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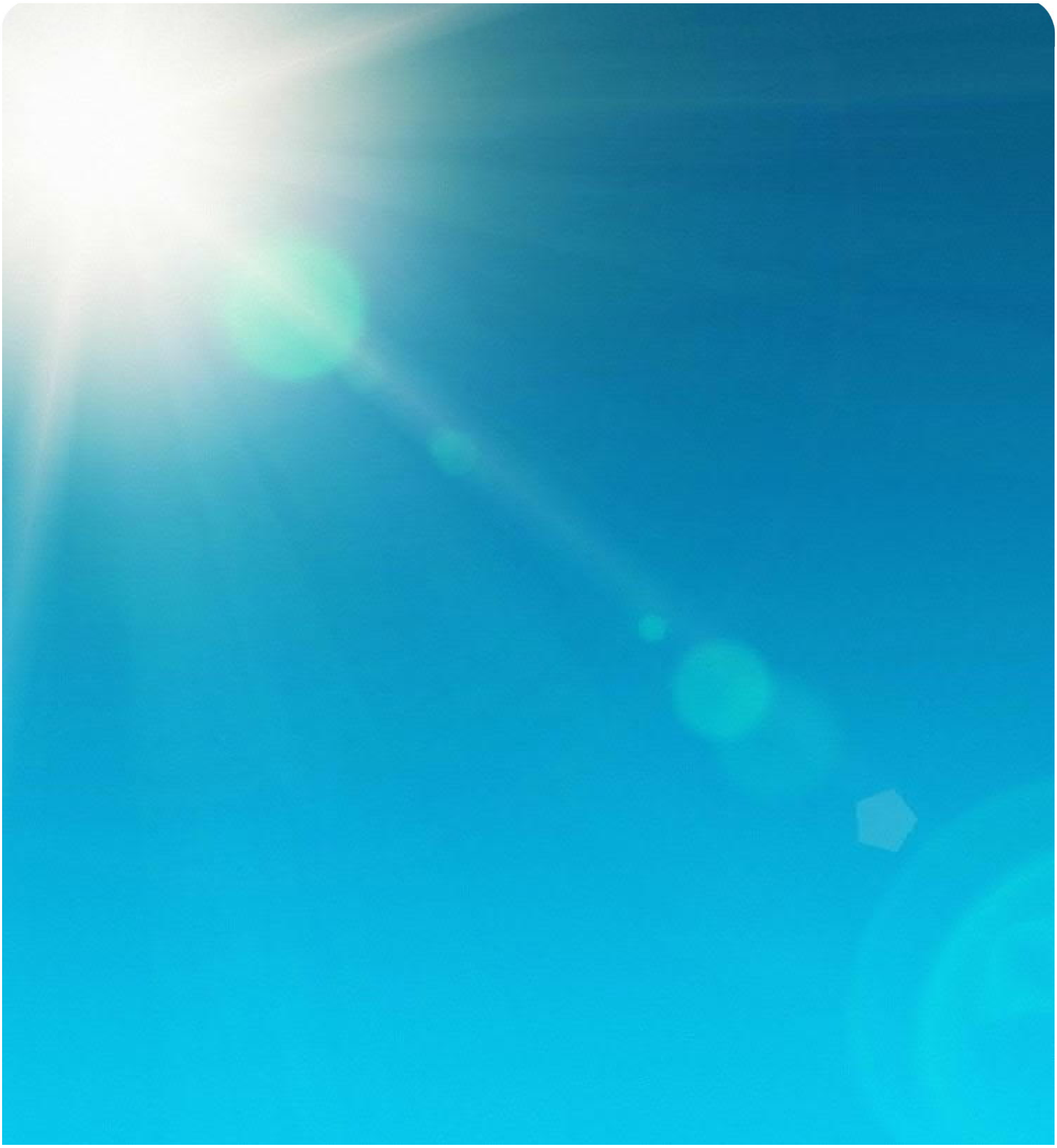
March 2022

Appendix M – Erosion Hazard Assessment

Australia-Asia PowerLink Environmental Impact Statement



Erosion Hazard Assessment

Australia-Asia PowerLink

Sun Cable Pty Ltd

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1 INTRODUCTION

EcOz Environmental Consultants (EcOz) has been commissioned by Sun Cable Pty Ltd to assess the erosion hazards and risks for the proposed Australia-Asia PowerLink (AAPowerLink) proposal, herein known collectively as 'the Proposal'. This document, an Erosion Hazard Assessment (EHA), is the first erosion and sediment control (ESC) related document for the Proposal, which incorporates a high level assessment of activities across the Proposal components, including, the Solar Precinct, the Overhead Transmission Line (OHTL) and the Darwin Converter Site.

An EHA is required to satisfy relevant approvals and for inclusion in the Environmental Impact Statement (EIS) for the proposal. It has been based on site information available at the time of preparation. A Primary Erosion and Sediment Control Plan (ESCP) based on additional site investigation data, and subsequent Progressive ESCPs, will be required prior to construction.

This assessment has been developed in accordance with International Erosion Control Association (IECA) best practice erosion and sediment control guidelines.

1.1 EIS Terms of Reference requirements

The Proposal is being assessed by the Northern Territory Environment Protection Authority (NT EPA) under the *Environment Protection Act 2019* (EP Act) at the level of an EIS. Information required in the EIS is outlined in the "*Terms of Reference (ToR) for the Preparation of an Environmental Impact Statement*" (NT EPA 2021). The ToR (Section 3.1 – Terrestrial environmental quality) require that an assessment be made as to the physical and chemical properties of the soil (including erosivity and fertility), existing erosion and other disturbances and address mitigation measures for erosion and sediment control. This EHA assesses this information.

1.2 Purpose

The purpose of this EHA is to assess the environmental hazard and risks associated with the Proposal works in relation to erosion. The EHA will provide a summary of the hazards and general high-level recommendations for erosion management as the proposal progresses. This EHA has been reviewed by a Certified Practitioner in Erosion and Control (CPESC).

It is intended as a preliminary, overarching, conceptual assessment or the proposal and does not include detailed provisions or designs for specific erosion and/or sediment controls (ESCs). Development of this assessment has been constrained by limited site specific information available at the time of preparation, and it is subject to change as further site investigations are conducted and detailed site information becomes available. This assessment is not approved for construction.

A Primary ESCP and a series of subsequent Progressive ESCPs will be required to describe work-site specific erosion and sediment management requirements for construction works and activities in site areas considered likely to have high erosion risk, and/or with potential to impact on sensitive environments. These site specific ESCPs shall be consistent and further detailed with the management strategies described in this EHA.

1.3 Scope

This EHA incorporates the following elements:

- Inclusion of an overarching erosion hazard and risk assessment
- Identification of the management strategy and controls to be implemented to effectively manage erosion, and subsequent mobilisation during the construction phase

2 PROPOSAL DESCRIPTION

The AAPowerLink proposal comprises six key components:

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

For the purposes of this EHA, only the terrestrial components within Australia of the Proposal have been assessed: the Solar Precinct, OHTL, Darwin Converter Site and Cable Transition Facilities.

The below sections provide a brief overview of the components of discussion, as listed above.

2.1 Solar Precinct

The site chosen for the Solar Precinct is located on the Powell Creek Station (located in the Barkly Region) approximately 70 km south-west of Elliott and 30 km west of the Stuart Highway and adjacent to the railway line. The Solar Precinct will occupy up to 12,000 ha of land for all solar fields, electrical and access corridors, ancillary infrastructure including the rail and logistics hubs, workforce accommodation, site offices and compounds and access roads. The 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.

Outside of the precinct, access roads, an airfield and OHTL services corridor connecting the precinct to the Stuart Highway and railway corridor, which will occupy approximately 236 ha of land.

2.2 OHTL

The OHTL is proposed to be predominantly located within the existing Alice Springs - Darwin Railway Corridor. 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.

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 cross Gunn Point Road. The section of the OHTL from Livingstone to Gunn Point Road is approximately 44 km and follows a Northern Territory Government (NTG) designated future utilities corridor that traverses the eastern outskirts of Darwin's rural area. The final 19 km of the OHTL continues within the NTG utilities corridor to the Darwin Converter Site at Murrumujuk runs parallel immediately west of the Gunn Point Road corridor.

Construction of the OHTL will require the use of a 12 m wide construction corridor along the entire OHTL route that will incorporate the OHTL structures and an access track to provide access for inspection and maintenance activities. For each OHTL structure, or pole, a temporary construction pad of up to 100 m (l) x 60 m (w) will be cleared to provide an area for assembly of the pole components and for operation of the equipment required to erect the pole. Construction will be staged along the OHTL with a series of work fronts across the length of the corridor.

2.3 Darwin Converter Site

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 immediately to the south of the access road to Murrumujuk and Gunn Point Beach. Within the site, approximately 55 ha of land will be developed, to house up to four Voltage Source Converters (VSC), a Battery Energy Storage System (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.

2.4 Cable Transition Facilities

The Cable Transition Facilities are located at Murrumujuk and comprise of three separate components to transfer power from onshore to offshore: Underground Cable Corridor, Land Sea Joint Station and Shore Crossing Site.

2.4.1 Underground Cable Corridor

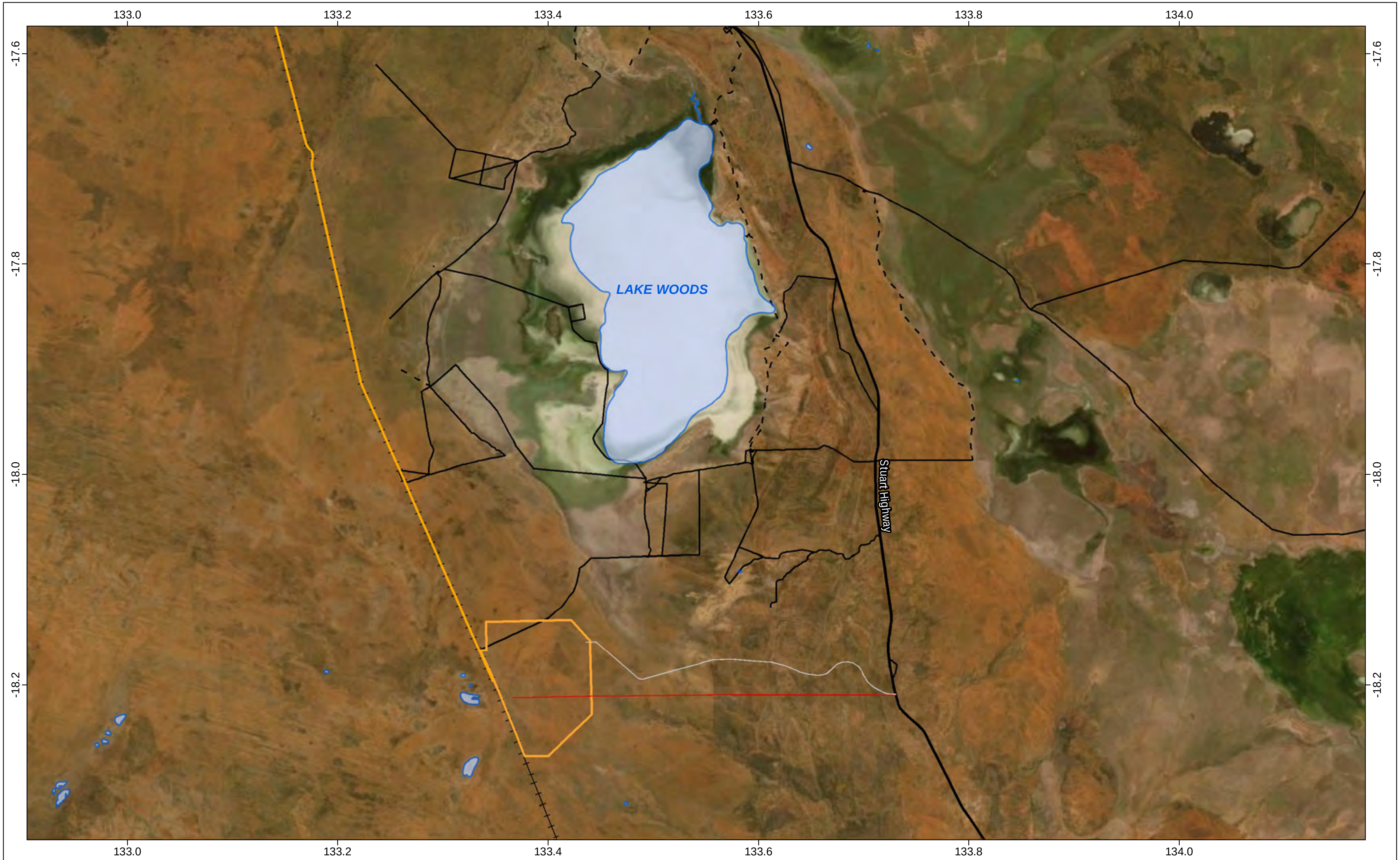
Power leaving the Darwin Converter Site en-route to Singapore, will be transferred by underground high-voltage direct current (HVDC) cables to the Land Sea Joint Station via an Underground Cable Corridor approximately 2.7 km long and 35 m wide, with a 9.5 ha footprint. The proposed corridor will be subject 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. The corridor will be partially cleared for construction purposes and reinstated with native grasses and cover species post construction.

2.4.2 Land Sea Joint Station

The Land Sea Joint Station (LSJ) will be a fenced 1 ha site located approximately 300 m inland from the beach. The Land Sea Joint Station will house multiple bays, one for each cable excavated to dimensions of approximately 20 m x 5 m, to connect the onshore cables to the offshore cables. The site will include a laydown construction area and accommodate excavators, generators, pumps, winches, surge arrestors, joint workshop, pipe storage, and ancillary infrastructure – including construction site offices, lighting, fuel storage and amenities.

2.4.3 Shore Crossing Site

The Shore Crossing Site is where the subsea cables will be winched from a barge located offshore to the LSJ Station. For each cable, an open trench will be dug from the LSJ Station across the shoreline out to the low water mark. The temporary trenches will be approximately 2 m wide and 0.5 – 2m deep. The cable will be laid in the trench and then buried using the material excavated from the trench. Post-construction, the land surface and beach will be reinstated and vegetation will be allowed to regrow. The disturbed corridor will then revert to an area with uninhibited public access consistent with current site conditions. Access to the area may be required for periodic faults, inspections or maintenance purposes.

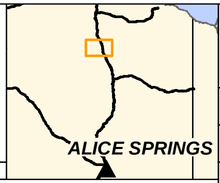


Legend

- OHTL
- Solar Precicnct
- Bitumen access road
- Gravel acess road
- Lakes
- Railway

Existing roads

- Principal road
- Secondary road
- Minor road
- Track



Map showing the location of the Solar Precinct

Project: Australia-Asia PowerLink	Reference: M-Files ID 206543	Figure 2-1	Revision: A
Coordinate System: GDA2020	Date: 02/12/2021		
0 5 10 15 20 Kilometers	Scale: 1:500,000	A4	

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

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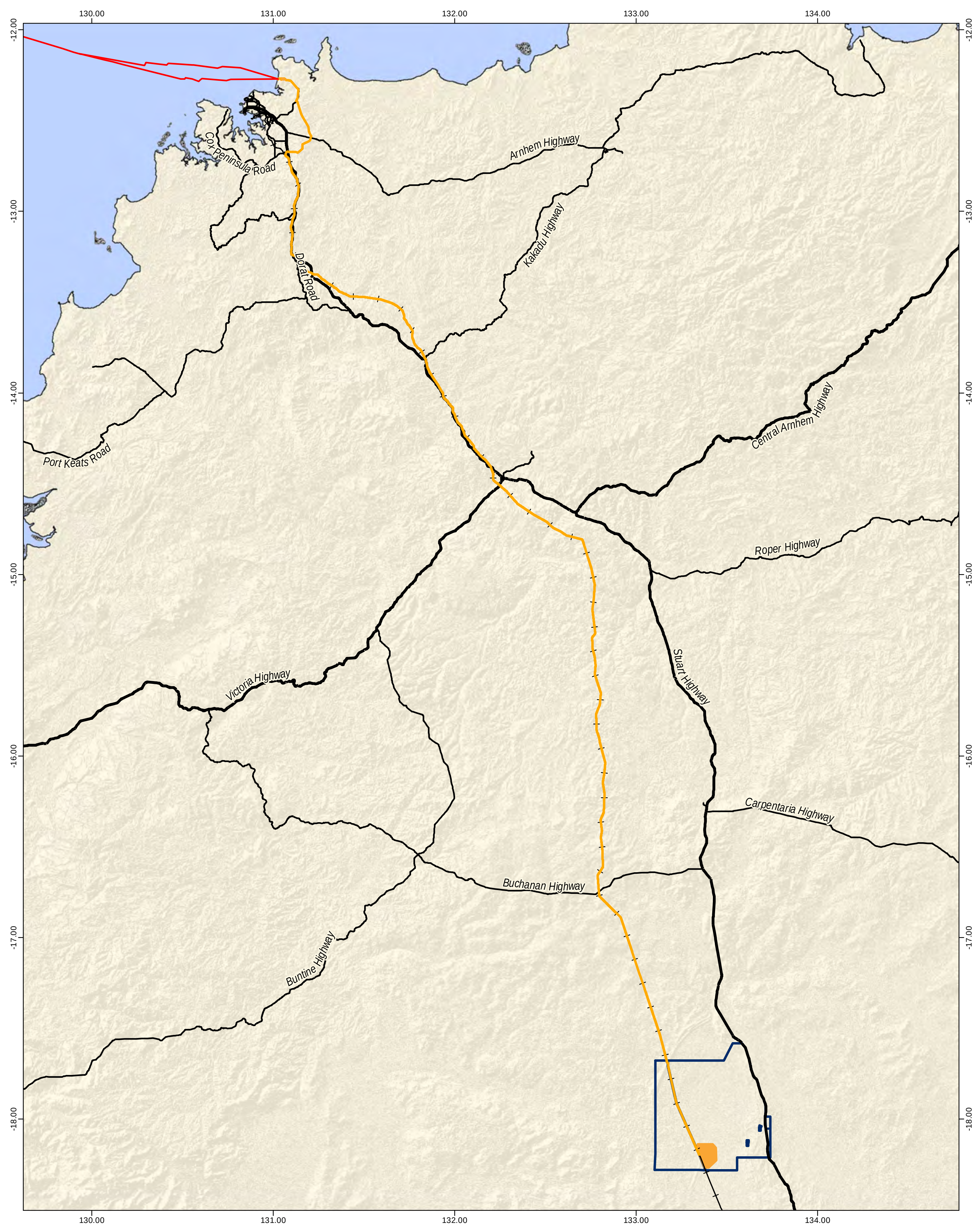


