

Section 8
Existing Terrestrial Environment



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8. Existing Terrestrial Environment

8.1 Studies and Surveys

This section describes the existing terrestrial environment and environmental conditions at the proposed onshore project area. Information is also provided on the physical and ecological environments of the north-west region of the Northern Territory within which the project area is located.

Environmental studies and surveys were undertaken as part of the EIA process to provide specific baseline information on some environmental aspects and to gain a better understanding of the potential environmental issues. There existed little reliable information, as no research had previously been undertaken in the project area, and field studies were difficult due to the remoteness and inaccessibility of the site.

Studies and surveys undertaken for this project include:

- desktop assessment of acid sulphate soils;
- desktop assessment of hydrology and water quality;
- terrestrial vegetation and flora surveys;
- biting insects surveys;
- terrestrial fauna surveys.

The methodologies and complete findings of the studies are presented in **Technical Appendices D–H, Volume 2** of this Draft EIS. Results have been summarised in the relevant sections below.

8.2 Physical Environment

8.2.1 Regional Physical Setting

The climate of the region is characterised as tropical monsoonal with a pronounced wet season when air temperature is hot and humidity is high. The region can experience some of the heaviest rainfall in Australia and is characterised by high intensity deluges during the wet season. Very little to no rain falls in the dry season. Winds generally show a strong seasonal pattern with easterlies dominant in the winter and westerlies dominant in the summer. Meteorological conditions may vary between coastal and inland areas.

The land surrounding the proposed project area is generally flat, with a slight slope (1:1000) to the west but there are hills and mountains in the broader region including the low Sugarloaf Ranges 10 km east of Wadeye, and the Wingate Mountains approximately 120 km to the east. The region is geologically stable, with low seismic activity and sediments of a Tertiary age to the coastal side of the Moyle River Fault, with older igneous and metamorphic rocks occurring to the east of the fault. Soils tend to be sands overlying loams in the coastal region, with more rugged, rocky terrain

more prevalent in the inland areas. Acid sulfate soils (ASS) are more likely to be encountered in coastal areas rather than inland.

The onshore Blacktip Project area is wholly located within the Moyle River Basin, within the southern sub-catchment. This sub-catchment has an area of approximately 250 km², and is in relatively good health as defined in the National Land and Water Audit (2002). There is no defined surface drainage nor an existing stream network in the project area. The nearest creek is Sandfly Creek, which is adjacent to Wadeye. Shallow aquifers characterise the region. Groundwater is of a high quality and is used by local communities as a drinking water source.

8.2.2 Meteorology

The purpose of this section is to describe the meteorology that is most pertinent to the terrestrial environment. Other climatic conditions, cyclones and storm surge, are discussed in **Section 7**.

Air Temperature: Air temperature in the project area is hot, particularly during the wet season. Temperatures for both the Wadeye and Wyndham weather stations are shown in **Table 8-1**. Wyndham is located approximately 200 km south-west from Wadeye, and is situated further inland, therefore it does not experience moderating effects from the ocean, and temperatures are generally higher than at Wadeye. The hottest month for both Wadeye and Wyndham is November and the coolest month is July. Annual temperature range for Wadeye is shown in **Figure 8-1**.

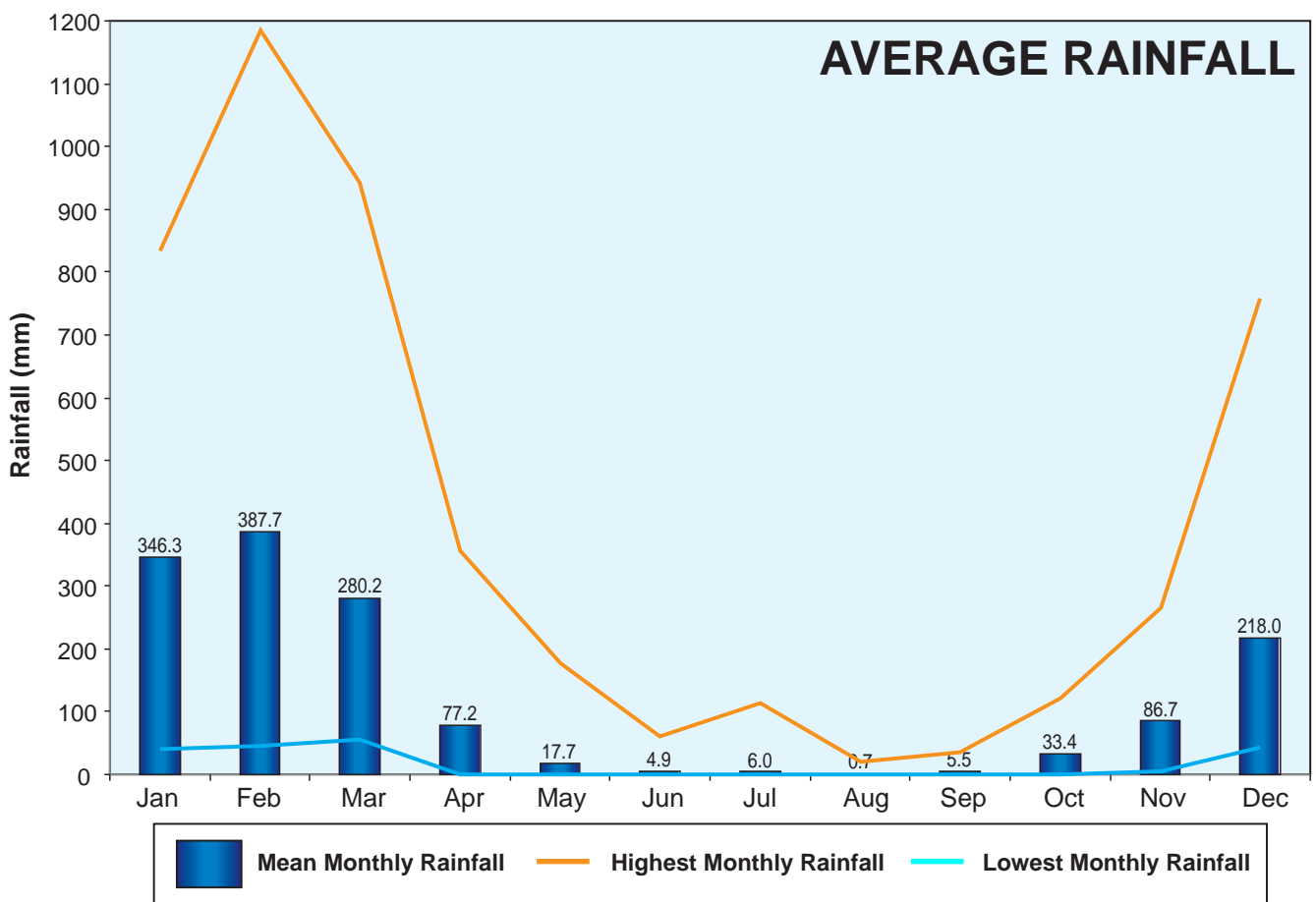
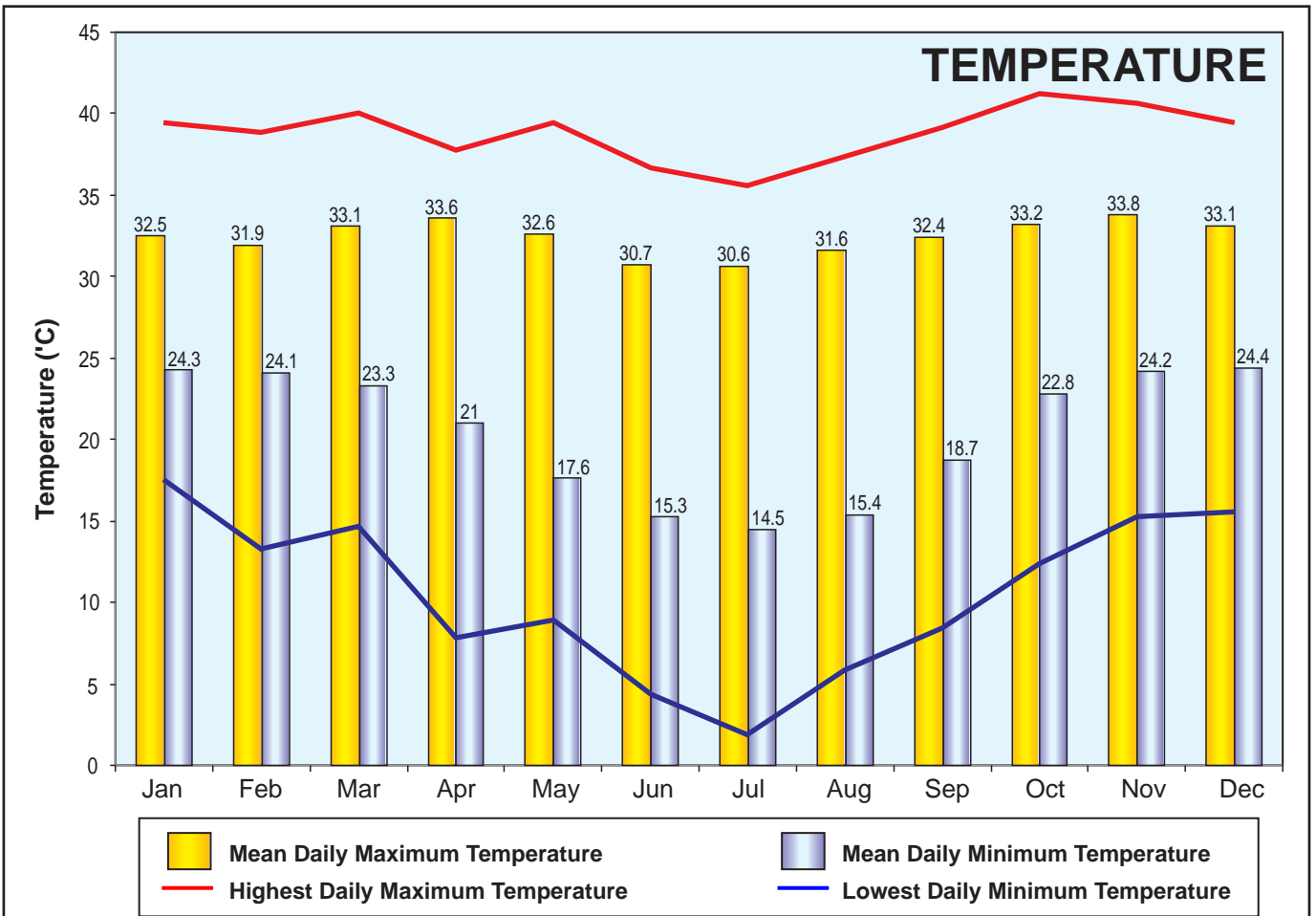
■ **Table 8-1 Average Temperatures for Wadeye and Wyndham**

	Wadeye (°C)	Wyndham (°C)
Mean Daily Maximum – November	33.8	39.4
Mean Daily Minimum – November	24.2	27.1
Mean Daily Maximum – July	30.6	31.2
Mean Daily Minimum – July	14.5	17.1

Humidity: Humidity in the region is highest in February, with onshore airflow contributing to the atmospheric moisture. The average relative humidity for Wadeye at 9 am is 88% in February, with Wyndham recording an average of 68%. Humidity in the dry season is much lower due to the consistent easterly winds, dropping to 57% (Wadeye) and 32% (Wyndham) in July. Wadeye experiences higher humidity overall due to its proximity to the coast. Annual 9am and 3pm averages for both Wadeye and Wyndham are shown in **Table 8-2**.

■ **Table 8-2 Annual Humidity Averages for Wadeye and Wyndham**

Annual Averages	Wadeye (%)	Wyndham (%)
Relative humidity at 9 am	72	46
Relative humidity at 3 pm	55	35



Data Source: Bureau Of Meteorology

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Rainfall and Storms: Rainfall in the region is monsoonal, mainly occurring in the wet season. Heavy rains are common, although rainfall decreases rapidly with distance from the coast. Very little to no rain falls in the dry season, particularly during June and August, with the possibility of droughts increasing with distance from the coast.

The annual average rainfall varies from 1464 mm at Wadeye to 765 mm for Wyndham, again due to the distances from the coast. Average annual rainfall for Wadeye is shown in **Figure 8-1**.

