DWER mapping identifies that the site is not located within an ESA and no ESA was identified within the 10km of the site (DWER, 2021d).

3.8 Conservation Areas

There is no Regional Parks or Department of Biodiversity Conservation and Attractions (DBCA) Managed Lands intersecting the site.

3.9 Flora and Vegetation

3.9.1 Interim Biogeographical Regionalisation of Australia

The Interim Biogeographic Regionalisation of Australia (IBRA) divides Australia into 89 bioregions based on major biological, geographical, and geological attributes. These bioregions are subdivided into 419 subregions as part of a refinement of the IBRA framework (Department of the Environment and Energy, 2016).

The entire site is mapped within the Carnarvon bioregion and the Cape Range (CAR01) subregion. The Carnarvon bioregion is composed of quaternary alluvial, aeolian and marine sediments overlying Cretaceous strata. A mosaic of saline alluvial plains with samphire and saltbush low shrublands, Bowgada low woodland on sandy ridges and plains, Snakewood scrub on clay flats, and tree to shrub steppe over hummock grasslands on and between red sand dune fields. Limestone strata with *Acacia stuartii* or *A. bivenosa* shrubland outcrop in the north, where extensive tidal flats in sheltered embayments support mangal (Kendrick and Mau, 2002).

3.9.2 Broad Vegetation Types

Mapping of the vegetation of the Perth region of WA was completed on a broad scale by Beard (1981). These vegetation units were re-assessed by Shepherd et al (2001) to account for clearing in the intensive land use zone, dividing some larger vegetation units into smaller units. Together, this pre-European database contains a total of 819 vegetation types within Western Australia.

The site is mapped within the Cape Yannare Coastal Plain 117 broad vegetation type (Figure 7). Cape Yannare Coastal Plain 117 is described as (Department of Primary Industries and Regional Development, 2018). The representation at a state, regional and local level is shown in Table 4.

Table 4: Broad Vegetation Types within the State, Regional and Local Representation (Government of Western Australia, 2019)

Vegetation Type	Pre-European Extent (ha)	Current Extent (ha)	Remaining (%)	Current Extent Managed in DBCA Lands (%)
Representation across Western Australia				
Cape Yannare Coastal Plain 117	919,517.05	886,005.79	96.36	14.79
Representation across the Carnavon Bioregion				
Cape Yannare Coastal Plain 117	12,424.35	10,907.99	87.80	27.48
Representation across the Cape Range Subregion				
Cape Yannare Coastal Plain 117	12,424.35	10,907.99	87.80	27.48
Representation across the Shire of Ashburton				
Cape Yannare Coastal Plain 117	14,506.04	9,073.90	62.55	19.13

The Environmental Protection Authority's (EPA) *Guidance Statement No. 33 – Environmental Guidance for Planning and Development* has set out a threshold for the retention of 10% of the pre-existing extent of native vegetation within constrained areas (EPA 2008). The Cape Yannare Coastal Plain vegetation meets the recommendation, it has 96.36% representation remaining within the State.

3.9.3 Flora and Vegetation Desktop Assessment

Database searches identified nine (9) conservation significant flora species occurring within 50 km of the site comprising of:

- No Threatened species
- Three Priority 1 species
- No priority 2 species
- Six priority 3 species
- No priority 4 species.

No State or Commonwealth listed TECs were identified within the site by the database searches. The State listed PEC Peedamulla (Cane River) Swamp Community occurs 24 km east of the site, however its listing category has not been evaluated during the site survey (360 Environmental, 2021).

3.9.4 Likelihood of Occurrence

The likelihood of occurrence assessment identified that of the nine (9) conservation significant flora species identified by the desktop assessment:

- No Threaten or Priority Listed Flora have been recorded within the site
- Two taxa were considered to have a high likelihood of occurrence based on habitat preference
- Three were considered to have a medium likelihood of occurrence based on habitat preference
- Four were considered to have a low likelihood of occurrence based on habitat preference.

An additional thirty (30) species were identified by the literature review; however, these were not included in the flora likelihood assessment as all were considered highly unlikely to occur within the site (360 Environmental,2021) (Appendix B).

3.9.5 Vegetation Survey Results

3.9.5.1 Vegetation Association

The Flora and Vegetation survey undertaken by 360 Environmental (June 2021) identified that there is one (1) vegetation association mapped across one broad landform (low coastal dune systems with mixed laterite sands) (Appendix B) .The vegetation within the site, VT1, was described as *Acacia coriacea* subsp. *coriacea* and *Acacia tetragonophylla* (with *Crotalaria cunninghamii* subsp. *sturtii*) mid to low sparse shrubland over *Cenchrus ciliaris* and *Eulalia aurea* low tussock grassland with *Triodia epactia* low sparse hummock grassland over *Euphorbia myrtoides* low sparse herb land (Figure 8).

3.9.5.2 Vegetation Condition

The vegetation condition within the site was determined to be Very Good, comprising of 100% of the site. Evidence of disturbance within the site include old vehicle tracks, littering and weeds (particularly infestations of *Cenchrus ciliaris*) (Figure 9).

3.9.5.3 Vegetation of Conservation Significance

No vegetation representative of any Commonwealth or State listed TECs or DBCA listed PECs were recorded within the site.

Of the vegetation within the site, none is considered to be of other conservation significance.

3.9.6 Flora Survey Results

3.9.6.1 Flora Composition

The Flora and Vegetation survey recorded a total of 33 taxa from 15 genera across 13 families. The dominant families were:

- Fabaceae (seven species, 24% of all taxa,)
- Poaceae (five species, 17 % of all taxa)
- Chenopodiaceae (three species, 10% of all taxa).

One (1) species was not able to be positively identified and has been tentatively listed as *Flueggea virosa*. Additionally, two (2) *Tephrosia* collections were not able to be positively identified due to species variability with the morphology based on the WAH reference collection. None of these taxa resemble any potentially occurring Threatened and Priority Flora, or flora of Conservation significance (360 Environmental, 2021).

3.9.6.2 Threatened or Priority Flora

No Threatened flora species pursuant to the EPBC Act 1999 and/or gazetted as Threatened pursuant to the BC Act 2016 were recorded during the survey.

No DBCA listed Priority flora species were recorded within the site.

3.9.6.3 Flora of Other Conservation Significance

Flora may be considered of other conservation significance if it represents a range extension, novel taxon, species that play a keystone role in a community, has relic status, is locally endemic, or represents the extent of a species range.

No taxa recorded within the site was considered to be of other conservation significance.

3.9.7 Introduced Flora

Four (4) introduced species were recorded within the site, representing 10% of the total taxa recorded. One of these, *Tamarix aphylla*, is listed as a Declared Pest under the BAM Act (Department of Primary Industries and Regional Development, 2018) and WoNS (Department of Agriculture Water and the Environment, 2020) (Table 5).

Table 5: Introduced Flora Species within the Site

Species	Common Name	Environmental Status	WONS
Cenchrus ciliaris	Buffel Grass		Not Listed
Aerva javanica	Kapok Bush		Not Listed
Tamarix aphylla	Athel Pine	Declared Pest – (DPIRD)	Listed
Washingtonia filifera	California Palm		Not Listed

3.10 Fauna

3.10.1 Desktop Assessment

The desktop assessment for the site identified fifty-nine (59) conservation significant terrestrial vertebrate fauna species potentially occurring within the site, comprising of:

- 47 bird species
- Four mammal species
- Eight reptile species (includes five turtle species known to breed in the Pilbara region)
- No amphibian species.

Species listed as Marine only under the EPBC Act, such as the Little Egret (*Egretta garzetta*), White-bellied Sea-Eagle (*Haliaeetus leucogaster*), Silver Gull (*Larus novaehollandiae*), as well as marine dependent species including sea snakes, whales and dolphins have been excluded from the likelihood of occurrence list as there is no marine habitat present within the site.

3.10.2 Conservation Significant Fauna Likelihood of Occurrence

The likelihood of occurrence assessment within the site for conservation significant fauna species identified by the desktop assessment identified that:

- No species had a high likelihood of occurrence
- 20 species had a medium likelihood of occurrence (19 bird species, one reptile species)
- 39 species had a low likelihood of occurrence (28 bird species, four mammal species, seven reptile species).

The results of the likelihood of occurrence are presented in Appendix C.

3.10.3 Fauna Habitat

One (1) broad fauna habitat was identified and mapped within the site. The coastal dune Fauna Habitat was continuous throughout the site and is analogous with the Coastal Dune (VT1) vegetation type. The habitat quality was identified to be good throughout the site.

3.10.4 Fauna Assemblage

The terrestrial vertebrate fauna survey recorded a total of 18 fauna species from 13 families, summarised in Table 6.

Table 6: Overview of Vertebrate Fauna Species Recorded

Fauna Group	Number of Species	Number of Families
Birds	14	9
Mammals	3	3
Reptiles	1	1
Amphibians	0	0
Total	**18**	**13**

3.10.4.1 Sightings

A total of fourteen (14) bird species from nine (9) families were recorded throughout the site. The most recorded species was the Zebra Finch (*Taeniopygia guttata)* followed by the White-plumed Honeyeater (*Ptilotula penicillata*) and the White-breasted Woodswallow (*Artamus leucorynchus).* The most speciose avifauna family was *Meliphagidae* (three taxa).

One (1) reptile species was tentatively identified, the Dune Dragon (*Ctenophorus femoralis),* with other dragon sightings representing the same genus, but the fast nature of these animals made positive identification difficult (360 Environmental,2021).

3.10.4.2 Tracks

Bird tracks were observed throughout the site, as were cat tracks. Small mammal and reptile tracks were also identified, most often occurring between clumps of thicker vegetation.

3.10.5 Conservation Significant Fauna

No fauna species of conservation significance (Threatened or Priority), or evidence of these species such as tracks, scats, nest, diggings, burrows, or direct sightings were recorded within or directly surrounding the site.

3.11 Heritage

3.11.1 Aboriginal Heritage

In Western Australia, the *Aboriginal Heritage Act 1972* protects places and objects customarily used by or traditional to the original habitants of Australia. A register of such places and objects is maintained under the Act, however, all sites are protected under the Act whether they are registered or not.

A search of the Department of Planning, Lands and Heritage's (DPLH) Aboriginal Heritage Inquiry System identified three registered Aboriginal Heritage sites within the site (Figure 10).

A search of the AHIS identified three (3) listed heritage locations associated with the site and one (1) additional location within 500 m of the site. These are described in Table 7.

Table 7: Aboriginal Heritage Locations

ID	Name	Type / Description
Onsite		
6617	Burubarladji	Mythological; not a protected area (extending from the south-eastern side of the site to the townsite)
6618	DEW TALU	Ceremonial, Water Source; not a protected area (covers the entire site)
8920	Onslow 1	Artefacts / Scatter, Midden / Scatter; not a protected area (covering at least a third of the southeastern side of the site)
Offsite		
6575	Jinta 1 Midden	Artefacts / Scatter, Midden / Scatter; not a protected area (500m metres from the site)

3.11.2 European Heritage

A search of State and Local Government heritage databases and available reports identified several heritage locations within 500m of the site. These are further described in Table 8. No European Heritage locations occur on the subject site.

Table 8: Other Heritage Locations

HCWA No.	Name	Type / Description
Heritage Council of WA Website (inHerit)		
15366	Police Residence (fmr)	3 First St, Onslow. The former police residence has aesthetic, historic, social, and representative cultural heritage significance and is a relic of Onslow's early settlement
15392	St Nicholas Church	19 Third Ave, Onslow. St Nicholas Church has significant aesthetic, historic, social and rarity heritage value.
15377	Residence - Sweeting	18 Third Ave, Onslow. The residence on Lot 326 has historic cultural heritage significance, being a remnant of the Old Onslow town site that has survived numerous storms.
15376	Residence	26 Third Ave, Onslow. The residence has aesthetic, historic and representative cultural heritage significance.
15367	Onslow Post Office and Residence	19-21 Second Ave, Onslow. The former Post Office and residence have aesthetic, historic and representative cultural heritage significance
15364	Beadon Hotel	22-26 Second Ave, Onslow. The Beadon Hotel has significant aesthetic, historic, social and rarity cultural heritage value.
Shire of Ashburton Local Government Heritage Inventory		
-	Fuel Storage Tanks	Includes the former Aviation Spirit tank, dieseline tank and furnace oil tanks 1 and 2, and the pump outstation and hose locker. These were present across several lots, with several (furnace oil tanks, dieseline tank and pump stations) immediately adjacent to the site. These were listed as having heritage value based on their physical form and their role in defence activities in World War II.

HCWA No.	Name	Type / Description
26612	Beadon Point Rear Navigational Leading Light	2 Second Ave, Onslow. Cultural significance as provided evidence of when Onslow was the major port for the Ashburton district. Demolished in 2019.

3.12 Bushfire Risk

As the site is mapped within a Bushfire Prone Area, *State Planning Policy (SPP) No. 3.7 Planning in Bushfire Prone areas* applies (Figure 8). The intent of this policy is to implement effective risk-based land use planning and development to preserve life and reduce the impact of bushfire on property and infrastructure.

The whole site is mapped within a Bushfire Prone Area. Development of the site requires a BMP and BEMP setting out risk management strategies for the life the development to satisfy the requirements of the SPP 3.7 (Appendix C and D).

4 Environmental Constraints and Management

4.1 Key Environmental Issues, Factors and Objectives

The potential impacts that may result from implementation of the proposed development and the site's key environmental features are discussed in this section. Management measures based on key legislation, guidelines, and policies are also outlined with the intent to mitigate the potential impacts.

The principles, factors, and objectives used by the EPA in assessing projects have been used in considering the environmental impact posed by the development and how these will be managed. The relevant factors and objectives of this proposal are outlined in Table 9 below and are addressed within this section.

Table 9: EPA Environmental Factors and Objectives

Theme	Factor	Objectives
Land	Flora and Vegetation	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.
	Terrestrial Fauna	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.
Water	Hydrological Process	To maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.
	Inland Waters Environmental Quality	To maintain the quality of groundwater and surface water so that environmental values are protected.

4.2 Vegetation and Flora

4.2.1 Background

The overall vegetation condition within the site was considered to be Very Good. The species diversity and abundance are consistent with the ecology and diversity of the Cape Range IBRA Subregion, and previous surveys of this level within the local area. *Tamarax aphyllla* is the only weed of conservation significance, listed as both a Declared Pest and a Weed of National Significance. No PECs or TECs were recorded with the site.

Flora of Conservation Significance

One (1) species was not able to be positively identified and has been tentatively listed as Flueggea *virosa*. Additionally, two (2) *Tephrosia* collections were not able to be positively identified due to species variability with the morphology based on the WAH reference collection. None of these taxa resemble any potentially occurring Threatened and Priority Flora, or flora of Conservation significance.

Introduced Flora

Four (4) weed species were recorded in the site, *Tamarix aphylla* (Declared Pest, WoNS) was the only declared weed identified on site. Based on the location relevant to the proposed development area and population extent, no addition action would be required.

Two (2) additional weed species *Cenchrus ciliaris, Washingtonia filifera* were also present, with *Cenchrus ciliaris* covering approximately 70% of the site.

Vegetation Types

Vegetation mapping within the site was representative of existing broad scale vegetation and soil and land system mapping for the locality.

The vegetation of the Coastal Dunes (VT1) is broadly representative of Cape Yannare Coastal Plain 117, described as grass-steppe hummock grassland *Triodia* spp. The vegetation type described in this report is not representative of any listed PEC or TEC.

4.2.2 Potential Impacts within the Site

The key potential impacts on terrestrial flora and vegetation from development of the site include:

- Degradation and disturbances of the adjacent vegetation, including rubbish dumping, and uncontrolled access
- Edge effects on native vegetation caused by the interaction with urban land uses, causing a decline in vegetation condition
- Dieback diseases
- Introduction and distribution of invasive weed species
- Hydrological changes.

4.2.3 Management Measures

Potential environmental impacts associated with the proposed development will be addressed through implementation of the following environmental management measures to ensure the environmental objectives for flora and vegetation are met:

- Careful control of the clearing of vegetation within the site during the construction phase
- Control of access between the uncleared area and the campsite development both during and after the construction phase
- Weed control
- Dieback control and management
- Fire management
- Establishment of open space will maintain the presents of native vegetation within the site.

This will ensure the long-term protection and viability of the vegetation and associated flora and fauna retained within the site. Implementation of a Construction Environmental Management Plan (CEMP) would be required to address management and protection of flora and vegetation on the site during the construction phase.

The proposed development has been designed to retain some native vegetation within the site and areas surrounding. The proposed master plan for the site is shown in Figure 2.