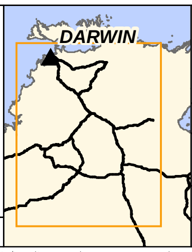
Legend

- ▲ Town
- Subsea cable corridor options
- OHTL Route
- Solar Precinct
- Powell Creek Station
- Railway

Existing roads

- Principal road
- Secondary road

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



Map showing the location of the OHTL

N

Project: Australia-Asia PowerLink

0 30 60 90 Kilometers

Scale: 1:2,900,000

Coordinate System: GDA2020 | A4

Reference: M-Files ID 206543

Date: 25/06/2021 | Figure 2-2 | Revision: A

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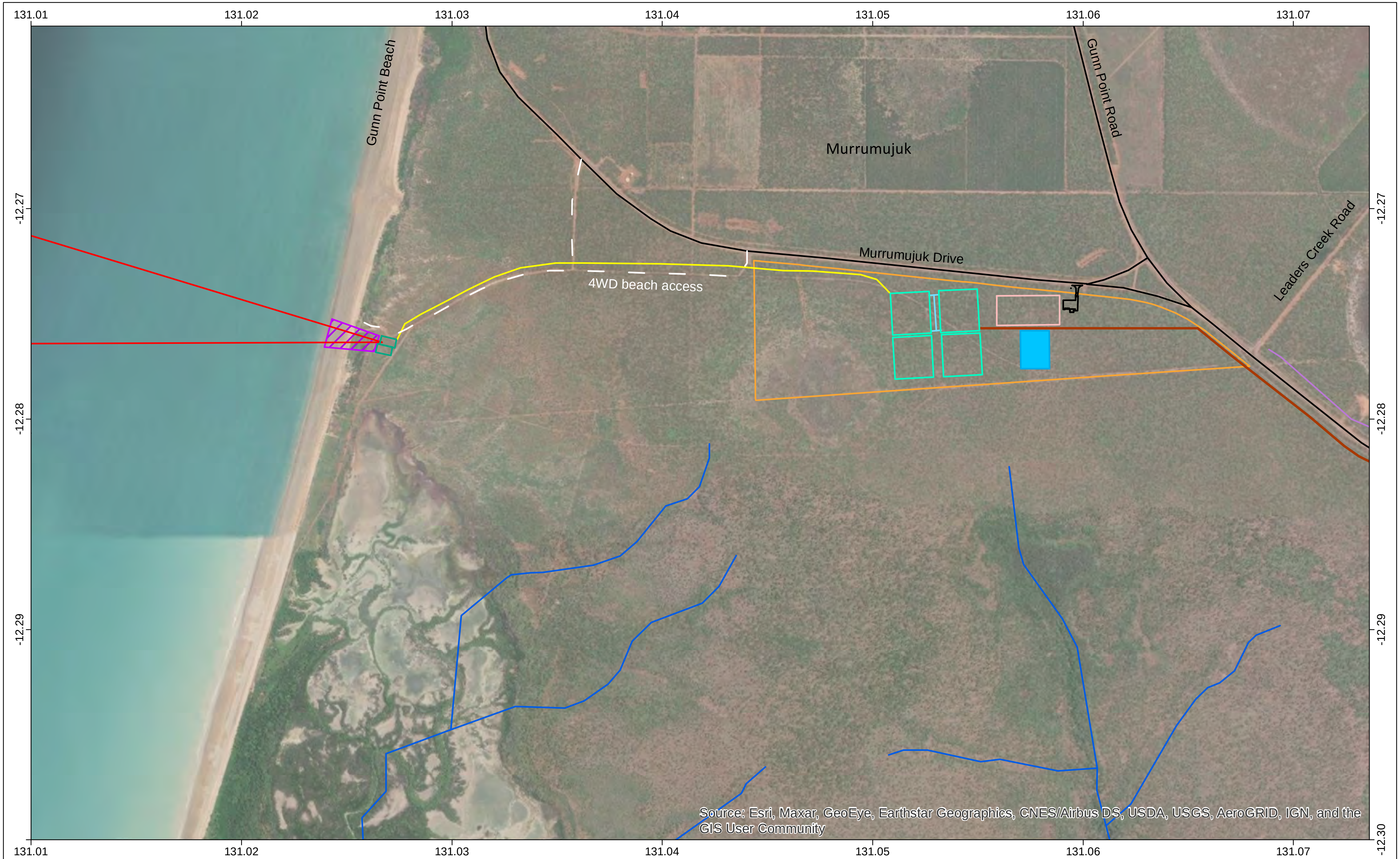

Legend

- Subsea Cable System Route options
- OHTL Route
- Darwin Converter Site
- Shore Crossing
- Battery Facility
- Land Sea Joint Station
- Operations and Maintenance Facility
- Voltage Source Converter
- Carpark and vehicle access
- Underground Cable Corridor
- Streams

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

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Map showing the location of the Darwin Converter Station and Cable Transition Facilities

Project: Australia-Asia PowerLink | Reference: M-Files ID 206543 | Figure 2-3 | Revision: A

Coordinate System: GDA2020 | Date: 02/12/2021

0 — 1 Kilometers | Scale: 1:25,000 | A4

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3 SITE CHARACTERISTICS

The site characteristics for each of the Proposal's components are summarised below.

3.1 Solar Precinct

3.1.1 Historical site activity

The Solar Precinct site has a history of pastoral land use and is developed with a number of access tracks, fence lines and bores. However, current pastoral activities on Powell Creek Station are of higher intensity in the north, which was one consideration when locating the Solar Precinct toward the southern boundary of the station. The closest residences to the site are at the Aboriginal outstation, Jangirurlu, which is 17 km to the east. The closest town to the Solar Precinct is Elliott, 70 km north-east.

Powell Creek Station is used by local traditional owners for hunting and fishing, particularly in the Lake Woods Conservation Area to the north east.

3.1.2 Climate

The site is located within an arid to semi-arid climate (referred by the Northern Territory Government (NTG) as the Arid zone), which is characterised by a low average annual rainfall and hot dry summers and cool dry winters. The closest, long-term, BoM water station is Elliott (station ID 015131), which is located approximately 70 km north of the Solar Precinct.

The mean average annual rainfall is 587.2 mm, with higher rainfall volumes typically occurring in the summer months associated with the northern monsoon. Annual rainfall can be highly variable from year to year – for example, 2019 experienced 97.6 mm of rain, while 2015 experienced 806.6 mm of rain. With the exception of 2020 – which exceeded the long term average by approximately 200 mm – the previous three years were below average.

Temperatures follow the seasonal patterns typical of northern and 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) – with the annual evaporation rate greatly exceeding annual rainfall. Surface water appears in streams and lakes seasonally during the wet season only.

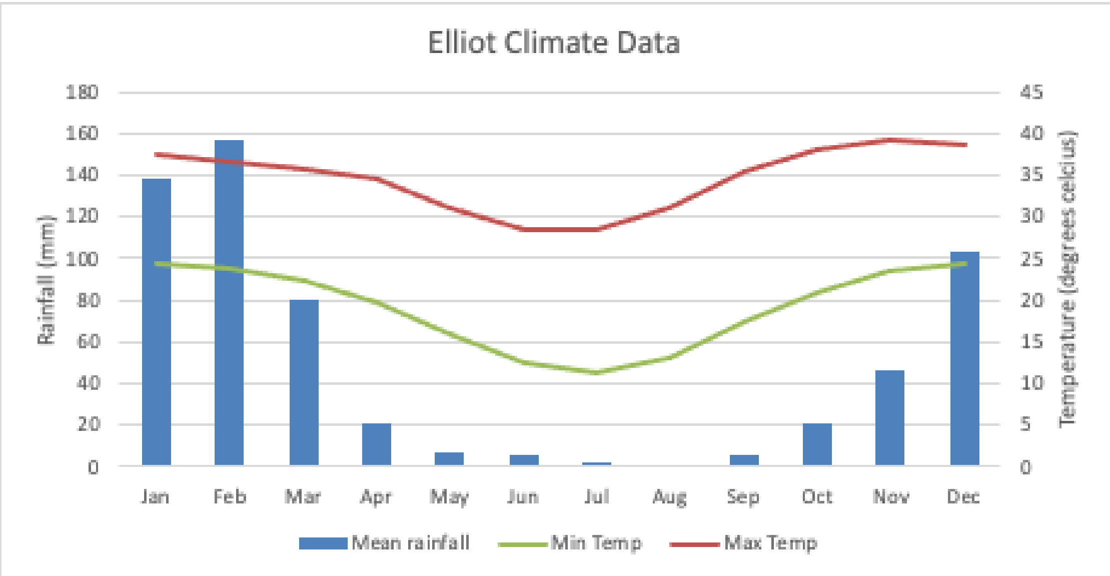


Figure 3-1. Elliott climate data (BoM, 2021)

3.1.3 Landform and soils

The Solar Precinct occurs mainly on Redsan land system, which is characterised by level to gently undulating plains with deep sandy soils, moderate erodibility and low likelihood presences of Potential Acid Sulfate Soils (PASS). Land types[1] across the Solar Precinct were mapped at 1:20,000 scale and land types along the access routes were derived from existing NT Government mapping (Lynch et al. 2012; Christian and Stewart 1968; Stewart et al. 1970), excepting for an approximately 12km section where no mapping is available. Field surveys undertaken by EcOz in November 2020 recorded land, soils and vegetation information at 76 sites in the Solar Precinct footprint, selected to represent each of the land types, and the main access route was subject to a helicopter flyover, to record the main landforms and identify any areas where specific values or sensitivities are present.

Solar Precinct

The land type mapping shows four land types present within the Solar Precinct, and five land types traversed by the sections of the proposed access routes where mapping is available. The helicopter traversed along the main bitumen access route identifying the following landforms:

- Low-lying lateritic plains
- Alluvial plains
- Low rocky hills, ridges and slopes (with lateritic soils with sandstone outcropping)
- Minor drainages and tributaries, often associated with rocky tributaries.
- Flat to undulating plateaux
- Black soil plains (small patch only).

Assessment of aerial imagery indicates that the unsealed access road route passes through similar land types. The four land types which occur within the Solar Precinct are provided in Table 3-1.

[1] A *land type* is a unit of land that incorporates 'a reasonably homogenous part of a land surface, distinct from surrounding terrain with consistent properties in landform, soils or vegetation' (Hooper 1970). They provide a finer level of detail than other types of regional mapping data – such as land systems, the National Vegetation Information System (NVIS) and land units.

Table 3-1. Land type summary (EcOz Environmental Consultants, 2021)

Land Type	Description	Soil description	Photograph	Area of survey area where soils occur
Land type A - sandplain	Sandplain; flat to very gentle slopes (<1%); drainage is via sheet flow in an easterly to north-easterly direction; there are no drainage features present; run-off is expected to be low (and slow due to little relief) with the majority of rainfall rapidly infiltrating into sandy loam soils.	Loamy sand; orange-brown to red-brown; no clay intersected during 1m auger at sites; Kandosols / Tenosols; thin sandy veneer on surface (aeolian deposits); some areas of greyish exposed loam; soil depth >1m; no surface gravel or rock; no outcrop present; erosion hazard is low; no salinity indicators present		11,107 ha
Land type B – loamy plain	Flat plain; gentle slope to the east (<1%); drainage is via sheet flow; no drainage features present; run-off is expected to be low and slow (due to little relief) with the majority of rainfall infiltrating into loamy soils.	Loam to sandy loam; grey-brown to red brown; Kandosols / Tenosols; loose sandy veneer on surface; numerous areas of greyish exposed loam; soil depth >1m; no surface gravel or rock; no outcrop present; observed erosion hazard is low; no salinity indicators present.		3050 ha

Land Type	Description	Soil description	Photograph	Area of survey area where soils occur
Land type C – alluvial flats	Flat plain; residual alluvial flats associated with significant (or potentially historic) outflow events from westerly flowing drainages from the Ashburton Range (namely Hunter Creek and, to a lesser extent, Burke Creek); drainage is via sheet flow; no drainage features present.	Sandy loam; grey to grey-brown, some area with redder tone associated with Aeolian (wind-blown) sands from adjacent sandplains; Kandosols / Tenosols some areas of minor crusting and cryptogam; numerous areas of greyish exposed loam; run-off is expected to be low and slow (due to little relief) with the majority of rainfall infiltrating into loamy soils. Water potentially takes longer to infiltrate in this land type; soil depth >1m; no surface gravel or rock; no outcrop present; erosion hazard is low; no salinity indicators present		957 ha
Land type D – shallow depressions	Shallow depression (localised); flat (<1%); minor run-on areas that become inundated for short periods of time following rainfall; drainage entering depressions is via sheet flow from surrounding plains (i.e. no drainage features).	Sandy loam; brown to grey-brown; Tenosols, Dermosols, Kandosols; seasonally inundated, but is not expected to hold water for long period of time due to sandy loam soils having a moderate to high infiltration potential; soil auguring only found clay soils at one depression (site 6); crusting and cryptogam are present; some large cracks present; termite mounds scattered (<1m); numerous areas of greyish exposed loam; soil depth >1m; no surface gravel or rock; no outcrop present; erosion hazard is low; no salinity indicators present.		118 ha

Access Tracks

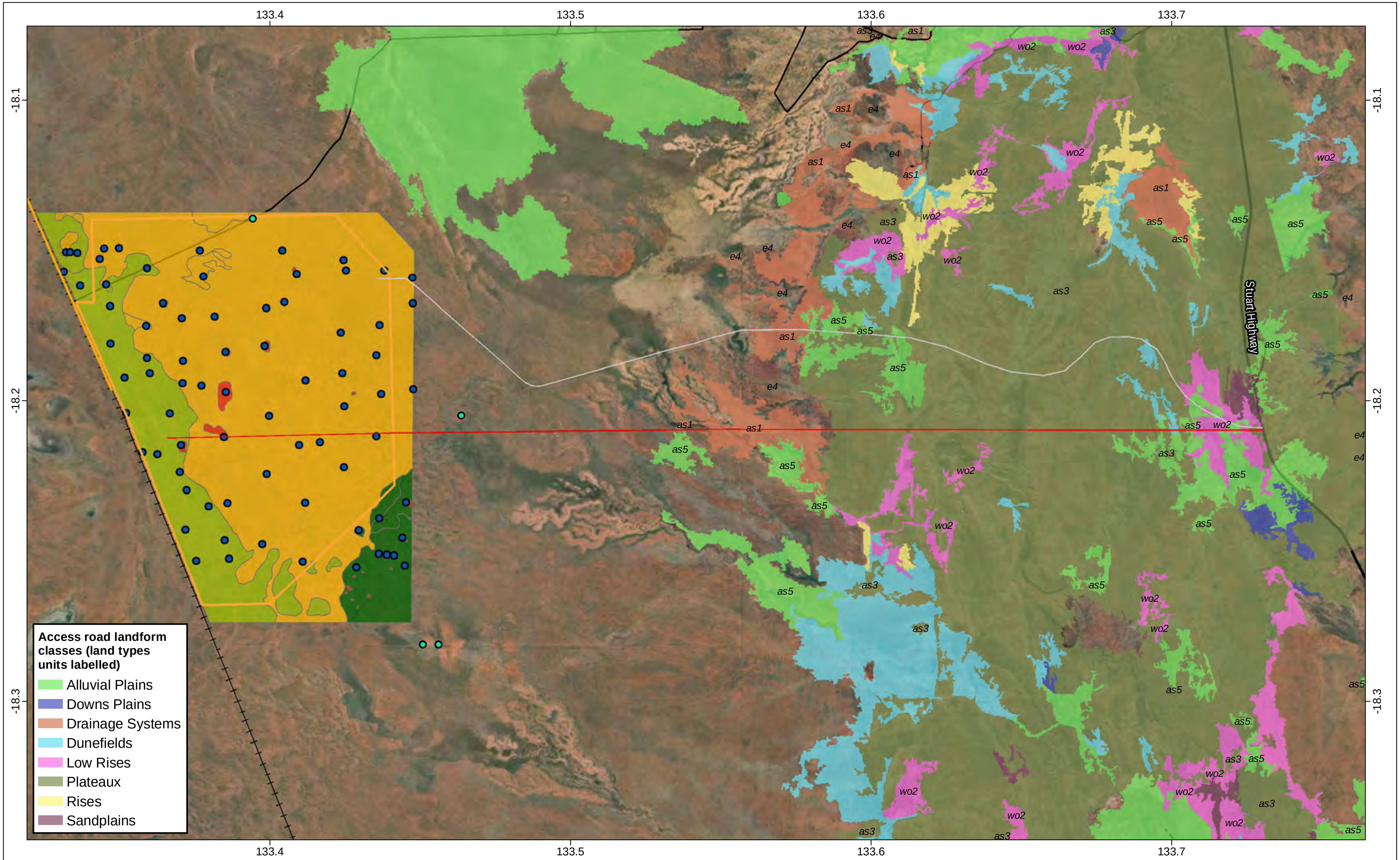
A desktop analysis of the landforms and soils intercepted within the access corridor are summarised in Table 3-2. Prior to the development of any Progressive ESCPs for the Solar Precinct, the land types within the access corridor will need to be verified.

