Fire breaks will be installed around the site boundaries and a bushfire response capability will be maintained on site to protect people and infrastructure from increased risks associated with more severe fire weather conditions.

The OHTL infrastructure will be engineered to withstand wind gusts from severe storm events with reference to Australia Standards for the relevant wind zones, which include both inland and coastal zones of the NT. The OHTL infrastructure on the ground (i.e., poles) may become inundated near major watercourses such as the Katherine River, and inundation events may become more extreme or more frequent due to climate change. However, the OHTL poles can withstand inundation, and no poles will be located within watercourses (the maximum span between poles is 450 m). Climate change risks are not predicted to be significant for the OHTL.

The Darwin Converter Site and Cable Transition Facilities are located outside of the mapped extent for storm surge in 2100 (including 1 in 100 year and 1 in 1,000-year events). Therefore, they are not expected to become inundated, even in extreme events that could occur with a future changing climate. The infrastructure will be designed and constructed to comply with building regulations that apply in the Darwin Building Control Area, for cyclonic conditions. Fire breaks will be installed around the site boundaries and a bushfire response capability will be maintained on site to protect people and infrastructure from increased risks associated with more severe fire weather conditions.

The AAPowerLink infrastructure will be located, designed, and engineered to withstand impacts from climate change. The key climate change considerations for the AAPowerLink relate to the rainfall events and flooding around the Solar Precinct, sea level rise and storm surge at the Darwin Converter Site, intense cyclones affecting the northern parts of the OHTL and Darwin Converter Site and fire weather considerations.

Importantly, minimising greenhouse gas emissions (GHG) is essential to avoid the worst impacts of climate change, and rapid emissions reductions are required to stay below 1.5-2 degrees of warming (IPCC 2021). The AAPowerLink has been identified as a key contributor to the NT's target of achieving net zero emissions by 2050. It is estimated that the AAPowerLink when fully operational will supply ~10% of the NT's total energy needs.

This includes supplying ~30% of the Darwin Katherine Electricity System from renewable sources and supplying seven times that amount of energy to industrial customers in the NT. The averted emissions represent an opportunity for significant GHG emissions reductions as further discussed in Chapter 12 Atmospheric Processes.

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[8] Australian Height Datum

2.10 Construction Schedule

The onshore construction program will run for approximately 60 months and is scheduled to commence in the first quarter of 2024. The offshore construction program will run for approximately 57 months and is scheduled to commence in the second quarter of 2024.

The construction timing sequence is as follows:

- Commence early works Q2 2023
- Commence construction at Solar Precinct Q2 2023
- Construction of OHTL Q1 2024 to Q 4 2026
- Construction of Darwin Converter Site Q1 2025
- Commence manufacture of submarine cable – 2024
- Installation of submarine cables – 2025 – 2029 (based on availability of cable)

During construction, land-based works will operate during a standard day shift. In limited cases, night shift, or 24-hours operation may be needed depending on the construction activities. Marine construction is likely to have multiple shifts operating on around the clock.

2.10.1 Workforce

Details of the onshore construction workforce numbers and locations where these personnel will be based are provided in Table 2-8. The construction workforce will operate on a roster basis, and it is anticipated that labour will be sourced labour from Tennant Creek, Elliott, Katherine, Alice Springs, and Darwin regions, as well as further abroad where specialist skills and large numbers of personnel are required.

Table 2-8. Approximate construction workforce numbers and locations

Project component	Workforce numbers	Duration (months)	Location
Solar Precinct	1000	30	Temporary construction camp established at the Solar Precinct site (refer Section 2.4.4)
Overhead Transmission Line	460	30	Mobile 'fly' camps established at localities along Stuart Highway between Elliott and Darwin. Existing accommodation providers to be used where possible. Temporary camps to be established in remote areas. (Refer Section 2.5.4.1.)
Darwin Converter Site and Cable Transition Facilities	230	30	Darwin based
Subsea cables	60	4.5yrs	Specialised contractors mobilised from overseas with additional support vessels and crew from the Darwin region

During the civil and earthworks preparation of the Solar Precinct, the workforce will be a mix of FIFO and local contractors and limited personnel transported. Personnel will fly-in for their roster predominantly from Darwin, where it will be more efficient and safer for them to do so due to time and distance. During the civil works phase, it is envisaged that the Elliott Airstrip will be utilised. Elliott Airstrip is a public airstrip and accessible by several charter companies operating out of Darwin. Elliott is suitable for Cessna C441 Conquest, a twin-engine, pressurised aircraft capable of carrying 9 Passengers.

It is estimated that approximately 16 Cessna flights per week may be required into and out of the Elliott Airstrip during the first 20 months of the construction phase, while civil and earthworks are undertaken at the site. This period also includes the construction of the airstrip at the Solar Precinct to service the main construction workforce and in support of ongoing operations.

A bus service utilising coasters and minibuses will be used to transport personnel between Elliott airstrip and the Powell Creek Solar Precinct.

2.11 Operational Details

2.11.1 Workforce

An estimated operations workforce of 350 personnel will be required to operate the Solar Precinct and Darwin Converter Site including OHTL maintenance. The Solar Precinct workforce will be a combination of local workforce sourced from regional areas proximate to the site, and fly-in-fly-out of Darwin and other capital cities in Australia to make up the balance of workforce required to operate the project. Personnel will be based at the onsite accommodation camp, with minimal requirement for use of local accommodation in Renner Springs or Elliott post-construction. Specialist technicians and contractors brought in as required from within Australia and overseas. The Darwin Converter Site will be operated by personnel based in Darwin, who will drive to and from site daily.