Additional environmental assessments may be required to be prepared as a condition of Development Approval, namely a Dieback Management Plan and Weed Management Plan to support the proposed development.

4.3 Terrestrial Fauna

4.3.1 Background

One (1) broad fauna habitat was observed within the site, consisting of Coastal Dunes. The coastal dune habitat contains limited microhabitat opportunities and is of low value to most conservation significant fauna species and overall fauna assemblages that occur in the broader area.

One (1) conservation significant fauna species, *Lerista planiventralis maryani* (P1), utilises dune habitat in the bioregion and records indicate that it historically occurred within 1 km of the site. A targeted terrestrial vertebrate survey utilising pitfall traps would be required to assess its presence or absence in the site with greater certainty.

Shorebirds, including conservation significant species, may use coastal dune areas within the site, however, these species are highly mobile and would not be reliant on the habitats within the site.

Clearing of vegetation within the site is unlikely to significantly impact most fauna species due to the abundance of similar habitat south of the site. However, if *Lerista planiventralis maryani* (P1) are inhabiting the site, clearing will have a significant impact on the local population.

4.3.2 Potential Impacts

The key potential impacts on terrestrial fauna and its habitat from development of the site include:

- Fauna deaths
- Habitat degradation
- Migration of fauna species.

4.3.3 Management Measures

Potential environmental impacts to terrestrial fauna and its habitat can be managed by implementing the following strategies:

- Careful control of the clearing of vegetation within the site during the development phase
- Fauna trapping and relocation of fauna
- Weed control
- Dieback control and management
- Fire management.

These actions will assist in ensuring the areas supporting fauna and fauna habitat area will be protected and maintained. Implementation of a CEMP would be required to address the management and protection of vertebrae fauna and fauna habitats. A Relocation Management Plan may be required to be prepared as a condition of Development Approval for the proposed development.

4.4 Hydrological Processes

4.4.1 Background

EPA's Environmental Factor Guideline for Hydrological Processes defines hydrological processes as the occurrence, distribution, connectivity, movement, and quantity of water. Altering hydrological regimes can significantly impact on water dependent ecosystems and other values supported by groundwater and surface water.

The site is hydrologically unconstrained with free draining sandy soils, clearance to groundwater, moderate to low risk of ASS (with some parts of the site with medium to high risk of ASS) and there are no regional service water features (DWER, 2021b).

A natural lake area is present approximately 200m to the southwest and is associated with the Onslow Salt site and operations (i.e it is assumed to be saline) (360 Environmental 2021). The site is located adjacent to the Indian Ocean. The proposed development might affect the coastal processes within the Onslow townsite and surrounding locality.

4.4.2 Potential Impacts

Potential impacts to hydrological processes from the proposed development include:

- Groundwater level changes from changes in land use and clearing. The development of the proposed accommodation and associated outbuildings has the potential to increase recharge of rainfall into groundwater through increased surface area of roofs, driveways, carparks, and roads.
- Increased runoff from hard surfaces into surrounding retained environments.
- Impact on coastal environment.

- Pollution from urban surfaces into surrounding environments.

4.4.3 Management Measures

A Local Water Management Strategy (LWMS) was prepared for the Onslow townsite by Hydro2 Hydrology and Josh Byrne and Associates on behalf of Landcorp in support of a Development Guide Plan developed for the expansion of Onslow townsite (Landcorp, 2012). The LWMS describes how the issues of surface and groundwater management associated with the proposed development will be managed. Key issues addressed in the LWMS include:

- **Storm Water Management Strategy:** The system will consist of minimizing piped drainage and using swales and overland flow paths in road reserves and linear multiple use corridors to retain and infiltrate minor events and safely convey flood flows. Area where natural topography precludes offsite conveyance will be designed to retain and infiltrate stormwater.
- **Groundwater Management Strategy:** Water quality aspects of groundwater management will be achieved via biofiltration in road swales and POS drainage corridors to treat and infiltrate storm water and reduce flow velocities to minimise erosion.
- **Coastal Inundation Management Strategy:** To assist in removing floodwaters in the existing townsite following a coastal inundation event, it is recommended the existing watercourse/drain which flows to the Beadon Creek Harbour be extended towards the town and graded appropriately to enable drainage from the townsite to access this outlet.
- **Urban Water Management Plans:** Urban Water Management Plans (UWMPs) will be a required to support subdivision applications for various stages of development within Onslow townsite.
- **Monitoring:** It is not envisaged any further additional predevelopment groundwater or surface water monitoring will be required to inform the UWMP and subdivision process. An alternative monitoring program of system performance is recommended for the site against a standardized proforma which will assess the performance of the system against its design. The program will consider processes such as vegetation health, scour, erosion, and deposition to inform the design of subsequent stages of development.

Monitoring outcomes will be used in a continual improvement capacity to review the implemented WSUD within the Onslow townsite and inform the planning and design approaches for subsequent stages of development. Any modification required to the LWMS would be identified through the review process of monitoring data and would require the agreement of all parties which are DWER, Shire of Ashburton and the developer (Landcorp, 2012)

The LWMS focuses on reducing nutrient loads in stormwater and onsite stormwater infiltration. Amended soils and ephemeral bioretention systems are stormwater. No management of groundwater levels is proposed.

An Urban Water Management Plan (UWMP) has been prepared by 360 Environmental to address the management of water associated with the proposed development and surrounding locality (Appendix E). The UWMP describes in detail how the water management issues described in the LWMS will be addressed. This will need to be approved by DWER as part of the Development Application.

The UWMP describes how water will be managed on site in the context of the site and overall surrounding locality. The management measures applicable to the proposed development include:

- **Stormwater management**: the main aim for stormwater management for the site is to mimic, as closely as possible, the predevelopment environment, post development. This will be achieved by maintaining where possible the natural topography of the site. Runoff throughout the site will be conveyed via overland flow, using the natural topography, to depression storage within the site. A Storm Water Management Strategy (SWMS) has been developed to identify that the site can effectively manage stormwater generated during minor and major rainfall events and meet design criteria.
- **Groundwater management**: Groundwater management focuses on groundwater levels, groundwater quality and acid sulphate soil management. For the site the following measures have been recommended:
    - **Groundwater levels:** The site's floor levels will be required to be raised to a minimum elevation of 6.4 m AHD, which will provide enough clearance to the AAMGL plus sea-level rise (approximately 2.7 m). Therefore, subsoil drainage is not proposed.
    - **Groundwater quality:** The proposed storm water management will ensure the quality of groundwater is maintained. The two key strategies include infiltrating the first flush of rainfall at the source and minimising the development footprint to replicate current (pre-development) conditions and natural groundwater recharge. In addition, maximizing native and waterwise vegetation within landscape areas and minimizing the use of fertilizers and pesticides onsite will help in maintaining water quality.
    - **Acid Sulphate Soil Management:** ASS investigations are commonly required as part of the conditions of a development application. As the site has been identified as having moderate to low risk of ASS and natural landform is to be used i.e. no excavation or earthworks will be required around the ASS identified area within the site.
- **Flood Management:** Overland flow will be safely conveyed to the natural depressions and the site will use natural flow paths. The site's development floor level has been designed to be at a minimum of 6.4 m AHD. This provides an adequate freeboard to the 100year return period cyclonic storm surge allowing for climate change as specified in the coastal strategy.

The SWMS shall be implemented pre and post construction of the development. During the construction phase, water management requires considering direct impacts from any construction activities and maintaining the pre-development hydrological regime at post-development. Following the completion of construction activities, maintenance of any the stormwater management infrastructure and assessment of their performance will be required. As there is no drainage pipes and pits system constructed on-site, swales near roads and car parks would be the key maintenance features. The UWMP is further detailed in Appendix E.

4.5 Aboriginal Heritage

4.5.1 Background

The *Aboriginal Heritage Act 1972* of Western Australia protects places and objects customarily used by or traditional to the original habitants of Australia. A register of such places and objects is maintained under the Act, however, all sites are protected under the Act whether they are registered or not.

The entire site is mapped within Aboriginal heritage sites including the following:

- Site ID.6618: is a ceremonial, water source type of site
- Site ID. 6617: is a mythological site which extends from the south-eastern side of the Study Area into the town
- Site ID. 8920: is an artefact/scatter, Midden registered site
- Site ID. 6575: is an artefacts/scatter, midden not a protected area.

4.5.2 Potential Impacts

Potential impacts to Aboriginal Heritage sites from the proposed development include:

- Disturbance or removal of unknown cultural heritage within the subsurface construction works
- Loss of value to Aboriginal Heritage sites caused by machinery, human interaction with sites.

4.5.3 Management Response

An ethnographic and archaeological survey of the site will be required to be undertaken by a suitably qualified consultant prior to development on the site. The survey will be undertaken in accordance with the provisions of the *Aboriginal Heritage Act 1972*. Approval for works within the registered Aboriginal Site may be conditional upon a heritage survey or Aboriginal Heritage due diligence being undertaken for the site (DPLH 2018).

These applications or surveys will be commenced separately as part of Development application process for this development.

4.6 Acid Sulfate Soils

4.6.1 Background

DWER Acid Sulfate Soils mapping identifies that a portion southern part of the site is mapped as having 'Moderate to Low' risk of ASS within the first 3 m of natural soil surface. The western side of the site is mapped as having 'Moderate to Low' risk of ASS within the first 3 m of natural soil surface and a 'High to moderate' risk of ASS occurring within 3 m of natural soil surface on the northwest side going to the north.

4.6.2 Potential Impacts

ASS is naturally occurring soils that contain iron sulfides that are generally found in a layer of waterlogged soil or sediment which are gentle in their natural state. When these soils are disturbed and exposed to air, they oxidise and produce sulphuric acid, iron precipitates and concentrations of dissolved heavy metals (WAPC 2008).

4.6.3 Management Response

A Preliminary Site Self-Assessment will be required to be undertaken to assess the presence and extent of ASS in accordance with the DER guidelines. This assessment shall be prepared as part of the Development Application. Depending upon the results of the preliminary assessment, and whether ASS will be disturbed in the construction phase of the development, an ASS Assessment and Dewatering Management Plan will be undertaken as a condition of Development Approval associated with the proposed development if necessary.

4.7 Contamination

4.7.1 Background

DWER Contaminated Sites Records identified that no contaminated sites occur within the site. The nearest identified site is a Restricted Use site approximately 1.6 km northeast of the site.

The desktop contamination assessment for the site concluded that that there have been no significant historical contaminating activities at the site, as the site has been vacant and undeveloped. However, six (6) AOPCs were identified, namely:

- AOPC 1 – Part of the site located adjacent to the former furnace oil aboveground storage tanks (ASTs) to the north of the site, and associated fuel pipelines and pumps (the offsite former furnace oil AST area. It was formerly classified as Contaminated – Remediation Required).
- AOPC 2 – Part of the site located adjacent to the former historical bulk fuel storage to the east (diesel line) of the site, and associated fuel pipelines and pumps.
- AOPC 3 – Part of the site located adjacent to the former historical bulk fuel storage to the south (aviation spirit) of the site, and associated fuel pipelines and pumps.
- AOPC 4 - Part of the site with a moderate to low risk of acid sulfate soils (ASS) being present within 3 metres of the soils surface.

- AOPC 5 - Potential unexploded ordnance (UXO) from activities during WWII (whole of site and Onslow Townsite).
- AOPC 6 - Potential asbestos from illegal fly-tipping or associated with offsite sources (whole of site).

4.7.2 Potential Impacts

The potential impacts for contamination from the site or surrounding sites include:

- Ground water pollution
- Human health and safety put at risk
- Air pollution
- Fauna habitat poisoning.

4.7.3 Management Response

Based on the conclusions from the desktop contamination assessment and gaps identified, the following management response is recommended.

- A UXO survey of the site should be considered prior to any site works commencing
- A HAZMAT site survey should be considered to evaluate the potential presence of asbestos at the site
- Conduct a review of any available contamination investigation and/or remediation reports describing works associated with former bulk fuel infrastructure (i.e. AOPC 1, AOPC 2 and AOPC 3) to determine the requirement for investigation onsite
- Site development plans should be reviewed to determine if ASS may be disturbed by development activities or if dewatering is to occur, and thereby determine the requirement for an ASSMP/DMP
- Depending on the findings of the above, consideration should be given to intrusive site investigations to:
    - Investigate the contamination status of soils (and potentially groundwater) onsite at AOPC 1, AOPC 2 and AOPC 3, to confirm there are no hydrocarbon impacts.
    - Assess the potential presence of asbestos (ACM, AF, or FA) in soils at the site. If identified to be present, asbestos remediation should be undertaken in accordance with Department of Health guidelines.
    - In the absence of any site investigations associated with AOPC 1, AOPC 2 or AOPC 3, an unexpected finds protocol (UFP) is recommended to be developed prior to site development works. The protocol should detail the management requirements should any of the contaminants of potential concern (COPCs) for the site be encountered during site development works.

The desktop contamination assessment report details these management measures (Appendix A). Additional contamination investigations may be required as a condition of Development Approval for the proposed development.

4.8 Bushfire Management

4.8.1 Background

The DLPH identifies the site within a Bushfire Prone Area. The proposed development is considered to be a vulnerable land use which triggers the requirements for the preparation of a BMP and BEMP to satisfy the provisions of the SPP No. 3.7 - Planning for Bushfire Prone Areas and Guidelines for Planning in Bushfire Prone Areas (WAPC 2017).

The BMP describes the specific BAL ratings applicable to the proposed development and identifies appropriate fire management measures to be implemented for the overall development. Additionally, a BEMP details the emergency and evacuation procedures applicable the site and its overall relationship to the Onslow Townsite.

4.8.2 Potential Impacts

The potential impacts of bushfire for the site and surrounding locality include:

- Loss of flora and fauna habitats
- Loss of infrastructure and services
- Destruction to coastal environment
- Destruction of personal property
- Destruction to townsite and surrounding locality
- Limited access within the entire townsite for fire purposes.

4.8.3 Management Measures

A BMP and BEMP was developed by Linfire Consultancy as part of the proposed Master Plan for the site. The BMP describes the measures that need to be implemented to minimise the impact of fire on the site and surrounding locality. The BEMP provides procedures to assist with the management of occupants during a bushfire emergency as well detailed site-specific information in order to assess the vulnerability of the development and location and extent of the hazard. These are summarised below:

Bushfire Management Plan

- **Onsite Landscaping and Staging Buffers:** If the development (and therefore clearing) is to occur on a staged basis, clearing in advance will need to occur to ensure building construction is not inhibited by a temporary vegetation extent located within adjacent development stages yet to be cleared. This can be achieved by ensuring that each approved stage subject to construction is surrounded by a suitably sized, on-site cleared, or low threat buffer to development (not including vegetation proposed to be retained

Once the buffers are created, they will need to be maintained on a regular and ongoing basis. Management will include slashing of grassland at 100 mm or lower, to achieve a low threat minimal fuel condition all year round, until such time that the buffer area is developed as part of the next development stage. This will assist in managing the current on-site temporary vegetation hazards.

- **Emergency Pedestrian Gates:** Emergency pedestrian gates are proposed in the fence surrounding the project area, to permit egress by on-site occupants to Onslow townsite, should offsite evacuation from the development be required. The gates are to have a minimum width of no less than 3.6 m to enable 2-3 people to pass through simultaneously. Both gates should be locked to restrict access, however a common key system is to be used with keys made available to on site Emergency Response Team and to local fire brigade personnel.
- **Road Verge Fuel Management:** Existing and proposed road verges that have been excluded as low threat are to be managed to ensure the understorey and surface fuels remain in a low threat. Ongoing road verge management will be the responsibility of the Shire.
- **Staging of Access:** If development is to occur on a staged basis, vehicular access arrangements will need to ensure that all occupants are provided with compliant public access and internal driveways at all stages. This can be achieved via construction of access in advance of stages.
- **BAL Compliance and/or BAL Assessment Report:** A BAL compliance and/or BAL assessment report may be prepared at the discretion of the Shire following completion of construction works and prior to issue of certificate of occupancy to validate and confirm the accuracy of the BAL contour assessment; or demonstrate any change in the assessed BAL or other management measures documented in this BMP. This may occur as a result of changes in building location, vegetation class or bushfire management approach. The Shire or Building Certifier may also require a revised BAL assessment to confirm the BAL rating to buildings, prior to submission of building license.
- **Building Construction Standards:** Bushfire construction provisions of the National Construction Code require that Class 1, 2, 3 and associated Class 10a buildings comply with the Bushfire specific construction requirements of AS3959, in accordance with the assessed BAL. The accommodation buildings within the proposed development are required to comply with AS3959 to the assessed BAL rating as identified on Figure 4 or through a subsequent BAL assessment (Appendix D).
- **Notification on Title:** Notification is to be placed on the Title of proposed lots subject to BAL-12.5 or higher (either through condition of subdivision or other head of power) to ensure landowners/proponents and prospective purchasers are aware that their lot is subject to an approved BMP and BAL assessment.