Thunderstorms consisting of lightning, thunder, heavy rainfalls and strong winds are a regular occurrence in the wet season, and are particularly common over coastal areas. Squalls, usually lasting less than half an hour, may also be associated with the thunderstorms.

Very little rain falls in the dry season and storm activity is minimal. Rainfall itself is not considered a major influence on design criteria of the project; however, associated cyclonic activity or flooding will be taken into consideration, particularly for various components of the project.

Floods: Much of the region is prone to flooding in the wet season, particularly areas in the region's extensive river catchments. Flooding is generally caused by heavy or persistent rainfall, but may also occur when cyclones develop or from storm surge in coastal areas. Cyclones are discussed in **Section 7**.

Flooding is a significant design consideration for the onshore components of the proposed Blacktip Project, and particularly influences the location of the onshore gas plant and access routes. As a result, an elevated area has been chosen for the plant site. Studies of flooding will be undertaken to determine design criteria of the plant and to assess potential environmental impacts, such as subsequent erosion or ponding of water on adjacent land. The results of these studies will be incorporated into the detailed design phase to ensure adequate drainage facilities are provided.

Dust Storms: There is little information regarding dust storms in the Wadeye area. However, dust is not considered an influencing factor on design of the project components.

Winds: Winds show a strong seasonal pattern, being predominantly from north-east, east or south-east in winter (April to July) and north-west, west and south-west in summer (September to February). March and August are transitional periods between summer and winter patterns when winds can blow from either direction. Wind speeds recorded for Wadeye vary from an average of 4.2 km/h in March to 7.7 km/h in July (Bureau of Meteorology 2004).

Wind studies undertaken by WNI show that there is a 0.1% chance of 20 kn winds persisting for longer than 12 hours at Troughton Island, 50 km from the proposed onshore gas plant (WNI 2004). Analysis of wind data from the airport near Wadeye indicates that there is only 0.16% chance of winds exceeding 15 kn during ambient weather conditions (**Figure 8-2**). Wind characteristics are especially important in the timing of shipping operations (for example berthing) in the nearshore or offshore areas.

8.2.3 Topography

As shown on **Figure 8-3**, the topographic elevation of the site for the proposed gas plant is between 10 m Australian Height Datum (mAHD) and 20 mAHD. The proposed pipeline landfall and gas pipeline route to the gas plant lies between 0mAHD and 20 mAHD with a slope of less than 1:1000 to the west.

The proposed plant site is generally flat with a slope of less than 1:1000 towards the west. A minor ridge is located to the south-east of the plant site.

A dune system is present to the east of the pipeline landfall characterised by low relief.

8.2.4 Land Systems

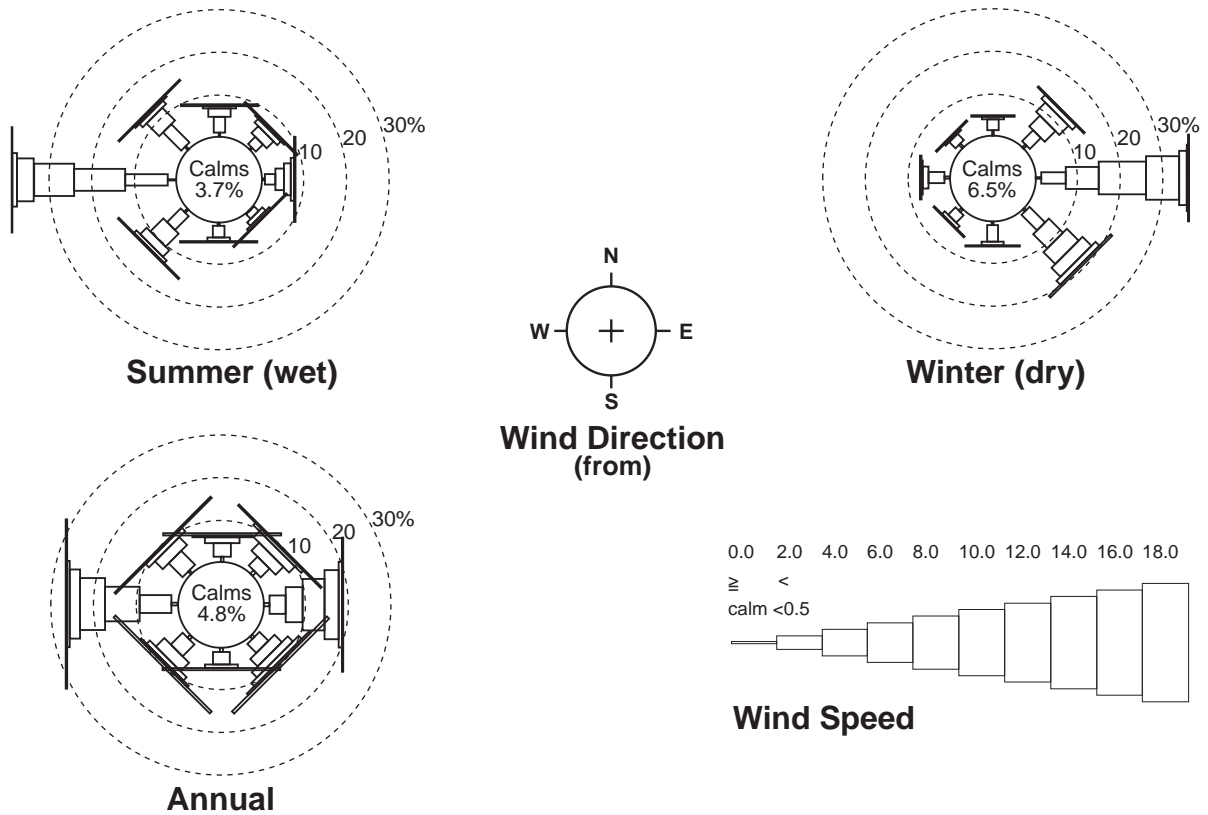
The proposed plant site is located on the Moyle Land System (NTG 2003). This system is described as gently undulating plains with slopes of less than 2.5%, which supports an open forest vegetation type.

The Moyle Land System is composed of colluvium, alluvium and aeolian deposits of deep red earths and sandy red earths, which are underlain by deeply weathered sandstone. Colluvium, alluvium and aeolian deposits are the result of sedimentary processes associated with the natural weathering of rock formations. Colluvium deposits result from depositional systems involving the transport of weathered materials by gravity. Alluvial deposits result from transport of weathered material by water, and aeolian deposits involve wind transport of weathered material. The parent material of these weathered soils is assumed to be the siltstones, sandstones and diamictite of the Port Keats group formation.

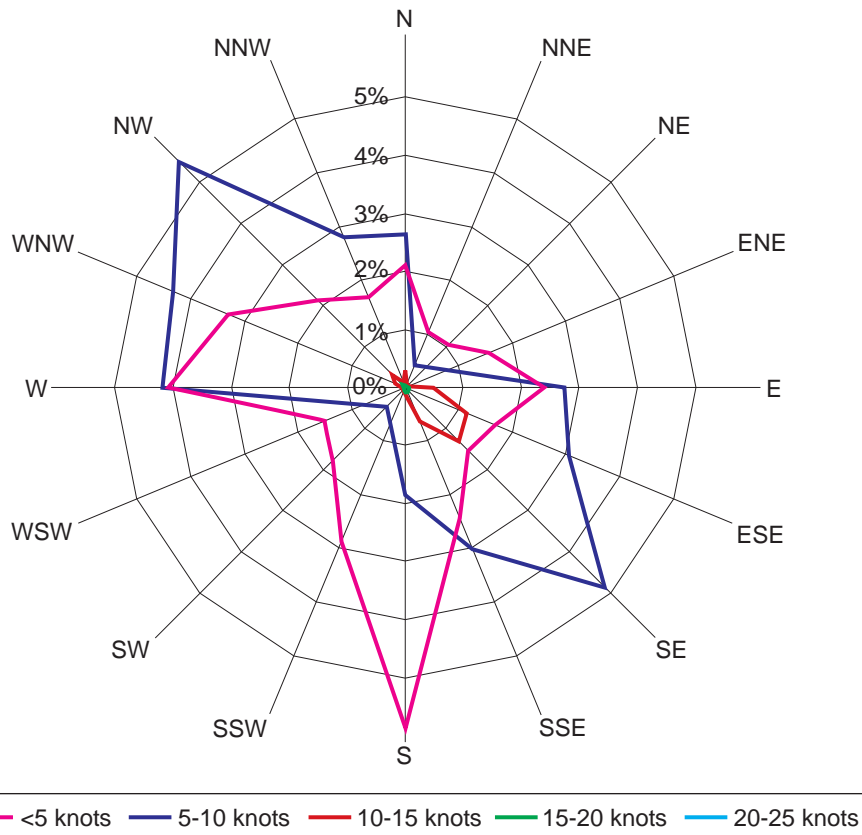
As shown on **Figure 8-4**, the proposed export pipeline will cross the Carpentaria Dune System on the northern end of Yelcherr beach (landfall) and then the Moyle Land System as it traverses eastward towards the proposed plant site. The Carpentaria Dune System is described as consisting of dunes and swales, beach deposits and sands. The dune system supports woodlands, monsoon thicket, grasslands, or is bare of vegetation. The sandy beach and dunes are alluvium and aeolian deposits, which under the current depositional environment would be constantly eroded and replenished by tidal movement and storm events. Anecdotal evidence indicates the dunes have undergone considerable erosion during recent years.

8.2.5 Geology and Soils

The proposed plant site is located on sand, soil, colluvium and black soil of Tertiary age (Bureau of Mineral Resources 1971). Sedimentary siltstones, silty sandstones, minor limestones, basal conglomerate and igneous diamictite of Permian age underlie these Tertiary age deposits (**Figure 8-5**).



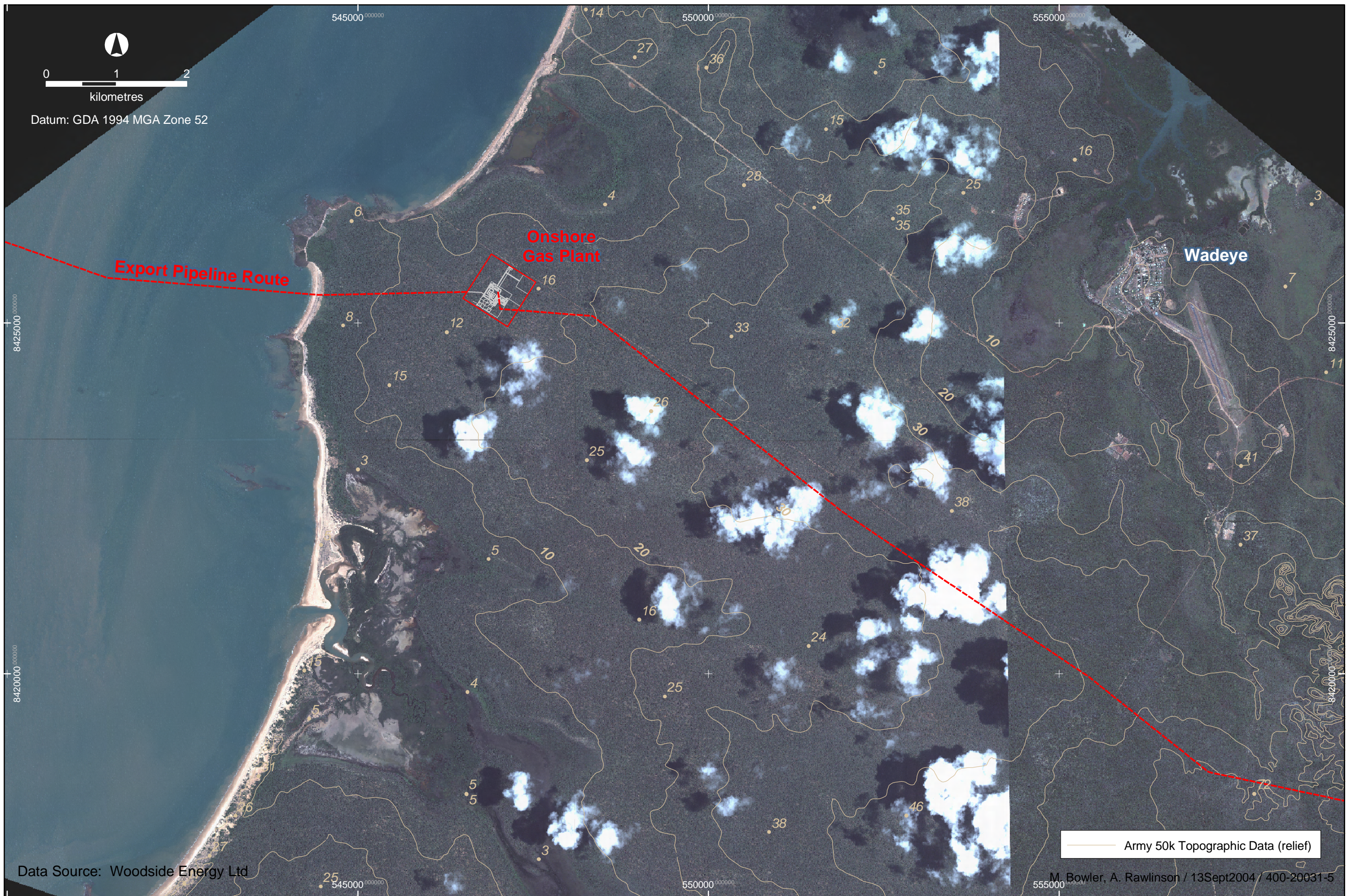
March 1992 – November 2000 Wind Roses from Troughton Island. Source: WNI Preliminary Metocean Conditions for Blacktip Location Joseph Bonaparte Gulf Prepared for Woodside Energy Limited Nov 2001