2.11.2 Waste management

Waste streams produced at the Solar Precinct and Darwin Converter Site as part of day-to-day operations will include:

- Inert solid wastes
- Wash bay and sediment basin solids
- Municipal solid waste
- Putrescible waste
- Listed waste
- Grey and black water
- Sewage sludge
- Waste oils/lubricants
- Industrial waste
- Electrical componentry.

In addition, the solar panels may need to be replaced or repowered after 40 years and the batteries approximately every 15 years. Large volumes of solid wastes will be produced during these events, and Sun Cable will investigate an appropriate response to waste management in consultation with licensed facilities. This may include investigation of options for component recycling to reduce waste arising from project activities generated as part of these events and for any damaged components through the project life, as detailed in Section 2.12.

The limitations of local landfill facilities in the NT are noted. Sun Cable will develop an appropriate response to waste management in consultation with licensed facilities during construction and operations.

2.11.3 Key activities offshore

Once the Subsea Cable System has been installed and suitably protected, it is not expected to require routine maintenance. Arrangements for survey and repair are described below.

2.11.3.1 In-service survey works

It is likely that routine surveys using standard geophysical survey equipment and/or ROVs to monitor buried cable depth and integrity of rock-berms will be undertaken, particularly in the initial years of operation, and should the local environmental conditions change or be suspected as having changed. This is particularly true for areas of mobile sand waves and high energy areas (e.g., nearshore). Regular survey of cable crossings may also be a requirement of a particular cable crossing agreement. Periodic inspections may be undertaken to identify cable exposures or spanning.

2.11.3.2 Submarine cable repairs

The most common reason for repair of a cable is damage caused by external interaction, typically by trawlers and commercial ship anchors. Such damage is usually localised depending on the energy of the interaction and whether the cable is merely impacted, mauled (where something is dragged with force along the cable for a distance) or dragged from the seabed.

Where a cable fault is detected, the relevant section of the cable will be located and retrieved to the surface for inspection and replacement. A repair will typically be carried out by a single vessel. A shallow water repair, in less than 10 m of water, will typically be made using an anchored or jack-up barge. In deeper water, a cable vessel will be used.

A cable repair invariably requires the insertion of additional cables and two additional cable joints. The joints for a cable repair are referred to as omega joints as described earlier in Section 2.8.4.2 and illustrated in Figure 2-52. The additional cable length required for the repair may be equal to approximately three times the depth of water at the site, and longer if the cables have been damaged over a distance or if the fault is difficult to locate. The extra length of a repaired short cable section means it cannot be returned to its exact previous alignment on the seabed, so the excess cable will be laid on the seabed in a loop off to one side of the original route. The excess cable and first joint of a longer repair section can be laid ‘in-line’ along the original route whilst the final joint will form an omega loop on the seabed. The additional joints and the extra cable length will be buried, typically using jetting machines, concrete mattresses or rock placement deployed from either the repair vessel itself or a separate specialised vessel.

A cable repair operation might be expected to have a duration of several weeks, depending on the type and extent of damage, burial requirements, and operational constraints such as weather.

2.11.3.3 Electromagnetic fields

The AAPowerLink will transmit electricity using HVDC, which is recognised as having a significantly lower level of EMF than HVAC lines, which are more typically used in Australia. Measurable EMFs are not expected from the HVDC infrastructure. The location of the cables, buried in the seabed, means very localised EMFs pose no risk to people.

2.12 Decommissioning & Rehabilitation

The transmission infrastructure is designed to have a lifespan of 70 years, whereas the solar and battery components may need to be replaced or repowered after approximately 40 and 15 years respectively. Sun Cable will investigate an appropriate response to waste management in consultation with licensed facilities during construction and decommissioning phases. This may include investigation of options for component recycling to reduce waste arising from decommissioning of project components.

Sun Cable has committed to establish a Renewable Energy Centre of Excellence in the Northern Territory of which recycling opportunities are anticipated to be an integral consideration of the Centre’s objectives.

It is expected that extraordinary advancements in recycling technology will have been made available in the timeframe proposed for decommissioning around the years 2068 – 2098. Furthermore, PV recycling facilities already exist in Australia, with a further two to be commissioned in 2021. Also, recycling sub-optimal panels is unlikely to be the best option. At 0.5% degradation per annum, they will still have plenty of life left at 50 years and will be perfectly usable for third parties.

A Decommissioning and Rehabilitation Plan, with define closure objectives and agreed criteria, will be developed in consultation with the pastoral lease holders, Traditional Owners, and relevant government agencies, prior to commencement of these activities. The plan will address the procedures for decommissioning based on the objectives identified below.

- The objective of site rehabilitation post-operations is to return the sites to a self-sustaining, free draining stable landform. The Solar Precinct will be fully decommissioned and rehabilitated post-operations with the intention of returning it to pastoral land use.
- The Railway Corridor will be rehabilitated to pre-existing land use (i.e., a utilities corridor) once the overhead transmission infrastructure is removed. Alternatively, the infrastructure may be transferred to the NT Government for ongoing use / upgrades for the purpose of supporting electricity transmission across the NT.
- Sites in Murrumujuk will be rehabilitated in accordance with the relevant master plans in place at the time, including where practical, efforts to return vegetation to the sites.
- Underground cables and the Subsea Cable System will be decommissioned and left *in situ*, subject to a final rehabilitation and decommissioning plan to be approved by the relevant authorities.

2.13 References

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