- **Compliance with Annual Firebreak Notice:** MRL is to comply with the current Shire of Ashburton annual firebreak notice, including any approved variations (should they exists). The firebreak notice requires that perimeter firebreaks are implemented on all properties within the town site that exceed 2000 m². The perimeter mineral earth firebreak is to be no less than 5 m wide and 4 m high and must be immediately inside the external property boundary (Appendix D).

Bushfire Emergency Management Plan

The BEMP is for the entire Onsite Townsite and has been designed to assist management to protect life and property in the event of a bushfire. The proposed development and occupant details include:

- Vulnerable occupants
- Communication Equipment and Strategy
- Vehicular access
- Pedestrian Access
- Firefighting and other emergency equipment
- Vegetation Management and Building Bushfire Construction.

The BEMP provides the following:

- **Emergency Contacts:** Identifies the onsite response team and emergency services and other organizations responsible for fire response.
- **Bushfire Emergency Warnings and Forecast Bushfire Information:** Details the bushfire emergence status information, the fire danger ratings, total fire ban days and the DFES emergency warning.
- **Bushfire Preparedness:** Details ongoing year-round and daily actions throughout the bushfire season preparation. These actions focus on management of onsite combustible material, maintenance of buildings, access routes and fire and emergency systems and ensuring emergency management preparedness, to not only reduce the intensity of bushfire impact but also to maximise the chance for successful occupant evacuation or refuge.
- **Awareness and Pre-emptive Procedures:** Details the procedures focus on forecast fire danger rating and the forecast total fire ban. It also outlines when and what monitoring actions are to be undertaken to ensure the facility maintains awareness of any forecast elevated bushfire weather days, and the associated pre-emptive procedures the facility can implement to respond to heightened risk.
- **Bushfire Emergency Triggers and Decisions Making:** Highlights that decision making is the responsibility of the onsite Chief Fire Warden in the case of a bushfire. There are two main response options for the Onslow facility which are offsite evacuation and

onsite shelter in place. These response actions will be subsequent to the standby and control shutdown action or an emergency shutdown.

- **Standby and Controlled Shutdown Procedures:** Details that where a bushfire is sufficiently far away that it is not clear whether it will impact the facility or vehicular access routes but is close enough to trigger a heightened level of awareness by occupants which may also include commencing a shutdown response by the facility. There is still considered adequate time for shutdown to be conducted in a controlled way in preparation for safe offsite evacuation.
- **Offsite Evacuation Response:** Details that where a bushfire is close enough to the facility and/or egress routes to require rapid shutdown of the development, with the intention of getting occupants to a place of relative safety. Priority shall be on ensuring occupants are evacuated offsite to safety, with a focus on egress routes, however if this unsafe to conduct, they shall be relocated to the onsite location to shelter-in-place.
- **Onsite Shelter-in-Place Response (Last Resort Action Only):** Identifies an alternative to offsite evacuation is for occupants to shelter-in-place within the facility. This would typically be expected to occur if there is insufficient time to conduct a safe offsite evacuation or the risk associated with offsite evacuation otherwise considered to be greater than sheltering in place on-site.

Further investigations to address limited access to the site and the townsite for fire purposes will be necessary. The BMP and BEMP will be required to be implemented as a condition of Development Approval for the proposed development.

5 Key Environmental Constraints and Management Review

Any potential environmental impacts that may result from change in land use and development of the Onslow Township Village are discussed below, along with management measures intended to mitigate any possible impacts (Table 10)

Table 10: Key Environmental Aspects

Environmental Aspect	Site Relevance	Approval and Management Considerations
Contamination	A desktop contamination assessment for the site concluded that there have been no significant historical contaminating activities at the site, as the site has been vacant and undeveloped. Six areas of potential concern (AOPC) were identified within the site.	A HAZMAT assessment to evaluate the potential presence of asbestos at the site. In the absence of contamination investigations associated with the identified AOPCs an unexpected finds protocol (UFP) is recommended to be developed prior to site development works. Additional assessments maybe required to be undertaken as a condition of Development Approval for the proposed development.
Acid Sulfate Soils	A desktop assessment identified that a portion of the site is identified as 'moderate to low risk of ASS, with a portion of the site to the north identified as 'moderate to high risk of ASS'.	A Preliminary Site Assessment will be undertaken to assess the presence and extent of ASS in accordance with DER guidelines. Depending on the results of the preliminary assessment, and whether ASS will be disturbed in the construction phase of the development, an ASS Assessment and Dewatering Management Plan may be required as a condition of Development Approval for the proposed development.
Surface Water and Groundwater	The site is located within Ashburton River surface water area and the closest water surface feature is 2.5 km east of the site. The Water Register indicates that the site lies within the Pilbara groundwater area and Ashburton subarea. Impacts on surface water and ground water include: • Groundwater level changes from changes in land use and clearing. The development of the proposed accommodation and associated outbuildings has the potential to increase recharge of rainfall into groundwater through increased	Implementation of the UWMP will be required to cater for development that will be proposed for the site. Two winters of surface water monitoring will be required. The UWMP will be implemented as a condition of Development Approval for the proposed development.

Environmental Aspect	Site Relevance	Approval and Management Considerations
	surface area of roofs, driveways, carparks, and roads. • Habitat modification (invasion of exotic species, clearing, introduction of feral and domestic animals, weed and pathogen introduction or spread). • Impact on costal processes. • Diminished water quality (nutrients, organic compounds, suspended solids, toxic compounds, and salinity) as a consequence of discharges. The UWMP identified appropriate measures and strategies to manage groundwater and surface water within the site and surrounding locality. The following measures have been suggested: • Stormwater management • Groundwater management • Flood management. The SWMS shall be implemented pre and post construction for the proposed development.	
Flora and Vegetation	A detailed flora and vegetation survey of the site identified 30 native taxa were recorded from 15 families. No Threatened flora species pursuant to the Environment Protection and Biodiversity Conservation Act 1999 and/or gazetted as Threatened pursuant to the Biodiversity Conservation Act 2016, or DBCA listed Priority flora species were recorded within the site. The *Tamarix aphylla* is the only weed listed as both a Declared Pest and Weed of National Significance by the Commonwealth Department Agriculture, Water, and the Environment found within the site.	Potential impacts to vegetation and flora are considered unlikely to be significant due to the type of vegetation on site. The vegetation has been considered insignificant locally and regionally. Management measures include weed control, fire management, dieback management and control and establishment of culture centre to retain native vegetation within the site. Preparation of a CEMP is recommended prior to construction. A Dieback Management Plan and Weed Management Plan may be required as a condition of Development Approval for the proposed development.
Fauna	One (1) fauna habitat was mapped within the site, with Coastal Dunes representing the most value to conservation significant fauna and overall fauna assemblages. No conservation significant species were recorded during the fauna survey. Fourteen (14) bird species and one (1)	Potential impacts to fauna habitats and conservation of fauna species. No conservation significant fauna was found in the survey. Fauna habitat could be protected. Careful control of the clearing of vegetation within the site during the development phase by careful control of the clearing of

Environmental Aspect	Site Relevance	Approval and Management Considerations
	reptile species were confirmed to be using the site.	vegetation within the site during the development phase. Having a fire management plan and controlling weeds around within retained areas and site surroundings. Relocation and trapping of vertebrae fauna will be necessary prior to construction commencing on the site. A Relocation Management Plan may be required as a condition of Development Approval for the proposed development. Preparation of a CEMP is recommended prior to construction. A Dieback Management Plan or Weed Management Plan may be required as a condition of Development Approval for the proposed development.
Heritage	A search of the Department of Planning, Lands and Heritage's (DPLH) Aboriginal Heritage Inquiry System identified three registered Aboriginal Heritage sites within the site (Figure 9). • Site ID: 6618 -is a ceremonial, water source type of site. This site covers the whole Study area. It is named DEW TALU. • Site ID: 6617- is a mythological site which extends from the south-eastern side of the Study Area into the town. The site is named BURUBARLADJI. • Site ID: 8920- is an artefact/scatter, Midden registered site. The site is within the Study area, covering at least a third of the southeast side of the site. • Add 4 one off site.	An ethnographic and archaeological survey of the site will be required by a suitably qualified consultant prior to any development. Preparation of a Cultural Heritage Management Plan in consultation with the Aboriginal knowledge holders for the area may be required to identify appropriate management measures and provisions for heritage areas to be retained and managed on site. A Section 18 Application will be required prior to construction. The additional surveys or applications will be required to form part of the Development Application separate to this application.
Bushfire Risk	The whole site is mapped within a Bush Fire Prone Area.	A BMP and BEMP) has been prepared for the site to satisfy the provisions of the SPP No. 3.7 - Planning for Bushfire Prone Areas and Guidelines for Planning in Bushfire Prone Areas. The BMP and BEMP will be implemented as a condition of Development Approval for the proposed development. Further investigations to address limited access into the entire townsite and the site will be necessary.

6 Summary and Conclusion

6.1 Summary of Key Findings

An assessment of environmental aspects of the Onslow Township Village has determined the following are relevant:

Contamination

A desktop contamination assessment for the site concluded that there have been no significant historical contaminating activities at the site, as the site has been vacant and undeveloped. However, six areas of potential concern (AOPC) were identified within the site. These AOPCs have been associated with the lack of soil or groundwater investigations undertaken at the site. It is understood offsite contamination (and possible remediation) associated with former fuel infrastructure located to the north has previously occurred. The nature and extent of existing and/or residual contamination in soil or groundwater is not known. The risk to the site is considered to be low.

Recommendations from the site contamination assessment include having a HAZMAT site to evaluate the potential presence of asbestos at the site. A review of any available contamination investigation and/or remediation reports describing works associated with former bulk fuel infrastructure to determine the requirement for investigation onsite would be required. In the absence of contamination investigations associated with the identified AOPCs an unexpected finds protocol (UFP) is recommended to be developed prior to site development works. Additional contamination assessments maybe required as a condition of Development Approval for the proposed development.

Acid Sulfate Soils

Acid Sulfate Soils (ASS) mapping undertaken by DWER indicates that a portion southern part of the site is mapped as having 'Moderate to Low' risk of ASS within the first 3 m of natural soil surface. An ASS investigation may be required if the works within the site will involve lowering the water table and earthworks beyond 3 m below the natural ground surface. An ASS Self-Assessment form should be filled out to identify the need of an ASS investigation. If required, prior to ground disturbing activities an ASS and Dewatering Management Plan (ASSDMP) can be developed to manage the ASS risk within the site.

A Preliminary Site ASS assessment shall be undertaken prior to construction. This assessment shall be undertaken as part of the Development Application. Depending upon the results of the preliminary assessment, and whether ASS will be disturbed in the construction phase of the development, an Acid Sulfate Soil Assessment and Dewatering Management Plan may be required as a condition of Development Approval for the proposed development.

Flora and vegetation

No Threatened flora species pursuant to the Environment Protection and Biodiversity Conservation Act 1999 and/or gazetted as Threatened pursuant to the Biodiversity Conservation Act 2016, or DBCA listed Priority flora species were recorded within the site.

Four (4) introduced flora species were recorded during the survey; including *Tamarix aphylla*, listed as both a Declared Pest and Weed of National Significance by the Commonwealth Department Agriculture, Water, and the Environment.

One (1) native vegetation type was mapped within the site, comprising mid to low *Acacia* trees, low shrubs, and grass lands. The vegetation type identified by the survey is predominantly uncleared and widespread within the bioregion. The vegetation mapped within the site is not considered to be locally or regionally significant. Vegetation condition within the site was concluded to be Very Good, with evidence of disturbance including vehicle tracks and weeds.

The retention of flora and vegetation for open space and surrounding accommodation buildings is recommended where possible. A CEMP would be required to be prepared prior to construction to address flora and vegetation significance for the site. A Dieback Management Plan and Weed Management Plan may be required as a condition of Development Approval for the proposed development.

Fauna

One (1) fauna habitat was identified within the site, with Coastal Dunes representing the most value to conservation significant fauna and overall fauna assemblages. No conservation significant species were recorded during the fauna survey. Fourteen (14) bird species and one (1) reptile species were recorded within the site.

A Relocation Fauna Plan may be required to relocate fauna species from within the site prior to construction. A CEMP would also be required to be prepared prior to construction to address fauna and fauna habitat significance for the site.

Surface water and Ground water

An Urban Water Management Plan (UWMP) has been developed by 360 Environment for the site. The UWMP details the measures and strategies to manage surface water and groundwater associated with the proposed development and surrounding locality. The UWMP will be required to be implemented as part of the Development Application approval process.

ESA and Conservation Areas

The site is not mapped within a conservation reserve or DBCA managed land. Mapping undertaken by DWER shows the site is not located within an ESA and no ESA was identified within the 10 km of the site. There will be no impact associated with ESA or Conservation Areas resultant from the proposed development of the site.

Aboriginal Heritage

Three Aboriginal sites have been identified within the site and one Aboriginal site is located within close proximity to the site.

An ethnographic and archaeological survey of the site will be required to be prepared by a suitably qualified consultant prior to any development of the site. The studies will inform on the approval works needed for the site.

Additional surveys and application will be required separate to this Development Application.

Bushfire Management

The whole site is identified within a Bushfire Prone Area as per SPP No. 3.7 - Planning for Bushfire Prone Areas. A BMP and BEMP has been prepared for the site to satisfy the provisions of the State Planning Policy No. 3.7 - Planning for Bushfire Prone Areas and Guidelines for Planning in Bushfire Prone Areas. The BMP and BEMP will be implemented as part of the Development Application process. Further investigations to address limited access within the entire townsite and the site for fire purposes will be necessary.

6.2 Conclusions

The key environmental issues identified in the EAR do not pose a significant constraint to development of the short stay workforce accommodation of the Onslow Township Village. Avoidance of important environmental assets during the master planning phase has resulted in the development having limited potential impact.

Where the environment could possibly be impacted, environmental management measures, additional investigations, surveys, or assessments (including additional approvals) are proposed to avoid or mitigate these impacts. Those issues not addressed through the development application process will be addressed in detail in the development and construction approval phase accordingly.

7 Limitations

This report is produced strictly in accordance with the scope of services set out in the contract or otherwise agreed in accordance with the contract. 360 Environmental makes no representations or warranties in relation to the nature and quality of soil and water other than the visual observation and analytical data in this report.

In the preparation of this report, 360 Environmental has relied upon documents, information, data, and analyses ('client's information') provided by the client and other individuals and entities. In most cases where client's information has been relied upon, such reliance has been indicated in this report. Unless expressly set out in this report, 360 Environmental has not verified that the client's information is accurate, exhaustive, or current and the validity and accuracy of any aspect of the report including, or based upon, any part of the client's information is contingent upon the accuracy, exhaustiveness, and currency of the client's information. 360 Environmental shall not be liable to the client or any other person in connection with any invalid or inaccurate aspect of this report where that invalidity or inaccuracy arose because the client's information was not accurate, exhaustive, and current or arose because of any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to 360 Environmental.

Aspects of this report, including the opinions, conclusions, and recommendations it contains, are based on the results of the investigation, sampling and testing set out in the contract and otherwise in accordance with normal practices and standards. The investigation, sampling and testing are designed to produce results that represent a reasonable interpretation of the general conditions of the site that is the subject of this report. However, due to the characteristics of the site, including natural variations in site conditions, the results of the investigation, sampling and testing may not accurately represent the actual state of the whole site at all points.

It is important to recognise that site conditions, including the extent and concentration of contaminants, can change with time. This is particularly relevant if this report, including the data, opinions, conclusions, and recommendations it contains, are to be used a considerable time after it was prepared. In these circumstances, further investigation of the site may be necessary.