Table 3-2. Existing land types intersected by the access corridor

Type	Landform	Soil
Sandstone hills – low hills, hills and stony plateaux on sandstone, siltstone, quartzite and conglomerate (deeply weathered in places); outcrop with shallow stony soils		
as1	Drainage systems. Valley bottoms with stream lines	Kandosols
as3	Plateaux. Nearly flat upland areas	Tenosols
as5	Alluvial plains. Valley bottoms with stream lines	Tenosols / Kandosols
Lateritic plains and rises – plains and rises associated with deeply weathered profiles (laterite) including sand sheets and other depositional products; sandy and earth soils		
e4	Dune fields. Gentle slops – some dunes	Tenosols
e4	Lateritic plains and rises Low flat areas	Tenosols
wo2	Low rises	Kandosols

Potential Acid Sulfate Soils

Potential acid sulfate soils (PASS) mapping indicates that there is a very low probability of PASS presence at the Solar Precinct site (Hill and Eadmeades 2008). In addition, Douglas Partners (2021) visually assessed the site to have an extremely low probability of PASS presence, with no requirement to be screened in further geotechnical investigations.

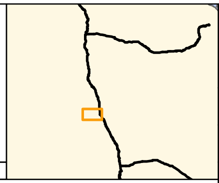


Legend

- OHTL
- Bitumen access road
- Gravel acess road
- Solar Precinct
- Soil sampling locations
- Land type check sites

Solar Precinct land types

- A - Sandplain
- B - Loamy plain
- C - Alluvial flats
- D - Shallow depressions



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Map showing the land types in the Solar Precinct and access corridors

Project: Australia-Asia PowerLink	Reference: M-Files ID 206543	Figure 3-2	Revision: A
Coordinate System: GDA2020	Date: 25/10/2021		
0 2 4 6 Kilometers	Scale: 1:175,000	A4	

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3.1.4 Topography and drainage

The local relief across the Solar Precinct and access tracks are minimal, with slopes ranging from 0.002% to 1%.

Apart from Lake Woods, all of the surface water in the region is ephemeral and episodic. The field survey, conducted in November 2020 determined that the Solar Precinct footprint does not contain any drainage lines or wetlands, however were noted in the access corridor routes. Rainfall run-off occurs as sheet flows towards the north-east. The road access corridor intersects a number of low order watercourses. The location of the Solar Precinct has been chosen to avoid impacts from flooding from Lake Woods (Surface Water & Erosion Solutions, 2021).

Lake Woods

The Solar Precinct footprint lies within the Lake Woods catchment. As detailed in the Hydrologic Modelling Study (2021), Lake Woods is a large ephemeral lake located approximately 30 km from Elliott. Lying west of the Stuart Highway, the lake generally occupies an area of approximately 350 – 500 km^2. However, during times of flooding and consistent heavy rainfall, Lake Woods can expand to occupy an area of over 1300 km^2. The modelled extents of Lake Woods during various Annual Exceedance Probability (AEP) events, which expresses the likelihood of a flood occurring in a given year as a percentage – i.e. 1 % AEP refers to a hydrological event that has a 1% chance of occurring in any given year.

Lake Woods is the largest ephemeral lake in the Northern Territory and is classified as being an *endorheic drainage basin* (De Caritat et al. 2019) – i.e. one that accumulates and retains water, and does not discharge to other drainage systems. Instead, its losses are due to evaporation or seepage.

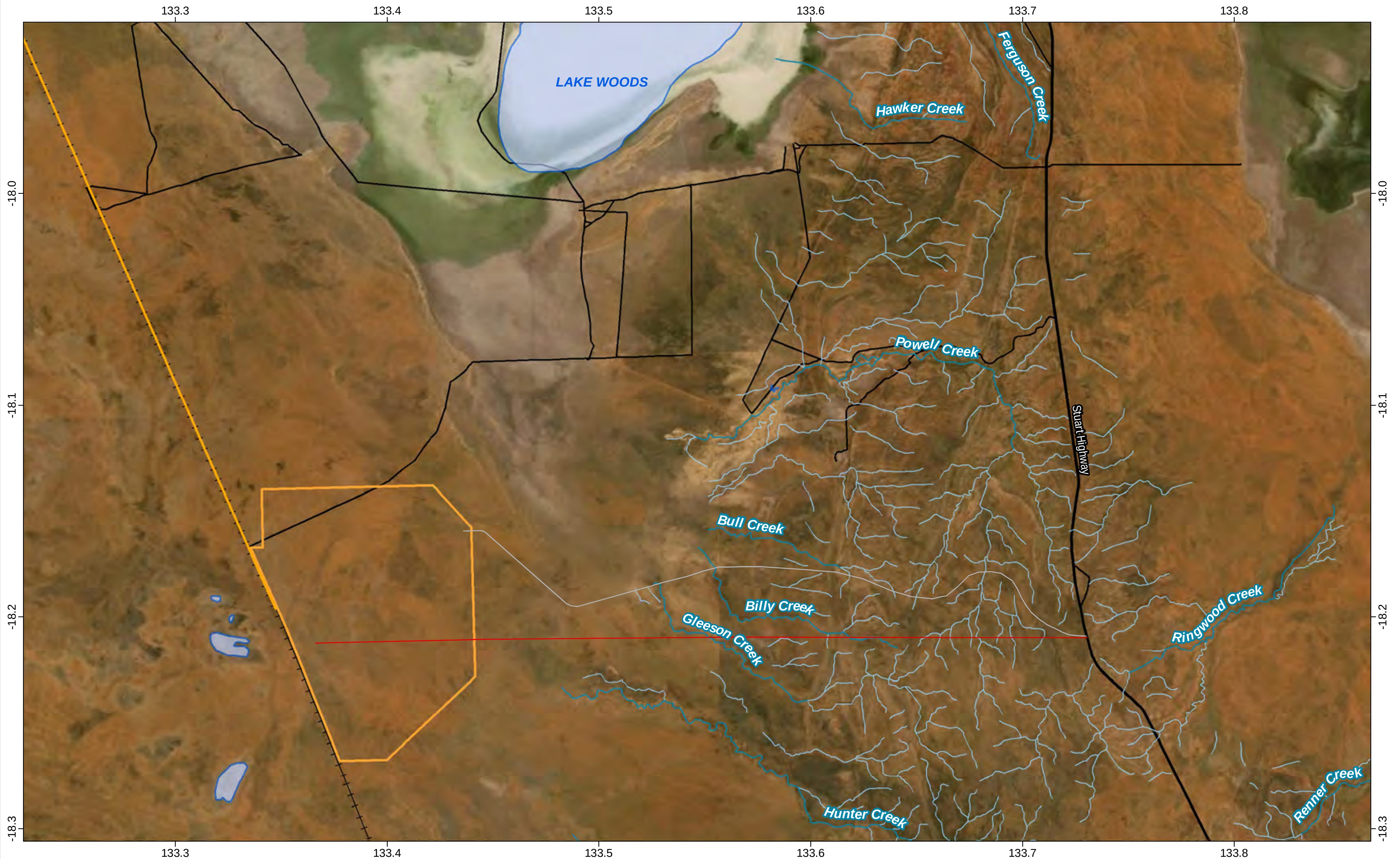
Lake Woods is located within the Wiso River basin, which extends from Alice Springs in the south, north to Daly Waters, west to Tanami (NT-WA border) and east to near Broadmere. The Wiso River basin catchment has a drainage surface area of over 78,000 km^2. There are three main stream catchments which impact surface water volume and flood impacts on Lake Woods. These are Lake Woods itself, Newcastle Creek catchment and Newcastle Waters (Ross Creek) catchment. The Newcastle Creek catchment covers an area of over 18,000 km^2 and is the most upstream catchment contributing to Lake Woods. The Newcastle Waters catchment is approximately 7,600 km^2 and receives inflows from Newcastle Creek. Lastly, the Lake Woods catchment is approximately 9,800 km^2 and lies downstream of the Newcastle Creek and Newcastle Waters catchments. The total drainage area of Lake Woods combined, including Ross Creek and Newcastle Creek is approximately 40,000 km^2 in area. There are smaller sub-catchments located south of the Lake Woods' catchments, which contribute to the inflows of Lake Woods.

Watercourses

The Solar Precinct does not encounter any drainage lines, due to its flat topography. There are a number of water crossings located to the east of the Solar Precinct site, upon which the access corridor may need to intersect during the construction phase of the Proposal. The drainage lines of interest include

- Bull Creek
- Billy Creek
- Gleeson Creek
- A number of minor ephemeral streams

Refer to Figure 3-3 for a visual representation of the drainage lines surrounding the Solar Precinct.

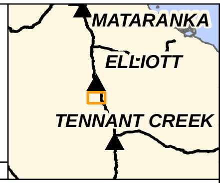


Legend

- OHTL
- Solar Precinct boundary
- Major Drainage
- Minor Drainage
- Bitumen access road
- Gravel access road
- Lakes

Existing roads

- Principal road
- Secondary road
- Minor road



Map showing Lake Woods, major watercourses surrouding the Solar Precinct and access corridors

Project: Australia-Asia PowerLink	Reference: M-Files ID 206543	Figure 3-3	Revision: A
Coordinate System: GDA2020	Date: 20/10/2021		
0 2.5 5 7.5 Kilometers	Scale: 1:250,000	A4	

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

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3.2 OHTL

3.2.1 Historical site activity

The OHTL will align predominantly within the Alice Springs to Darwin Railway Corridor which is leased to AustralAsia Railway Corporation (AARC) and operated by One Rail Australia (ORA) under a lease agreement with the Crown. The OHTL will be established in an easement within the Railway Corridor for which Sun Cable will enter into an agreement with both AARC and ORA. Some sections of the OHTL may fall outside of the Railway Corridor where diversions are required to avoid constrained land around townships as well as the final 66 km from Livingstone through to the Darwin Converter Site, which follows a NTG designated future utilities corridor. The sections of the OHTL that are not in the Railway Corridor will be operated under lease and easement arrangements negotiated with the landholders.

3.2.2 Climate

The OHTL extends from the Solar Precinct near Elliott, north approximately 800 km to Darwin. Over this distance there are a range of climatic conditions from arid and semi-arid climate in the south, to tropical monsoon climate in Darwin. The OHTL runs through two climate zones; the Humid zone and the Arid zone, both of which are shown in Figure 3-4 and discussed below.

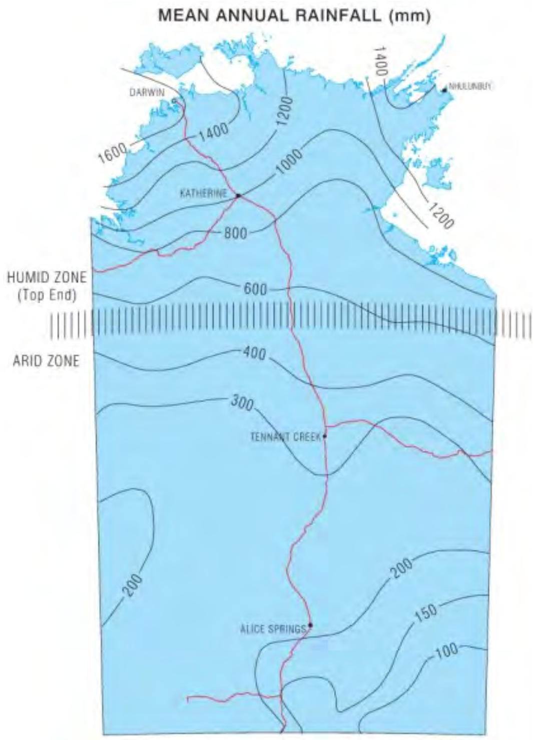


Figure 3-4. Humid vs Arid zones of the Northern Territory (NTG, 2016)

Humid zone

The Humid zone is characterised by a tropical monsoon climate, with a pronounced wet season from November to April, and very little rainfall from May to October. Mean rainfall in these areas ranges from 600mm per year to 1700 mm per year. For the purposes of the OHTL climate assessment, the Darwin Airport BoM station (station ID 014015) was used as an example, due to its long term data record.

The mean average annual rainfall is 1734.6 mm, with higher rainfall volumes typically occurring in the summer months associated with the northern monsoon. 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.

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) – with the annual evaporation rate exceeding annual rainfall.

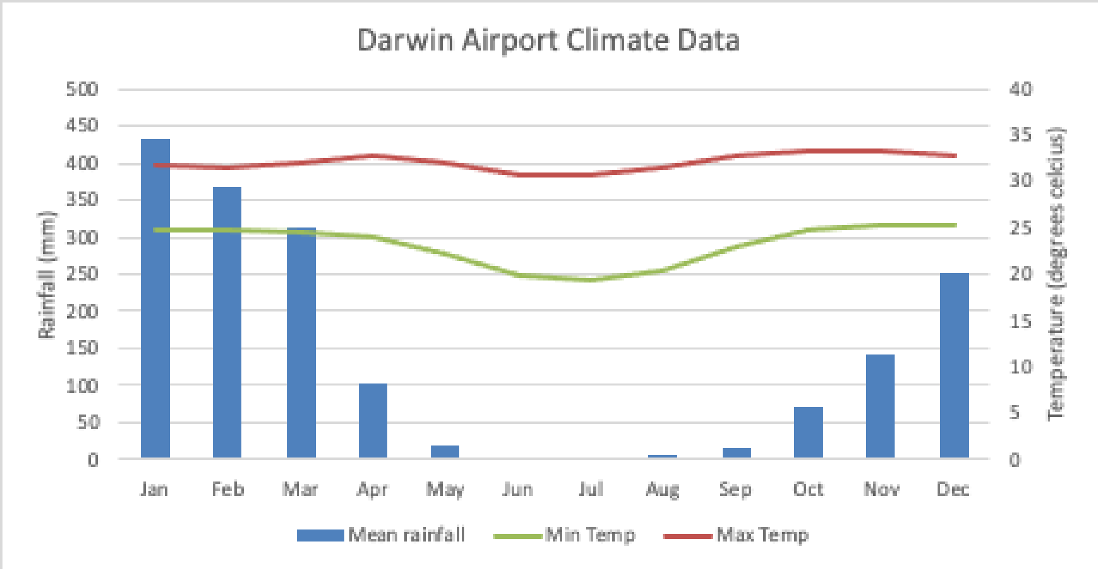


Figure 3-5. Darwin Airport climate data (BoM, 2021)

Arid zone

The Arid zone is characterised by a low-average annual rainfall and hot dry summers and cool dry winters. Mean rainfall in these areas range from 100 mm to 550 mm per year. Climate information for the Arid zone, specific to the OHTL can be found in Section 3.1.2, which references climate data from the Elliott BoM station (station ID 015131).

3.2.3 Landform and soils

Land and soils that occur along the OHTL services corridor have been described with reference to available landform mapping (Lynch et al. 2012; Christian and Stewart 1968). The 750 km long corridor intersects 11 landform classes as described Table 3-3

The OHTL corridor traverses various landforms from Elliott to Darwin. In general, the northern half of the OHTL services corridor predominantly traverses lateritic plains and rises, and sandstone plains and rises. The southern half predominantly traverses lateritic plains and rises, and desert sandplains. Table 3-3 describes the different landforms within the different geographic regions along the OHTL. Landforms of particular interest when it comes to terrestrial environmental quality includes alluvial floodplains, granite hills and sandstone hills, as these areas are distinctly different to the plains that form the majority of the landform along the OHTL. These landforms are mainly in the northern section of the OHTL (Kilometre Point [KP] 550 and higher), within the Pine Creek, Adelaide River and Darwin regions.