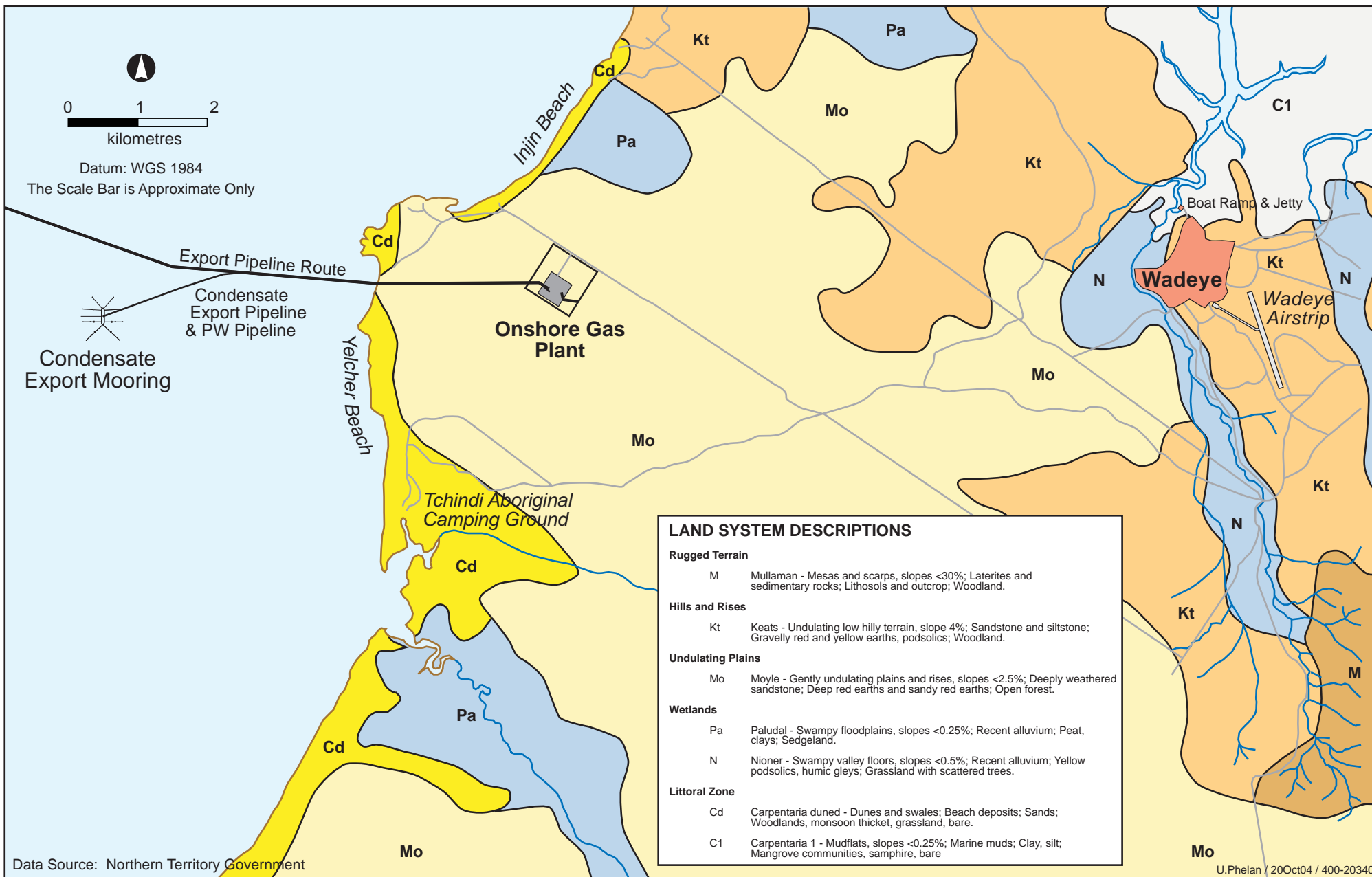
Data Source: Woodside Concept Basis for Design Data Sheet. Onshore Site Data

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Data Source: Northern Territory Government

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The export pipeline will cross alluvial dune and beach deposits of Quaternary age at the landfall and then the above detailed Tertiary age deposits as it traverses eastward towards the proposed plant site. The Permian age deposits as detailed above underlie these Quaternary age deposits (Bureau of Mineral Resources 1971).

Yelcherr Beach extends approximately 200 m from the Carpentaria Dune System at low tide. The hard black rock observed at the two headlands on the northern and southern sides of the proposed landfall site is most likely Permian aged igneous diamicite. Geomorphology of the area suggests the thickness of marine sediments at Yelcherr Beach may be limited due to shallow Permian Age bedrock.

Oil and coal explorations have been conducted in the area to the east of the proposed plant site, between the proposed plant site and Wadeye (Woodside 2003e). Exploration details are unknown (for example depth of investigation); however, the absence of extensive investigations and associated development in the area suggests the absence or non-viability of oil and coal reserves in the area.

Seismic Stability: The Northern Territory has a relatively low exposure to seismic activity, as defined by AS1170.4 (1993) with the most active area being centred around Tennant Creek, nearly 800 km from the proposed onshore project facilities. There are several faults located in the general area of the proposed plant site (Bureau of Mineral Resources 1971). The closest is the Moyle Fault located approximately 30 km to the east of the plant site. As there is no recorded seismic activity in the area, it would appear that the faults are inactive.

The township of Wadeye, 10 km from the proposed gas plant, has an earthquake acceleration coefficient of 0.09a. According to AS 1170.4, this coefficient is an index related to the expected severity of earthquake ground motion. The predicted exposure to seismic activity for the proposed plant site and export pipeline route, including the landfall is low.

During a seismic event, seismic loads may reduce the effective soil pore pressure to zero, which could result in liquefaction of the soils. Liquefaction is generally observed in saturated fine to medium grained soils.

Soil Types: Soil in the area of the proposed plant site is described in **Table 8-3**.

■ **Table 8-3 Soil Characteristics**

Characteristic	Description
Topsoil Texture	Sand
Subsoil Texture	Loam
Topsoil pH	4.9–5.6
Subsoil pH	4.9–7.0
Total Nitrogen (Topsoil)	0.05–0.1%
Total Phosphorus (Topsoil)	<0.02%
Organic Carbon (Topsoil and Subsoil)	<0.3%
Present Hillslope Erosion	0–0.5t/ha/yr (very low)
Rainfall Erosivity R Factor (rainfall intensity and storm kinetic energy)	10,000–20,000 MJ.mm/ha.hr.yr (moderate to high)
Parent Lithology	Duricrust

Source: Natural Heritage Trust – Australian Natural Resources Atlas from the Natural Land and Water Resources Audit 2001

A limited intrusive investigation of the soil profile at the proposed plant site and along the proposed gas pipeline route was conducted in March 2002 (Woodside 2003e). Results of the investigation are summarised below:

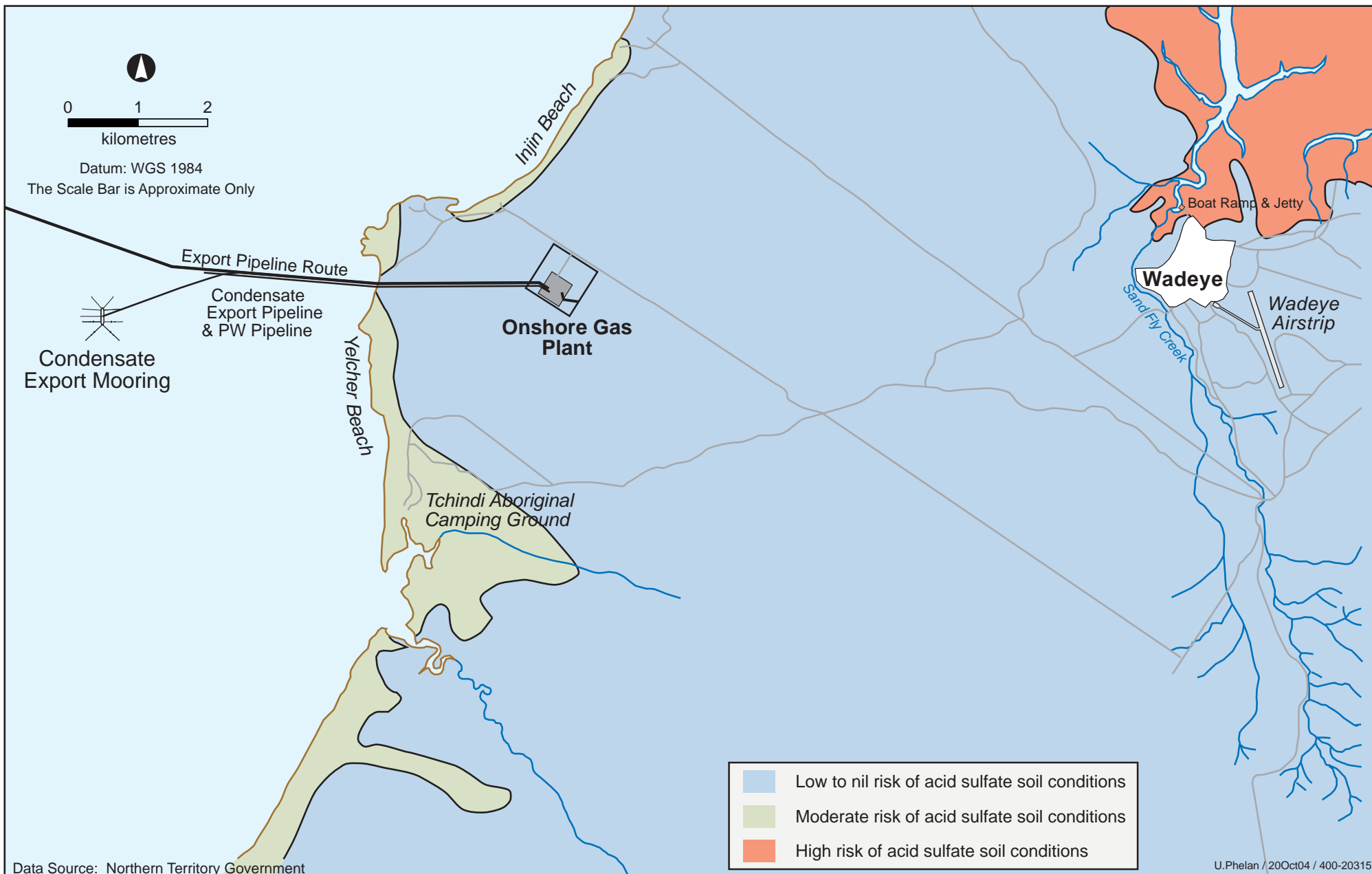
- The soil profile at the proposed plant site consists of well-consolidated sandy clay to clayey sand.
- The soil profile along the proposed gas pipeline route becomes less sandy from the landfall towards the proposed plant site.
- A laterite layer was observed at the surface underlain by sandy clay on the immediate landward side of the Carpentaria Dune System.
- Plastic clay was observed at 1.2 mbg at the landfall.