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Figures

Legend

- Study Area Boundary
- Cadastral Lines

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2020
- OTHER DATA SOURCED LANDGATE 2020
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2020
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LOCALITY MAP

PROJECT ID	DATE
4755	07/07/2021

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

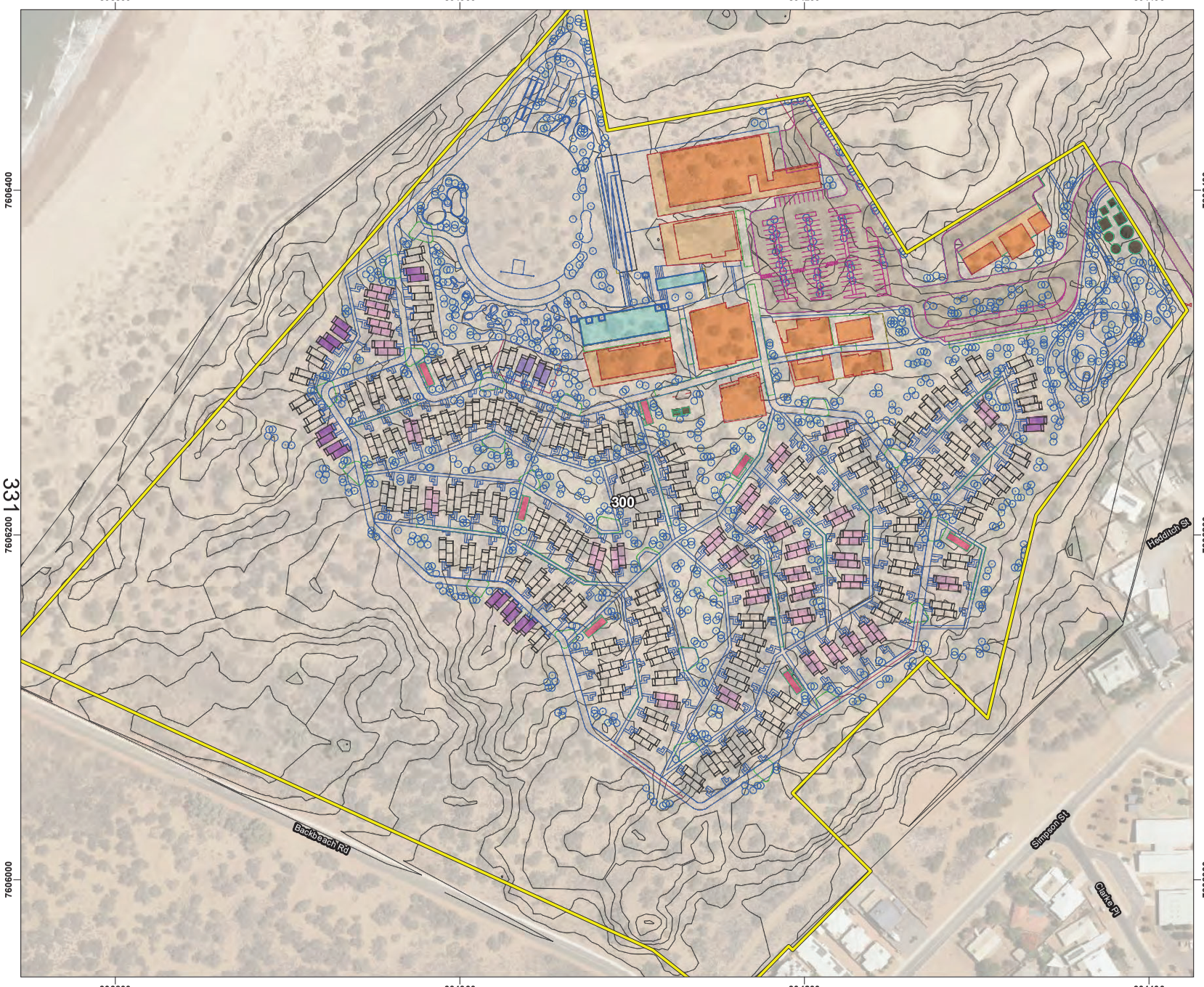
CREATED	CHECKED	APPROVED	REVISION
LF	VM	FJ	0

Mineral Resources Limited
Lot 300 Back Beach Road Onslow

Onslow
Environmental Assessment Report

Figure 1
Study Area Location

K:\Projects\9.0 APP\4755 Lot 300 Back Beach Road Onslow EAR\4755 F01 Study Area Location.mxd



Legend

- Survey Area Boundary
- BUILDING
- COVERED OUTDOOR SPACE
- SERVICES
- WATER BODY
- ROAD/CAR PARK
- FIELD STORE (WITH LAUNDRY)
- ACCOMMODATION PODS (SLEEPS 4)
- ACCOMMODATION PODS (SLEEPS 2)
- ACCESSIBLE ACCOMMODATION PODS (SLEEPS 2)

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
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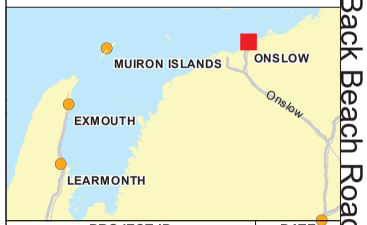
LOCALITY MAP



PROJECT ID	DATE
4755	02/08/2021

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
LF	VM	TS	0

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Lot 300 Back Beach Road Onslow

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Environmental Assessment Report

Figure 2
Proposed Master Plan

K:\Projects\10. WAM\4757 Lot 300 Back Beach Rd, Onslow\4757 F02 Master Plan.mxd

Legend

Study Area Boundary

Soil Land System

- 201Du: Dune fields supporting soft spinifex and minor hard spinifex grasslands.
- 201Li: Bare coastal mudflats (unvegetated), samphire flats, sandy islands, coastal dunes and beaches, supporting samphire low shrublands, sparse acacia shrublands and mangrove forests.
- 201On: Undulating sandplains, dunes and level clay plains supporting soft spinifex grasslands and minor tussock grasslands.

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
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- OTHER DATA SOURCED LANDGATE 2020
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LOCALITY MAP

PROJECT ID	DATE
4755	23/07/2021

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

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Lot 300 Back Beach Road Onslow

Onslow
Environmental Assessment Report

Figure 3

Soil Land Systems

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Legend

- Study Area Boundary

Acid Sulfate Soils Risk

- High to moderate risk
- Moderate to low risk

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2020
- OTHER DATA SOURCED LANDGATE 2020
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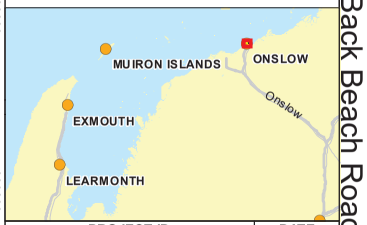
LOCALITY MAP



PROJECT ID	DATE
4755	23/07/2021

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
LF	VM	FJ	0

Mineral Resources Limited
Lot 300 Back Beach Road Onslow

Onslow
Environmental Assessment Report

Figure 4
Acid Sulfate Soils

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Legend

- Study Area Boundary

Areas of Potential Concern

- Former Aviation Spirit Pump Station
- Former Dieseline Pump Station
- Former Pump Out Station for bulk fuel ASTs
- Lot 381 Former Furnace Oil ASTs
- Lot 383 Former Dieseline AST
- Lot 658 - Former Aviation Spirit
- AOPC 1 - parts of site adjacent the former Furnace Oil ASTs and/or associated infrastructure
- AOPC 2 - parts of site adjacent the former Dieseline AST and/or associated infrastructure
- AOPC 3 - parts of site adjacent the former Aviation Spirit AST and/or associated infrastructure
- AOPC 4 - part of site with Moderate to Low risk of ASS within 3m of site surface
- AOPC 5 - UXO risk for whole of site (and Onslow Townsite)
- AOPC 6 - Potential asbestos (whole of site)

NOTE:
dashed lines = approximate fuel lines associated with former bulk fuel infrastructure

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0 80 160 240 Meters
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N

LOCALITY MAP

PROJECT ID	DATE
4755	05/08/2021

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
LF	VM	FJ	0

Mineral Resources Limited
Lot 300 Back Beach Road Onslow

Onslow
Environmental Assessment Report

Figure 5
Areas of Potential Concern

K:\Projects\9.0 APP\4755 Lot 300 Back Beach Road Onslow EAR\4755 F05 Areas of Potential Concern.mxd

Legend

- Study Area Boundary

Hydrography

- Watercourse - minor
- Lake
- Area Subject to Inundation
- Marine Construction - wharf/jetty
- Tidal Flat
- Reef Area
- Coastal Waterline

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2020
- OTHER DATA SOURCED LANDGATE 2020
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2020 (© Western Australian Land Information Authority 2020)

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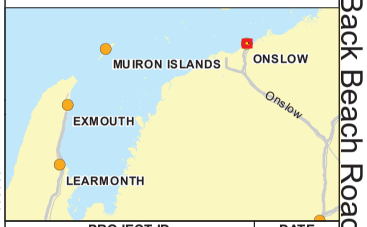
LOCALITY MAP



PROJECT ID	DATE
4755	27/07/2021

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
LF	VM	FJ	0

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Lot 300 Back Beach Road Onslow

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Environmental Assessment Report

Figure 6
Hydrography

K:\Projects\9.0 APP\4755 Lot 300 Back Beach Road Onslow EAR\4755 F06 Hydrography.mxd

Legend

- Study Area Boundary
- Cadastral Lines

Broad Vegetation Types

- CAPE YANNARE COASTAL PLAIN_117: Grass-steppe
- CAPE YANNARE COASTAL PLAIN_127: Tidal mud flat
- CAPE YANNARE COASTAL PLAIN_676: Samphire

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
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- OTHER DATA SOURCED LANDGATE 2020
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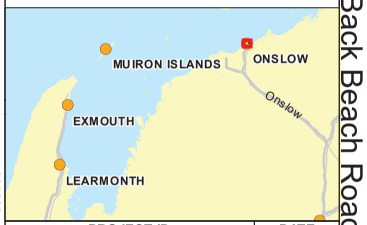
LOCALITY MAP



PROJECT ID	DATE
4755	27/07/2021

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
LF	VM	FJ	0

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Lot 300 Back Beach Road Onslow

Onslow
Environmental Assessment Report

Figure 7
Vegetation Associations

K:\Projects\9.0 APP\4755 Lot 300 Back Beach Road Onslow EAR\4755 F07 Vegetation Associations.mxd

Legend

- Survey Area Boundary
- Cadastral Lines

Vegetation Types

- Ac

Weed of National Significance

- *Tamarix aphylla*

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2020
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- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2020 (© Western Australian Land Information Authority 2020)

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LOCALITY MAP

PROJECT ID	DATE
4755	27/07/2021

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
LF	VM	FJ	0

Mineral Resources Limited
Lot 300 Back Beach Road Onslow

Onslow
Environmental Assessment Report

Figure 8
Vegetation Types

K:\Projects\9.0 APP\4755 Lot 300 Back Beach Road Onslow EAR\4755 F08 Vegetation Types.mxd

Legend

- Survey Area Boundary
- Cadastral Lines

Vegetation Condition

- Very Good (VG)

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2020
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LOCALITY MAP

PROJECT ID	DATE
4733	27/07/2021

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
LF	VM	FJ	0

Mineral Resources Limited
Lot 300 Back Beach Road Onslow

Onslow
Environmental Assessment Report

Figure 9
Vegetation Condition

K:\Projects\9.0 APP\4755 Lot 300 Back Beach Road Onslow EAR\4755 F09 Vegetation Condition.mxd

Legend

- Study Area Boundary

Aboriginal Heritage

- Registered Sites
- Lodged Sites

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2020
- OTHER DATA SOURCED LANDGATE 2020
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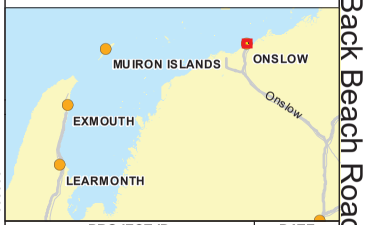
LOCALITY MAP



PROJECT ID	DATE
4755	27/07/2021

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
LF	VM	FJ	0

Mineral Resources Limited
Lot 300 Back Beach Road Onslow

Onslow
Environmental Assessment Report

Figure 10
Aboriginal Heritage Sites

K:\Projects\9.0 APP\4755 Lot 300 Back Beach Road Onslow EAR\4755 F10 Aboriginal Heritage Sites.mxd

Appendices

Appendix A
Lot 300 Back Beach Road, Onslow, Contamination Review

360 environmental

Lot 300 Back Beach Road, Onslow WA

Desktop Contamination Assessment

Prepared for

Mineral Resources Limited (MRL)

July 2021

people • planet • professional

Document Reference	Revision	Prepared by	Reviewed by	Admin Review	Submitted to Client	
					Copies	Date
4756AA_Rev0	Internal Draft	DO	RB	-		20/7/21
4756AA_Rev1	Client Draft	DO	RB	LI	1 x electronic	21/7/21
4756AA_Rev2	Client Final	DO	RB	LI	1 x electronic	27/7/21

Disclaimer

Executive Summary

360 Environmental Pty Ltd (360 Environmental) was commissioned by Mineral Resources Limited (MRL) to complete a desktop contamination assessment of the proposed development site located at Lot 300 Back Beach Road in Onslow, Western Australia.

The primary objectives of this desktop assessment are to identify areas of potential concern (AOPC) associated with onsite or offsite contamination, identify data gaps associated with contamination, and to provide advice on potential future works to address those data gaps.

Based on the findings of this desktop assessment and review of available information, it is concluded that there have been no significant historical contaminating activities at the site, as the site has been vacant and undeveloped. However, six (6) AOPC were identified, namely:

- AOPC 1 – Part of the site located adjacent to the former furnace oil aboveground storage tanks (ASTs) to the north of the site, and associated fuel pipelines and pumps (the offsite former furnace oil AST area was formerly classified as Contaminated – remediation required)
- AOPC 2 – Part of the site located adjacent to the former historical bulk fuel storage to the east (dieseline) of the site, and associated fuel pipelines and pumps
- AOPC 3 – Part of the site located adjacent to the former historical bulk fuel storage to the south (aviation spirit) of the site, and associated fuel pipelines and pumps
- AOPC 4 - Part of the site with a moderate to low risk of acid sulfate soils (ASS) being present within 3 metres of the soils surface
- AOPC 5 - Potential unexploded ordnance (UXO) from activities during WWII (whole of site and Onslow Townsite)
- AOPC 6 - Potential asbestos from illegal fly-tipping or associated with offsite sources (whole of site).

The following data gaps were identified associated with the above AOPCs:

- There have been no soil or groundwater investigations undertaken at the site however it is understood offsite contamination (and possible remediation) associated with former fuel infrastructure located to the north has previously occurred. Reports presenting details of investigation(s) and/or remediation offsite have not been identified and as such the specific scope and/or effectiveness of any remediation works is not well understood. In this regard the nature and extent of existing and/or residual contamination in soil or groundwater is not known. The risk to the site is considered to be LOW.
- It is not known if the soils in the area marked as having a moderate to low risk of ASS being present are potential or actual ASS. The requirement to investigate is dependent on whether development plans for the site involve disturbance of potential ASS material or if dewatering may be required. Management measures, such as development of an ASS management plan (ASSMP) or dewatering management plan (DMP), would be

dependent on the findings of any ASS investigation. The risk to the site is considered to be LOW.

- Onslow Townsite (including the site) is listed on the Department of Defence (DoD) UXO Mapping Application as having a Slight Potential for the presence of UXO. It is not known if a detailed UXO survey has been undertaken at the site, or if records exist of any historical UXO searches or recovery operations in relation to the site. Information on possible UXO presence in AECOM (2010) was anecdotal in nature. The risk to the site is considered to be LOW to MODERATE.
- Without a hazardous materials (HAZMAT) survey of the site or previous site investigations, it is not known if asbestos containing materials (ACM), asbestos fines (AF) or fibrous asbestos (FA) are present at the site. If these are present, they may be a source of potential contamination for onsite and offsite, current and future, receptors (human health). The risk to the site is considered to be LOW to MODERATE.

Based on the data gaps identified, the following recommendations are made:

- A UXO survey of the site should be considered prior to any site works commencing.
- A HAZMAT site survey should be considered to evaluate the potential presence of asbestos at the site.
- Conduct a review of any available contamination investigation and/or remediation reports describing works associated with former bulk fuel infrastructure (i.e. AOPC 1, AOPC 2 and AOPC 3) to determine the requirement for investigation onsite.
- Site development plans should be reviewed to determine if ASS may be disturbed by development activities or if dewatering is to occur, and thereby determine the requirement for an ASSMP/DMP.
- Depending on the findings of the above, consideration should be given to intrusive site investigations to:
    - Investigate the contamination status of soils (and potentially groundwater) onsite at AOPC 1, AOPC 2 and AOPC 3, to confirm there are no hydrocarbon impacts.
    - Assess the potential presence of asbestos (ACM, AF or FA) in soils at the site. If identified to be present, asbestos remediation should be undertaken in accordance with Department of Health guidelines.
    - In the absence of any site investigations associated with AOPC 1, AOPC 2 or AOPC 3, an unexpected finds protocol (UFP) is recommended to be developed prior to site development works. The protocol should detail the management requirements should any of the contaminants of potential concern (COPCs) for the site be encountered during site development works.