Table 3-3. Landforms and soils along the OHTL

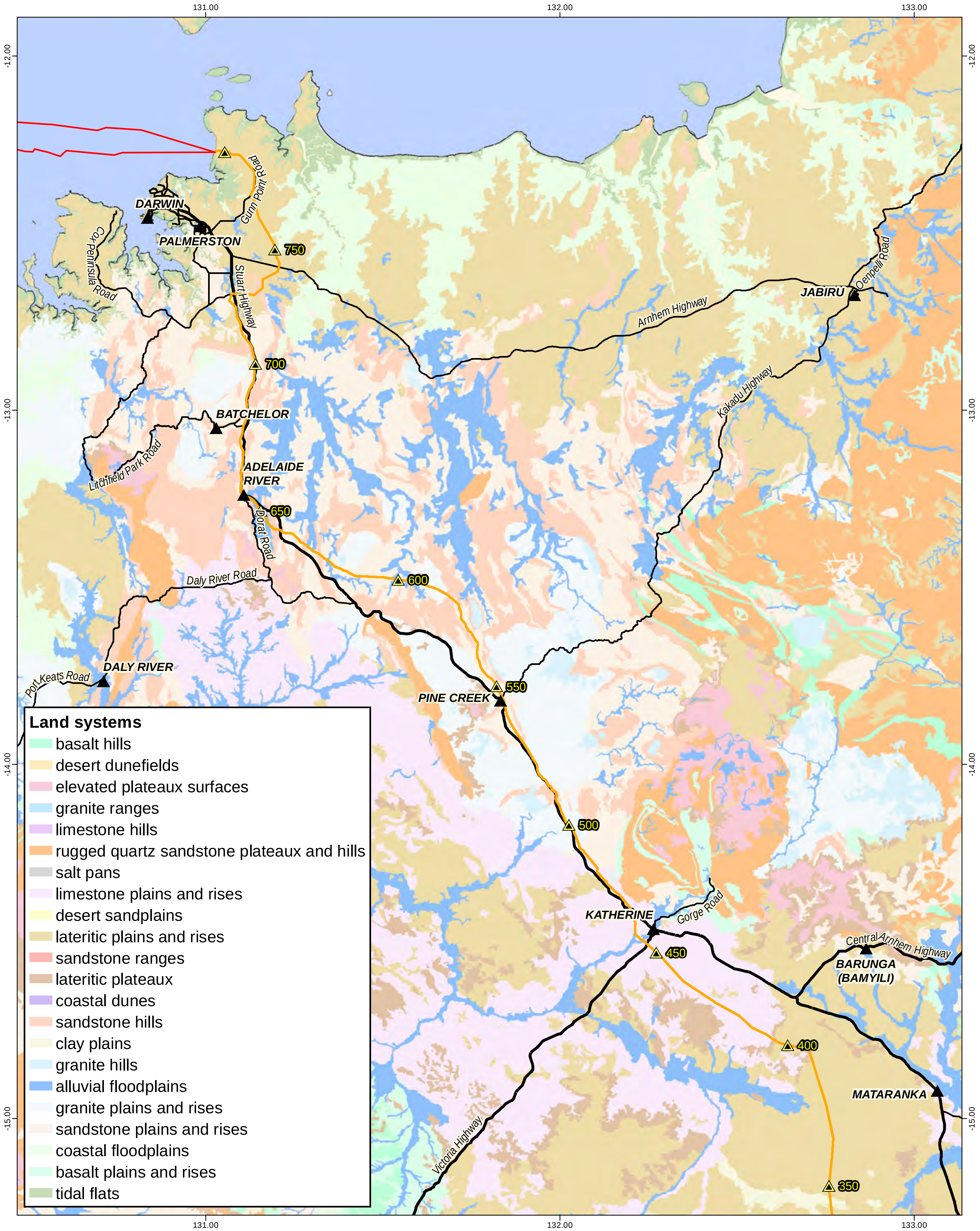
Class	Landform	Soil*	Land systems
Alluvial floodplains	Alluvial floodplains, swamps, drainage depressions and alluvial fans; sandy, silty and clay soils on Quaternary alluvium	Red, brown, yellow silty and sandy earths, brown and grey clays	Banyan, Effington, Fabian, Flatwood, Jundee, McKinlay, Western
Clay plains	Level to gently undulating clay plains (black soil plains); cracking clay soils	Olive brown, brown and grey clays*	Larrimah

Class	Landform	Soil*	Land systems
Coastal Floodplains	Low swampy coastal flood plains and depressions	Tenosolic and Kandosolic Redoxic Hydrosols	Pinwinkle
Desert sandplains	Level to undulating sandplains with red sands	No description*	Redsan
Granite hills	Low hills and hills mostly on granite, gneiss, rhyolite and some schist; common rock outcrop and surface stone with shallow gritty or stony soils	Skeletal soils and minor coarse sandy yellow soils	Currency
Granite plains and rises	Gently undulating to undulating plains with rises and low hills on granite, schist, gneiss (deeply weathered in places); coarse grained sandy, earthy and texture contrast soils	Stony and gravelly red and yellow sandy earths.	Cully
Lateritic plains and rises	Plains and rises associated with deeply weathered profiles (laterite) including sand sheets and other depositional products; sandy and earth soils	Loamy or gravelly red and yellow earths, siliceous and earthy sands, sandy brown and earths.*	Atlas_Ms14, Banjo, Birrimbah, Birrimbah 1, Bulwaddy, Claravale, Elsey, Forrest, Kay, Keating, Keckwick, Keefers Hut, Knifehandle, Krans, Sturt, Woggaman 1
Lateritic plateaux	Plateaux, scarps and some rises on deeply weathered sediments; shallow soils with rock outcrop	Shallow, skeletal sandy red and yellow earths	Yujullowan
Limestone plains and rises	Plains, rises and plateaux on weathered and unweathered Cambrian limestone, dolomite, chalcedony, shale, sandstone and siltstone with associated sand sheets; sandy and earth soils	Brown sandy and loamy soils, sandy and loamy red and yellow earths.	Beemla, Budbudjong, Jindara, Kimbyan, Tagoman, Wallingin
Sandstone hills	Low hills, hills and stony plateaux on sandstone, siltstone, quartzite and conglomerate (deeply weathered in places); outcrop with shallow stony soils	Skeletal soils and outcrop with minor sandy red and yellow gradational soils and shallow gravelly lithosols*	Baker
Sandstone plains and rises	Plains, rises and plateaux on mostly on sandstone, siltstone, claystone, shale and some limestone; commonly shallow soils with surface stone and rock outcrop	Skeletal soils and shallow gravelly loams and sands; yellow and red earths*	Bend, Bustard, Rumwaggon

**Soil and vegetation descriptions apply to northern NT only – these details are not available for southern NT land systems*

Potential Acid Sulfate Soils

Potential acid sulfate soils (PASS) mapping created by the NT Government (Hill and Eadmeades 2008) indicates that there is only a very low probability of PASS presence along the majority of the OHTL corridor. There are some sections of high probability of occurrence (>70% chance of occurrence) located at Adelaide River, Burrell Creek, Edith River and Katherine River (CSIRO 2013). The acid in PASS can impact soil and water quality, corrode metal and weaken concrete (Water Quality Australia n.d.). The presence of PASS may need to be considered in relation to any risk posed to the pole foundations; however, is not an environmental concern as the soils will not be excavated.



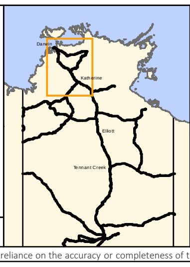
Legend

- ▲ Town
- Subsea cable corridor route options
- OHTL Route
- Solar Precinct
- Kilometre points

Existing roads

- Principal road
- Secondary road

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



Map of land systems across the proposed OHTL alignment (northern portion)

N

Project: Australia-Asia PowerLink

0 10 20 30 40 Kilometers

Scale: 1:1,500,000

Coordinate System: GDA2020 | A4

Reference: M Files ID 206543

Date: 25/10/2021 | Figure 3-6 | Revision: A

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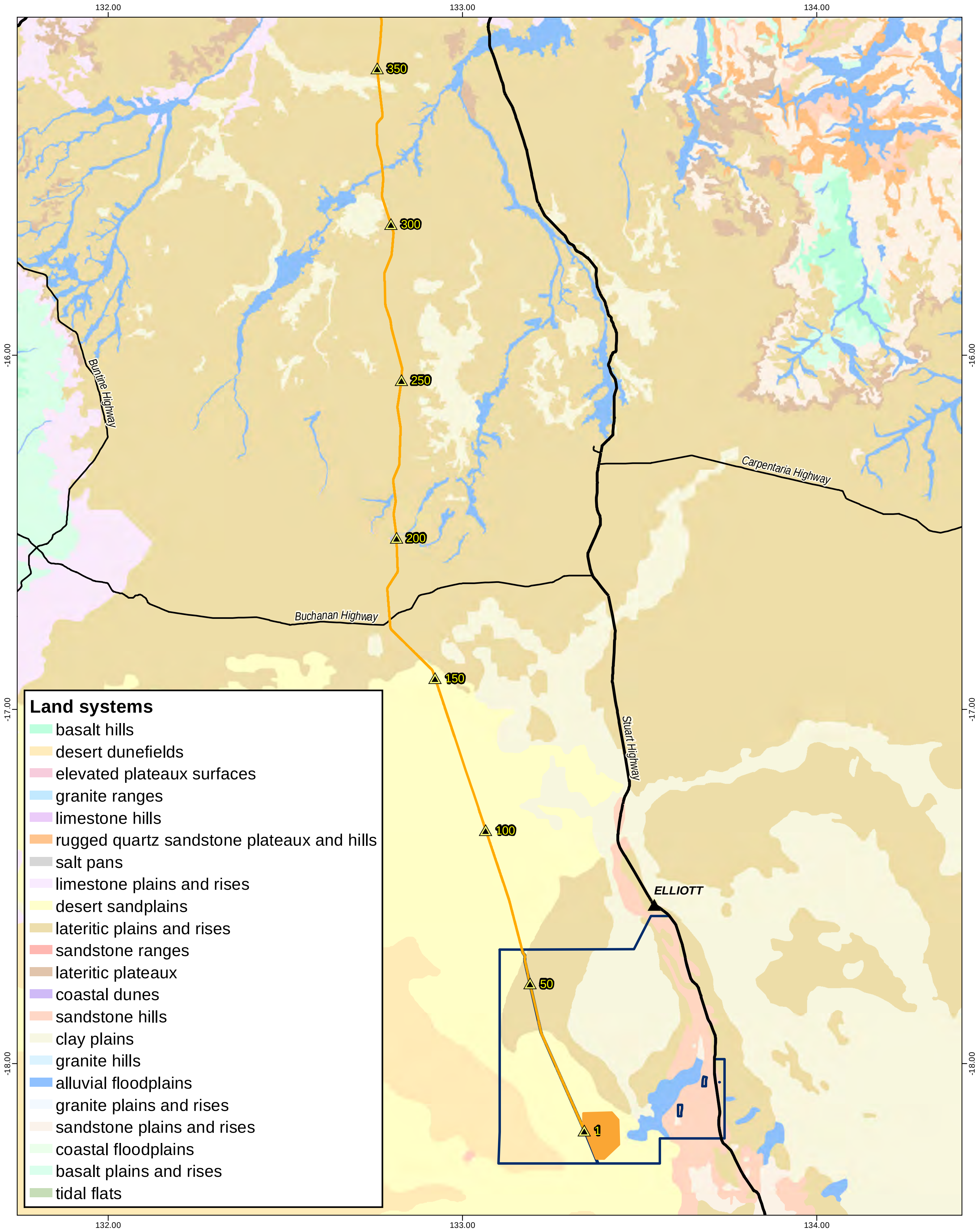


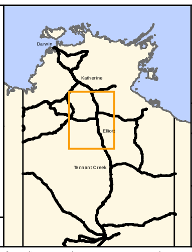
Legend

- Town
- OHTL Route
- Solar Precinct
- Powell Creek Station
- Kilometre points

Existing roads

- Principal road
- Secondary road

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



Map of land systems across the proposed OHTL alignment (southern portion)

N

Project: Australia-Asia PowerLink

0 10 20 30 40 Kilometers

Scale: 1:1,500,000

Coordinate System: GDA2020 | A4

Reference: M-Files ID 206543

Date: 25/10/2021 | Figure 3-7 | Revision: A

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3.2.4 Topography and drainage

Topography

The alignment of the proposed OHTL is alongside the existing Alice Springs – Darwin Railway Corridor. Preliminary analysis of the projected slopes along the 750 km alignment show that the average slope is approximately 0.2%. The maximum slope identified was approximately 2%. The OHTL alignment slope generally increases as it leaves the Solar Precinct in Elliott, before beginning its decent to the Murrumujuk site along Darwin's coast. Figure 3-8 shows the OHTL alignment (red line) and its respective elevation and slope (graph) from Elliott (left) to Darwin (right).

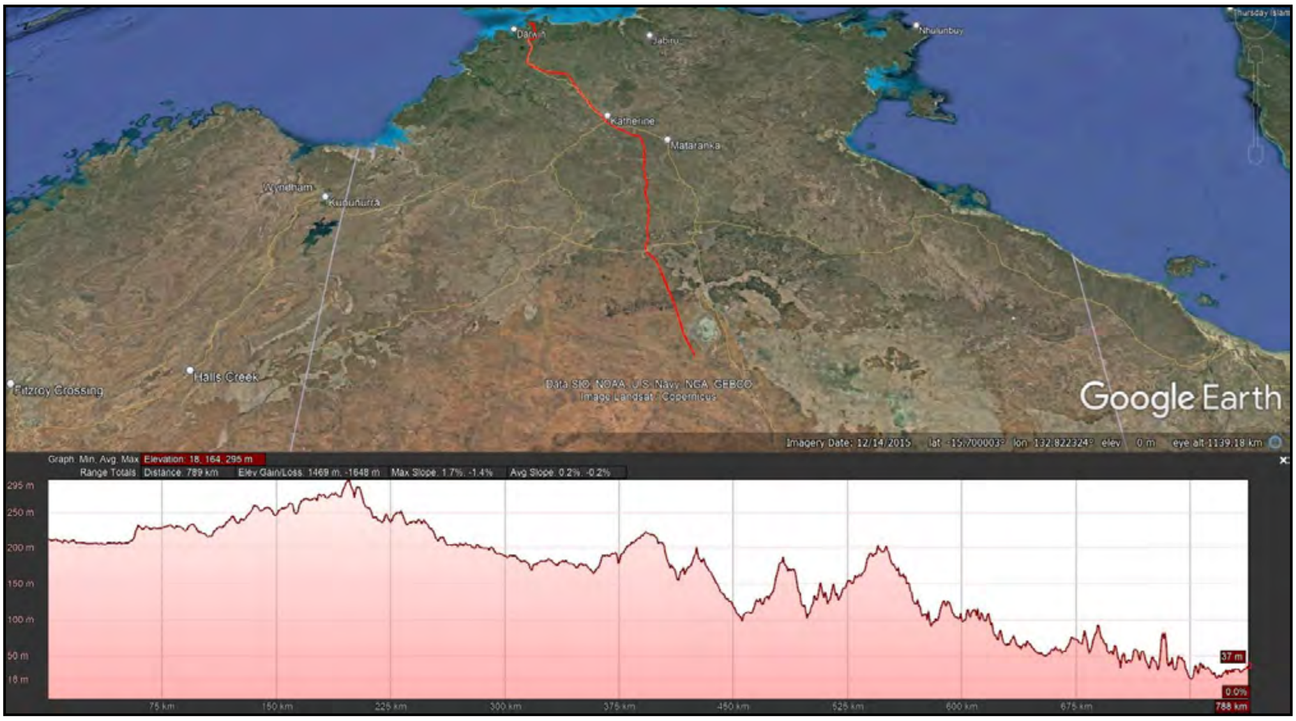


Figure 3-8. Alignment and slope of the proposed OHTL from Elliott to Murrumujuk

Surface water

The OHTL stretches across a number of surface water drainage regions – namely the river basins for the Finniss, Elizabeth, Howard, Darwin, Blackmore, Adelaide, Mary, Daly, Roper and Wiso Rivers. In the south of the OHTL route, watercourses are typically ephemeral and episodic; the north is a combination of ephemeral and perennial watercourses.

Watercourses

The OHTL along the Railway Corridor will cross a total of 154 watercourses and drainage lines over the planned route, with a wide range of stream orders. Stream order relates to a hierarchy of watercourse branches; the higher the watercourse's order, the more branches it has upstream. Of these watercourses, the vast majority are minor streams or drainage lines of stream order 1. At the upper limit there are three stream order 5 watercourses (Edith, Fergusson and Adelaide Rivers) and one stream order 6 watercourse (Katherine River) (Table 3-4).

Table 3-4. Stream order and number of watercourses crossed by the OHTL

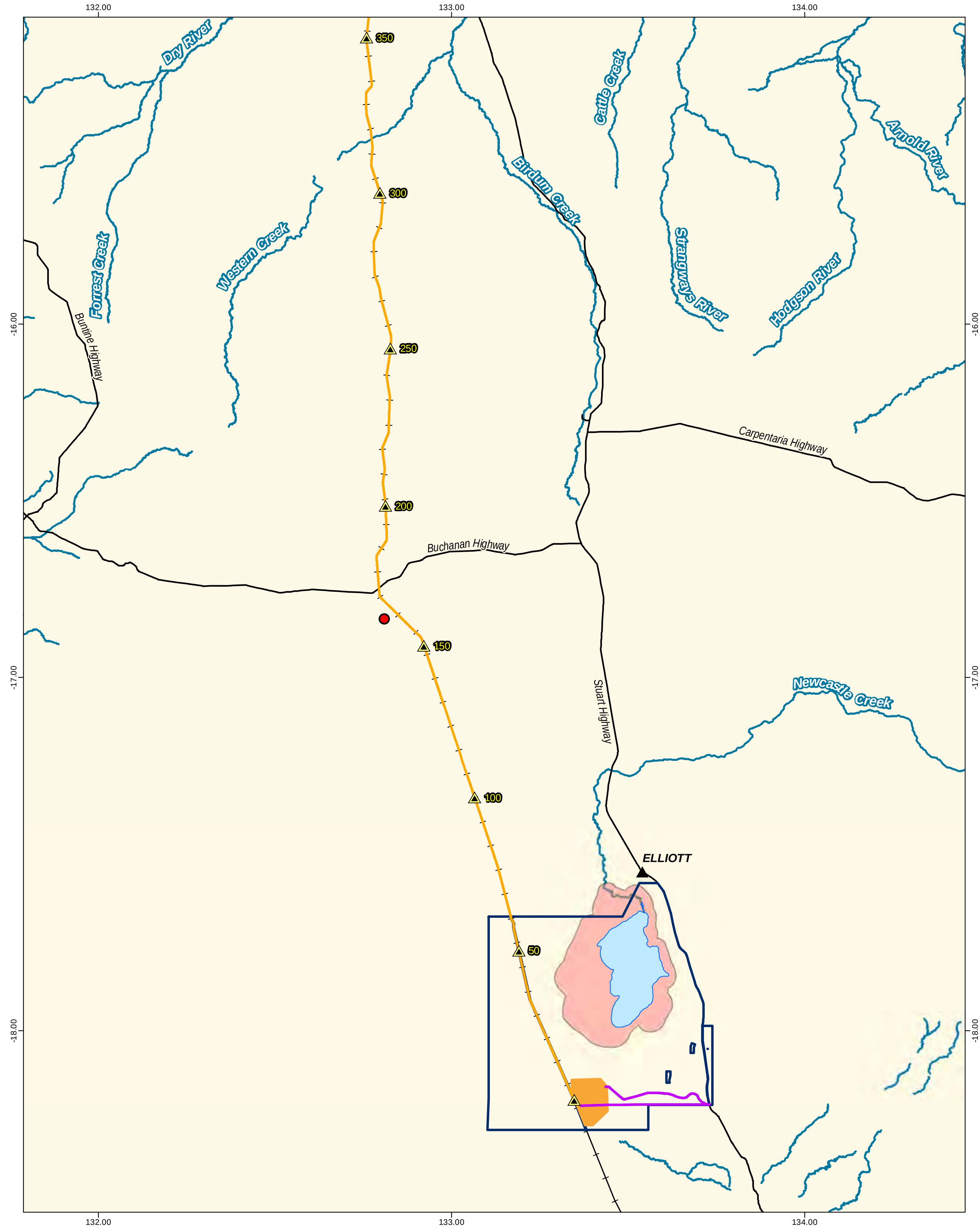
Order	Number of watercourses crossed by OHTL
1	98
2	28
3	14
4	10
5	3
6	1

Throughout the OHTL and Railway Corridor there are a number of minor culverts that facilitate overland flow. These locations have not been quantified as part of Table 3-4 because the installation of OHTL infrastructure will not impede water movement through these locations or prevent water moving though the Railway Corridor. These locations also contain no riparian vegetation, and are mostly indiscernible from the surrounding environment (EcOz 2021).