Further geotechnical site investigations were undertaken in September 2004; the results will be available before the end of 2004.

Acid Sulphate Soils: Acid sulphate soils (ASS) are soils that contain iron sulfides which, when drained or disturbed, produce sulfuric acid and result in the release of soluble iron, sulfate, aluminium and other toxic metals.

A desktop ASS assessment was conducted by SKM (2004a). Results of this investigation indicated that there is a low to nil risk of ASS conditions associated with the majority of the pipeline route and the proposed plant site. However, a moderate to high risk of ASS conditions was identified in soils associated with the landfall. To confirm the potential for ASS, ASS site investigations were undertaken in the project area in September 2004; the results will be available before the end of 2004. Preliminary indications are that ASS will not be an issue.

As shown in the ASS risk map (**Figure 8-6**) the potential acid sulphate soils are confined to the Carpentaria Dune System.



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8.2.6 Hydrology, Hydrogeology & Water Quality

A desktop study of the hydrology, hydrogeology and water quality associated with the onshore project area was undertaken. This section summarises the results of this study, which are detailed in a full report in **Appendix E, Volume 2**.

Surface Water Catchments: The onshore Blacktip Project area is wholly located within the Moyle River Basin. The Moyle River Basin Surface Water Management Area (NLWRA 2000) comprises sub-catchments that are described as being unaffected by development. The project area is located in the southern sub-catchment, which has an area of approximately 250 km². The average annual runoff is estimated to be around 600,000 ML/annum. Total diversions are believed to be negligible in this sub-catchment, which is largely undeveloped.

There is no well-defined surface drainage in the onshore project area. The closest surface water systems are the coastal inlets and seasonally inundated swamps that occur landward of Injin Beach approximately 1 km to the north of the proposed gas plant site, and at the southern end of Yelcherr Beach approximately 3 km to the south of the shore crossing. Ephemeral surface water runoff from the project area would appear to support these coastal wetland ecosystems. The Yelcherr Beach inlet is the main drainage system for the catchment. The nearest creek is Sandfly Creek near Wadeye, this will be the only watercourse directly affected by the project as it will be crossed by an access road proposed between Wadeye and the project area. No watercourses will be crossed by the proposed pipeline. Perennial and annual streams that occur in proximity to the project area are shown in **Figure 8-7**.

Limited stream flow measurements obtained from stream gauging stations in the region indicate that the creeks and streams have peak flows in the middle of the wet season (**Figure 8-7**). Flows peak in December and January at the Port Keats gauge at Dee Creek, which is similar to that in the southern sub-catchment where the onshore development will be located. Stream flows typically cease each year following the wet season and do not occur again until the next wet season. The largest flows in the region have been measured at the perennial watercourses of the Daly River near Nauiyu (150 km north-east), Tom Turners Creek near Peppimenarti (75 km north north east) and the Moyle Rover between Peppimenarti and Nganmariyang (Palumpa, 70 km east). These systems will be traversed by access routes to the project area.

Surface Water Quality: The absence of surface waters in the project area limits the need for detailed understanding of physical and chemical water quality parameters expected in the surface waters in the region. Water quality monitoring in the Wadeye region to date is insufficient to accurately assess baseline water chemistry. However, surface water samples collected as part of the Wadeye/Nauiyu Water Resources study (Haig and Matsuyama 2002) provide data that are indicative of the range of baseline conditions that could be expected in surface water systems in the region surrounding the onshore project area. Ninety-five percent confidence interval values for key physical water quality parameters are shown in **Table 8-4**.

■ **Table 8-4 Baseline Surface Water Quality for the Wadeye Region**

Parameter	Baseline Measurements
PH units	7.4–7.6
Electrical conductivity	354–450 $\mu\text{S}\cdot\text{cm}^{-1}$
Temperature	21–30°C
Turbidity	73–92 NTU

Groundwater: A study of water resources of the Wadeye and Nauiyu region, undertaken by Haig and Matsuyama (2003), indicates that the proposed onshore project area is underlain by upper Permian sedimentary rocks of the Kulshill formation. The lithology consists of sandstone, siltstone and claystone sediments with relatively shallow aquifers. A high yielding, widespread shallow aquifer system underlies the proposed location of the onshore project area. An impervious claystone at a depth of 50 to 100 m marks the base of the aquifer. The shallow aquifers in the region commonly yield greater than 5 L/s and less often 10 L/s, although higher yielding bores are associated with fracturing or a local source of recharge.

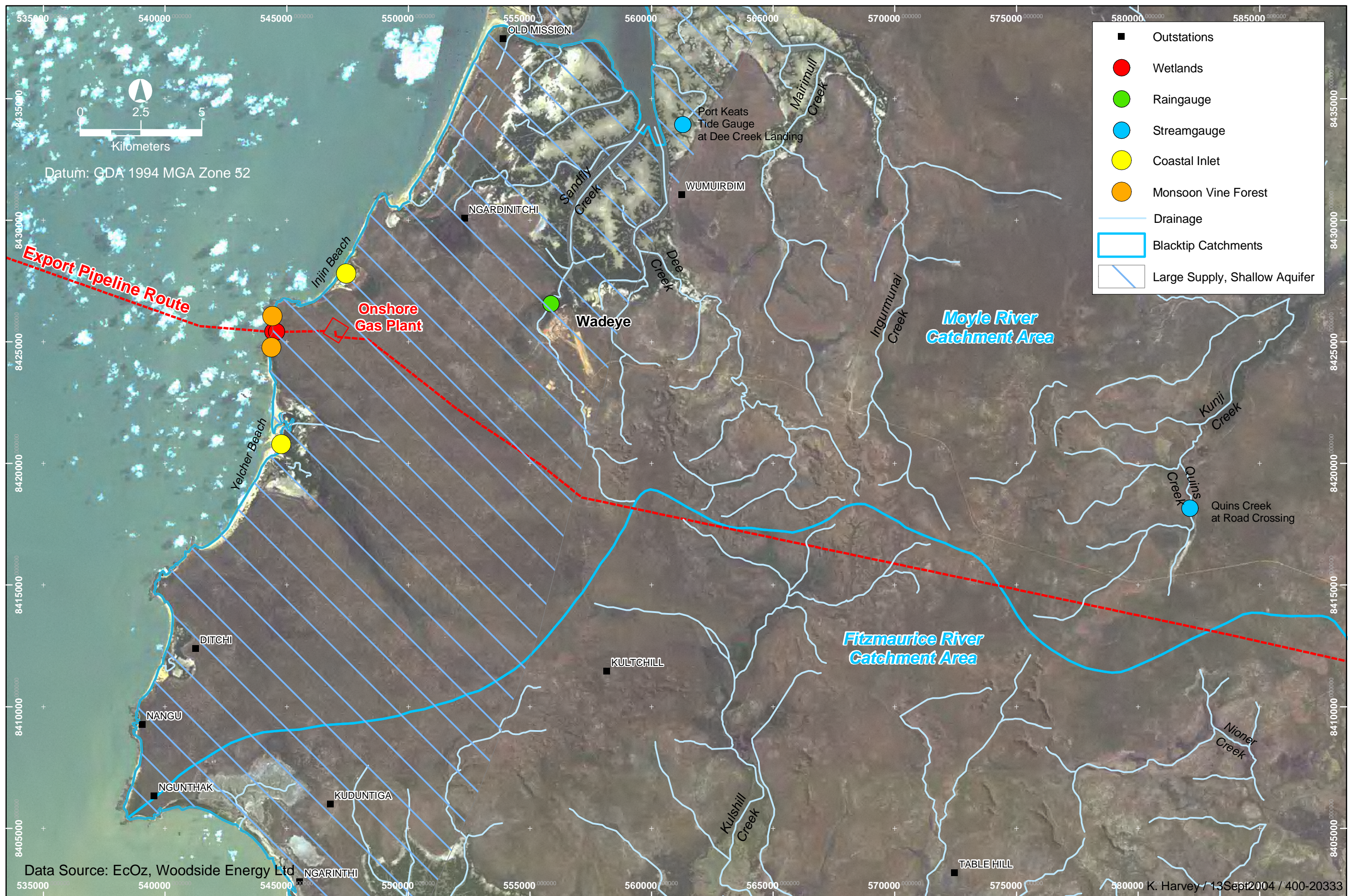
The existing and potential beneficial uses of groundwater from the aquifers in the Wadeye region are:

- potable water supply
- residential and agricultural development
- ecosystem maintenance

The aquifers are a source of potable groundwater for the community of Wadeye and the outstations of Ditchi, Nangu, Kuduntiga, Ngardinitchi, Old Mission, Kuy and Yedderr. Ngardinitchi, located 10 km to the north-east of the onshore project area, is the closet outstation to the proposed project area that relies on groundwater for its potable water supply. Aquifers in the project area are considered to be a significant resource that will underpin agricultural and residential development in the Wadeye region into the future.

Environmental beneficial uses of the groundwater include maintaining wetlands and spring fed vegetation through the dry season. Ecosystems near to the project area that are likely to be dependent to some extent on recharge from groundwater throughout the dry season are:

- the inlets and associated swamps at the southern end of Yelcherr Beach 3 km south of the proposed shore crossing, and at Injin Beach 1 km to the north of the site proposed for the onshore gas plant;
- the monsoon vine forest patches that occur within 1 km to the north and south of the shore crossing.



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The Yelcherr Beach inlet is the main drainage system for the catchment in which the project area is located. Measurements of changing water levels summarised in the Wadeye and Nauiyu Water Resources Study (Haig and Matsuyama 2003) indicate that groundwater levels are stable over time and the volume of use from the municipal bore fields has not caused any noticeable impact on areas of environmental significance. Groundwater depth in the project area has not been measured. Studies will be undertaken prior to construction for the purpose of identifying drainage requirements, designing drainage infrastructure and selecting appropriate bore locations.

Figure 8-7 illustrates hydrogeology, existing bore locations and water dependent ecosystems in the Wadeye region.

Ground Water Quality: The results of water sampling of outstations and community bores in the Wadeye region (Haig and Matsuyama 2003) indicate that the quality of groundwater is generally within the Australian and New Zealand Water Quality and Monitoring Guidelines (ANZECC 2000). Water quality analyses from three outstation and community bores near to the onshore project area are summarised in **Table 8-5** together with the groundwater investigation levels (GIL's). The GIL values, with consideration of ambient groundwater qualities, form the basis for the assessment of contaminated groundwater and associated risks and are taken from the Australian Water Quality Guidelines (ANZECC 2000) and the Australian Drinking Water Guidelines (ADWG 1996). The GIL values define acceptable water quality at the point of use and apply as investigation levels at the point of extraction and as response levels at the point of use, or where there is likelihood of an adverse environmental effect at the point of discharge. The monitoring results give an indication of the baseline quality that can be expected in the aquifers that underlie the onshore project area. It is considered by Hollingsworth *et al.*, (2004) that the quality of the regional groundwater resources is high, and the value of these resources as a source of potable water, supporting residential and agricultural development and ecosystems, requires a high level of protection.

8.3 Ecological Environment

This section summarises baseline information on the ecological environment of the onshore project area and the surrounding region from reports on surveys and studies undertaken for the project, which are included in full in **Volume 2** of this Draft EIS. This information was used to assess the potential environmental impacts of the proposed onshore development, which are discussed in **Section 11**.

8.3.1 Regional Ecological Setting

The onshore development is located in the Darwin Coastal Bioregion identified in the 'Interim Biogeographic Regionalisation of Australia' (Environment Australia 2000). The ecological attributes that characterise the Bioregion have been documented and assessed by Woinarski (2002a) and are summarised below.