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1 Introduction

360 Environmental Pty Ltd (360 Environmental) was commissioned by Mineral Resources Limited (MRL) to complete a desktop contamination assessment of the proposed development site located at Lot 300 Back Beach Road in Onslow, Western Australia (herein referred to as the site).

1.1 Objectives

The primary objectives of this desktop assessment are to identify areas of potential concern (AOPCs) associated with onsite or offsite contamination, identify data gaps associated with contamination, and to provide advice on potential future works to address those data gaps.

1.2 Scope of Works

360 Environmental undertook the following scope of works as part of the desktop contamination assessment:

- Desktop review of publicly available information (online databases, websites, etc.)
- Desktop review of relevant client-provided investigation reports and design drawings
- Consideration of potential sources of contamination and identification of AOPCs
- Identification of data gaps associated with the potential contamination
- Provision of recommendations for further works to address data gaps.

1.3 Information Sources

The following information sources were utilised for the desktop review to identify critical environmental aspects relevant to the project.

Table 1: Databases and Information Sources

Aspect	Database Searches/Relevant Literature
Tenure and Land Uses	
Land Uses	• Department of Planning, Lands and Heritage (DPLH) PlanWA Interactive Map, https://espatial.dplh.wa.gov.au/PlanWA/Index.html?viewer=PlanWA (accessed online 15 July 2021) (DPLH 2021).
Aboriginal Heritage/Native Title	• Aboriginal Heritage Inquiry System, https://espatial.dplh.wa.gov.au/AHIS/index.html?viewer=AHIS (accessed online 16 July 2021) (DPLH 2021).
European Heritage	• Shire of Ashburton Local Government Heritage Inventory, October 2019 (Shire of Ashburton 2019). • inherit Heritage register (accessed online 15 July 2021) (HCWA 2021).
Reserves/Conservation Areas/ESAs	• Perth Regional Ecological Linkages, GIS Dataset. Perth Biodiversity Project (2008). • Bush Forever Sites, GIS Dataset. Department of Planning (2014). • Clearing Regulations - Environmentally Sensitive Areas, GIS Dataset. Department of Water and Environmental Regulation (2018a).

Aspect	Database Searches/Relevant Literature
Physical and Hydrological Aspects	
Acid Sulfate Soils	• Acid Sulfate Soils, Swan Coastal Plain, GIS Dataset. Department of Water and Environmental Regulation (2019a).
Contamination and Hazardous Substances	• Contaminated Sites DWER Records, GIS Dataset. Department of Water and Environmental Regulation (DWER) (accessed online 15 July 2021). • Department of Defence (DoD) UXO Mapping Application, https://www.whereisuxo.org.au/ (accessed online 17 July 2021).
Groundwater	• Water Register, https://maps.water.wa.gov.au/#/webmap/register. Department of Water and Environmental Regulation (accessed online 15 July 2021).
Surface Water/Drainage	• Hydrography – Swan Coastal Plain (Detailed Mapping) GIS Dataset, Department of Water and Environmental Regulation (2019b) • Hydrography Linear (Hydrography), GIS Dataset, Department of Water and Environmental Regulation (2018c).

1.4 Regulatory Guidelines

In Western Australia, suspected or known contamination is legislatively addressed under the Contaminated Sites Act and regulated by the DWER Contaminated Sites Branch. This PSI follows the approach to reporting, investigating and remediating suspected or known contaminated sites as guided by the assessment protocols defined in the revised (2013) *National Environmental Protection Measure (Assessment of Site Contamination)* [2013 NEPM ASC] schedules, the DWER *Assessment and Management of Contaminated Sites Guidelines*, dated December 2014 (DER, 2014) [AMCS Guideline] and Department of Health (2009) Assessment, Remediation and Management of Asbestos-Contaminated Sites in Western Australia.

2 Site Information and Setting

2.1 Site Identification

Site identification and land use information is summarised in **Table 2.**

Table 2: Site Identification

Aspect	Detail
Primary address	Lot 300 Back Beach Road, Onslow WA 6710
Lot Details	Lot 300 on Deposited Plan 067927
Current Owner	Unallocated Crown Land
Property details (Vol/Fol)	3160/90
Local Government Authority	Shire of Ashburton
Zoning	Conservation, Recreation and Nature Landscape
Local Planning Scheme	Shire of Ashburton Scheme No. 7
Regional Planning Scheme	None
Structure Plans	Onslow Townsite Expansion Structure Plan
State Planning Policies	3.7 – Planning in Bushfire Prone Areas
Boundary Coordinates [Geographic Datum Australia (GDA 1994 MGA Zone 50)] (refer **Figure 1**)	**Reference** / **Easting (mE)** / **Northing (mN)** 1 / 303735 / 7606131 2 / 304071 / 7606513 3 / 304422 / 7606330 4 / 304154 / 7605925
Site Area	20.4485 hectares (ha)
Current Land Use	Vacant, undeveloped
Proposed Land Use	500 (TBC) resort-style fly-in fly-out accommodation facility
Contaminated Sites Status	The site is not shown as classified on the Contaminated Sites Database (CSD) (accessed online 15 July 2021). A Basic Summary of Records (BSR) search was undertaken with the results indicating that as of 27/07/2021 the site has not been reported as a known or suspected contaminated site, either prior to or after the commencement of the *Contaminated Sites Act 2003*. The BSR response is provided in **Appendix A**.

2.2 Surrounding Land Uses

Identified land uses in each direction from the site as identified during this desktop assessment are summarised in **Table 3**.

Table 3: Surrounding Land Uses

Direction from site	Current land use(s)
North	The site is immediately abutted by the former location of the furnace oil above ground storage tanks (ASTs), now vacant land used for tourism purposes (i.e. Lookout Point and Onslow Memorial Park), then beach followed by waters of the Indian Ocean.
East	Some residential properties are located to the east of the site and bordering First St, Third Ave or Simpson St. Also to the east are community facilities including Onslow Primary School, the Onslow Community Garden, a church and police station. The location of the former dieseline/water storage AST is vacant.
South	The site is bound by Back Beach Rd and small area of residential development, followed by a vacant portion of the site operated by Onslow Salt, then infrastructure of Onslow Salt.
West	The site is immediately abutted by vacant land with a memorial boardwalk, then Sunset Beach and the Indian Ocean (with a loading jetty associated with Onslow Salt). The former aviation spirit AST is still present, approximately 210m to the south of the site, having been converted to residential use.

2.3 Environmental Setting

2.3.1 Environmental Setting

The environmental setting of the site is summarised within **Table 4**.

Table 4: Environmental Setting

Attributes	Detail	Onsite	Offsite
Topography		The site has a low point of approximately 6 m above Australian Height datum (mAHD) in the southwest corner and rises to a high of approximately 16 mAHD near the northeast corner, before falling to 9 mAHD near Third Ave. The site tends to undulate gently from southeast to southwest through the centre of the site, before again falling away along the northwest boundary (GoogleEarthPro, accessed online 15 July 2021).	The ground level generally fluctuates around the dunal areas around the site and drops down towards beach areas. Salt mining areas to the southwest are topographic lows.
Geology and Soils	Regional geology	Onslow is located in the Carnarvon Geological Region and within the Exmouth Province of the Western Coastlands Physiographic Region (AECOM, 2010). The Exmouth Province is characterised by sandy or alluvial plans associated with drainage systems such as the Ashburton River. Coastland adjacent to the river is characterised by sandy beaches and dunal systems of the Quaternary shoreline and coastal eolian deposits. Onslow is situated on a large sandy island, with the most seaward point located over an old coral reef, forming Beadon Point (AECOM 2010). Regional soils are predominantly red sands in the dune fields and red soils in the plains (AECOM 2010).	
	Local geology	No site investigations are understood to have been undertaken. Based on the aerial photographs and the site location, the site is expected to reflect the regional geology and comprise coastal dunes, being calcareous and siliceous sands, locally shelly and/or cemented (beach rock).	
	Acid sulfate soils	Part of the site (central portion running to the southwest site boundary at Back Beach Rd) is mapped as having a moderate to low risk of acid sulfate soils (ASS) occurring within 3m of the natural soil surface but high to moderate risk of ASS below 3 m of the natural soil surface (ASS Risk Map, Pilbara Coastline, DWER-053).	
Hydrogeology	Regional hydrogeology	There is limited hydrogeological information for the site and Onslow area. AECOM (2010) notes that Onslow is located within the Ashburton Sub-Area of the Pilbara Groundwater Area. The freshwater aquifer beneath the townsite is understood to be of limited supply and is not extracted for human consumption, with town potable supplies sourced from bores approximately 30 km to the east (AECOM 2010)	
	Local hydrogeology	No groundwater investigations are understood to have been conducted at the site.	No nearby offsite groundwater investigations were identified in this investigation.
	Groundwater quality and protection	Groundwater is anticipated to range from fresh to saline. Potable water is sourced from approximately 30 km to the east and a large salt lake is present to the southwest of the site. Given the proximity of the site close to the Indian Ocean, groundwater beneath the site is likely to be saline. No groundwater investigation reports associated with the site were identified.	
	Groundwater abstraction licence(s)	There are no abstraction licences associated with the site.	A search of the Water Register indicates one groundwater abstraction licence within 500m of the site. The licence (181614) is registered to Onslow Development and applies to the property to the immediate north of the site (Lot 381 on Plan 205465) and has an annual allocation of 16,000kL. The use of this abstraction (and whether the allocation is utilised) is not provided.

Attributes	Detail	Onsite	Offsite
	Registered bores	A search of the Water Information Reporting (WIR) and the Australian Groundwater Explorer indicate there are no registered or licensed groundwater wells at the site.	A search of the WIR database identified three (3) registered bores while a search of the Australian Groundwater Explorer identified a total of four (4) sites within 500m of the site. The sites are summarised as follows: • 70610006 – Onslow Artesian No. 2, drilled in 1899, with a measured static water level in 1899 of 6 mbgl. • 70610297 – Onslow Oval • 70612248 – monitoring well installed in 1997 to a depth of 12.7 mbgl. • 70612247 – monitoring well installed in 1997 to a depth of 9.1 mbgl.
Surface Water	Surface water protection	The site and surrounds are not located within any surface water protection area.	
	Ambient surface water bodies, wetlands and flood plains	No natural, constructed water bodies or wetlands exist on the site.	A natural lake area, visible in the earliest aerial photograph, is present approximately 200m to the southwest and is associated with the Onslow Salt site and operations (i.e. it is assumed to be saline).
Contaminated Sites	Contaminated Sites Database (CSD)	The site is not a listed on the CSD and there are no classified properties adjoining the site. Note that it is possible properties classified as "possibly contaminated – investigation required" (PCIR) may be near the site. PCIR sites are not listed on the CSD.	There are currently no classified sites listed within 1 km of the site, with the nearest being more than 2 km to the southeast. 360 Environmental notes that AECOM (2010) reported nearby Lot 381, the site of the former 2,300kL furnace oil ATSs adjacent to the northern site boundary, as being classified as Contaminated – remediation required. That report noted the ASTs had been installed on an oil-saturated sand bed, and that anecdotal evidence indicated pipes containing oil had been uncovered during installation of a sewer pit. Those pipes were presumably associated with the tanks and may have run out to the former jetty to the north. Remediation was noted to be occurring in 2010 (AECOM 2010), the outcomes of which are not known. A search of the CSD in July 2021 did not identify the site as classified and the BSR search determined the site has not been reported as known or suspected contaminated site (refer **Appendix A**).
Environmental Protection	Environmental Sensitive Areas (ESA)	The site is not located in an ESA.	There are no ESAs located within a 500m radius of the site.

Attributes	Detail	Onsite	Offsite
Heritage	Aboriginal heritage	There are three (3) registered heritage sites associated with the site (Place IDs 6617, 6618 and 8920). These are described in Section 2.4.1.	There is one (1) registered heritage site within 500m of the site (Place ID 6575). This is described in Section 2.4.1.
	European heritage	There are no registered Historical Heritage locations at the site.	There are six (6) registered heritage locations within 500m of the site [and a further two (2) reported in Shire of Ashburton (2019)]. These are further described in Section 2.4.2.

2.4 Heritage Sites

2.4.1 Aboriginal Heritage

A search of the AHIS identified three (3) listed heritage locations associated with the site and one (1) additional location within 500m of the site. These are described in **Table 5**.

Table 5: Aboriginal Heritage Locations

ID	Name	Type / Description
Onsite		
6617	Burubarladji	Mythological; not a protected area
6618	DEW TALU	Ceremonial, Water Source; not a protected area
8920	Onslow 1	Artefacts / Scatter, Midden / Scatter; not a protected area
Offsite		
6575	Jinta 1 Midden	Artefacts / Scatter, Midden / Scatter; not a protected area

2.4.2 Other Heritage Sites

A search of state and local government heritage databases and available reports identified several heritage locations within 500m of the site. These are further described in **Table 6**.

Table 6: Other Heritage Locations

HCWA No.	Name	Type / Description
Heritage Council of WA Website (inHerit)		
15366	Police Residence (fmr)	3 First St, Onslow. The former police residence has aesthetic, historic, social and representative cultural heritage significance and is a relic of Onslow's early settlement
15392	St Nicholas Church	19 Third Ave, Onslow. St Nicholas Church has significant aesthetic, historic, social and rarity heritage value.
15377	Residence - Sweeting	18 Third Ave, Onslow. The residence on Lot 326 has historic cultural heritage significance, being a remnant of the Old Onslow town site that has survived numerous storms.
15376	Residence	26 Third Ave, Onslow. The residence has aesthetic, historic and representative cultural heritage significance.
15367	Onslow Post Office & Residence	19-21 Second Ave, Onslow. The former Post Office and residence have aesthetic, historic and representative cultural heritage significance
15364	Beadon Hotel	22-26 Second Ave, Onslow. The Beadon Hotel has significant aesthetic, historic, social and rarity cultural heritage value.
Shire of Ashburton Local Government Heritage Inventory		
-	Fuel Storage Tanks	Includes the former Aviation Spirit tank, dieseline tank and furnace oil tanks 1 and 2, and the pump outstation and hose locker. These were present across several lots, with several (furnace oil tanks, dieseline tank and pump stations) immediately adjacent to the site. These were

HCWA No.	Name	Type / Description
		listed as having heritage value based on their physical form and their role in defence activities in World War II.
26612	Beadon Point Rear Navigational Leading Light	2 Second Ave, Onslow. Cultural significance as provided evidence of when Onslow was the major port for the Ashburton district. Demolished in 2019.

3 Site History

3.1 Historical Aerial Review

A review of publicly available online historical aerial imagery (dating back to 1970) was undertaken on 15 July 2021. Observed changes to the site and surrounding area are described in **Table 7**. Copies of the historical aerial imagery reviewed are provided in **Appendix B**.

Table 7: Historical Aerial Photographs

Year	Photograph Description	
	Onsite	Offsite
1970	The site is undeveloped with natural ground cover.	• Fuel storage infrastructure is visible to the north [two furnace oil above ground storage tanks (ASTs)], east (dieseline AST and pump station) and south (aviation pump station and aviation spirit AST). • Residential properties are present to the east and southeast of the site and the jetty is present to the north at Beadon Point. • Land to the west is undeveloped.
2001	The site appears similar to the 1970 aerial photograph and remains undeveloped with natural ground cover.	• Most of the fuel storage infrastructure remains and appears generally similar to the 1970 aerial photograph. • Additional residential properties are present to the immediate east and south of the site, including across Simpson St. • The jetty to the north is no longer present however a jetty associated with Onslow Salt, present to the southwest of the site, is now present to the west of the site.
2010	The site appears similar to the 2001 aerial photograph and remains undeveloped with natural ground cover.	• The two furnace oil ASTs to the north have been removed and some bioremediation of impacted soil occurred. Other fuel infrastructure in the vicinity appears similar to the 2001 aerial photograph. • Minor changes are evident among the residential properties east and southeast of the site.
2017	The site appears similar to the 2010 aerial photograph and remains undeveloped with natural ground cover.	• The remaining small AST to the north of the site has been removed, as has the former dieseline AST east of the site (which historically had been converted to a water storage tank for the town). • The remainder of the area appears generally similar to the 2010 aerial photograph.
2020	The site appears similar to the 2017 aerial photograph and remains undeveloped with natural ground cover.	• Much of the surrounding area appears similar to the 2017 aerial photograph.