An access track is required for construction, operation and maintenance of the OHTL corridor. For much of the OHTL, this track is already present within the railway corridor, crossing the same watercourses as identified above. Where a new track needs to be constructed, existing crossings will be utilised wherever possible; however, some new crossings may be required particularly after KP 722 where the OHTL deviates from the Railway Corridor.

OHTL Utilities Corridor

The OHTL Utilities Corridor crosses 28 watercourses, the vast majority of which are minor drainage lines of stream order 1. The route crosses the upper reaches of the Elizabeth River, which is stream order 3, and contains approximately 180 m width of riparian vegetation. There are a smaller number of stream order level 2 crossings where riparian vegetation appears to be present (DEPWS 2019c). The OHTL will span watercourses where possible to minimise the direct impact on the watercourses.



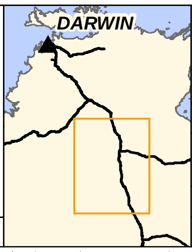
Legend

- OHTL
- Solar Precinct
- Kilometre Points
- Solar Precinct access roads
- Towns
- Homesteads
- Powell Creek Station
- Lake Woods
- Major Drainage
- Minor Drainage
- Railways
- Roads

Sites of Conservation Significance

- Lake Woods

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



Map of watercourses along the proposed OHTL alignment (KP0 - KP350)

N

Project: Australia-Asia PowerLink

0 15 30 45 Kilometers

Scale: 1:1,500,000

Coordinate System: GDA2020

A4

Reference: M-Files ID 206543

Date: 25/06/2021 | Figure 3-9 | Revision: A

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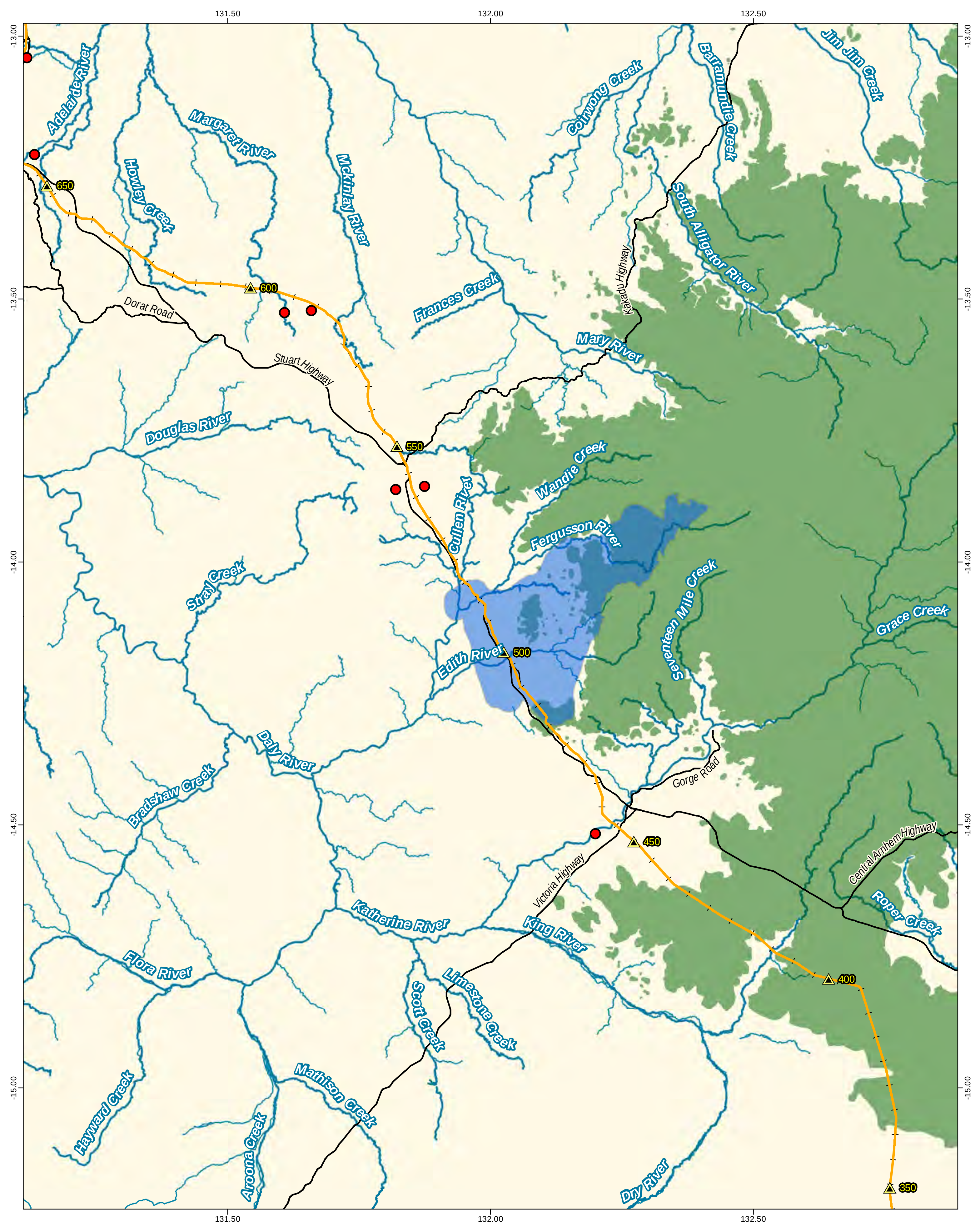


Legend

- OHTL Route
- Kilometre Points
- Towns
- Homesteads
- Major Drainage
- Minor Drainage
- Railways
- Roads

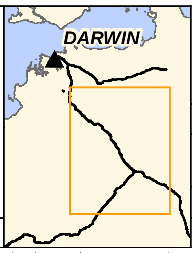
Sites of Conservation Significance

- Yinberrie Hills

Threatened ecological communities

- Arnhem Plateau Sandstone Shrubland Complex

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



Map of watercourses along the proposed OHTL alignment (KP350 - KP650)

N

Project: Australia-Asia PowerLink

0 10 20 30 Kilometers

Reference: M-Files ID 206543

Date: 25/06/2021 | Figure 3-10 | Revision: A

Scale: 1:1,000,000

Coordinate System: GDA2020 | A4

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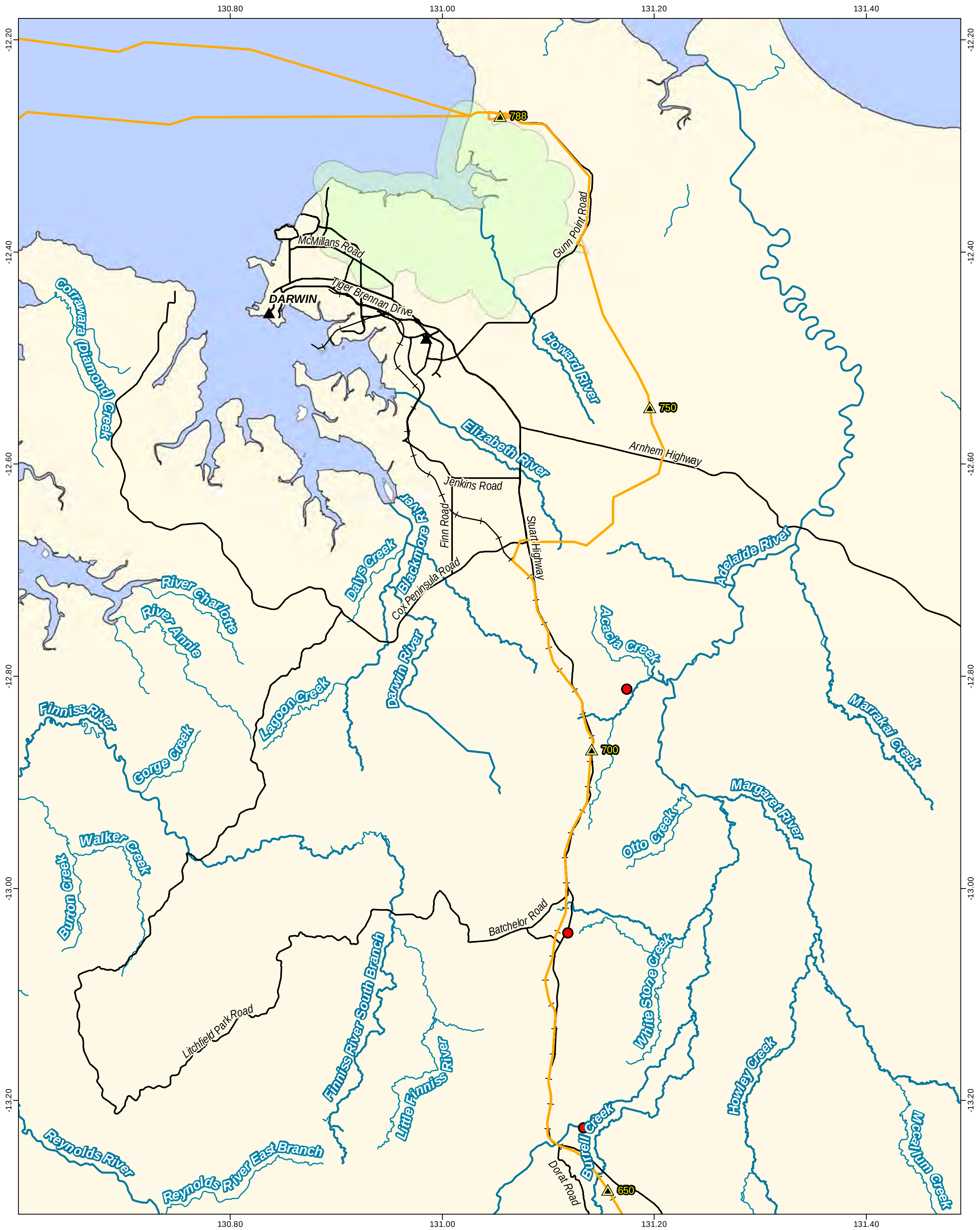


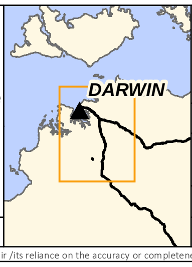
Legend

- Sun Cable infrastructure
- Kilometre Points
- Towns
- Homesteads
- Major Drainage
- Minor Drainage
- Railways
- Roads

Sites of Conservation Significance

- Shoal Bay

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



Map of watercourses along the proposed OHTL alignment (KP650 - KP788)

N

Project: Australia-Asia PowerLink

0 5 10 15 Kilometers

Reference: M-Files ID 206543

Date: 25/06/2021	Figure 3-11	Revision: A

Scale: 1:500,000

Coordinate System: GDA2020 | A4

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3.3 Darwin Converter Site and Cable Transition Facilities

3.3.1 Historical site activities

The Darwin Converter Site and Cable Transition Facilities are located at Murrumujuk, immediately south of the Murrumujuk and Gunn Point Beach access road. The site is undeveloped Crown Land. The land immediately to the west is approved for development of a prawn aquaculture facility as part of Project Sea Dragon owned by Seafarms Group Ltd. Further west, the Gunn Point Beach is a popular recreation and camping area, and the land to the south is part of the Tree Point Conservation Reserve.

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 around Gunn Point. The Durduga Tree Point Aboriginal Association holds freehold land (informally the 'Tree Point Community') 6 km south within the Tree Point Conservation Area. This land parcel hosts a small community consisting of fewer than 15 dwellings that are occupied variously throughout the year. Both Larrakia Rangers and Tiwi custodians participated separately as cultural monitors in the cultural heritage survey.

3.3.2 Climate

Murrumujuk, similarly to Darwin, has a tropical monsoon climate with a pronounced wet season from November to April, and very little rainfall from May to October. The closest long-term Bureau of Meteorology weather station for rainfall is Leaders Creek (station ID 014048) and for temperature is Darwin Airport (station ID 014015).

The mean average annual rainfall is 1808.90 mm, with higher rainfall volumes typically occurring in the summer months associated with the northern monsoon. Annual rainfall can vary from year to year – for example, 2017 experienced 2,203 mm of rain, while 2014 experienced 1,630 mm of rain.

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) – with the annual evaporation rate exceeding annual rainfall.

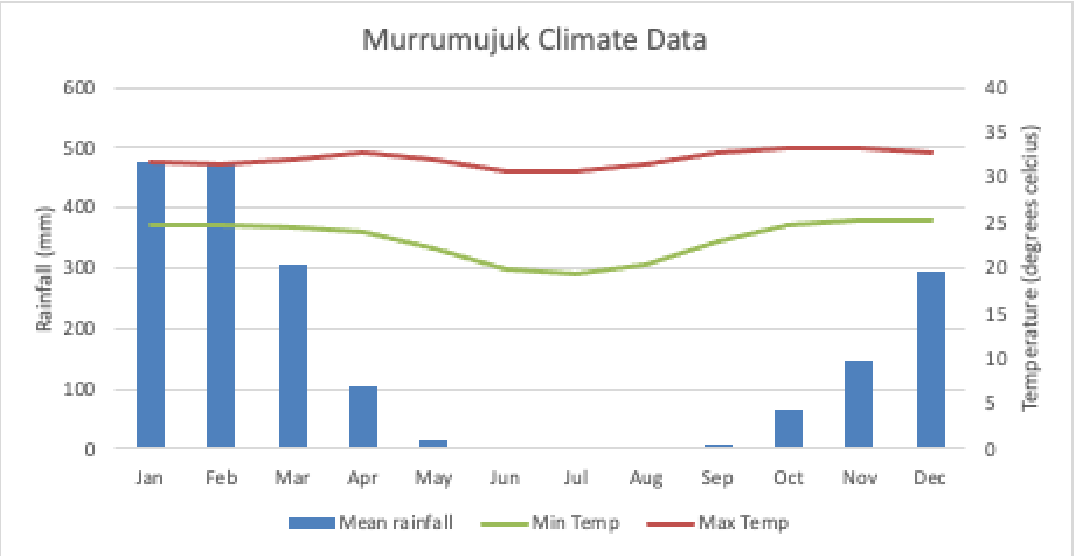


Figure 3-12. Murrumujuk climate data (BoM, 2021)

3.3.3 Landform and soils

Land unit mapping prepared by Easey et al. (2020) indicates that the Darwin Converter Site is located on undulating upland plains with coarse unconsolidated sands and gravelly soils, associated within land unit 8.

There is a small section of swamp located in the south-western corner of the site; however, this area is outside of the direct disturbance footprint. Land units are described in Table 3-5 and shown in Figure 3-13 (Easey et al. 2020).