The Darwin Coastal Bioregion comprises gently undulating plains on lateritised Cretaceous sandstones and siltstones; sandy and loamy red and yellow earths and siliceous sands, from near the

mouth of the Victoria River to just west of Coburg Peninsula. The Northern Territory Vegetation Map (Wilson *et al.*, 1990) shows around 60% of the Bioregion as being covered by Darwin Woollybutt *Eucalyptus miniata*, Darwin Stringybark *E. tetradonta* open-forest with canegrass *Sarga* species grassland understorey. This vegetation community dominates the area proposed for onshore development. A further three vegetation types occupy greater than 5% of the Darwin Coastal Bioregion. These are:

- Stringybark *Eucalyptus tetradonta*, Darwin Woollybutt *E. miniata*, Smooth-stemmed Bloodwood *Corymbia bleeseri* open-forest with *Sarga sp.* grassland understorey
- Northern Box *Eucalyptus tectifica*, Round Leaf Box *Corymbia latifolia* woodland with *Sarga spp.* grassland understorey
- Saline tidal flats with scattered chenopod low shrubland.

The region is considered to have a relatively high diversity of threatened species according to Woinarski (2002a). Twenty-three species of flora and fauna that occur in the Bioregion are listed as 'threatened' at the Northern Territory level and 15 species are 'threatened' nationally. The distributions of a number of 'threatened' fauna species, namely the Northern Brush-tailed Phascogale *Phascogale tapoatafa pirata*, Brush-tailed Tree-rat *Conilurus penicillatus*, False Waterrat *Xeromys myoides* and Red Goshawk *Erythrotriorchis radiatus*, potentially extend to the onshore development area. This observation is based on the habitat requirements of these species only, as none of the listed threatened flora species are known to occur in the area and field surveys in the region have been extremely limited.

The Bioregion contains some of the most extensive and rich floodplain environments in northern Australia, extensive and diverse mangrove forests, and significant rainforest and riparian vegetation. It is the most important ecological region in the Northern Territory for colonially breeding waterfowl, although no significant breeding areas have been identified in proximity to the onshore project area. Parts of the RAMSAR listed Kakadu Stage 1 and 2 wetlands and the Coburg Peninsula, and seven wetlands of national significance (Whitehead and Chatto 2001) occur in the Bioregion. The closest wetlands of significance to the onshore development are the Moyle River floodplain, located approximately 50 km east of the project area, and the Daly-Reynolds floodplain-estuary system, the lower reaches of which are located over 200 km east of the project area.

Most of the Darwin Coastal Bioregion is in reasonably good ecological condition. For the project area this observation has been confirmed in ecological assessments undertaken in the preparation of this document. The major regional threats are urban development and horticulture, invasion of *Mimosa Mimosa pigra* on the floodplains, and saltwater intrusion. None of these issues are a major concern in the area proposed for the onshore development, which is remote from urban development and horticultural land-uses. Changed fire regimes, feral animals, and weeds, have had subtle impacts more pervasively across the Bioregion. There are few resources or planning mechanisms directed at the south-western part of the Bioregion, which is where the project area is located.

■ **Table 8-5 Baseline Groundwater Chemistry for the Wadeye Region**

Bore RN	Community	Bore yield (L/s)	pH	EC ($\mu\text{S/cm}$)	TDS mg/L	Na mg/L	K mg/L	Ca mg/L	Mg mg/L	Fe (total) mg/L	Total Hardness mg/L	Total Alkalinity mg/L	SiO ₂ mg/L	Cl mg/L	SO ₄ mg/L	NO ₃ mg/L	HCO ₃ mg/L	F mg/L
RN02 5961	Ditchi	10	6.1	50	55	3	4	3	1	0.7	8	12	22	6	4	1	15	0.1
RN02 4308	Ngardinitchii	5	6.5	75	70	5	4	5	1	1.1	17	17	22	10	5	1	20	0.1
RN02 7211	Wadeye	22	4.8	28	27	3	1	1	1	0.1	4	2	16	6	1	1	2	0.1
GIL			6–8	1500		300		1000	<600	0.3				250	400			

GIL - Groundwater Investigation Level

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8.3.2 Vegetation and Flora

A study of the vegetation and flora at the onshore project area was undertaken. This included a desktop review, consultation with experts from the Northern Territory Parks and Wildlife Service Herbarium, and field surveys in both the early dry season and early wet season. This section summarises the results of the vegetation and flora study, which is detailed in a full report in **Appendix F, Volume 2**.

Vegetation Communities: Five vegetation communities have been described and mapped in the onshore project area based on interpretation of high-resolution satellite imagery and field surveys. These communities and corresponding sites sampled during the field surveys are summarised in **Table 8-6**. Vegetation communities and survey sites are mapped in **Figure 8-8**.

■ Table 8-6 Vegetation Communities Surveyed in the Onshore Project Area

Vegetation community	Survey sites
Mixed species low open woodland	OSP6, OSP1
<i>Eucalyptus miniata</i> and <i>E. tetradonta</i> forest with mixed species tree\shrub layer and <i>Sarga sp.</i> tussock grasses	OSP2, GP1, GP3, OUT1
<i>Eucalyptus miniata</i> and <i>E. tetradonta</i> tall woodland to open woodland with mixed species tree\shrub layer and <i>Sarga sp.</i> and <i>Heteropogon triticeus</i> tussock grasses	OSP3, OSP4, OSP5, GP2
Sand dune community	SC1, SC2
Monsoon vine forest	MVF1

The vegetation communities that occur at the pipeline shore crossing, along the onshore export pipeline route and at the proposed gas plant site are described in this section. Botanical data and site descriptions and photos collected during field surveys are collated in the full report in **Appendix F, Volume 2**.

Vegetation Communities Traversed by the Shore Crossing: The section of the pipeline shore crossing landward of the highwater mark traverses a west facing coastal sand dune, which is sparsely vegetated with the grasses *Spinifex longifolius* and *Sarga plumosum*, and a number of herbaceous and succulent species including *Ipomoea pes-caprae*, *Fimbristylis sericea* and *Gomphrena sp.* (**Plate 8-1**).

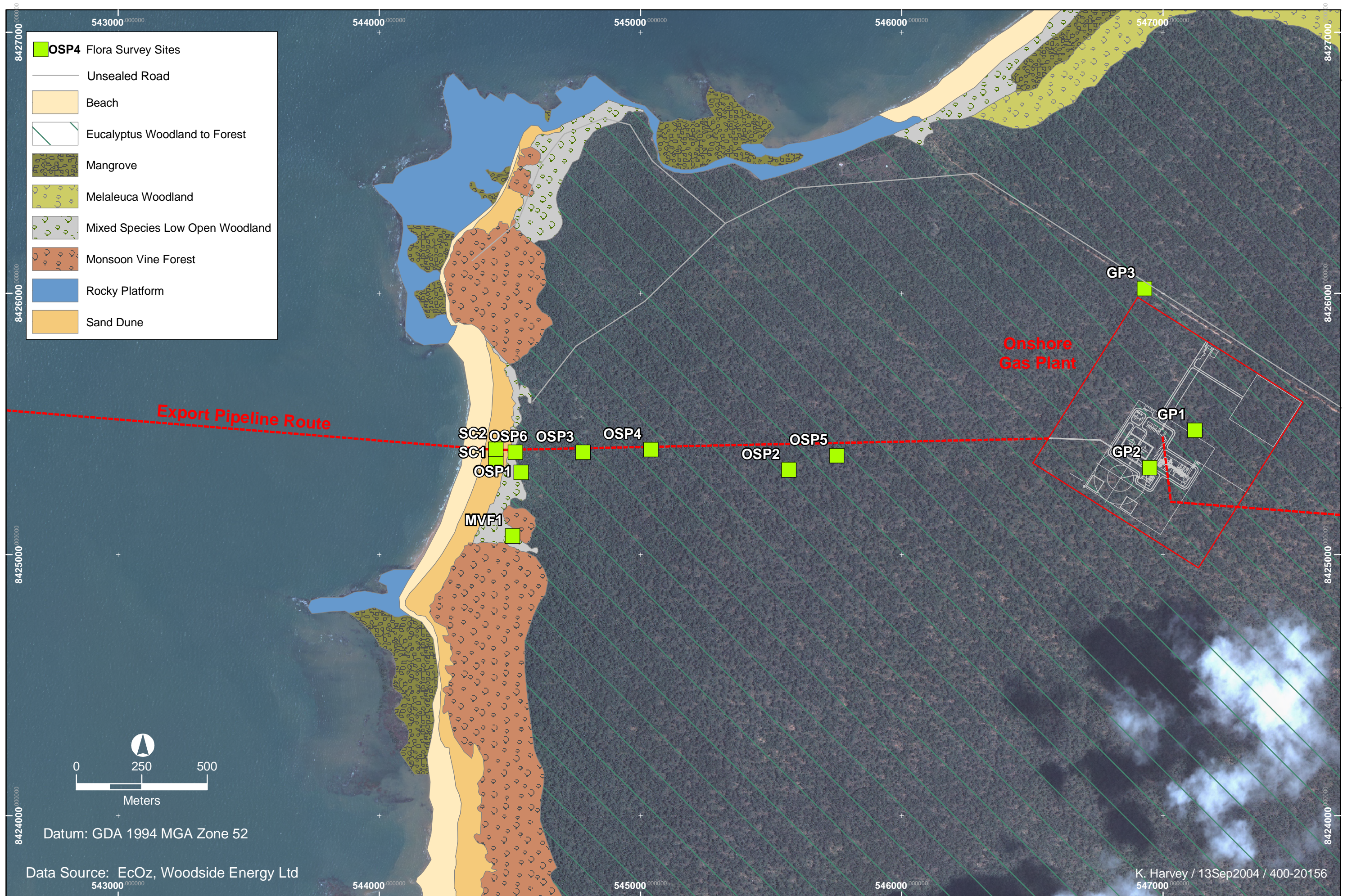
Vegetation Communities Traversed by the Onshore Export Pipeline Route: The onshore pipeline route traverses a low open woodland community that occurs on the hind dunes in damp sandy soils (**Plate 8-2**). This community is comprised of a mixture of tree and shrub species including, Red Bush-apple *Syzygium suborbiculare*, Pandanus *Pandanus spiralis*, Black Wattle *Acacia auriculiformis*, Billy Goat Plum *Terminalia ferdinandiana*, Broad-leaved Cabbage-gum *Corymbia confertiflora* and the Cycad *Cycas maconochiei ssp. maconochiei*. The ground layer is comprised of tussock grasses *Heteropogon contortus* and *H. triticeus*.

Further landward, the onshore pipeline route traverses forests to open woodlands dominated by Darwin Woollybutt *Eucalyptus miniata* and Darwin Stringybark *E. tetradonta* (**Plate 8-3**). Species that are common in the mid-storey of these communities include Billy-goat Plum *Terminalia ferdinandiana*, Red-flowered Kurrajong *Brachychiton megaphyllus*, Cocky Apple *Planchonia careya* and *Cycas maconochiei ssp. maconochiei*. The ground layer is typically comprised of tussock grasses *Sarga sp.* and *Heteropogon sp.*

Vegetation Communities at the Gas Plant Site: The vegetation within the 800 m by 800 m area proposed for the onshore gas plant is tall open forest to woodland dominated by Darwin Stringybark *Eucalyptus tetradonta* and Darwin Woollybutt *E. miniata*. Other species that typically occur in the canopy include Ironwood *Erythrophleum chlorostachys* and Billy-goat Plum *Terminalia ferdinandiana*. The mid-storey of this community is typically sparse and is comprised of a mixture of tree and shrub species. The Cycad *Cycas maconochiei ssp. maconochiei* is a common feature of the understorey. The ground layer is mainly comprised of tussock grasses *Heteropogon triticeus* and *Sarga sp.*

Seasonal variations in the vegetation communities along the export pipeline route, and at the site proposed for the gas plant, are mainly related to the species composition of the understorey. During the early dry season surveys (May 2002) the understorey was comprised of annual *Sarga sp.* and *Heteropogon sp.* tussock grasses, and juvenile trees and shrubs. In December 2003 (early wet season) the communities had been exposed to a recent fire. The annual grasses that dominated the community in the early dry season were dormant and many of the juvenile trees and shrubs were burnt off by the fire, leaving Cycads and larger trees as the dominant understorey plants. Seasonal variations in the vegetation communities in the onshore project area are illustrated in **Plate 8-3 to Plate 8-6**.

Flora Species: Surveys and Herbarium records for the onshore project area document 90 flora species from 43 genera. Lists of species recorded at the shore crossing, pipeline, gas plant site and in the rainforest patch south of the shore crossing, are provided in the full report in **Appendix F, Volume 2**.