3.2 Previous Environmental Investigations

Relevant investigation reports sighted for this investigation (or referenced within signed reports) are identified and summarised in **Table 8**, noting no environmental investigations specifically targeting the site were identified

Table 8: Previous Reports

Report	Report Summary	Relevance to Site
AECOM (2010) Environmental Due Diligence	AECOM completed an environmental due diligence (EDD) on behalf of LandCorp as part of preparatory works in support of the expansion of the townsite as part of the Onslow Townsite Strategy A limited Preliminary Site Investigation (PSI) was completed as part of the EDD and included identification of potentially contaminating activities, industries or land uses relevant to the site and subsequent development of a conceptual site model for the site. The Limited PSI identified a number of potentially contaminating land uses on and in vicinity of the development area and associated recommended actions should the townsite expansion occur.	The EDD investigation area incorporates part of the site as defined in this investigation. Some of the associated potentially contaminating activities, industries and land uses of AECOM (2010) are relevant to the site, including: • Old furnace oil tank, Lot 381 • Old dieseline AST, Lot 383 • Old aviation spirit tank, Lot 385 • Dieseline (Lot 651) and aviation spirit (Lot 658) pumping stations • Fuel pipeline. AECOM (2010) summarises key areas of potential concern, some of which that are relevant to the site, including potential hydrocarbon contamination associated with the bulk storage facilities, the likely presence of fuel/oil in the pipeline on decommissioning and possible product loss from the pipeline, and the possible effects of inundation on contamination migration.
Kelsall (1995) Bulk Fuel Installation, Onslow	Referenced within AECOM (2010), this report described the installation and history of the bulk fuel installation facilities, as described by the engineer who designed the facilities. The report notes that cyclone damage occurred to the fuel installation throughout its history, and that sections of the pipeline were removed by Medalia and Benn Pty Ltd, but further information on the removal is not known.	Parts of the bulk fuel installation facilities were located immediately adjacent the site and are known to have been contaminated (e.g. the furnace oil tank on Lot 381). The locations of former fuel pipelines from the tanks to pump out stations are indicated to be close to the eastern boundary of the site.
Department of Maritime Archaeology (1995) Port Related Structures on the Coast of Western Australia	The Department of Maritime Archaeology (DMA) of the Western Australian Maritime Museum reported on port-related structures in Western Australia. The report notes that the new Onslow jetty at Beadon Point was built in 1923 and was subsequently used for resupplying fuel to naval and other ships during World War (WW) II. The township and port were also the headquarters for nuclear bomb tests in the Montebello Islands in 1952-1956.	Describes the use of the kitty for fuel resupply, and the damage and destruction to the jetty from cyclones in 1953, 1958, and three cyclones in 1961. The report also notes that asbestos from Wittenoom Gorge was exported from a land-backed wharf in Beadon Creek between 1943 and 1966. The nature of the asbestos exported and the exact location of the wharf are not known.

4 AOPC and Data Gaps

4.1 AOPCs

AOPCs are those areas on a site that may have potentially polluting activities, industries and land uses that could result in contamination of surficial and subsurface media. For purposes of this report, AOPCs are generally characterised as areas where:

- Sources from which potential releases of contaminants of potential concern (COPCs) to the environment either currently exist, or have historically existed
- Operational processes, such as storage, handing, and transport of hydrocarbons or other COPC could result in releases to the environment
- Potential polluting activities, such as illegal dumping of asbestos waste, of a scale sufficient to adversely impact surficial and/or subsurface conditions.

360 Environmental have identified six (6) AOPCs at or within the vicinity of the site, and associated COPC) based on the findings of the desktop assessment, including review of the site history and available information. These are summarised in **Table 9** with AOPCs depicted on **Figure 2**.

Note that there is no direct evidence of potential offsite sources impacting the site, as no investigations have been completed at the site and a site inspection was not undertaken as part of the desktop assessment.

Table 9: AOPC and COPC

AOPC	Area / Details	COPC
1	Area adjoining the former furnace oil ASTs and associated fuel infrastructure to the north Based on the previous classification of Lot 381 to the north as Contaminated – remediation required in accordance with the Contaminated Sites Act 2003. The site was classified in January 2007 on the basis of total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAHS) in soil at the site. Contamination was associated with the storage and use of fuels associated with the former refuelling station for submarines during World War II (AECOM, 2010). Based on review of AECOM (2010) it is understood remediation was being undertaken in 2010. However the specific activities and outcomes are not known as no investigation or remediation reports have been sighted to confirm the nature and extent of any remediation activities.	Hydrocarbons, polyaromatic hydrocarbons, heavy metals
2	Area adjoining the former dieseline AST to the east and associated pipeline Based on the previous use of Lot 383 to the immediate east of the site for the storage of dieseline. AECOM (2010) notes that the AST historically sat on a bed of oil-saturated sand and the underground pipe from the AST to the pump out station north of the site was wrapped in bitumen-soaked hessian and buried at a depth of approximately 0.6 mbgl. The AST is understood to have been decommissioned and then re-engineered by Water Corporation for use as a water supply storage tank, receiving water from the Cane River borefield east of Onslow. The use of the former AST for dieseline storage, the bitumen-saturated bed on which it sat, the bitumen-soaked hessian wrap of the pipeline have the potential to be sources of contamination through spillage or product loss from damage to fuel infrastructure.	Hydrocarbons, polyaromatic hydrocarbons, heavy metals

AOPC	Area / Details	COPC
3	Area adjoining or near the former aviation spirit pump station to the south and associated pipeline Based on the previous use of Lot 658 (as reported in AECOM 2010) as a pump out station for the aviation spirit tank to the south of the site at Lot 385, and the pipeline route from the tank to the station and down towards the former jetty location to the north of the site. The use of the former AST for aviation spirit storage, the bitumen-saturated bed on which it sat, and the likely bitumen-soaked hessian wrap of the pipeline are potential sources of contamination.	Hydrocarbons, polyaromatic hydrocarbons, heavy metals
4	Part of the site with a moderate to low risk of ASS being present Based on the identification of part of the site as having a moderate to low risk of ASS being present at less than 3 m depth and high to moderate risk of ASS being present beyond 3 m depth. Site redevelopment works may disturb and/or expose ASS. ASS may impact construction materials and exposed ASS has the potential to produce acidic leachate or groundwater.	Acidic soils and/or leachate
5	Entire site Onslow Town Site (which includes the site) is listed within the Department of Defence (DoD) Unexploded Ordnance (UXO) Mapping Application (accessed online 17 July 2021) as having a Slight Potential for the presence of UXO. The description provided is as follows: "Anti-aircraft artillery live firing practices using high explosive ammunition during WW (World War) II. Aerial bombing also highly likely. For land use planning advice contact the WA Department of Fire and Emergency Services (advice@dfes.wa.gov.au) and quote location number N26 and page number C-275. Where a Defence report is available, it will be listed below and can be found on the Defence UXO Website". Note that no report was listed in the mapping application. AECOM (2010) noted that although at the time of reporting Onslow was not considered to have a slight or substantial risk of UXO potential, Onslow was subject to an air raid on 15 September 1943 during which bombs were dropped. It was not clear how many bombs had been dropped or whether all exploded on impact (AECOM 2010).	UXO
6	Entire site 360 Environmental notes that although there is no evidence of historical development at the site, asbestos containing materials (ACM) or potential ACM (PACM) may be present as a result of illegal fly-tipping of waste materials at the site, the effects of cyclonic activity, or historical exporting of asbestos from a wharf in Beadon Creek. It is noted that several large cyclones have impacted Onslow, including three in 1961 that damaged buildings and destroyed the jetty to the north of the site. Such events have the potential to transport building materials some distance and therefore may have resulted in ACM or PACM being present at the site.	Asbestos [ACM sheeting, asbestos fines (AF), fibrous asbestos (FA)]

4.2 Potential Receptors

Potential receptors to the AOPC are described in **Table 10**.

Table 10: Potential Receptors

Potential Receptor	Relevant AOPC
Onsite human health (including future site workers, future site residents and intrusive maintenance workers)	AOPC 1, AOPC 2, AOPC 3, AOPC 4, AOPC 5, AOPC 6
Offsite human health (current/future workers and residents in the vicinity of the site)	AOPC 1, AOPC 2, AOPC 3, AOPC 4, AOPC 5, AOPC 6

4.3 Potential Migration Pathways

The potential migration pathways between AOPCs and potential receptors both onsite and offsite are described in **Table 11**.

Table 11: Potential Migration Pathways

Migration Pathway	Detail
Exposure to impacted soils via direct contact (i.e. by dermal contact, inhalation and accidental ingestion) from AOPC 1, AOPC 2 and AOPC 3.	Onsite The site is vacant, undeveloped and has natural surface cover. It is considered unlikely that offsite residents or workers would be exposed to onsite soils. Future site workers involved in the development of the site may be exposed to contaminated soils if present. Fauna, if present, are unlikely to contact impacted soils, given the likely depth of impact if present. Flora types are currently not known, therefore the risks associated with contaminant uptake are unknown. Offsite Residents or maintenance workers are more likely to be exposed to offsite soils potentially impacted by AOPC 1, AOPC 2 and AOPC 3, but these sources are not directly associated with the site.
Volatilisation and subsequent migration of hydrocarbon vapour (potentially present in hydrocarbon impacts sands associated with AOPC 1, AOPC 2 and AOPC 3)	Onsite There are no man-made surface coverings or structures at the site, thus if impacted onsite soils were present there is no risk of migration of vapours into aboveground structures. Future site residents, workers and maintenance workers may be exposed to hydrocarbon vapour in the event soil contamination is present at the site and structures are built. Offsite Residents in properties adjacent AOPC 1, AOPC 2 or AOPC 3 are at higher risk of exposure to hydrocarbon vapours, although there is no current evidence of actual contamination associated with these AOPC and AOPC 1 is understood to have been remediated.
Abstraction of COPC in groundwater	Onsite There are no groundwater abstraction bores at the site and it is not known if future development of the site will include groundwater abstraction. The facilities requirements indicate a potable water treatment plant, but it is not indicated if water will be sourced from the site. Offsite One groundwater abstraction licence is associated with the property to the north of the site, although the ultimate use of this groundwater (and whether the allocation is utilised) is not known. As most water used in the Onslow Town site is sourced from abstraction bores east of the town, exposure to potential contaminants is unlikely.
Disturbance of ASS resulting in the development of acidic leachates and acidification of groundwater and/or effects on construction materials	Onsite ASS pose a risk to future site development works if soils are determined to be ASS and development activities disturb those materials. If present, ASS could affect the integrity and longevity of construction materials. Offsite Not relevant to offsite receptors unless disturbed onsite and stockpiles of ASS material develop leachate which runs off the site.

Migration Pathway	Detail
Direct contact with UXO associated with AOPC 5	Onsite The site is currently vacant and undeveloped however it is not known if the site is fenced/access is restricted. Although the likelihood of UXO being present is given as Slight, potential risk of exposure is possible. Risk to future site workers involved in site development are higher, as site works involving machinery and excavations are likely to occur and could contact UXO, if present. Offsite Risks to current and future offsite residents and workers is considered low, given the level of development in the surrounding area.
Inhalation of asbestos fibres from AOPC 6	Onsite The site is vacant and undeveloped with no current site users. If present onsite, ACM, AF or FA could pose a risk to future site users Although there is no current evidence of asbestos being present at the site [a hazardous materials (HAZMAT) survey has not been undertaken at the site] asbestos building products were likely historically used in nearby properties and asbestos products were historically exported from a wharf on Beadon Creek. Damage during cyclonic activities (building products) or demolition and potential losses during transport (asbestos export), exacerbated by potential wind-blown transport during cyclonic activity, may have occurred (although considered unlikely). Offsite Given the age of the Onslow Town site, it is likely that asbestos building products (such as in asbestos fencing or cladding) were historically used. These materials may have been damaged in historical cyclone activity or site redevelopment/demolition works and therefore pose a risk to current offsite residents and workers.

4.4 Source-Pathway-Receptor Linkages

For a particular contaminant to present a risk to receptors, three components must be present:

- **Source** - A potentially hazardous substance that has been released into the environment
- **Pathway** - A mechanism by which receptors can become exposed to the source or derivatives of the source
- **Receptors** - The human or ecological component potentially at risk of experiencing an adverse response following exposure to the source or derivatives of the source.

If one of these three components (referred to as SPR linkages) are missing from an exposure scenario, then there can be no risk. Following the desktop assessment the following SPR linkages were identified as having the potential to be complete at the site if the site is redeveloped:

SPR 1: UXO are potentially present at the site and pose a risk to potential future onsite workers involved in site development works. Although the likelihood of their presence is listed as Slight, the potential human health impacts of exposure for future site workers are high, thus the overall risk associated with UXO (AOPC 5) is considered **LOW to MODERATE**.

SPR 2: Asbestos materials may be present at the site and no HAZMAT survey has been undertaken. Although the likelihood of these being present onsite is low, the potential human

health impacts of exposure for future site workers or residents are high, the overall risk associated with asbestos (AOPC 6) is considered **LOW to MODERATE**.

SPR 3: The potential presence of onsite soil or groundwater contamination associated with offsite bulk fuel infrastructure is not known and no previous onsite investigations have been identified. Although the adjoining site to the north has previously been classified as Contaminated – remediated required, remediation is understood to have occurred, the likelihood of impacts to future site workers or residents is considered low. The overall risk from AOPC 1, AOPC 2 and AOPC 3 is considered **LOW**.

SPR 4: Part of the site is listed as having a moderate to slight risk of ASS being present, although no ASS investigations have been undertaken and specific site development plans (i.e. areas of excavation, the requirement for dewatering) are not known. If present, the risk of ASS to future site workers and the groundwater receptor is considered **LOW**.

4.5 Data Gaps

The identification of data gaps supports determination of information necessary to meet the objectives for completing the desktop contamination assessment. Data gaps relevant to the project are summarised in **Table 12**.

Table 12: Data Gaps

Data Gap	AOPC(s)	Description
1	AOPC 1, 2, 3	There have been no soil or groundwater investigations at the site, however it is understood contamination (and remediation) associated with former fuel infrastructure offsite to the north has previously been identified (AECOM 2010). Reports presenting details of investigation(s) and/or remediation offsite have not been identified and as such the specific scope and/or effectiveness of any remediation works is not well understood. In this regard, the nature and extent of existing and/or residual contamination in soil or groundwater is not known.
2	AOPC 4	It is not known if the soils in the area marked as having a moderate to low risk of ASS being present are potential or actual ASS. The requirement to investigate is dependent on whether development plans for the site involve disturbance of potential ASS material or if dewatering may be required. Management measures, such as development of an ASS management plan (ASSMP) or dewatering management plan (DMP), would be dependent on the findings of any ASS investigation.
3	AOPC 5	Onslow Townsite is listed on the DoD UXO Mapping Application as having a Slight Potential for the presence of UXO. It is not known if a detailed UXO survey has been undertaken at the site, or if records exist of any historical UXO searches or recovery operations in relation to the site. Information on possible UXO presence in AECOM (2010) was anecdotal in nature.
4	AOPC 6	Without a HAZMAT survey of the site or previous site investigations, it is not known if ACM, AF or FA are present at the site. If these are present, they may be a source of potential contamination for: current offsite residents and workers through wind-blown transport of fibres; future site workers involved in the development of the site through ground disturbance activities; or potential future site residents and site workers post development through wind-blown transport of fibres.

5 Conclusions and Recommendations

Based on the findings of this desktop assessment and review of available information, it is concluded that there have been no significant historical contaminating activities at the site, as the site has been vacant and undeveloped. However, six (6) AOPC were identified, namely:

- AOPC 1 – Part of the site located adjacent to the former furnace oil ASTs to the north of the site, and associated fuel pipelines and pumps [the offsite former furnace oil AST area was formerly classified as Contaminated – remediation required (AECOM 2010)].
- AOPC 2 – Part of the site located adjacent to the former historical bulk fuel storage to the east (dieseline) of the site, and associated fuel pipelines and pumps.
- AOPC 3 – Part of the site located adjacent to the former historical bulk fuel storage to the south (aviation spirit) of the site, and associated fuel pipelines and pumps.
- AOPC 4 - Part of the site with a moderate to low risk of acid sulfate soils (ASS) being present within 3 metres of the soils surface.
- AOPC 5 - Potential UXO from activities during WWII (whole of site and Onslow Townsite).
- AOPC 6 - Potential asbestos from illegal fly-tipping or associated with offsite sources (whole of site).