Table 3-5. Land units and soil characteristics within the Darwin Converter Site and Cable Transaction Facilities footprint

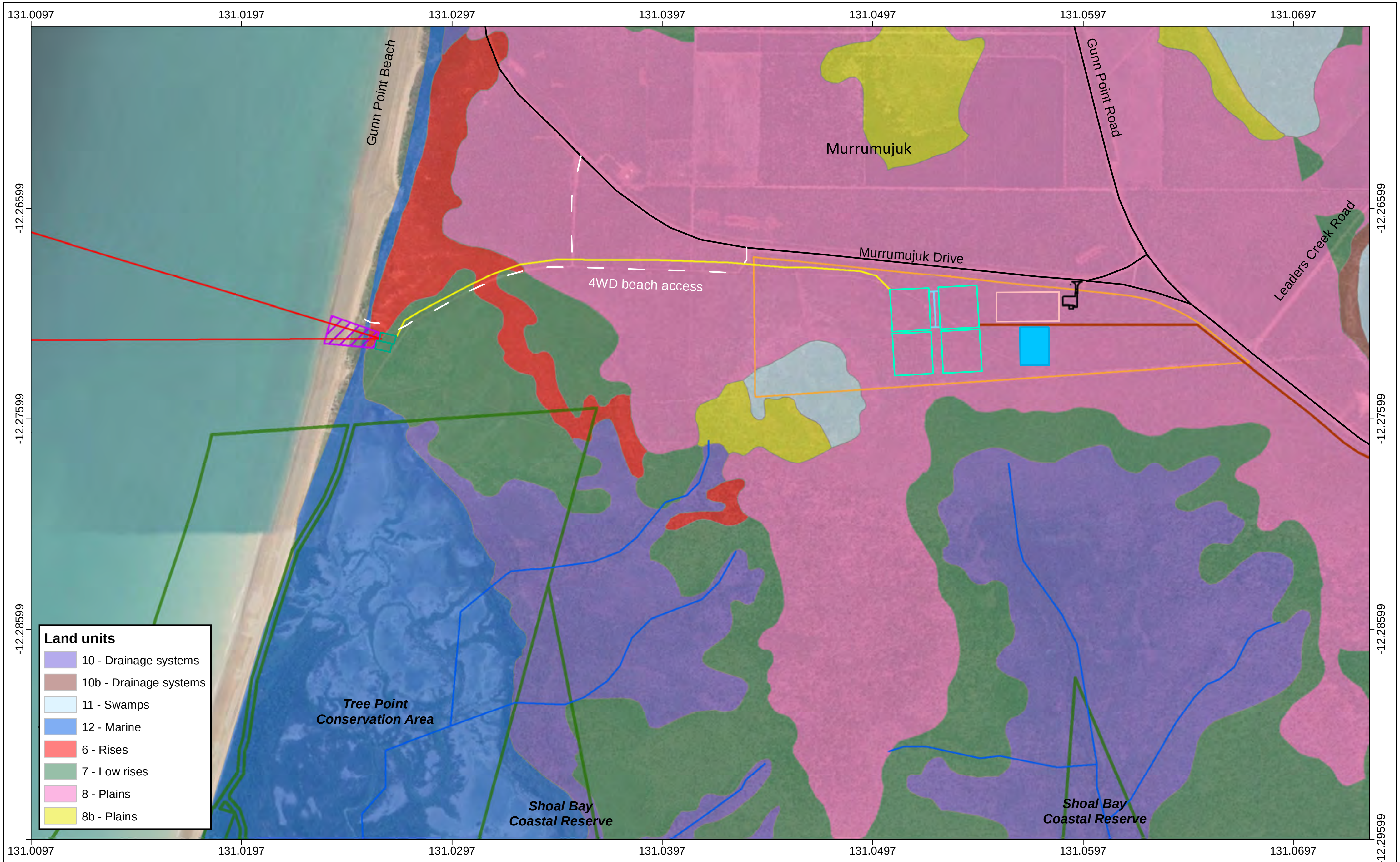
Land Unit	Description	Dominant soil order	Soil depth (m)	Slope range	Drainage	Runoff	Permeability
11 – Swamps	Swamps, billabongs and closed depressions	Hydrosols	>1	<1 %	Very poorly drained	None	Slow
8 – Plains	Level to gently undulating upland plains	Kandosols	>1.5	1-2 %	Well drained	Very slow	Moderately permeable
7 – Low rises	Low rises and gently inclined pediment slopes	Kandosols	0.25-0.5	1-3 %	Well drained	Slow to moderately rapid	Moderately permeable
6 – Rises	Rises and short steep slopes	Rudosols	<0.25	5-15 %	Well drained	Moderately rapid to rapid	Moderately permeable

Land unit mapping indicates the Cable Transition Facilities traverse four land units. The landform and soils characteristics are summarised in Table 3-5.

Potential Acid Sulfate Soils

There are no areas of PASS within the Darwin Converter Site footprint. The majority of the footprint is of sufficient distance from the coast to not contain PASS; however, the Land Sea Joint Station and trenching required for the subsea cables will pass through a section of high probability PASS just offshore of the beach (Lynch et al. 2012). Further information about PASS can be found in the Acid Sulfate Soils Management Plan (ASSMP), developed by EcOz in 2021.

Map of land units within the Darwin Converter Site and Cable Transition Facilities



Legend

- Subsea Cable corridor options OHTL
- Route
- Darwin Converter Site
- Shore Crossing
- Battery Facility
- Land Sea Joint Station
- Operations and Maintenance Facility
- Voltage Source Converter
- Carpark and vehicle access
- Underground Cable Corridor
- Streams
- NT Parks and Reserves

Source: NTG - Roads, Flora, Land Units and Parks and Reserves Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User

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Project: Australia-Asia PowerLink	Reference: M-Files ID 206543	Figure 3-13	Revision: A
Coordinate System: GDA2020	Date: 25/10/2021		
0 1 Kilometers	Scale: 1:25,000	A4	SUN CABLE

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3.3.4 Topography and drainage

Topography

The HVDC underground cable corridor traverses level to gently undulating plains, with slopes ranging from 1-3%, well-drained kandosols and very slow run-off characteristics, before reaching rises in the west with higher slope ranges of 5-15%, with well-drained rudosols and kandosols.

The Land Sea Joint Station is located on moderately to steeply sloping land that forms the transition between the upland plains and the beach. The soils are well-drained kandosols with moderate to rapid run-off characteristics. These areas only form a small portion of the Cable Transition Facilities footprint.

Surface water

There are no watercourses or streams that intersect the Darwin Converter Site or the Cable Transition Facilities footprint. The closest streams are located south of the footprint and travel into the Tree Point Conservation Area (DEPWS 2019). It is assumed that surface water run-off at the Darwin Converter Site footprint travels via overland flow into these streams, or directly into the ocean.

Existing erosion

There is some existing erosion at, and adjacent to, the Cable Transition Facilities caused by 4WD beach access tracks that lead onto Gunn Point beach. Four-wheel driving and camping are common in this area and appears to have led to some degradation of the beach dunes. Existing erosion will need to be formally identified prior to the development of any further ESCP and issue of construction drawings.

4 EROSION HAZARD AND RISK ASSESSMENT

Erosion risk refers to the evaluation of the "risk" of soil erosion when consideration is given to both the degree of erosion (consequence) and the likelihood of the erosion occurring. Best practice erosion control depends on the likelihood and intensity of expected wind or rainfall and therefore requires an assessment of erosion risk utilising information such as mean monthly rainfall data and mean monthly erosivity (i.e low, medium and high) (IECA, 2008).

Erosion hazard is assessed using the Revised Universal Soil Loss Equation – RUSLE (IECA 2008). This is used to predict the long term, average, annual soil loss from sheet and rill erosion under specified management conditions. This method was adopted due to its capability in being able to provide specific detail around estimated soil loss volumes and risk ratings for each of the Proposal's components.

4.1 Assessing erosion risk, erosion hazard and soil loss

4.1.1 Erosion risk

Erosion risk ratings are based upon rainfall erosivity or rainfall depth for the tropical monsoonal bioregion and semi-arid region Proposal construction areas. Ratings are calculated based on average monthly rainfall data (via BoM) or monthly erosivity data (IECA or from the Darwin Harbour Advisory Committee Research Group Ratings). Rainfall depth is only used where erosivity data is not available.

The ratings are shown in Table 4-3 for the Solar Precinct, Table 4-6 to Table 4-11 for the OHTL and Table 4-14 for the Darwin Converter Site.

The erosion risk rating system is taken from *IECA* Table 4.4.1 and Table 4.4.2, respectively, where:

Table 4-1. Erosion risk rating system (IECA, 2008)

Rating	Average monthly erosivity (R-factor)	Average monthly rainfall depth (mm)
Very Low	0 to 60	0 to 30
Low	61 to 100	31 to 45
Moderate	101 to 285	46 to100
High	286 to 1500	101 to 225
Extreme	> 1501	> 226

4.1.2 Erosion hazard using RUSLE

Erosion hazard considers surface area, land slope, soil type and land use in addition to raindrop impact. Potential soil loss is determined from the Revised Universal Soil Loss Equation – RUSLE (IECA 2008). This is commonly used to predict the long term, average, annual soil loss from sheet and rill erosion under specified management conditions. The RUSLE is represented by the following equation:

A = R * K * L * S * P * C, where:

A: estimated soil loss (tonnes/ha/yr)

R: rainfall erosivity factor

K: soil erodibility factor

LS: slope length/gradient factor

P: erosion control practice factor

C: ground cover and management factor

The following paragraphs outline each of the components that contribute to the RUSLE equation.

Rainfall erosivity (R–factor)

The rainfall erosivity factor (R-factor) is a measure of the ability of rainfall to cause erosion. It is a product of two components: total energy (E) and maximum 30-minute intensity for each storm (Landcom 2004). The R-factor is an input component in measuring estimated soil loss using the RUSLE calculation. In cases where the R-factor is not made available by IECA or the Darwin Harbour Advisory Committee Research Group, the following annual R-factor equation can be used.

$$R = 164.74\ (1.1177)^{S}\ S^{0.6444}$$

Where:

$$S = 2\ yr\ ARI, 6hr\ event\ (0.5\ EY\ design\ rainfall)$$

Erodibility (K-factor)

The K-factor is a numerical representation of the ability of soils to resist the erosive energy of rain (IECA 2008). Soil texture is the principle component affecting K, but soil structure, organic matter and profile permeability also contribute. Various K factors will have been adopted for the Proposal, based on the location of proposed infrastructure within different land types and soil conditions. K-factors can be identified from IECA 2008 *Table E5 – Typical K-factors based on Unified Soil Classification System*.

Slope (LS–factor)

The LS-factor describes the combined effect of slope length and slope gradient on soil loss.

Cover factor (C–factor)

The cover and management factor is a measure of the level of soil surface protection provided by various groundcovers. It can include a proportion of vegetation, rock, hardstand, paving, soil binders, matting and associated non-erodible material. The C-factor for the proposal will vary depending on stabilisation and management of surfaces exposed by construction and operation and is to be updated progressively within each Progressive ESCP. For the purposes of this EHA, a combination of pre-construction and post-construction scenarios have been assessed.

Erosion control practice factor (P–factor)

The P-factor measures the combined effect of all support practices and management variables. It also represents structural methods for controlling erosion (IECA 2008). The nominated P-factor for all areas within the proposal without permanent stable groundcover is 1.3 (based on the default construction phase condition).

4.1.3 Estimated soil loss

Estimated soil loss from the site can be categorised into seven distinct categories, which outline the volume of soil lost per year in tonnes per hectare. The soil loss classes as identified by IECA Table 3.1 are as follows:

Table 4-2. Soil loss class (IECA, 2008)

Erosion hazard	Soil loss (tonnes/ha/year)	Soil Loss Class
Very Low	0 - 150	1
Low	151 - 225	2
Low to Moderate	226 - 350	3

Erosion hazard	Soil loss (tonnes/ha/year)	Soil Loss Class
Moderate	351 - 500	4
High	501 – 750	5
Very High	751 - 1500	6
Extremely High	>1501	7

The following sections breakdown each of the abovementioned erosion risk and hazard factors, to identify an overall soil loss risk rating for each of the components of the Proposal.

4.2 Solar Precinct

The below section summarises the erosion hazard assessment. The full calculations can be found in Appendix A.

4.2.1 Erosion risk – rainfall depth

Erosion risk ratings were calculated for the Solar Precinct using mean monthly rainfall depth data from the Elliott BoM station, as monthly erosivity figures were not available from the Darwin Harbour Advisory Committee Research Group for Elliott. These ratings are shown in Table 4-3.

Table 4-3. Erosion risk rating – mean monthly rainfall depth (Elliott BoM, 2021)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall depth (mm)	137.9	156.3	79.7	20.5	6.5	5.4	2.8	1.0	5.5	20.8	46.7	103.4
Rating	High		Moderate	Very Low							Moderate	High

4.2.2 Erosion hazard

The inputs for the RUSLE equation for the Solar Precinct are shown below in Table 4-4. The outputs of the RUSLE equation (soil loss and risk rating) are shown in Table 4-5.

Table 4-4. Solar Precinct - RUSLE equation inputs

Factor	Description	Value	Comment
A	estimated soil loss (tonnes/ha/yr)	variable	As calculated per catchment
R	rainfall erosivity factor	2,411	Calculated using the annual R-factor equation
K	soil erodibility factor	0.030	Based on soil information for the catchment. It is recommended that further geotechnical analysis of soils occur, prior to the development of any Progressive ESCP and construction works.
LS	slope length/gradient factor	1% slope, 200m length	Based on maximum catchment characteristics
P	erosion control practice factor	1.3	Construction phase condition
C	ground cover and management factor	0	Based on proposed surface cover. Bare soil/erosive surface has been assumed for the majority of the proposal (access roads) as a conservative measure, the camp surface has been previously used and is hard ground and therefore assumed to have a different C-factor. The C-factor for the proposal will vary depending on stabilisation and management of surfaces exposed by construction and operation and is to be updated progressively within each specific ESCP

Table 4-5. Solar Precinct - soil loss and risk rating

Solar Precinct Component	Area	Soil loss (tonnes/ha/year)	Soil loss class (risk rating)
Solar Precinct	11,997 ha	23	1 – Very Low
Operational building infrastructure*	3.2 ha	23	1 – Very Low
Access Road (gravel)	30 ha	23	1 – Very Low
Access Road (bitumen)	42 ha	23	1 – Very Low
Airstrip	6 ha	23	1 – Very Low

** The Operational building infrastructure is located within the boundary of the Solar Precinct*

4.2.3 Erosion hazard and risk summary

Erosion risk at the Solar Precinct is high over the months of December to February due to significant rainfall and flooding events that may occur over these months. This indicates that erosion controls and groundcover management will be integral to minimising soil erosion hazards associated with proposal works and ground disturbance, across all months, but particularly between November to March.

The Solar Precinct and associated infrastructure have been assigned a ‘very low’ soil loss class risk rating according to the RUSLE equation, per hectare. However, given the extent and size of the disturbed area, presents a significant risk if not managed appropriately.

4.2.4 Mitigation measures

Based on the soil loss and risk ratings calculated above, a range of mitigations measures should be considered by Sun Cable pre, during and post construction. These measures include:

- Providing a high level of protective groundcover[2]. A comparison of the soil erosion potential, based on pre and post construction groundcover (refer to Appendix A), shows the quantitative difference in soil loss and subsequent erosion hazard to the environment if works are staged in a progressive manner and with final groundcover conditions. The difference in staging works with progressive groundcover of up to 70%, could see a reduction in over 20 t/ha/year of soil loss in some cases.
- Careful planning when developing construction methodology, particularly when it comes to site preparation, clearing and staging of works. Progressive ESCPs, when developed will need to detail specific drainage, erosion and sediment controls for each of the stages of works. Works will need to occur in a progressive manner, with each area stabilised prior to progressing to the next stage.

Refer to Section 5, for examples of the types of drainage, erosion and sediment controls that could be implemented within the Solar Precinct.

[2] Groundcover refers to any infrastructure or hardstand material that will cover disturbed soils from rainfall and wind impacts, e.g. gravel, concrete or solar panels.

4.3 OHTL

The below section summarises the erosion hazard assessment for the OHTL. The full calculations can be found in Appendix B. For the OHTL erosion hazard and risk assessment a construction pad of 600 m x 100m (0.6 ha) and a construction corridor of 300 m by 12 m (0.36 ha) was assessed for each OHTL pole.

4.3.1 Erosion risk – rainfall erosivity and rainfall depth

Erosion risk will vary throughout the year depending on the climate and rainfall runoff trends in the area. As the OHTL traverses through a large portion of the Northern Territory, with varying climate conditions, the erosion risk rating for each area varies. Erosion risk ratings were calculated for the OHTL using mean erosivity data from the Darwin Harbour Advisory Committee Research Group Ratings (Darwin Airport, Adelaide River, Pine Creek and Katherine). For Daly Waters and Elliott, the erosion risk rating was derived using mean monthly rainfall depth data from BoM for the Daly Waters Station (ID 014618) and Elliott Station (ID 015013).

Table 4-6. Darwin Airport erosion risk ratings for the OHTL

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Erosivity (mm)*	4496	3512	2826	808	160	15	5	47	80	472	948	2355
Rating	Extreme			High	Moderate	Very Low			Low	High		Extreme

Table 4-7. Adelaide River erosion risk ratings for the OHTL

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Erosivity (mm)	3146	2407	1862	895	91	0	3	4	113	401	1089	2159
Rating	Extreme			High	Low	Very Low			Moderate	High		Extreme

Table 4-8. Pine Creek erosion risk ratings for the OHTL

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Erosivity (mm)	2810	2323	1446	631	56	0	31	4	48	387	958	2090
Rating	Extreme		High		Very Low					High		Extreme

Table 4-9. Katherine erosion risk ratings for the OHTL

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Erosivity (mm)	2252	1686	1334	308	25	0	19	10	45	202	627	1955
Rating	Extreme		High		Very Low					Moderate	High	Extreme

Table 4-10. Daly Waters erosion risk ratings for the OHTL

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall depth (mm)	165.4	165.4	120.1	23.6	5.0	5.6	1.5	1.7	4.9	22.5	59.4	110.0
Rating	High			Very Low							Moderate	High

Table 4-11. Elliott erosion risk ratings for the OHTL

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall depth (mm)	137.9	156.3	79.7	20.5	6.5	5.4	2.8	1.0	5.5	20.8	46.7	103.4
Rating	High		Moderate	Very Low							Moderate	High

4.3.2 Erosion hazard

The inputs for the RUSLE equation for the Solar Precinct are shown below in Table 4-12. The outputs of the RUSLE equation (soil loss and risk rating) are shown in Table 4-13.