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■ Plate 8-1 Sand Dunes Near Shore Crossing



■ Plate 8-2 Low Open Woodland Landward of Sand Dunes

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- **Plate 8-3 Eucalyptus Forest Traversed By The Onshore Pipeline – Photo Taken Early Dry Season (May)**



- **Plate 8-4 Eucalyptus Forest Traversed by the Onshore Pipeline – Photo Taken Late Dry Season (Oct)**

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- **Plate 8-5 Eucalyptus Forest at Gas Plant Site – Photo Taken Early Dry Season (May)**



- **Plate 8-6 Eucalyptus Forest at Gas Plant Site – Photo Taken Late Dry Season (Oct)**

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8.3.3 Conservation Significance of Vegetation and Flora

The onshore project area, as described above, is dominated by Darwin Woollybutt *Eucalyptus miniata* and Stringybark *E. tetradonta* woodland and forest habitats. This habitat is widespread and well represented in the Darwin Coastal Bioregion and is the dominant vegetation association across the Northern Territory. The communities in the project area are largely undisturbed by humans, except for the presence of a few minor bush tracks that are used by the local Aboriginal people. The Eucalyptus woodland/forest is regularly burnt but is largely unaffected by weeds and feral animals. Based on these observations, the ecological integrity of the vegetation in the onshore project area is considered to be high. In the context of the large regional extent of Eucalyptus woodland and forest vegetation, the area that will be cleared for the project is considered unlikely to impact on regional vegetation conservation. Smaller areas and patches of restricted vegetation including monsoon vine forest, sand dune communities, wetlands and riparian forests, occur within the Eucalyptus woodland/forest matrix that dominates the region surrounding the onshore project area. These communities, because of their restricted distribution, and associated value as habitat for species of flora with a restricted distribution, are considered to be of higher conservation value. The conservation significance of more restricted vegetation communities that occur in and surrounding the onshore project area are discussed below.

Monsoon Vine Forests: Patches of monsoon vine forest occur on the hind dunes at the northern and southern ends of the section of Yelcherr Beach where the pipeline shore crossing is proposed. These patches are dominated by the large trees *Tamarind Tamarindus indica*, Red Bush-apple *Syzygium suborbiculare* and Billy-goat Plum *Terminalia ferdinandiana*, and have a dense and diverse understorey of trees, shrubs and vines. Dense patches of monsoon vine forest also occur in association with the estuarine ecosystems that occur to the north and south of the project area. These monsoon vine forest communities have a high diversity of species compared with other communities surveyed in the project area, and are relatively unaffected by weeds, fire and feral animals, and anthropogenic disturbance. Monsoon vine forests typically provide habitat for specialised, and often rare, flora species, with 30% of the known species having been recorded from only 10 patches (Russell-Smith & Bowman 1992). None of the flora species identified in the monsoon vine forests near to the project area are considered to be of special conservation significance. As communities, all rainforest patches are significant in a regional context because of the high level of patch interdependence (Price *et al.*, 1998). The high ecological integrity of the monsoon vine forests in and surrounding the project area, and their reliance on regional connectivity of patches, grants them high conservation significance.

Sand Dunes: Extensive beach and sand dune environments occur along the section of Yelcherr Beach where the pipeline will come onshore, further to the north of the project area at Injin Beach and south of the project area which is a continuation of Yelcherr Beach. The sand dunes at the northern end of Yelcherr Beach have been disturbed in the past by the extraction of sand, and a narrow vehicle track runs along the edge of the foredune. Beyond this localised area of disturbance the sand dunes are largely intact and there has been limited invasion of weed species.

The sand dune communities are ecologically important through their role in protecting the coastline. They act as a buffer against wave damage during storms and cyclones, protecting the land behind from salt water intrusion and allowing the development of more complex plant communities in areas protected from salt water inundation, sea spray and strong winds. The dunes also act as a reservoir of sand, to replenish and maintain the beach at times of erosion. Given that sand dune communities play a key role in maintaining the integrity of landward vegetation communities, and that they are highly susceptible to disturbance, they are considered to be of high conservation significance.

Wetlands: No wetland communities occur in areas identified for development of the shore crossing, onshore export pipeline and gas plant. A number of wetlands do occur in areas surrounding the project area where activities associated with the establishment of water bores, access routes, sourcing of construction materials and establishment of laydown areas may occur. Open grassland and paperbark swamps occur in association with the estuarine ecosystems at Injin Beach to the north of the project area, and at the southern end of Yelcherr Beach to the south of the project area. The Moyle River floodplain, which is a wetland of national importance (Environment Australia 2001), is located 50 km to the east of the project area. The Moyle floodplain has been assessed as having a high conservation value due to its vegetation being relatively weed-free and undisturbed (Whitehead and Chatto 2001).

Riparian: The closest riparian communities to the project area are associated with the coastal inlets that occur at Injin Beach and Yelcherr Beach. Numerous minor and major rivers and creeks also occur in areas surrounding the project area where activities associated with the establishment of water bores, access routes, sourcing of construction materials and establishment of laydown areas, may occur. Riparian communities are typically floristically diverse, contain distinct flora species assemblages, and provide essential 'refugia' habitat for many species of fauna, especially during the 'dry' season. Riparian vegetation communities are of regional conservation significance through their role in maintaining the health of river and creek ecosystems.

'Threatened' Species: None of the plant species recorded during field surveys of the project area are declared 'threatened' species under Northern Territory or Commonwealth legislation. A review of the known distribution of all 'threatened' plant species that occur in the Northern Territory did not reveal any species with a distribution in proximity to the project area. The plants *Zeuxine oblonga* and *Schoutenia ovata* are the 'threatened' plant species with the closest known distribution to the project area. *Zeuxine oblonga* is known from a wet rainforest site on the Daly River (Kerrigan, Cowie and Baker 2002a). This vegetation type does not occur in the project area. *Schoutenia ovata* is known from monsoon vine thickets on granite and limestone outcrops near Tipperary Station (Kerrigan, Cowie and Baker 2002b). The monsoon vine forest patches in close proximity to the project area have been surveyed in both the early and late dry season. No species of significance were identified during these surveys. Overall, the project area is largely comprised of eucalyptus woodland communities, which typically do not contain a high proportion of rare species. Therefore, the likelihood of 'threatened' species occurring in the project area is considered to be low.

Other Protected Species: Plant species belonging to the families Cycadaceae and Orchidaceae are typically regionally restricted in distribution and are of conservation significance for this reason. All species in these families are ‘Protected Wildlife’ under section 3 of the *Northern Territory Wildlife Regulations*.

One species of Cycad, *Cycas maconochiei ssp. maconochiei*, has been observed in the project area where it forms a dominant understorey component of the eucalyptus woodland. The epiphytic orchids, *Cymbidium canaliculatum* and *Dendrobium spp.*, are abundant throughout the project area where they have been observed growing on the trunks of Cycads and eucalyptus trees. None of the cycad and orchid species identified in the project area is classified as ‘threatened’ at the Northern Territory or Commonwealth level.

8.3.4 Weeds

Weed species that occur, or are likely to occur, in the project area and the surrounding region were identified from bioregional reports, Northern Territory Herbarium records and field surveys (**Table 8-7**). Weeds are present in low numbers in the project area. Scattered Rubber-bush *Calotropis procera* plants occur on the beach dunes, and scattered infestations of *Hyptis Hyptis suaveolens* were observed in the hind dunes and in monsoon vine forests adjacent to the project area. Rubber-bush and Hyptis plants were recorded at sites labelled as SC1, SC2, OSP1 and MVF1 in **Figure 8-8**. Snake Vine *Stachytarpheta sp.* and Wild Passionfruit *Passiflora foetida* were also observed in the near coastal areas during field surveys. Other weed species are likely to be present, but in low numbers.

Numerous ‘declared’ weed species are known to occur in the region surrounding the project area, and in areas that will be used for access routes to the site. Species that pose a significant threat to the environment have been identified and discussed by Woinarski (2002a), and are summarised below.

The floodplains across the Darwin Coastal Bioregion face a range of serious threats from weed incursion, notably *Mimosa Mimosa pigra*, which completely re-models floodplain composition and structure, and Olive *Hymenachne Hymenachne amplexicaulis* and Para Grass *Brachiaria mutica*. There are no floodplain environments in the project area, although Mimosa, Olive Hymenachne and Para Grass may be present at river and creek crossings along the access routes to the project area and at locations where construction material will be sourced for the project. The extensive eucalypt forests in the Darwin Coastal Bioregion are affected by the rapid spread to dominance in the understorey of the exotic pasture grasses Gamba Grass *Andropogon gayanus* and Mission Grass *Pennisetum pedicellatum* and *P. polystachion*, which exacerbate the detrimental impacts of an increasing frequency of extensive hot, late dry season fires. These species are common along the access routes between Darwin and Katherine, and along access routes to the project area. Heavy infestations of weeds (such as Noogoora Burr, Parkinsonia, and Castor-oil plant) are a feature of most riparian systems in the Ord-Bonaparte bioregion, which is also traversed by access routes to the project area.

- **Table 8 7 Weed Species that Occur, or Potentially Occur, in the Project Area and in Regions to the East that will be used for Access and Sourcing of Material**

Weed Species		Classification* in the Project Area
Species Name	Common Name	
<i>Andropogon gayanus</i>	Gamba Grass	A, except in Finniss River, Adelaide River, Mary River and Daly River catchments where D
<i>Bidens pilosa</i>	Cobblers Pegs	Not declared
<i>Brachiaria mutica</i>	Para Grass	Not declared
<i>Calotropis procera</i>	Rubber-bush	C
<i>Cascabela thevetia</i>	Yellow Oleander	Potential weed
<i>Hyptis suaveolens</i>	Hyptis	D & C
<i>Hymenachne amplexicaulis</i>	Olive Hymenachne	A, except in Finniss River, Adelaide River, Mary River and Daly River catchments where D
<i>Jatropha gossypifolia</i>	Bellyache Bush	C
<i>Mimosa pigra</i>	Mimosa, Giant Sensitive Plant	C
<i>Parkinsonia aculeata</i>	Parkinsonia	C
<i>Passiflora foetida</i>	Wild Passionfruit	Not declared
<i>Pennisetum pedicellatum</i>	Annual Mission Grass	D & C
<i>Pennisetum polystachion</i>	Mission Grass	C
<i>Senna obtusifolia</i>	Sicklepod	D & C
<i>Senna occidentalis</i>	Coffee Senna	D & C
<i>Sida acuta</i>	Spiny Head Sida	D & C
<i>Sida cordifolia</i>	Flannel Weed	D & C
<i>Sida rhombifolia</i>	Paddy's Lucerne	D & C
<i>Stachytarpheta sp.</i>	Snake Weed	C
<i>Tribulus terrestris</i>	Caltrop	Not declared
<i>Xanthium strumarium</i>	Noogoora Burr	B

* Key: Class A – to be eradicated. Class B – growth and spread to be controlled. Class C – not to be introduced. Class D – not to be spread by human means. Class E – species under an approved strategy. Note: No strategies are currently in place for the project lease area.

8.3.5 Fauna Habitats and Species

The terrestrial fauna of the onshore project area was documented through field surveys undertaken in June 2004, with reference to existing reports and databases, and in consultation with zoologists from the Northern Territory Parks and Wildlife Service. The information provided in this section is summarised from the full report on the terrestrial fauna study, which is provided in **Appendix H, Volume 2**.

Fauna Habitats: Four fauna habitats were mapped in and immediately adjacent to the onshore project area, based on amalgamation of vegetation communities interpreted from high resolution satellite imagery and field surveys. The habitats are:

- eucalyptus forests and woodlands
- sand dunes

- monsoon vine forests
- mangroves

The presence of these habitats was verified on the ground and surveys were conducted in the eucalyptus forests and woodlands, and in adjacent monsoon vine forests. Only the eucalyptus woodland to forest and sand dune habitats are located within the proposed onshore development footprint. The fauna habitats that occur in the project area are mapped in **Figure 8-9** along with the location of survey sites.

Survey Results: Fauna surveys were undertaken from 1–5 June 2004 using standard field methods, including ‘Elliot’ and cage trapping, pitfall traps, diurnal active searching and opportunistic observations. Four survey sites were established in habitats representative of the most dominant habitat type in the onshore project area, eucalyptus open forest/woodland. Two sample sites were established in the monsoon vine forest habitats (also known as dry rainforests) that occur at the northern and southern ends of the section of Yelcherr Beach where the shore crossing is located. Active searches for signs of the false water-rat *Xeromys myoides* were undertaken in the mangroves, and opportunistic observations of shorebirds and seabirds were made along Yelcherr Beach. No suitable habitats and no signs of the false water-rat were found.