The following data gaps were identified associated with the above AOPCs:

- There have been no soil or groundwater investigations undertaken at the site however it is understood offsite contamination (and possible remediation) associated with former fuel infrastructure located to the north has previously occurred. Reports presenting details of investigation(s) and/or remediation offsite have not been identified and as such the specific scope and/or effectiveness of any remediation works is not well understood. In this regard the nature and extent of existing and/or residual contamination in soil or groundwater is not known. The risk to the site is considered to be **LOW**.
- It is not known if the soils in the area marked as having a moderate to low risk of ASS being present are potential or actual ASS. The requirement to investigate is dependent on whether development plans for the site involve disturbance of potential ASS material or if dewatering may be required. Management measures, such as development of an ASSMP or DMP, would be dependent on the findings of any ASS investigation. The risk to the site is considered to be **LOW**.
- Onslow Townsite (including the site) is listed on the DoD UXO Mapping Application as having a Slight Potential for the presence of UXO. It is not known if a detailed UXO survey has been undertaken at the site, or if records exist of any historical UXO searches or recovery operations in relation to the site. Information on possible UXO presence in AECOM (2010) was anecdotal in nature. The risk to the site is considered to be **LOW to MODERATE**.
- Without a HAZMAT survey of the site or previous site investigations, it is not known if ACM, AF or FA are present at the site. If these are present, they may be a source of potential contamination for onsite and offsite, current and future, receptors (human health). The risk to the site is considered to be **LOW to MODERATE**.

Based on the data gaps, the following recommendations are made:

- A UXO survey of the site should be considered prior to any site works commencing.
- A HAZMAT site survey should be considered to evaluate the potential presence of asbestos at the site.
- Conduct a review of any available contamination investigation and/or remediation reports describing works associated with former bulk fuel infrastructure (i.e. AOPC 1, AOPC 2 and AOPC 3) to determine the requirement for investigation onsite.
- Site development plans should be reviewed to determine if ASS may be disturbed by development activities or if dewatering is to occur, and thereby determine the requirement for an ASSMP/DMP.
- Depending on the findings of the above, consideration should be given to intrusive site investigations to:
    - Investigate the contamination status of soils (and potentially groundwater) onsite at AOPC 1, AOPC 2 and AOPC 3, to confirm there are no hydrocarbon impacts.
    - Assess the potential presence of asbestos (ACM, AF or FA) in soils at the site. If identified to be present, asbestos remediation should be undertaken in accordance with Department of Health guidelines.
- In the absence of any site investigations associated with AOPC 1, AOPC 2 or AOPC 3, an unexpected finds protocol (UFP) is recommended to be developed prior to site development works. The protocol should detail the management requirements should any of the COPCs for the site be encountered during site development works.

6 Limitations

This report is produced strictly in accordance with the scope of services set out in the contract or otherwise agreed in accordance with the contract. 360 Environmental makes no representations or warranties in relation to the nature and quality of soil and water other than the visual observation and analytical data in this report.

In the preparation of this report, 360 Environmental has relied upon documents, information, data and analyses ("client's information") provided by the client and other individuals and entities. In most cases where client's information has been relied upon, such reliance has been indicated in this report. Unless expressly set out in this report, 360 Environmental has not verified that the client's information is accurate, exhaustive or current and the validity and accuracy of any aspect of the report including, or based upon, any part of the client's information is contingent upon the accuracy, exhaustiveness and currency of the client's information. 360 Environmental shall not be liable to the client or any other person in connection with any invalid or inaccurate aspect of this report where that invalidity or inaccuracy arose because the client's information was not accurate, exhaustive and current or arose because of any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to 360 Environmental.

Aspects of this report, including the opinions, conclusions and recommendations it contains, are based on the results of the investigation, sampling and testing set out in the contract and otherwise in accordance with normal practices and standards. The investigation, sampling and testing are designed to produce results that represent a reasonable interpretation of the general conditions of the site that is the subject of this report. However, due to the characteristics of the site, including natural variations in site conditions, the results of the investigation, sampling and testing may not accurately represent the actual state of the whole site at all points.

It is important to recognise that site conditions, including the extent and concentration of contaminants, can change with time. This is particularly relevant if this report, including the data, opinions, conclusions and recommendations it contains, are to be used a considerable time after it was prepared. In these circumstances, further investigation of the site may be necessary.

7 References

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Figures

Legend

Approximate Site Boundary

Site Coordinates GDA94 MGA50

Point ID	Easting	Northing
1	303735	7606131
2	304071	7606513
3	304422	7606330
4	304154	7605925

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2020
- OTHER DATA SOURCED LANDGATE 2020
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2020
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0 100 200 300
Metres

N

LOCALITY MAP

PROJECT ID	DATE
4754	15/7/2021

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
DO	TS	TS	1

Mineral Resources Limited
Lot 300 Back Beach Rd, Onslow

Desktop Contamination Assessment

Figure 1
Site Location

Legend

- Approximate Site Boundary

Areas of Potential Concern

- AOPC 1 - parts of site adjacent the former Furnace Oil ASTs and/or associated infrastructure
- AOPC 2 - parts of site adjacent the former Dieseline AST and/or associated infrastructure
- AOPC 3 - parts of site adjacent the former Aviation Spirit AST and/or associated infrastructure
- AOPC 4 - part of site with Moderate to Low risk of ASS within 3m of site surface
- AOPC 5 - UXO risk for whole of site (and Onslow Townsite)
- AOPC 6 - Potential asbestos (whole of site)

NOTE: dashed lines = approximate fuel line locations associated with former bulk fuel infrastructure

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2021
- OTHER DATA SOURCED LANDGATE 2021
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2021
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0 100 200 Metres

N

LOCALITY MAP

PROJECT ID	DATE
4754	15/7/2021

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
DO	TS	TS	1

Mineral Resources Limited
Lot 300 Back Beach Rd, Onslow

Desktop Contamination Assessment

Figure 2
Areas of Potential Concern

Appendices

Appendix A
Basic Summary of Records Results

Your ref: Onslow BSR
Our ref: DMO 7279
Enquiries: Registrar
Phone: 1300 762 982
Fax: (08) 6364 7001
Email: info@dwer.wa.gov.au

Dion Mark Oulton
360 Environmental
57A Shearn Cres
Doubleview WA 6018

Dear Sir/Madam

BASIC SUMMARY OF RECORDS REQUEST

Thank you for your Basic Summary of Records request for the site consisting of the following parcel(s) of land:

- LOT 300 ON PLAN 67927 as shown on certificate of title LR3160/90 known as 300 Back Beach Rd, Onslow WA 6710

which Department of Water and Environmental Regulation (the department) received on 15/07/2021.

A search of the department's records of known and suspected contaminated sites was undertaken however, our records indicate that as of 27/07/2021 this site has not been reported to the department as a known or suspected contaminated site either prior to or after the commencement of the *Contaminated Sites Act 2003*.

For general enquiries, please contact the Registrar on 1300 762 982.

Yours sincerely

Michelle Brierley, A/Manager

CONTAMINATED SITES REGULATION
Delegated Officer under section 91
of the *Contaminated Sites Act 2003*

27/07/2021

Enc. Receipt Number RR023087

Appendix B
Historical Aerial Photographs

Historical Aerial Imagery	
Image	**Image Date**
	September 1970
	September 2001

Historical Aerial Imagery	
Image	**Image Date**
	September 2010
	May 2017

Historical Aerial Imagery	
Image	Image Date
	November 2020

360 environmental

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Appendix B
Lot 300 Back Beach Road, Onslow, Flora and Fauna Survey

360 environmental

Lot 300 Back Beach Road, Onslow

Flora and Fauna Report

Prepared for

Rowe Group

July 2021

people • planet • professional

Document Reference	Revision	Prepared by	Reviewed by	Admin Review	Submitted to Client	
					Copies	Date
4733AA_Rev0	Internal Draft	B. Duncan P. Walker J. Webb	M. Lohr M. Stone	-	-	
2249AA_Rev1	Client Draft	B. Duncan P. Walker J. Webb	M. Lohr M. Stone	LI	1x electronic	26/07/2021

Disclaimer

Executive Summary

Rowe Group commissioned 360 Environmental Pty Ltd (360 Environmental) to undertake a biological survey (Detailed Flora and Vegetation, Basic Vertebrate Fauna) for the proposed development of short stay worker accommodation at Lot 300 Back Beach Road, Onslow (the Survey Area). The Survey Area is located in the Carnarvon bioregion of Western Australia. The Survey Area covers approximately 25 ha.

The purpose of the assessment was to identify key biological values within the Survey Area to support the Environmental Assessment Report (EAR) process and approvals applications for development. This report presents the background, methods, results, and discussion of the survey undertaken.

Flora and Vegetation

Database searches returned nine conservation significant species occurring within 40 km of the Survey Area, of which, two species were determined as having a high likelihood of occurrence and three species as having a medium likelihood of occurrence.

A Detailed Flora and Vegetation Survey was conducted within the proposed development site in the optimal flowering period for the region.

Across the survey area, 30 native taxa were recorded from 15 families. No Threatened flora species pursuant to the Environment Protection and Biodiversity Conservation Act 1999 and/or gazetted as Threatened pursuant to the Biodiversity Conservation Act 2016, or DBCA listed Priority flora species were recorded within the Survey Area.

Four introduced flora species were recorded during the survey; including **Tamarix aphylla*, listed as both a Declared Pest and Weed of National Significance by the Commonwealth Department Agriculture, Water, and the Environment.

One native vegetation type was mapped within the Survey Area, comprising mid to low *Acacia* trees, low shrubs and grass lands. The vegetation type identified by the survey is predominantly uncleared and widespread within the bioregion. Given this, the vegetation mapped within the Survey Area is not considered to be locally or regionally significant.

The level of survey undertaken was consistent with the requirements of a Detailed Flora and Vegetation survey. The expected low diversity and relatively uniform landforms means the findings of the report are sufficient to inform impact assessment for the project area.

Vegetation condition within the Survey Area was Very Good (Trudgen, 1991). Evidence of disturbance included vehicle tracks and weeds.

Vertebrate Fauna

The vertebrate fauna desktop assessment identified 59 conservation significant species occurring within 20 km of the Survey Area. An assessment of the likelihood of occurrence within the Survey Area was undertaken and identified that, of the potential conservation significant fauna, no species had a high likelihood of occurrence, 20 had a medium likelihood of occurrence, and 39 had a low likelihood of occurrence.

Fauna habitat mapping was based on a combination of field observations and fauna habitat assessment data. One fauna habitat was mapped within the Survey Area, with Coastal Dunes representing the most value to conservation significant fauna and overall fauna assemblages.

No conservation significant species were recorded during the fauna survey. Fourteen bird species and one reptile species were confirmed to be using the Lot 300 Back Beach Rd Survey Area.

Abbreviations

Abbreviations used through the report are described below in Table 1.

Table 1: Abbreviations

Abbreviation	Description
BoM	Bureau of Meteorology
DBCA	Department of Biodiversity, Conservation and Attractions
DP	Declared Pest
EN	Endangered
EPA	Environmental Protection Authority
GIS	Geographic Information System
IBRA	Interim Biogeographic Regionalisation for Australia
IBSA	Index of Biodiversity Surveys for Assessments
MA	Marine
MI	Migratory
NVIS	National Vegetation Information System
OS	Other Specially Protected Fauna
P	Priority
PEC	Priority Ecological Community
PMST	Protected Matters Search Tool
Survey Area	The Survey Area is approximately 25 ha and is located on Lot 300 Back Beach Road, Onslow, WA
TEC	Threatened Ecological Community
TPFL	Threatened and Priority Flora
VU	Vulnerable
VT	Vegetation Type as determined under NVIS guidance statement
WA	Western Australia
WAH	Western Australian Herbarium
WoNS	Weeds of National Significance

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1 Introduction

1.1 The Project

Rowe Group commissioned 360 Environmental Pty Ltd (360 Environmental) to undertake a biological survey (Detailed Flora and Vegetation, Basic Vertebrate Fauna) for the proposed development of short stay worker accommodation at Lot 300 Back Beach Road, Onslow (the Survey Area). The Survey Area is located in the Carnarvon bioregion of Western Australia. The Survey Area covers approximately 25 ha (Figure 1).

1.2 Objectives and Scope

The purpose of the survey was to delineate key flora and fauna values within the Survey Area and identify potential environmental sensitivities that may impact the approvals process.

The scope of works was to:

- Undertake a desktop assessment and likelihood of occurrence to determine environmental values and conservation significant flora, fauna, habitat, vegetation, or other environmental features (such as riparian areas, wetlands) relating to the Survey Area
- Carry out a Detailed Flora and Vegetation and Basic Vertebrate Fauna Survey to assess flora, vegetation, and vertebrate fauna values in accordance with EPA Guidance
- Conduct targeted flora survey for potentially occurring Threatened and Priority listed
- Prepare a technical flora, vegetation, and vertebrate fauna survey report
- Provide all spatial/mapping data collected during the survey in IBSA format.

This report presents the background, methods, results, and discussion of the surveys undertaken to support the above objectives.

Legend

- Survey Area Boundary
- Cadastral Lines

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2020
- OTHER DATA SOURCED LANDGATE 2020
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2020 (© Western Australian Land Information Authority 2020)

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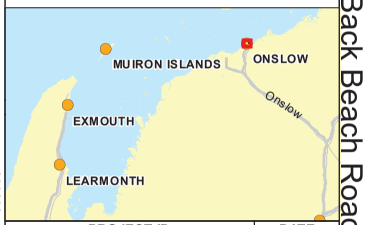
LOCALITY MAP



PROJECT ID	DATE
4733	22/07/2021

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
LF	BD	SW	0

Rowe Group
Lot 300 Back Beach Road, Onslow

Flora and Fauna Report

Figure 1
Survey Area

K:\Projects\1.0 EBS\4733 Lot 300 Back Beach Road Onslow Flora and Fauna\4733 F01 Survey Area.mxd

2 Background

2.1 Legislative Context

Western Australian flora and fauna is protected formally and informally by legislative and non-legislative measures:

Legislative measures:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- WA *Biodiversity Conservation Act 2016* (BC Act)
- WA *Environmental Protection Act 1986* (EP Act)
- WA *Biosecurity and Agriculture Management Act 2007* (BAM Act).

Non-legislative measures:

- WA Department of Biodiversity Conservation and Attractions (DBCA) Priority lists for fauna, flora, and ecological communities
- Weeds of National Significance (WoNS)
- Recognition of locally significant populations by DBCA.

These protection mechanisms are supported by guidance documents published by the Environmental Protection Authority (EPA) and Department of Agriculture, Water and the Environment (DAWE; formerly Department of Environment, and Department of Sustainability, Environment, Water, Population and Communities):

- Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (Environmental Protection Authority, 2016a)
- Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (Environmental Protection Authority, 2016b)
- Matters of National Environmental Significance Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999 (Department of the Environment, 2013)
- Survey Guidelines for Australia's Threatened Mammals (Department of Sustainability Environment Water Population and Communities, 2011a)
- Survey Guidelines for Australia's Threatened Reptiles (Department of Sustainability Environment Water Population and Communities, 2011b)
- Survey Guidelines for Australia's Threatened Birds Under the Environment Protection and Biodiversity Conservation Act 1999 (Department of the Environment Water Heritage and the Arts, 2010).

2.2 Existing Environment

2.2.1 Climate

The closest long-term Bureau of Meteorology weather station with a complete dataset is Onslow Airport (Station 5017), located approximately 3.0 km south of the Survey Area.

Climate statistics were calculated utilising data from the most current climate normal, which is defined as a 30-year interval (Bureau of Meteorology, 2007), where possible. A climate normal is a period long enough to include year-to-year variations while avoiding the influence of longer-term changes in climate (Bureau of Meteorology, 2007).

The long-term mean minimum temperature for Onslow Airport ranges from 13.9˚C (July) to 25.5˚C (February) (1991 to 2020) and the long-term mean maximum temperature ranges from 26.4˚C (July) to 36.7˚C (January and February) (Figure 1) (Bureau of Meteorology, 2021).

The Onslow Airport weather station recorded 278.0 mm of rainfall in the 12 months prior to the survey (July 2020 to June 2021), which is 27.2 mm above the long-term average of 250.8 mm (Bureau of Meteorology, 2021). In the three months prior to the survey (April to June 2021), 143.8 mm of rainfall was recorded, which is 67.1 mm above the long-term average of 76.7 mm for the same time period (Bureau of Meteorology, 2021).