Table 4-12. OHTL - RUSLE equation inputs

Factor	Description	Value	Comment
A	estimated soil loss (tonnes/ha/yr)	variable	As calculated per catchment
R	rainfall erosivity factor	variable	Calculated using the Darwin Harbour Advisory Committee Research Group (Darwin Airport, Adelaide River, Pine Creek and Katherine) and the annual R-factor equation (Daly Waters and Elliott)
K	soil erodibility factor	variable	Based on soil information for the catchment. It is recommended that further geotechnical analysis of soils occur, prior to the development of any Progressive ESCP and construction works.
LS	slope length/gradient factor	1% slope, 100m length	Based on maximum catchment characteristics. In instances closer to the Darwin Converter Site, slopes can increase to 1.7%
P	erosion control practice factor	1.3	Construction phase condition
C	ground cover and management factor	0	Based on proposed surface cover

Table 4-13. OHTL - soil loss and risk rating

Region / Landform class	Area	Soil loss (tonnes/ha/year)	Soil loss class (risk rating)
Elliott			
Desert sandplains	0.6 ha per pole installation 0.36 ha per construction corridor between poles	10	1 – Very Low
Lateritic plains and rises		27	1 – Very Low
Daly Waters			
Lateritic plains and rises	0.6 ha per pole	50	1 – Very Low

Alluvial floodplains	installation 0.36 ha per construction corridor between poles	50	1 – Very Low
Katherine			
Lateritic plains and rises	0.6 ha per pole installation 0.36 ha per construction corridor between poles	98	1 – Very Low
Limestone plains and rises		121	1 – Very Low
Lateritic plateaux		62	1 – Very Low
Pine Creek			
Limestone plains and rises	0.6 ha per pole installation 0.36 ha per construction corridor between poles	151	2 - Low
Sandstone plains and rises		151	2 - Low
Granite plains and rises		77	1 – Very Low
Granite hills		103	1 – Very Low
Alluvial floodplains		123	1 – Very Low
Sandstone hills		151	2 - Low
Adelaide River			
Alluvial floodplains	0.6 ha per pole installation 0.36 ha per construction corridor between poles	139	1 – Very Low
Sandstone hills		171	2 - Low
Sandstone plains and rises		171	2 - Low
Darwin			
Lateritic plains and rises	0.6 ha per pole installation 0.36 ha per construction corridor between poles	179	2 - Low
Sandstone hills		221	2 - Low
Sandstone plains and rises		221	2 - Low
Alluvial floodplains		179	2 - Low
Coastal floodplains		221	2 - Low

4.3.3 Erosion hazard and risk summary

As the OHTL traverses through a large portion of the Northern Territory, with varying climate conditions, the erosion risk rating for each area varies, as risk is dependent on rainfall characteristics. In general, erosion risk increases in severity and duration north of Daly Waters for the months of October to April where the wet season has a stronger influence.

In addition, landform classes such as sandstone hills, sandstone plains and rises, coastal floodplains and limestone plains and rises present a high risk ranking (and soil loss class) in comparison to the other landform classes. These landform classes are more commonly observed in the Pine Creek, Adelaide River and Darwin regions. As all these regions also experience high rainfall erosivity, erosion potential is greater.

4.3.4 Mitigation measures

Based on the soil loss and risk ratings calculated for each of the land systems within the OHTL, further measures should be considered by Sun Cable as to the construction of the OHTL, as each land system and area. Measures such as:

- More detailed controls where works are to occur over higher risk months (December to March) from Darwin to Pine Creek, targeting the land systems which have a higher soil erodibility factor.
- In areas where the OHTL crosses watercourses, consideration should be taken to minimise disturbance in and around buffers and riparian areas. This may include, increasing or decreasing the length between each pole.

- If the construction pads for the pole installation, impedes on buffers or riparian zones, a specific ESCP will need to be developed to mitigate further impact to those areas.
- Reinstating vegetative cover around areas of the power pole once the construction pads have been removed will be critical to reduce further impact of the disturbance area on the surrounding environment. The remaining area exposed will be the access track. Refer to Appendix B for RUSLE calculations.

Similarly to the Solar Precinct, consideration by Sun Cable should occur when developing the construction methodology for the OHTL. Progressive ESCPs should be developed targeting, low, medium and high risk areas, with specific controls implemented, relevant to the level of risk ascertained in the calculations above. Refer to Section 5, for examples of the types of drainage, erosion and sediment controls that should be considered.

4.4 Darwin Converter Site and Cable Transition Facilities

The below section summarises the erosion hazard assessment for the Darwin Converter Site and Cable Transition Facilities. The full calculations can be found in Appendix C.

4.4.1 Erosion risk – rainfall erosivity

Erosion risk ratings were calculated for the Darwin Converter Site and Cable Transition Facilities using the mean erosivity figures for Darwin airport, provided by the Darwin Harbour Advisory Committee Research Group. These ratings are shown in Table 4-14.

Erosion risk ratings range from high to extreme for the wet season (November to April), with very low to high risk for the dry season (May to October).

Table 4-14. Erosion risk ratings for the Darwin Converter Site and Cable Transition Facilities

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Erosivity (mm)	4496	3512	2826	808	160	15	5	47	80	472	948	2355
Rating	Extreme			High	Moderate	Very Low			Low	High		Extreme

4.4.2 Erosion hazard

The inputs for the RUSLE equation for the Solar Precinct are shown below in Table 4-15. The outputs of the RUSLE equation (soil loss and risk rating) are shown in Table 4-16.

Table 4-15. Darwin Converter Site / Cable Transition Facilities - RUSLE equation inputs

Factor	Description	Value	Comment
A	estimated soil loss (tonnes/ha/yr)	Variable	As calculated per catchment
R	rainfall erosivity factor	15724	Calculated by the Darwin Harbour Advisory Committee Research Group
K	soil erodibility factor	0.053	Based on soil information for the catchment. It is recommended that further geotechnical analysis of soils occur, prior to the development of any Progressive ESCP and construction works.
LS	slope length/gradient factor	Variable	Darwin Converter Site – 2% slope, 200 m length Cable Transition Facilities – 1%, 5%, 10% and 15% slope, 100 m length
P	erosion control practice factor	1.3	Construction phase condition
C	ground cover and management factor	0	Based on proposed surface cover.

Table 4-16. Darwin Converter Site / Cable Transition Facilities - soil loss and risk rating

Component (Slope %)	Area	Soil loss (tonnes/ha/year)	Soil loss class (risk rating)
Darwin Converter Site development footprint	55 ha	628	5 - High

Cable Transition Facilities (1%)	10.5 ha	221	2 – Low
Cable Transition Facilities (3%)		780	6 – Very High
Cable Transition Facilities (5%)		1463	6 – Very High
Cable Transition Facilities (15%)		6397	7 - Extreme

4.4.3 Erosion hazard and risk summary

Erosion risk at the Darwin Converter Site and the Cable Transition Facilities are high to extreme over the wet season months (November to April). The majority of the Darwin Converter Site and Cable Transition Facilities are within the low rises and plains land units which have slopes of 1-3% and a lower erosion risk rating of very low to low, during the dry season months.

Of further interest are lengths of the Cable Transition Facilities which present an extremely high erosion risk where slopes range from 5% to 15% within the rises land unit. This land unit is only present in a small area of the Cable Transition Facilities and these locations may need to be isolated from the rest of the site during construction to minimise erosion impacts on the surrounding areas. Slopes will need to be confirmed on site to ensure controls are appropriate, and applicable to the slope.

Furthermore, the Darwin Converter Site presents a high soil loss risk across the year and in addition to its area of disturbance (55 ha), will present an even more significant erosion risk to the environment.

4.4.4 Mitigation measures

Similarly to the Solar Precinct, the size and extent of the Darwin Converter Site and Cable Transition Facilities add an additional level of risk in addition to the soil loss calculations, particularly during the wet season months. Measures listed below should be taken into consideration, pre, during and post construction.

- It is recommended that initial site establishment works are scheduled in the dry season, where the erosion risk is very low to moderate.
- The soil loss class risk rating determined for the Darwin Converter Site and the Cable Transition Facilities were assessed in both their pre and post construction condition, identifying a quantifiable volume of soil lost across the year. Progressive construction, implementation of groundcover measures and completion of final works will decrease the soil loss rating. Refer to Appendix C for the calculations.
- Careful planning when developing construction methodology, particularly when it comes to site preparation, clearing and staging of works. Progressive ESCPs, when developed will need to detail specific drainage, erosion, and sediment controls for each of the stages of works. Works will need to occur in a progressive manner, given the large scale of the site.
- Maintaining as much vegetative cover as possible as well as ensure that vegetative buffers are in good condition, can assist in sediment control.
- Vegetation clearing will mean that there is an available resource (mulch) that can be utilised as a control such as mulch berms and ground cover to assist with increasing groundcover and reducing soil loss.

Refer to Section 5, for examples of the types of drainage, erosion and sediment controls that should be considered.

5 EROSION AND SEDIMENT CONTROL MEASURES

Erosion and sediment control measures required during construction and operation are derived based on the site specific erosion hazard and risk. Conceptual descriptions of the considerations and controls are provided in the sections below, based on the current level of design detail of the Proposal. Detailed drainage, erosion and sediment controls will need to be considered in further detail, in regards to placement, sizing, with detailed design and sizing within future Progressive ESCPs for the Proposal.

5.1 Primary and progressive ESCPs

The purpose of an ESCP is to detail the proposed measures for a site under construction. They are typically considered 'live' documents which should be revised based on the evolution of the site.

A Primary ESCP should first be developed by Sun Cable for each proposal component and at a minimum include:

- Identify any further soil issues (sodic, dispersive, existing erosion etc) and update any further receiving environment information
- Provide an outline of the initial construction staging and construction methods
- Update of the erosion hazard and risk assessment (RUSLE), detailing specific catchments
- Identify the minimum sediment control measures for each catchment (Type, 1, 2 or 3)
- Provide concept plans showing catchments, overland flow direction, drainage, area of works, placement of controls and clean water vs dirty water diversion
- Preliminary sizing of controls i.e. culverts, sediment ponds (if required)
- Highlight areas where additional focus may be required to mitigate erosion issues

Progressive ESCPs should be developed as the detailed design for each of the components is completed. Progressive ESCP's should include the following:

- Site or catchment specific details (i.e. one of the construction pads along the OHTL), including size, construction schedule, brief methodology of what's being construction
- Written and drawn explanation of specific erosion, sediment and drainage control measures as per the IECA guidelines. Measures should be written in a way that contractors implementing the controls can understand what needs to occur.
- Staged drawings (if required)
- Design information for controls and major structures (i.e. drainage lines, sediment basins etc)
- Clear details of roles and responsibilities of all involved implementing the ESCP (including plan development, changes, inspections, maintenance and auditing)
- Provide clear details for rehabilitation of disturbed areas.

5.2 Site preparation

Site preparation is a key component of an ESCP and a large components involves protection and clearing of vegetative material.

5.2.1 Vegetation clearing

Vegetation clearing (where required) is to be undertaken in accordance with applicable approvals and will require and a Progressive ESCP to cover these works. Clearing methodology to be included in the ESCP should cover the following:

- Clearing activities to be implemented consistent with the *NTG Land Clearing Guidelines* (DENR 2019)
- Vegetation clearing shall be kept to the minimum amount necessary to allow access and/or approved activities.
- Areas of protected vegetation and significant areas of vegetation which are to be retained, must be clearly identified prior to the commencement of clearing
- Approved areas for native vegetation clearing to be clearly identified.
- Previously cleared areas shall be utilised where possible for laydown and turn around points.
- Disturbance to natural watercourses and associated riparian zones must be limited to the minimum practicable.
- Cleared vegetation is to be retained and reused in site rehabilitation wherever possible.

5.2.2 Buffers

Sun Cable will be required to maintain riparian buffer strips around impacted drainage features (relates largely to works within the OHTL where watercourses are prominent) to protect riparian habitats and vegetation. Buffer distances are as per the *NT Land Clearing Guidelines* (NTG 2019).

Table 5-1. Riparian buffer widths (NTG 2019)

Riparian class	Stream order	Min buffer width (m)	Measured from
Drainage depression	NA	25	The outer edge of the drainage depression, which is the extent of the associated poorly drained soils and associated vegetation.
Intermittent streams	1st	25	The outer edge of the riparian vegetation or levee (whichever is greater). If braided channels are present, the edge of the outer-most stream channel.
Intermittent streams	2nd	50	As above
Creeks	3rd & 4th	100	As above
Rivers	5th or higher	250	As above

The adoption of the buffer distances, as listed in Table 5-1, will have the following benefits:

- Reduce velocity of runoff entering drainage depressions and watercourses via sheet flow
- Promoting capture of sediment
- Reduce erosion within riparian areas (wind and water)
- Provide network of linked habitats and wildlife corridors
- Provision of shade and amenity

5.3 Drainage control

Drainage controls include measures for the diversion of 'clean' stormwater runoff around and through the proposal area; and the diversion of 'dirty' site stormwater runoff to enable treatment of sediment prior to release offsite, as defined below:

Clean water:

Water that both enters site from an external source and has not been further contaminated by sediment within site; or water that has originated from the site and is of such quality that it does not need to be treated in order to achieve the required water quality standard (IECA 2008). Site clean water constitutes surface runoff from areas of non-erodible cover, including vegetation, hardstand, soil binder, mats or blankets (e.g. geotextile fabric).

Dirty water:

Water not defined as clean, thereby requiring treatment with appropriate controls prior to release from site (IECA 2008).

Temporary drainage controls installed as part of construction will enable management of stormwater within work areas. Drainage controls will perform the following functions:

- Enable diversion of 'clean' up-slope run-on water either around or through the site at non-scouring velocities.
- Enable collection of 'dirty' runoff generated within construction areas and the delivery of this water to an appropriate sediment control measure.
- Minimise the risk of soil erosion caused by site-generated flows within the proposal area, through the use of 'intermediate' flow treatment and release points.
- Control of the flow velocity, volume and location of water passing through the proposal area at drainage line and waterway crossings.

Potential controls may include:

- Catch drains – for collection and diversion of sheet flow across a slope or around soil disturbances.
- Diversion channel – for diversion of large concentrated flows.
- Flow diversion bank – flow diversion at base of fill slopes; cross drainage on unsealed roads.
- Mulch berm – primarily a sediment filter berm, but may also be used as a flow diversion bank.
- Chutes – discharge of concentrated flows down steep slopes.
- Check dams (e.g. rock) – velocity control device within concentrated flow channels. Also used as sediment control.
- Culverts.

5.4 Erosion control

Prevention of erosion is the primary approach for the prevention of adverse impacts associated with sedimentation. Construction activities are to be undertaken so as to reduce the duration of soil exposure to erosive forces (wind and water), either by holding the soil in place or by shielding it. Measures to be used include a variety of construction practices, structural controls and vegetative measures aimed at managing runoff at a non-erosive velocity, and the protection of disturbed soil surfaces.

Potential controls may include:

- Undertaking construction activities in dry months when erosion risk is low.
- Promptly stabilising exposed areas once construction phase has been completed (permanent landscaping).
- Protection of soil surface (temporary and permanent) including placement of hardstand surfaces, use of soil binder, vegetation establishment (including mulch), and protection with mats and blankets (e.g. jute, geotextile fabric) where practical.
- Consideration of the use of ameliorants to stabilise catchment surfaces and reduce erosion (e.g. spreading Gypsum (calcium sulfate) across disturbed areas).
- Application of dust suppression by wetting of exposed surfaces (i.e. use of water trucks), application of soil binder, and/or application of soil cover.

5.5 Sediment control

Effective erosion and sediment hazard reduction is best achieved by undertaking main earthworks activities during dry months, rather than focussing on implementation of extensive sediment control measures (IECA 2008).

Sediment control standards are based on catchment area and soil loss calculations, and include Types 1, 2 and 3 as described below.

5.5.1 Type 1 Sediment control standard

A Type 1 sediment control is typically the minimum requirement for the following scenario:

- Catchment area > 1 ha where soil loss > 150 t/ha/yr

A Type 1 sediment control standard is provided by purpose-built sediment basins, designed to collect and settle sediment-laden water. They generally perform two main functions:

- Rapid settlement of coarse-grained particles (e.g. sand and coarse silt) during all storm events that flow through the basin; and
- Settlement of fine-grained particles that are allowed to pass through the basin under controlled conditions.

This enables sediment basins to reduce turbidity levels of construction runoff water, thereby reducing potential for ecological harm.

Application to the Proposal

Type 1 sediment controls will be required in areas where there is land disturbance greater than 1 ha and potential soil loss is greater than 75 t/ha/yr; or where potential soil loss is greater than 150 t/ha/yr for catchments less than 1 ha. It is likely that a sediment pond may only be required within the Darwin Converter Site, whereby construction of the facility is approximately 55 ha with a high erosion risk rating (over 600t/ha/yr soil loss). Its requirement will be dependant on the construction staging and timing and ability to stabilise disturbed surfaces efficiently.

5.5.2 Type 2 Sediment control standard

A Type 2 sediment control is the minimum requirement for the following scenarios:

- Catchment area > 1,000 m^2 and soil loss > 75 t/ha/yr

- Catchment area > 2,500 m^2 and soil loss of 75 – 150 t/ha/yr.

A Type 2 sediment trap will demonstrate the following characteristics:

- Under typical flow conditions (discharge and suspended sediment concentration), is capable of capturing and holding at least 90% of material > 0.14 mm.
- Sufficient sediment retention capacity to capture and hold one month's sediment loss from the catchment
- Designed to maintain its hydraulic and structural integrity under normal site conditions.

Type 2 controls include:

- Rock Filter Dam (RFD) - RFDs are structures formed by the incorporation of geotextile (e.g. A19 bidum®) and a coarse rock filter (40-75 mm nominal diameter).
- Filter Bag/Tube - Filter tubes are geotextile bags through which site runoff is directed to enable filtering and treatment of sediment.
- Coir logs - Coir logs are biodegradable tubes filled with densely packed coconut fibre wrapped in coir netting. They can be used as flow diversion berms or to provide sediment control by providing temporary ponding and filtering of site runoff.
- Mulch berms - Berms of coarse mulch located along the contour. Often incorporate a rock filter dam discharge point.