A total of 60 fauna species were recorded during field surveys of the onshore project area, including one mammal species, 46 bird species, 11 reptiles and two frog species. The eucalypt forest and woodland habitats were the most species rich of the sites, with richness recorded ranging from 25 to 29 species per site. The two rainforest patches contained 15 and 19 species, respectively. These differences are expected and do not relate directly to the conservation significance of the habitats, as many of the rainforest species are more restricted in distribution than those from the eucalypt forest sites.

A further 106 species that were not recorded during the field surveys were recorded in the Northern Territory Fauna Atlas records within 20 km of the project area. These additional species may or may not occur in the project area, depending on suitable habitat being available. A full list of species recorded in field surveys and from the desktop review is provided in the full survey report in **Appendix H, Volume 2**.

Mammals: Only one species of mammal, the agile wallaby, was recorded during the field surveys. The agile wallaby is a common and wide spread species found in many environments in northern Australia. A further five species were recorded or predicted in the Northern Territory Fauna Atlas. Some species of conservation significance potentially occur in the area, although they have never been recorded there. These are discussed below.

Birds: Forty-six bird species were recorded during the field surveys. The surveys added 19 species to the original list of species recorded in the Northern Territory Fauna Atlas bringing the total actually or potentially present to 117 species. Of these species, a large number, about one third, are coastal species, not found in the forests. Some of the bird species are strongly associated with monsoon vine forests, and others strongly associated with the eucalyptus forests and woodlands.

The ones strongly associated with the monsoon vine forests are of conservation significance because of the restricted size and distribution of these monsoon vine forest patches around the coast and into the hinterland. These are further discussed below.

Reptiles: Eleven reptile species were recorded during the field surveys. Six of these species were new records for the region, and added to the list recorded on the Northern Territory Fauna Atlas, bringing the total to thirty. While some of these species have specific habitat requirements, such as associations with freshwater, none other than the saltwater crocodile, are considered to be of conservation significance. The saltwater crocodile is discussed below.

Amphibians: Only two frog species were recorded during the field surveys. Both were new records for the region, resulting in nine amphibian species being recorded for the region. Previously, seven species were recorded in the Northern Territory Fauna Atlas as occurring or potentially occurring in the region. None of the species is considered to be of conservation significance.

Introduced Species: No introduced species were recorded in the project area during field surveys. Species that are likely to occur include the feral pig *Sus scrofa*. Signs of pigs were recorded in the area during previous investigations (Noel Preece, *pers. obs.* 2003), and they are likely to be present from time to time.

Feral animals, mainly pigs and buffalo, are identified as a key threatening process in the Darwin Coastal Bioregion where the onshore development will be located. In this region, the monsoon rainforest patch network is being degraded by feral animals (principally pigs). The extensive eucalypt forests are broadly affected by feral animals and livestock and the condition of riparian zones is generally declining because of damage associated with proliferation of feral pigs and buffalo, and (in some cases) unrestricted access by livestock (Woinarski 2002a). The effects of pigs and buffalo in the onshore project area are minimal due to the lack of preferred wetland habitats and the low numbers of animals likely to be present.

The Cane Toad *Bufo marinus* is an introduced species that now occupies much of Queensland, northern New South Wales and the Top End of the Northern Territory. Concerns about the ecological impacts of cane toads relate to the effects of predation, competition and lethal toxic ingestion on native species. The cane toad is currently nominated for listing as a 'key threatening process' under the Commonwealth EPBC Act. Cane toads are not yet present in the onshore project area, but it is expected that they will naturally move into the area in the next few years. Their current range extends west of Katherine, and sightings have been reported in the Lower Daly River region (Frogwatch NT, accessed 14 May 2004).



Datum: GDA 1994 MGA Zone 52

Dat Source: EcOz, Woodside Energy Ltd

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8.3.6 Biting Insects

Biting mosquitoes and midges can be considerable pests within a few kilometres of the coast in the Northern Territory (Whelan 1991). These pests can disrupt the work force by causing direct effects due to their painful bites, and indirect effects due to secondary infection and loss of a sense of well being. Minor biting midge pest problems can occur near freshwater lakes and streams. Mosquitoes are a serious public health issue in the Northern Territory, both as pest insects and as vectors of a number of human diseases. Diseases in the area include the potentially fatal Murray Valley encephalitis virus (MVEV), Kunjin virus (KUNV), Ross River virus (RRV) and Barmah Forest virus (BFV). Mosquitoes are also potential vectors for malaria (which is not currently present in the Northern Territory).

The onshore gas plant boundary is located approximately 1 km from the nearest shoreline, approximately 1.5 km south of a tidal and paperbark swamp (Swamp 1), and approximately 3 km north of a tidal swamp (Swamp 2). Preliminary observations of aerial photographs indicated these were potentially significant mosquito breeding sites likely to affect the onshore development. The main mosquito species considered likely to affect the onshore development was the salt marsh mosquito *Ochlerotatus vigilax*, and the common banded mosquito *Culex annulirostris*. Both of these species are vectors for RRV and BFV, with *Cx. Annulirostris* also a vector for MVEV. The onshore development was also considered to be subject to a potentially low biting midge pest problem arising from the mangrove areas associated with these tidal swamps, and from the three mangrove foreshore sites adjacent to the onshore pipeline crossing.

Survey & Assessment: A field survey was conducted in June 2004 to locate actual and potential freshwater and brackish-water mosquito breeding sites. Adult mosquito trapping was conducted one night before the full moon in June 2004 to monitor the post wet season peak in *Anopheles*, *Culex*, *Coquillettidia* and *Mansonia* mosquito species numbers, and the monthly peak of the human pest mangrove biting midge species *Culicoides ornatus*. The full report of the June 2004 survey is provided in **Appendix G, Volume 2**. Further biting insect trapping is proposed for September 2004 to indicate peak season pest biting midge numbers, and in November 2004 to indicate peak season salt marsh mosquito numbers. Additional field surveys will be conducted to locate further potential mosquito breeding sites.

A desktop assessment was made using aerial photography to locate potential biting pest breeding sites.

Biting Midges: *Culicoides ornatus* was the principal species of biting midge collected, representing 87.4% of all biting midges recovered. The largest biting midge breeding sites likely to affect the Blacktip Project area are the upper tidal creek mangrove areas associated with Swamp 2, which is located approximately 3 km south-west of the onshore gas plant. Minor breeding sites may be the *Sonneratia* mangrove foreshores adjacent to the onshore pipeline crossing. Minor breeding sites may also be located in the small mangrove tidal creek area associated with Swamp 1, approximately 1.5–2 km north of the onshore gas plant.

Mosquitoes: The species occurring in highest numbers during June 2004 were, in decreasing order of prevalence, *Anopheles farauti s.l.* (the Australian malaria mosquito), *Culex annulirostris* (the common banded mosquito), *Coquillettidia xanthogaster* (the golden mosquito), *Cx. sitiens* (the salt water *Culex* mosquito) and *Ochlerotatus vigilax* (the salt marsh mosquito). *Anopheles farauti s.l.*, *Cx. annulirostris* and *Oc. vigilax* will be the most important mosquito species affecting the Blacktip Project development area.

By far the major source of mosquitoes to the Blacktip Project area will be Swamp 1, located approximately 1.5 km north of the onshore gas plant. This swamp will be a breeding ground for extreme numbers of *Oc. vigilax*, very high numbers of *An. farauti s.l.* and high to very high numbers of *Cx. annulirostris*. This swamp will also be a breeding ground for non-disease transmitting pest mosquito species such as *Cq. xanthogaster*, *An. bancroftii* and *Mansonia uniformis*.

Swamp 2, a tidal and rainwater influenced swamp located approximately 3km south-west of the onshore gas plant, will also provide pest numbers of *Oc. vigilax* to the development sites. The interdunal areas adjacent to the coastal vine thicket to the south (referred to as ‘Southern Coastal Vine Thicket’) of the onshore gas pipeline crossing is also a likely significant *Oc. vigilax* breeding site.

8.3.7 Conservation Significance of Fauna Species and Habitats

The conservation significance of fauna and habitats in and surrounding the project area was assessed with reference to the following:

- threatened species listed under the *Territory Parks and Wildlife Conservation Act 2000*;
- threatened and migratory species listed under the *Environment Protection and Biodiversity Conservation Act 1999*;
- near-threatened and regionally restricted species;
- habitats of ‘threatened’ species and habitats with outstanding biodiversity values.

Threatened Species: None of the species recorded during surveys are classified as ‘threatened’ under Northern Territory or Commonwealth legislation. Fourteen species of fauna classified as ‘threatened’ in the Northern Territory, including four bird species, two fishes, one mammal, one reptile and six marine turtles, are known to occur in the wider Darwin Coastal Bioregion (Woinarski 2002a). The nationally ‘threatened’ mammal, the False Water-rat *Xeromys myoides*, also occurs in this bioregion.

Table 8-8 documents the conservation status and range of each of these species, and the likelihood of animals occurring in habitats in or near the onshore project area. Sea turtles are covered in **Section 7**.

■ **Table 8-8 Conservation Status and Distribution of 'Threatened' Species known to occur in the Wider Darwin Coastal Bioregion**

Species name	NT listing	EPBC listing	Distribution and likelihood of occurrence in the project area
Mammals			
Brush-tailed Tree-rat <i>Conilurus penicillatus</i>	VUL	-	The preferred habitat of the Brush-tailed Tree-rat <i>Conilurus penicillatus</i> is tall eucalypt forests with a shrubby understorey, although in some locations within its range it also occurs on coastal grasslands (Woinarski 2002c). The project area is well south of the known distribution of this species. Advice from the NT Bioregional Assessment Unit (Alaric Fisher pers. comm.) is that survey effort in the near-coastal tall open forest habitats in the west of the NT has been low and this species may occur in these habitats. On the basis of this advice, the possibility of this species occurring in the project area can not be discounted.
False Water-rat <i>Xeromys myoides</i>	NT	VUL	A poorly known native rodent, the False Water-rat <i>Xeromys myoides</i> is found to inhabit a variety of well-watered habitats from mangrove forests to sedge lakes (Strahan 1995). The species has previously been recorded in the Northern Territory from the South Alligator River, Daly River and most recently from the Glyde River in north-east Arnhem Land (Woinarski <i>et al.</i> 2000a). The False Water-rat could potentially occur in the estuarine environments surrounding the project area (Woinarski <i>pers. comm.</i> 2004). Surveys in mangrove habitats on the headlands that flank the northern and southern end of Yelcher Beach near the project area failed to find this species. This does not preclude its presence in the more well developed mangrove and saline grassland habitats that occur further to the north and south of the project area. In the event that <i>X. myoides</i> does occur in these habitats it is considered unlikely that they will be affected by the project which is at least 2 to 3 km away.
Birds			
Yellow chat <i>Epthianura crocea tunneyi</i>	EN	EN	The Yellow Chat is typically nomadic and inhabits the open, well-grassed swamplands of Northern Australia particularly those semi-arid regions that are prone to drying out where they frequent the edges of surface water bodies (Readers Digest 1997). The subspecies <i>Epthianura crocea tunneyi</i> is restricted to a small geographic area encompassing the floodplains from the Mary River to the East Alligator River (Schodde and Mason 1999), and within this area it is known from only about 12 sites (Woinarski 2002b). The known range of this species does not extend to the project area, and given the lack of suitable floodplain habitats in proximity to the project area it is considered unlikely that this species would occur there.
Red Goshawk <i>Erythrotriorchis radiatus</i>	VUL	VUL	The Red Goshawk occurs across much of northern Australia, from near Broome in the south-west Kimberley to south-eastern Queensland (Woinarski 2001). This species lives in coastal and sub-coastal tall open forests and woodlands, tropical savannas traversed by wooded or forested rivers, and along the edges of rainforest (Marchant & Higgins 1993). The range of this species extends to the project area and there is potential for this species to occur in tall forest habitats in and surrounding the project area. Nest sites of this species are particularly vulnerable (Garnett and Cowley 2000). No nest sites have been identified during field surveys of the project area.
Gouldian Finch <i>Erythrura gouldiae</i>	EN	VUL	Gouldian Finches occupy two different regions of the landscape on an annual cycle. In the dry season and part of the late wet season, between Feb and Oct, they live within wooded hills that contain a group of Eucalyptus species commonly referred to as "snappy gum" (<i>Eucalyptus tintinnans</i> , <i>E. brevifolia</i>). These species of trees provide nesting sites. During this period they feed upon native Sorghum (cane-grass <i>Sarga spp.</i>) and find water at small rocky waterholes that remain in the hills until next wet season. In the wet season Gouldian Finches move from the hills into the lowland drainage lines to feed upon perennial grasses that begin to seed mid Dec (Lewis 2001). Gouldian Finches have not previously been recorded in proximity to the project area and the preferred habitats of this species do not occur there.
Partridge Pigeon <i>Geophaps smithii smithii</i>	VUL	VUL	The Partridge Pigeon (subspecies <i>Geophaps smithii smithii</i>) lives primarily in open forest and woodland dominated by Darwin Stringybark <i>Eucalyptus tetradonta</i> and Darwin Woollybutt <i>E. miniata</i> that has a structurally diverse understorey (F. Fraser pers. comm., cited in Garnett and Crowley 2000). The species is now recorded only in sub-coastal NT, principally from Kakadu and between Katherine and Darwin and the Tiwi Islands; also recorded near the McKinlay, Daly and Finnis Rivers and west of Katherine (Garnett and Crowley 2000). The known range of this sub-species of the Partridge Pigeon does not extend as far west as the project area, and it was not recorded during field surveys of the project area.
Reptiles			
Yellow-snouted Ground Gecko <i>Diplodactylus occultus</i>	VUL	-	The Yellow-snouted Ground Gecko <i>Diplodactylus occultus</i> is the only 'threatened' terrestrial reptile species known to occur in the Darwin Coastal bioregion. It is known from only a few localities, almost entirely from the northwest areas of Kakadu National Park and appears to occur in well-developed leaf litters and grasses in open Eucalyptus dominated forests (Beggs and Armstrong 2001). The known range of this species does not extend to the project area and it is considered highly unlikely that the species would occur there.
Fishes			
Speartooth Shark <i>Glyphis sp. A</i>	-	EN	In the Northern Territory, the Speartooth Shark is known only from the Adelaide-Alligator Rivers region (Stirrat and Larson 2002). The known range of this species does not extend to the project area, and given that there are no permanent fresh water-bodies, it is considered that this species will not occur there.
Freshwater Sawfish <i>Pristis microdon</i>	DD	VUL	Freshwater Sawfish <i>Pristis microdon</i> is the largest fish found in Australia's fresh waters. Its range now appears to be extremely restricted, and it is now known only from a few northern Australian river systems. In the NT the species is known to occur in the Adelaide, Victoria and Daly Rivers (Pogonoski <i>et al.</i> , 2002). Its know range does not include the project area and there are no permanent freshwater habitats nearby.