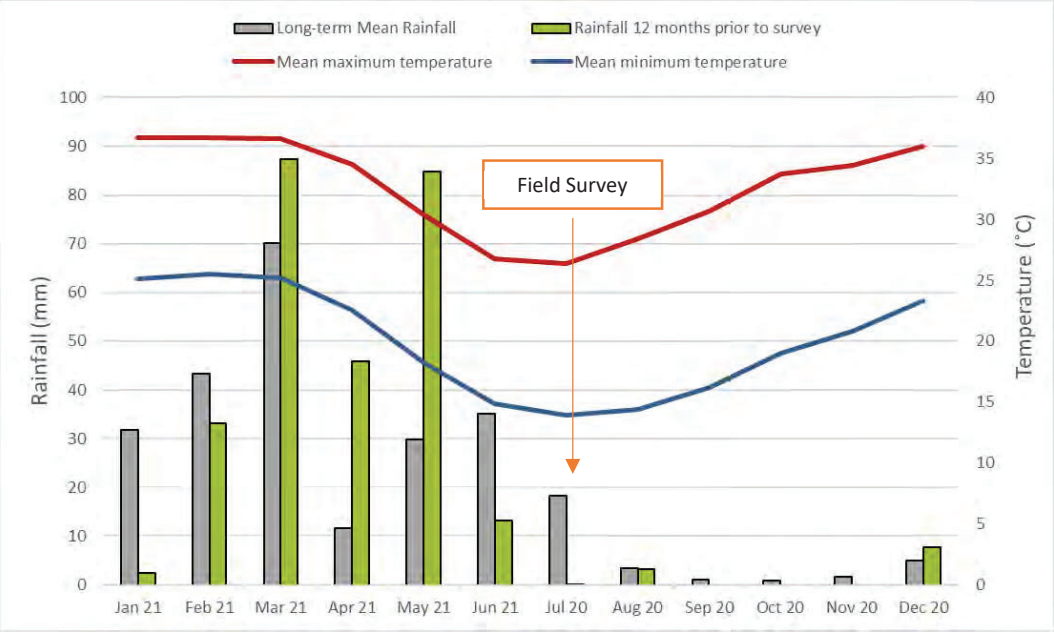


Figure 2: Long term and Monthly Total Rainfall, Maximum and Minimum temperatures for Onslow Airport (5017) (Bureau of Meteorology, 2021).

2.2.2 Interim Biogeographic Regionalisation of Australia

The Interim Biogeographic Regionalisation of Australia (IBRA) divides Australia into 89 bioregions based on major biological, geographical, and geological attributes. These bioregions are subdivided into 419 subregions as part of a refinement of the IBRA framework (Department of the Environment and Energy, 2016). The Survey Area occurs within the Carnarvon bioregion and the Cape Range (CAR01) subregion.

The Cape Range subregion (CAR01) is characterised by a mosaic of saline alluvial plains with samphire and saltbush low shrublands, low woodland on sandy ridges and plains, snakewood scrub on clay flats, and tree to shrub steppe over hummock grasslands on and between red sand dune fields (Kendrick and Mau, 2002). The subregion is represented by limestone strata with *Acacia stuartii* or *Acacia bivenosa* shrubland outcrop in the north, where extensive tidal flats in sheltered embayments support mangal.

2.2.3 Soil Landscapes and Land Systems

Soil landscapes and land system mapping of Western Australia describes broad soil and landscape characteristics from regional to local scales, ranging from 1:20,000 to 1:250,000 (Department of Agriculture and Food WA, 2012). The Survey Area occurs within the Dune System (201Du), which is described as dune fields supporting soft spinifex and minor hard spinifex grasslands.

2.2.4 Hydrography

The Survey Area does not intersect any major watercourses or water bodies that are mapped by State Government GIS databases (Threatened Species Scientific Committee, 2016). The Survey area is located 160 m from the coastal waterline.

2.2.5 Broad Vegetation Types

Mapping of pre-European vegetation in Western Australia was completed on a broad scale (1:1,000,000) by Beard (1976). These vegetation types were later refined by Shepherd *et al.* (2002) resulting in 819 vegetation types.

The Survey Area is mapped over the Cape Yannare Coastal Plain 117, which is a grass steppe characterised by hummock grassland (*Triodia* spp.). Representation of the system associations at a local, regional, and state level is shown in Table 2.

Table 2: Broad Vegetation Types within the State, Regional and Local Representation (Government of Western Australia, 2019).

System and Vegetation Association	Pre-European Extent (ha)	Current Extent (ha)	Extent Remaining (%)	Current Extent Managed in DBCA Lands (%)*
Representation across Western Australia				
Cape Yannare Coastal Plain 117	919,517.05	886,005.79	96.36	14.79
Representation across the Carnarvon Bioregion				
Cape Yannare Coastal Plain 117	12,424.35	10,907.99	87.80	27.48
Representation across the Cape Range (CAR01) Subregion				
Cape Yannare Coastal Plain 117	12,424.35	10,907.99	87.80	27.48

System and Vegetation Association	Pre-European Extent (ha)	Current Extent (ha)	Extent Remaining (%)	Current Extent Managed in DBCA Lands (%)*
Representation across the Shire of Ashburton				
Cape Yannare Coastal Plain 117	14,506.04	9,073.90	62.55	19.13

*As a portion of the current extent

2.2.6 Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are declared by the Department of Water and Environmental Regulation (DWER) to prevent the degradation of important environmental values such as Threatened flora, Threatened Ecological Communities (TECs) or significant wetlands.

The Survey Area does not occur within a mapped ESA. The nearest ESA is associated with an offshore island located approximately 11 km north of the Survey Area (Department of Water and Environmental Regulation, 2018).

2.2.7 Conservation Areas

The Survey Area is not identified within a Conservation Area. The nearest conservation areas are Unallocated Crown Land (LR3046/473), vested under the department of Planning, Lands and Heritage, which is located approximately 22 km south of the Survey Area and the Cane River Conservation Park, which is located 57 km southeast of the Survey Area and is vested under the Conservation Commission of Western Australia.

3 Methods

The survey methods are consistent with the EPA's Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment (2016a) for a Detailed Flora and Vegetation Survey and Desktop Assessment and the EPA's Technical Guidance - Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (2016b) for a Basic Fauna Survey and Desktop Assessment.

3.1 Desktop Assessment

3.1.1 Literature Review

Background information on the Survey Area and surrounds was compiled prior to the field survey (see Section 2.1). Historical vegetation mapping (Beard, 1976; Shepherd, Beeston and Hopkins, 2002), land systems mapping (Department of Agriculture and Food WA, 2012), and the IBRA classification system (Kendrick and Mau, 2002) were consulted to provide broad contextual knowledge of the vegetation units and habitat likely to be encountered within the Survey Area.

The literature review also considered a selection of biological reports detailing assessments undertaken in the region, that were publicly available:

- A Level 1 Vertebrate Fauna Assessment of the Proposed Tubridgi to Wheatstone Gas Pipeline, Western Australia (Ninox Wildlife Consulting, 2013)
- Detailed flora and vegetation survey for the Pilbara Waste Management Facility (Phoenix Environmental Sciences, 2018)
- Flora and vegetation assessment – Ashburton North Strategic Industrial Area (ANSIA) Phase 2 Area (RPS Group, 2019)
- Flora and Vegetation of the CS2 – Tubridgi – Wheatstone Gas Pipeline Project Area (Mattiske Consulting Pty Ltd, 2013)
- Flora and vegetation survey and terrestrial fauna survey for the Pilbara Regional Waste Management Facility (Phoenix Environmental Sciences, 2017)
- Onslow Townsite Strategy Flora, Vegetation and Fauna Assessment (ENV Australia Pty Ltd, 2011)
- Pilbara Ports Authority - Port of Ashburton - Eastern Port Precinct - Additional Clearing Areas Flora Survey (Vicki Long & Associates, 2020)
- West Pilbara Iron Ore Project Onslow Rail Corridor – Level 1 Fauna Assessment (Biota Environmental Sciences, 2008)
- West Pilbara Iron Ore Project Onslow Rail Corridor Terrestrial Fauna Survey (Biota Environmental Sciences, 2009)
- West Pilbara Project Ashburton East Rail Route Flora and Vegetation Scoping Study (Astron Environmental Services, 2008a)
- West Pilbara Project Onslow Rail Route Flora and Vegetation Survey (Astron Environmental Services, 2008b).

3.1.2 Database Searches

Database searches were undertaken to compile a list of potential flora and fauna and identify potential conservation significant flora, fauna, and ecological communities within or surrounding the Survey Areas (Table 3, Appendix A). In addition, an EPBC Protected Matters Search (PMST) was undertaken to identify the potential for Matters of National Environmental Significance (MNES) to occur within or surrounding the Survey Area (Department of Agriculture Water and the Environment, 2020).

The search area for each parameter was varied to reflect distances recommended by DBCA. The search areas are herein referred to collectively as the Study Area.

Table 3: Database Searches of the Survey Area

Database Name	Date Received	Search Target	Search Area
Threatened and Priority Ecological Communities database search (Department of Biodiversity Conservation and Attractions, 2021b)	12 June 2020	TECs and PECs	50 km buffer around the Survey Area
Threatened and Priority Flora (TPFL) database search (Department of Biodiversity Conservation and Attractions, 2020)	25 May 2020	Threatened and Priority Flora	50 km buffer around the Survey Area
Western Australian Herbarium flora database search (Department of Biodiversity Conservation and Attractions, 2021d)			50 km buffer around the Survey Area
DBCA Threatened and Priority Fauna database search (Department of Biodiversity Conservation and Attractions, 2021c)	27 May 2020	Threatened and Priority Fauna	20 km buffer around the Survey Area
NatureMap (Department of Biodiversity Conservation and Attractions, 2021a)	13 July 2021	Threatened and Priority flora and fauna, and inventory of potential flora and fauna	Flora: 40 km buffer around the Survey Area Fauna: 20 km buffer around the Survey Area
Protected Matters Search Tool (Department of Agriculture Water and the Environment, 2021a)	13 July 2021	Commonwealth listed Threatened flora and fauna and TECs	20 km buffer around the Survey Area

3.1.3 Likelihood of Occurrence

Conservation significant flora and fauna species identified from the desktop assessment were assessed to determine the likelihood of their occurrence within the Survey Area, both prior to

and post field survey. The assessment was completed based on the likelihood of occurrence criteria presented in Table 4.

Only species recorded within the Survey Area or considered to have a high or medium likelihood of occurrence are discussed in detail. Species classified as having a low likelihood of occurrence based on the above criteria will not be discussed unless a justification for this classification is required.

For fauna, species listed only as Marine under the EPBC Act were not included as conservation significant as the Marine listing only applies within Commonwealth marine areas.

Table 4: Likelihood of Occurrence Criteria

Rank	Flora and Fauna Criteria
Previously Recorded	The species has been previously recorded in the Survey Area
High (Likely to occur)	• There are existing records of the species in close proximity to the Survey Area (within 10 km), and for fauna has been recorded in the Survey Area in the last 10 years • The species is strongly linked to a specific habitat, which is present in the Survey Area; or • The species has more general habitat preferences, and suitable habitat is present.
Medium (May occur)	• There are existing records of the species from the locality (between 10 km and 20 km), however ○ The species is strongly linked to a specific habitat, of which only a small amount is present in the Survey Area; or ○ The species has more general habitat preferences, but only some suitable habitat is present. • There is suitable habitat in the Survey Area, but the species is recorded infrequently in the locality.
Low (Unlikely to occur)	• The species is linked to a specific habitat, which is absent from the Survey Area; or • Suitable habitat is present, however there are no existing records of the species from the locality (within 20 km) despite reasonable previous search effort in suitable habitat; or • There is some suitable habitat in the Survey Area, however the species is very infrequently recorded in the locality.

3.2 Field Surveys

The flora and vegetation survey was undertaken by Senior Botanist Jason Webb with assistance from Ecologist Christina Walker between 19th and 21st July 2021. Data was recorded from six quadrats and extensive site traverses Refer to Figure 3 for survey effort and quadrat locations.

All plants collected were taken under flora collecting permits held by Jason Webb and Christina Walker pursuant to Regulation 62 of the *Biodiversity Conservation Regulations 2018* (Table 5).

Table 5: Field Personnel

Personnel	Role	Flora Collection Permit
Jason Webb	Senior Botanist Planning, flora fieldwork, plant identification, data interpretation and report preparation.	FB62000168, TFL 75-1920
Christina Walker	Ecologist Planning, fauna field work, data interpretation and report preparation.	FB62000305

Legend

- Survey Area Boundary
- Cadastral Lines
- GPS Tracks
- Quadrats
- Habitat Assessment

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2020
- OTHER DATA SOURCED LANDGATE 2020
- AERIAL PHOTOGRAPHY SOURCED LANDGATE 2020 (© Western Australian Land Information Authority 2020)

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LOCALITY MAP

PROJECT ID	DATE
4733	22/07/2021

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
LF	BD	SW	0

Rowe Group
Lot 300 Back Beach Road, Onslow

Flora and Fauna Report

Figure 3
Survey Effort

Attachment 13.2A - DAP/21/02078 -DA 21-67 | L300 Back Beach Road, Onslow

K:\Projects\1.0 EBS\4733 Lot 300 Back Beach Road Onslow Flora and Fauna\4733 F03 Survey Effort.mxd

3.3 Flora and Vegetation

3.3.1 Establishment of Flora Sites

Six flora quadrats (50m x 50m) were sampled within the Survey Area.

The northwest corner of each quadrat was recorded using a handheld Garmin GPS. Data collect within each quadrat consisted of:

- Site code
- Date and recorder
- Landform and soil description
- Relevant site descriptors including, slope, aspect, litter cover, bare ground cover and fire history
- Inventory of vascular flora including the approximate average height and percentage foliar cover for each taxon recorded
- Vegetation description in accordance with the National Vegetation Information System (NVIS) Level 6 'sub-association'
- Vegetation condition in accordance with the Eremaean and Northern Botanical Provinces vegetation condition scale (Environmental Protection Authority, 2016a), and evidence of disturbance (e.g. clearing, rubbish, feral animals, weed incursion and evidence of dieback) where present
- Photograph from the northwest corner and vegetation occurring within the site.

Between quadrat locations, opportunistic observations were recorded. These observations include:

- Changes in vegetation structure and composition
- Changes in vegetation condition
- Taxa not previously recorded
- Flora of conservation significance
- Significant weed populations.

3.3.2 Opportunistic Flora

Additional flora taxa observed opportunistically around flora sites or while traversing on foot within the Survey Area were also recorded. Where populations of conservation significant flora taxa, Declared Pests (DPs) or WoNS were encountered, a GPS location and a count of the individuals present was recorded.

3.3.3 Targeted Searching

Prior to the survey, conservation significant flora with the likelihood or potential to occur within the Survey Area was compiled (Appendix C). Field personnel familiarised themselves with photographs, reference samples and descriptions of these taxa before conducting the survey.

The entire Survey Area was not systematically searched. Rather, targeted searching focussed on habitat suitable for Threatened flora and P1 and P2 flora, as per standard practice in the Pilbara.

Personnel also actively searched for conservation significant flora species in and around flora sites, while traversing on foot within the Survey Area and in known locations or preferred habitat encountered in the Survey Area.

Where Threatened or Priority flora were encountered in the field a GPS location was taken and a count of individuals was recorded, followed by a search in the local vicinity to determine if any other individuals were present nearby and delineate population boundaries where relevant. Specimens of any potential conservation significant flora that could not be identified in the field were collected for identification and lodgement at the Western Australian Herbarium (WAH).

3.3.4 Taxonomy and Nomenclature

Where identification of plant taxa was not possible in the field, specimens were collected for identification using resources at the WAH. Identification of flora collections was completed by experienced taxonomists Pierre-Louis De-Kock, Ben Eckermann, Simon Colwill and Megan Stone at the WAH. Any difficult specimens were submitted to WAH specialists for formal identification.

The finalised species list was checked against FloraBase (Western Australian Herbarium, 2021) for taxonomic currency, and to determine the conservation status and known distribution of each taxon. Introduced species were checked against the current BAM Act Declared Plants list and the WoNS list to determine their status (Department of Agriculture Water and the Environment, 2021b; Department of Primary Industries and Regional Development, 2021).

Any conservation significant flora taxa, including potential Threatened and Priority species, range extensions and potential new taxa were submitted to the WAH for verification and lodgement. Where relevant, Threatened and Priority Flora Report Forms (TPRFs) were submitted to DBCA.

3.3.5 Statistical Analyses

Quadrat data as well as field observations were used to define the vegetation association mapping boundaries.

Species data was analysed with Primer v. 7 statistical software. Classification of survey sites was determined utilising the hierarchical agglomerative technique, which produces a dendrogram diagram displaying similarity between survey sites (Clarke and Warwick, 2001). Cluster analysis of a species similarity matrix is a recognised method for describing species assemblages (i.e. vegetation communities; Clarke and Warwick, 2001).

The data matrix was analysed using classification techniques in Primer v7 with estimation of species richness via the methods of Chao (1984). Certain taxa were amalgamated prior to analyses, where species, variants or forms were not identifiable for all specimens. The dissimilarity between sites was determined using the Bray-Curtis measure. The Bray-Curtis measure is a widely used assessment of ecological distance, which reflects compositional change, providing quantitative output for similarity between samples. The resulting dendrogram provided the framework for the vegetation associations and assigning survey sites to the particular groups.