Application to the Proposal

Type 2 controls will be applied across most, if not all of the Proposal components, pending the construction staging and timing approach. Key areas within each component where Type 2 controls can be applied include

- Mulch berms located along the boundaries of cleared areas, particularly where vegetative material is available (i.e OHTL construction pads, Darwin Converter Site)
- Coir logs or filter bags/tubes to be located within drainage channels (i.e. within the Solar Precinct). Filter bags can also be placed around open trenches such as that within the Cable Transition Facilities.
- RFD's to be located upstream of the discharge/outlet point (i.e. Solar Precinct and Darwin Converter Site)

5.5.3 Type 3 Sediment control standard

A Type 3 sediment control is the minimum requirement where calculated soil loss is < 75 t/ha/yr. A Type 3 sediment trap will demonstrate the following characteristics:

- Under typical flow conditions (discharge and suspended sediment concentration), is capable of capturing and holding at least 90% of material > 0.42 mm.
- Sufficient sediment retention capacity to capture and hold one month's sediment loss from the catchment
- Designed to maintain its hydraulic and structural integrity under normal site conditions.

Type 3 controls include:

- Rock berms - clean rock may be placed as a perimeter berm to filter sheet flow runoff from site (typical size 75-150 mm).
- Sediment fence - sediment fence may be used in locations where placement of rock berms is not practical (due to access, materials and equipment constraints).

Application to the Proposal

Similarly to the Type 2 controls, Type 3 controls will also be applied across most, if not all of the Proposal components, pending the construction staging and timing approach. They can be applied in conjunction with both Type 1 and Type 2 controls.

Both rock berms and sediment fences can be applied as boundary controls to filter sheet flow across a disturbed site, out of boundary. In addition, they can be applied to drainage lines or channels.

5.5.4 Supplementary sediment control

Supplementary sediment controls are not considered effective to meet the Type 3 classification in isolation but form an important component of the erosion and sediment control system when implemented as supplementary controls. Supplementary controls that may be implemented during the construction program include:

- Soil binder
- Check dams
- Construction exits

In addition to adopting measures as per IECA Standard Drawings, variations to these may be implemented where it can be demonstrated that they are equally as effective and meet the intent of IECA standards.

5.6 Site stabilisation

Following the completion of construction activities, long-term protection of the site from erosion will be provided by the final constructed infrastructure of the Proposal, including solar panels, constructed roads, lined drainage channels and revegetation of disturbed areas, as per the applicable engineering plans when developed.

In the context of erosion and sediment control, the following practices will assist in achieving site stabilisation and long-term protection for downstream environments:

- Site preparation and revegetation works are commenced as soon as practicable after completion of each stage of earthworks.
- Topsoil (if required) is managed to ensure preservation of its long-term value (i.e. limits to stockpiling duration, and stockpiling height limits).
- Selected plant species for revegetation are appropriate for site conditions and endemic to local vegetation communities.
- Erosion and sediment controls are to remain in place until minimum 75% self-sustaining groundcover (or equivalent) is achieved for disturbed areas, with minimum of 90% for drainage features.

6 SUMMARY AND RECOMMENDATIONS

This EHA undertaken for the Proposal has identified that, whilst the soil loss risk ratings remain low overall, the extent and size of the disturbed area, presents a significant risk if not managed appropriately. Adequate consideration by Sun Cable must be placed on erosion and sediment control through all stages of the Proposal (i.e. planning, design and construction) to ensure the risk and hazard to the environment is managed to reduce environmental impacts.

The following recommendations are provided to assist in managing the erosion risk throughout the Proposal:

- Emphasis should be placed on developing a clear construction schedule and staging approach which takes into consideration works that may occur over the high risk months (i.e. December to March). The development of any Primary or Progressive ESCP will need to reflect the timing and staging, to ensure controls are appropriate.
- Staging of the construction of the Solar Precinct is crucial in ensuring that that soil loss and overall risk remains very low. Stabilisation of constructed areas will be crucial in maintaining this.
- No areas of disturbance should be left exposed to rainfall or dust-producing winds without an adequate degree of protection throughout all stages of the Proposal.
- Site stabilisation and rehabilitation targets should be assigned as key performance indicators or hold points in relevant construction contracts to ensure targets are met in a timely manner.
- Revegetation and landscaping schedules are to include provision of short-term ground-cover crops or erosion control measures whilst facilitating permanent species establishment.
- Separation of clean and dirty water. Diversion of up-slope, run-on water around construction areas
- Stormwater management plans also need to factor in cleaning and maintenance schedules of stormwater infrastructure due to the likelihood of sediment build-up in any temporary or permanent drainage.
- A primary site-wide Erosion and Sediment Control Plan (ESCP) should be developed for each proposal component to provide contractors a basis on which to develop site-specific ESCPs.
- Type 1 sediment controls (sediment basin) will be required in areas where there is land disturbance greater than 1 ha and potential soil loss is greater than 75 t/ha/yr; or where potential soil loss is greater than 150 t/ha/yr for catchments less than 1 ha
- All proposal ESCPs are to be developed by a suitably qualified ESC specialist and/or reviewed by a CPESC.

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APPENDIX A SOLAR PRECINCT CALCULATIONS

Solar Precinct RUSLE Calculations

Table 1 – Erosion risk rating – mean monthly rainfall depth (Elliot BoM, 2021)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall depth (mm)	137.9	156.3	79.7	20.5	6.5	5.4	2.8	1.0	5.5	20.8	46.7	103.4
Rating	High		Moderate	Very Low							Moderate	High

Table 2 – Solar Precinct – RUSLE equation inputs

Factor	Description	Value	Comment
A	estimated soil loss (tonnes/ha/yr)	variable	As calculated per catchment
R	rainfall erosivity factor	2,411	Calculated using the annual R-factor equation
K	soil erodibility factor	0.030	Based on soil information for the catchment. It is recommended that further geotechnical analysis of soils occur, prior to the development of any Progressive ESCP and construction works.
LS	slope length/gradient factor	1% slope, 200m length	Based on maximum catchment characteristics
P	erosion control practice factor	1.3	Construction phase condition
C	ground cover and management factor	0	Based on proposed surface cover. Bare soil/erosive surface has been assumed for the majority of the project (access roads) as a conservative measure, the camp surface has been previously used and is hard ground and therefore assumed to have a different C-factor. The C-factor for the project will vary depending on stabilisation and management of surfaces exposed by construction and operation and is to be updated progressively within each specific ESCP

Table 3 – RUSLE Calculations

Project component	Solar Precinct		Operational building infrastructure		Access Road (gravel)		Access Road (bitumen)		Airstrip	
Area - ha	12,000		3.2		30		42		6	
Rainfall erosivity (R)	2411		2411		2411		2411		2411	
Soil erodibility (K)	0.030		0.030		0.030		0.030		0.030	
Slope length (L)	200		200		200	20	200	20	200	200
Slope gradient (S)	1		1		1	3	1	3	1	1
Length/gradient (LS)	0.25		0.25		0.25	0.34	0.25	0.34	0.25	
Erosion control practice (P)	1.3		1.3		1.3		1.3		1.3	
Ground cover in disturbed catchment - %	0	80	0	70	0	50	0	80	0	70
Ground cover in disturbed catchment (C)	1	0.25	1	0.05	1	0.145	1	0.025	1	0.05
Soil loss (t/ha/yr)	23	1	23	1	32	5	32	1	23	1
Soil loss class (risk rating)	1 - Very Low	1 - Very Low	1 - Very Low	1 - Very Low	1 - Very Low	1 - Very Low	1 - Very Low	1 - Very Low	1 - Very Low	1 - Very Low

APPENDIX B OHTL CALCULATIONS

OHTL RUSLE Calculations

Table 1 – OHTL – RUSLE equation inputs

Factor	Description	Value	Comment
A	estimated soil loss (tonnes/ha/yr)	variable	As calculated per catchment
R	rainfall erosivity factor	2,411	Calculated using the annual R-factor equation
K	soil erodibility factor	0.030	Based on soil information for the catchment. It is recommended that further geotechnical analysis of soils occur, prior to the development of any Progressive ESCP and construction works.
LS	slope length/gradient factor	1% slope, 200m length	Based on maximum catchment characteristics
P	erosion control practice factor	1.3	Construction phase condition
C	ground cover and management factor	0	Based on proposed surface cover. Bare soil/erosive surface has been assumed for the majority of the project (access roads) as a conservative measure, the camp surface has been previously used and is hard ground and therefore assumed to have a different C-factor. The C-factor for the project will vary depending on stabilisation and management of surfaces exposed by construction and operation and is to be updated progressively within each specific ESCP

Table 2 – OHTL – K Factors

Class	Soil	K-factor
Alluvial floodplains	Red, brown, yellow silty and sandy earths, brown and grey clays	0.043
Clay plains	Olive brown, brown and grey clays	0.025
Coastal Floodplains	Tenosolic and Kandosolic Redoxic Hydrosols	0.053
Desert sandplains	No description	0.015
Granite hills	Skeletal soils and minor coarse sandy yellow soils	0.036
Granite plains and rises	Stony and gravelly red and yellow sandy earths.	0.027
Lateritic plains and rises	Loamy or gravelly red and yellow earths, siliceous and earthy sands, sandy brown and earths.	0.043
Lateritic plateaux	Shallow, skeletal sandy red and yellow earths	0.027
Limestone plains and rises	Brown sandy and loamy soils, sandy and loamy red and yellow earths.	0.053
Sandstone hills	Skeletal soils and outcrop with minor sandy red and yellow gradational soils and shallow gravelly lithosols	0.053
Sandstone plains and rises	Skeletal soils and shallow gravelly loams and sands; yellow and red earths	0.053

Table 3 – OHTL – R values

Location	Annual Erosivity
Darwin Airport	15724
Adelaide River	12172
Pine Creek	10783
Katherine	8464
Daly Waters	4352
Elliot	2411

Table 4 - Elliot erosion risk ratings for the OHTL

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall depth (mm)	137.9	156.3	79.7	20.5	6.5	5.4	2.8	1.0	5.5	20.8	46.7	103.4
Rating	High		Moderate	Very Low							Moderate	High

Table 5. OHTL - Soil loss and erosion hazard summary (Elliot)

Project component	Desert Sandplains	Lateritic plains and rises
Area - ha	0.6ha per pole installation. Number of poles to be confirmed	
Rainfall erosivity (R)	2411	
Soil erodibility (K)	0.053	0.043
Slope length (L)	100	
Slope gradient (S)	1	
Length/gradient (LS)	0.20	
Erosion control practice (P)	1.3	
Ground cover in disturbed catchment - %	0	
Ground cover in disturbed catchment (C)	1	
Soil loss (t/ha/yr)	34	27
Soil loss class	1 – Very Low	1 – Very Low

Table 6. Daly Waters erosion risk ratings for the OHTL

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall depth (mm)	165.4	165.4	120.1	23.6	5.0	5.6	1.5	1.7	4.9	22.5	59.4	110.0
Rating	High			Very Low							Moderate	High

Table 7 - Soil loss and erosion hazard summary (Daly Waters)

Project component	Lateritic plains and rises	Alluvial floodplains
Area - ha	0.6ha per pole installation. Number of poles to be confirmed	
Rainfall erosivity (R)	4352	
Soil erodibility (K)	0.043	0.043
Slope length (L)	100	
Slope gradient (S)	1	
Length/gradient (LS)	0.20	
Erosion control practice (P)	1.3	
Ground cover in disturbed catchment - %	0	
Ground cover in disturbed catchment (C)	1	
Soil loss (t/ha/yr)	50	50
Soil loss class	1 – Very Low	1 – Very Low

Table 8 Katherine erosion risk ratings for the OHTL

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Erosivity (mm)	2252	1686	1334	308	25	0	19	10	45	202	627	1955
Rating	Extreme		High		Very Low					Moderate	High	Extreme

Table 9. OHTL - Soil loss and erosion hazard summary (Katherine)

Project component	Lateritic plains and rises	Limestone plains and rises	Lateritic plateaux
Area - ha	0.6ha per pole installation. Number of poles to be confirmed		
Rainfall erosivity (R)	8464		
Soil erodibility (K)	0.043	0.053	0.027
Slope length (L)	100		
Slope gradient (S)	1		
Length/gradient (LS)	0.20		
Erosion control practice (P)	1.3		
Ground cover in disturbed catchment - %	0		
Ground cover in disturbed catchment (C)	1		
Soil loss (t/ha/yr)	96	119	60
Soil loss class	1 – Very Low	1 – Very Low	1 – Very Low

Table 10. Pine Creek erosion risk ratings for the OHTL

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Erosivity (mm)	2810	2323	1446	631	56	0	31	4	48	387	958	2090
Rating	Extreme		High		Very Low					High		Extreme

Table 11. OHTL - Soil loss and erosion hazard summary (Pine Creek)

Project component	Limestone plains and rises	Sandstone plains and rises	Granite plains and rises	Granite hills	Alluvial floodplains	Sandstone hills
Area - ha	0.6ha per pole installation. Number of poles to be confirmed					
Rainfall erosivity (R)	10783					
Soil erodibility (K)	0.053	0.053	0.027	0.036	0.043	0.053
Slope length (L)	100					
Slope gradient (S)	1					
Length/gradient (LS)	0.20					
Erosion control practice (P)	1.3					
Ground cover in disturbed catchment - %	0					
Ground cover in disturbed catchment (C)	1					
Soil loss (t/ha/yr)	151	151	77	103	123	151
Soil loss class	2 - Low	2 - Low	1 – Very Low	1 – Very Low	1 – Very Low	2 - Low

Table 12. Adelaide River erosion risk ratings for the OHTL

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Erosivity (mm)	3146	2407	1862	895	91	0	3	4	113	401	1089	2159
Rating	Extreme			High	Low	Very Low			Moderate	High		Extreme

Table 13. OHTL - Soil loss and erosion hazard summary (Adelaide River)

Project component	Alluvial floodplains	Sandstone hills	Sandstone plains and rises
Area - ha	0.6ha per pole installation. Number of poles to be confirmed		
Rainfall erosivity (R)	12172		
Soil erodibility (K)	0.043	0.053	0.053
Slope length (L)	100		
Slope gradient (S)	1		
Length/gradient (LS)	0.20		
Erosion control practice (P)	1.3		
Ground cover in disturbed catchment - %	0		
Ground cover in disturbed catchment (C)	1		
Soil loss (t/ha/yr)	139	171	171
Soil loss class	1 – Very Low	2 - Low	2 - Low

Table 14. Darwin Airport erosion risk ratings for the OHTL

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Erosivity (mm)*	4496	3512	2826	808	160	15	5	47	80	472	948	2355
Rating	Extreme			High	Moderate	Very Low			Low	High		Extreme

Table 15. OHTL - Soil loss and erosion hazard summary (Darwin)

Project component	Lateritic plains and rises	Sandstone hills	Sandstone plains and rises	Alluvial floodplains	Coastal floodplains
Area - ha	0.6ha per pole installation. Number of poles to be confirmed				
Rainfall erosivity (R)	15724				
Soil erodibility (K)	0.043	0.053	0.053	0.043	0.053
Slope length (L)	100				
Slope gradient (S)	1				
Length/gradient (LS)	0.20				
Erosion control practice (P)	1.3				
Ground cover in disturbed catchment - %	0				
Ground cover in disturbed catchment (C)	1				
Soil loss (t/ha/yr)	179	221	221	179	221
Soil loss class	2 - Low	2 - Low	2 - Low	2 - Low	2 - Low

APPENDIX C DARWIN CONVERTER SITE AND CABLE TRANSITION FACILITIES CALCULATIONS

Darwin Converter Site and Cable Transition Facilities RUSLE Calculations

Table 1 – Erosion risk ratings for the Darwin Converter Site and Cable Transition Facilities

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Erosivity (mm)	4496	3512	2826	808	160	15	5	47	80	472	948	2355
Rating	Extreme			High	Moderate	Very Low			Low	High		Extreme

Table 2 – Darwin Converter Site / Cable Transition Facilities – RUSLE equation inputs

Factor	Description	Value	Comment
A	estimated soil loss (tonnes/ha/yr)	Variable	As calculated per catchment
R	rainfall erosivity factor	15724	Calculated by the Darwin Harbour Advisory Committee Research Group
K	soil erodibility factor	0.053	Based on soil information for the catchment. It is recommended that further geotechnical analysis of soils occur, prior to the development of any Progressive ESCP and construction works.
LS	slope length/gradient factor	Variable	Darwin Converter Site – 2% slope, 200m length Cable Transition Facilities – 1%, 5%, 10% and 15% slope, 100m length
P	erosion control practice factor	1.3	Construction phase condition
C	ground cover and management factor	0	Based on proposed surface cover.

Table 3 - Soil loss and erosion hazard summary Darwin Converter Site

Project component	Darwin Converter Site – 0% cover	Darwin Converter Site – 70% vegetative cover
Area - ha	55	
Rainfall erosivity (R)	15,724	
Soil erodibility (K)	0.053	
Slope length (L)	200	
Slope gradient (S)	2%	
Length/gradient (LS)	0.58	
Erosion control practice (P)	1.3	
Ground cover in disturbed catchment - %	0	70
Ground cover in disturbed catchment (C)	1	0.05
Soil loss (t/ha/yr)	628	31
Soil loss class	5 - High	1 – Very Low

Table 4 - Soil loss and erosion hazard summary Cable Transition Facilities

Project component	1% slope		3% slope		5% slope		15% slope	
Area - ha	1		1		1		1	
Rainfall erosivity (R)	15,724		15,724		15,724		15,724	
Soil erodibility (K)	0.053		0.053		0.053		0.053	
Slope length (L)	100		100		100		100	
Slope gradient (S)	1%		3%		5%		15%	
Length/gradient (LS)	0.20		0.72		1.35		5.90	
Erosion control practice (P)	1.3		1.3		1.3		1.3	
Ground cover in disturbed catchment - %	0	70	0	70	0	70	0	70
Ground cover in disturbed catchment (C)	1	0.05	1	0.05	1	0.05	1	0.05
Soil loss (t/ha/yr)	221	11	780	39	1463	73	6397	320
Soil loss class	2 - Low	1 – Very Low	6 – Very High	1 – Very Low	6 – Very High	1 – Very Low	7 – Extremely High	3 – Low to Moderate

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