Note: Species lists are taken from Woinarski (2000a) but have been updated to reflect recent changes to the conservation status of some species

Vul – Vulnerable; DD – Data Deficient; EN – Endangered; NT –Near Threatened

Two of the listed ‘threatened’ species included in **Table 8-8**, the Red Goshawk *Erythrotriorchis radiatus* and Brush-tailed Tree-rat *Conilurus penicillatus*, have a known range that extends to the onshore project area. These species were not recorded in the current field surveys and there are no previous records within a 20 km radius of the project area. This does not preclude their presence in the onshore project area where suitable tall forest habitat exist, however, it does indicate that:

- The presence of sensitive Red Goshawk nesting sites in the area is unlikely.
- There is unlikely to be significant populations of the Brush-tailed Tree-rat present.

Another ‘threatened’ fauna species, the Northern Brush-tailed Phascogale *Phascogale tapoatafa pirata* has been identified by the Northern Territory Parks and Wildlife Service (Woinarski and Fisher., *pers. comm.*, 2003) as potentially occurring in the region. The Northern Brush-tailed Phascogale is a strongly arboreal dasyurid marsupial that typically inhabits open forest with sparse ground cover. The mammal could potentially occur in the tall forest habitats in and surrounding the onshore project area (Alaric Fisher., *pers. comm.*, 2004), although the closest confirmed recent records are from Litchfield National Park, some 160 km north-east of the project area. Formerly, this species was widespread throughout the dry sclerophyll forests and woodlands of tropical and temperate Australia (Strahan 1995; Maxwell *et al.*, 1996). Although much of its habitat has been reduced for agriculture on a national scale, the records of the tropical sub-species indicates that the range is widespread but sparse, making it vulnerable to localised extinction. In the region where the project area is located, habitats of this species are extensive and largely unaffected by development.

Migratory Species: No migratory species (as defined by the EPBC Act) have been recorded in the onshore project area in field surveys, but eight species have been identified as likely to occur. The species include the saltwater crocodile *Crocodylus porosus*, the migratory wetland bird species oriental pratincole *Glareola maldivarum*, oriental plover *Charadrius veredus*, little curlew *Numenius minutus*, and the migratory terrestrial bird species melville cicadabird *Coracina tenuirostris*, white-bellied sea eagle *Haliaeetus leucogaster*, barn swallow *Hirundo rustica*, rufous fantail *Rhipidura rufifrons*. A number of ‘migratory’ sea turtles and mammals may inhabit the surrounding marine environments as discussed in **Section 7.3**.

The saltwater crocodile *Crocodylus porosus* is unlikely to be present in the onshore project area due to the lack of permanent waterbodies, however, this species is likely to be present in the marine environments surrounding the project area and also in the coastal estuarine environments and larger freshwater rivers and creeks.

No waterbird roosting sites have been recorded in the onshore project area and the area is not considered to be significant for waterbirds (Chatto., *pers. comm.* 2004). There are some seabird breeding roosts (ie. terns) recorded in proximity to the proposed pipeline landfall site, however, these are considered to have a low significance as groups typically consist of numbers in the low hundreds (Chatto., *pers. comm.*, 2004). The proposed onshore development is considered unlikely to cause significant impacts on these colonies (Chatto., *pers. comm.*, 2004) as suitable habitats are

abundant in the region away from the project area. No shorebird roosts have been identified in the project area.

Near-Threatened and Regionally Restricted Species: Fifty-five terrestrial fauna species are classified as Near-Threatened in the Northern Territory (NT Parks & Wildlife web site, July 2004: http://www.nt.gov.au/ipe/pwcnt/index.cfm?attributes.fuseaction=open_page&page_id=4315). The known range of 20 of these species extends to the project area (**Table 8-9**). Habitats typically used by 11 of the species occur in the project area.

■ **Table 8-9 Near-Threatened Fauna Species with a Known Range that Extends to the Onshore Project Area**

Species	Habitat in or Near Project Area
Mammals	
Northern Quoll <i>Dasyurus hallucatus</i>	Yes
Lesser Wart-nosed Horseshoe-bat <i>Hipposideros stenotis</i>	Yes
Ghost Bat <i>Macroderma gigas</i>	No
Black-footed Tree-rat <i>Mesembriomys gouldii</i>	Yes
Northern Nailtail Wallaby <i>Onychogalea unguifera</i>	Yes
Nabarlek <i>Petrogale concinna</i>	No
Western Chestnut Mouse <i>Pseudomys nanus nanus</i>	No
Pale Field-rat <i>Rattus tunneyi</i>	No
Orange Horseshoe Bat <i>Rhinioncteris aurantius</i>	Yes
False Water Rat <i>Xeromys myoides</i>	Yes
Birds	
Australian Bustard <i>Ardeotis australis</i>	No
Bush Stone-curlew <i>Burhinus grallarius</i>	Yes
Emu <i>Dromaius novaehollandiae</i>	Yes
Yellow-rumped Mannikin <i>Lonchura flaviprymna</i>	No
Square-tailed Kite <i>Lophoictinia isura</i>	Yes
Grass Owl <i>Tyto capensis</i>	No
Masked Owl <i>Tyto novaehollandiae kimberli</i>	Yes
Clamorous Reed Warbler <i>Acrocephalus stentoreus</i>	No
Reptiles	
Chameleon Dragon <i>Chelosania brunnea</i>	Yes
Worrell's Turtle <i>Emydura subglobosa worrelli</i>	No

The known range of five terrestrial fauna species that are endemic to the Top End Coastal Bioregion (combined Darwin Coastal and Arnhem Coast) extends to the project area (**Table 8-10**). A number of endemic sea snakes and marine turtles also occur in the region. These species are discussed in **Section 7-3**.

■ **Table 8-10 Regionally Endemic Fauna with a Known Range that Extends to the Onshore Project Area**

Species	Habitat in or Near Project Area
Mammals	
False Water-rat <i>Xeromys myoides</i>	Yes
Birds	
Chestnut Rail <i>Eulabeornis castaneoventris</i>	No
Barn Swallow <i>Hirundo rustica</i>	Yes
Asian Dowitcher <i>Limnodromus semipalmatus</i>	No
Reptiles	
<i>Glaphyromorphous nigricaudis</i>	Yes

Significant Sites and Habitats: Habitats with special biodiversity conservation values that occur in proximity to the project area include monsoon vine forest and coastal estuarine systems dominated by mangroves. No sites with special conservation significance to fauna were identified in the immediate vicinity of the project area, however, the wider Darwin Coastal Bioregion does contain some ecologically significant sites worthy of mention. This section provides a brief description of the significance of the monsoon rainforest habitats that occur in proximity to the project area, and some sites with regional and national conservation significance.

Dry Monsoon Rainforest: The closest monsoon vine forest communities to the onshore project area occur at the northern and southern ends of the section of Yelcherr Beach where the pipeline will come on-shore. Monsoon vine forests are also likely to occur in association with the estuarine systems that occur along the coast to the north and south of the project area. The patch to the south is located 320 m from the seaward end of the export pipeline corridor and the patch to the north is located approximately 250 m from the seaward end of the export pipeline corridor. Monsoon vine forests are considered to be highly significant environments for wildlife in the region, supporting a distinctive fauna (Woinarski (http://savanna.ntu.edu.au/information/dk/dk_pa.html) - accessed 20 May 2004). Fauna species typically associated with monsoon vine forests (Bach *et al.*, 1999; Price *et al.*, 1998; Woinarski 1993) that were recorded during field surveys near the project area include those listed in **Table 8-11**.

■ **Table 8-11 Birds Recorded In Monsoon Vine Forests During the Surveys 2004**

Common Name	Species Name
Emerald Dove ⁽²⁾	<i>Chalcophaps indica</i>
Rose-crowned Fruit-Dove ⁽¹⁾⁽²⁾⁽³⁾	<i>Ptilinopus regina</i>
Varied Triller ⁽²⁾	<i>Lalage leucomela</i>
Little Shrike-thrush ⁽²⁾	<i>Colluricincla megarhyncha</i>
Yellow Oriole ⁽¹⁾⁽²⁾⁽³⁾	<i>Oriolus flavocinctus</i>
Green-backed Gerygone ⁽²⁾	<i>Gerygone chloronota</i>
Spangled Drongo ⁽²⁾	<i>Dicrurus bracteatus</i>

Bach *et al.*, 1999⁽¹⁾; Woinarski 1993⁽²⁾; Price *et al.*, 1999⁽³⁾

Especially in the wet season, the rainforests provide concentrations of fruit far greater than those across the rest of the landscape, and these attract flying-foxes and fruit-eating pigeons, orioles, cuckoos and figbirds. Many of these animals move between rainforest patches and the surrounding open forest. The conservation of this rainforest environment is probably dependent upon the maintenance of as many patches as possible and extensive areas of their surrounding habitats (Woinarski (http://savanna.ntu.edu.au/information/dk/dk_pa.html) - accessed 20 May 2004).

Waterbird Habitats: The sub-coastal wetlands of the monsoonal wet-dry tropics of the Top End are recognised for their high conservation value for waterbirds (Whitehead & Chatto 1996). The Darwin Coastal Bioregion contains all or part of several nationally important wetland systems (Woinarski 2002a). The nearest 'important wetland' to the project area is the Moyle Floodplain and Hyland Bay system, which is located 50 km to the east. These floodplains are most notable for their waterbird fauna and are considered to be one of the most important areas for colonial breeding waterbirds in the NT (Chatto 2000).