Shire of East Pilbara Local Planning Scheme No. 4

Scheme Amendment Proposal – Newman Airport Industrial Precinct

Prepared for Shire of East Pilbara
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Shire of East Pilbara Local Planning Scheme 4

Scheme Amendment Proposal – Newman Airport Industrial Precinct

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1.0

Introduction

1.0 Introduction

1.1 Request for Amendment

This report constitutes a formal proposal from the Shire of East Pilbara to initiate an amendment to *Local Planning Scheme No. 4* (LPS4) which aims to facilitate the development of an identified precinct of the Newman Airport Estate for industrial purposes.

The report outlines the justification, including the policy and legislative framework, environmental conditions and service infrastructure availability relevant to the zoning and Scheme provisions for the area.

1.2 Classification of Amendment

The amendment is proposed as a 'Standard' Amendment under the provisions of Regulation 34 of the *Planning and Development (Local Planning Scheme) Regulations 2015* on the basis that it is considered to be consistent with the Shire's endorsed draft *Local Planning Strategy* currently under consideration of the WAPC, and consistent with the detailed planning for Newman Airport as outlined in the *Newman Airport Masterplan* (2020). Preliminary consultation with the Department of Planning, Lands and Heritage has occurred on the classification of the amendment and confirmed their in-principle support for progression as a Standard amendment.

1.3 The Proponent

The proponent for this application is the Shire of East Pilbara as the local government responsible for the subject area and the implementation of the Scheme and broader planning framework.

1.4 Subject Land

The subject land is identified as a portion of Crown Reservation R44775 as outlined in **Figure 1**. The proposed amendment incorporates an area of 36.87 Hectares. The subject area is shown as Areas A and B which represent the staging of the proposed development area, with Area A representing the first stage at 9.48Ha, and Area B representing the second and final stage of 27.39Ha.

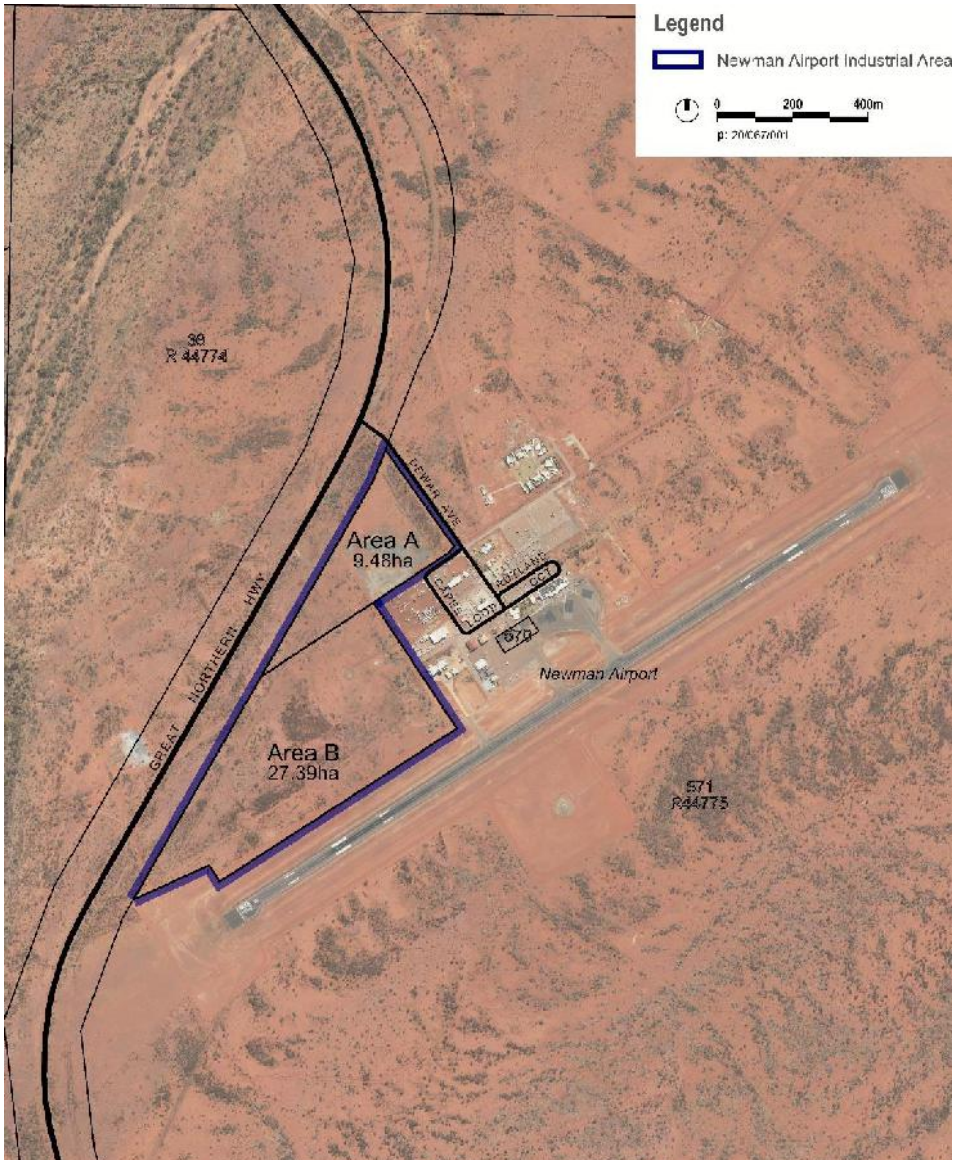


Figure 1: Scheme amendment subject site adjacent to the Newman Airport.

Section

2.0

Site and Context

2.0 Site and Context

2.1 Subject Site

The subject land is located on Crown Reserve R44775 – 571 which, since 1996, is under the management of the Shire of East Pilbara in accordance with a Management Order issued by the Department of Lands (**Figure 2**).

The subject site is 11km south-east of the Newman Townsite and immediately west of the Newman Airport (**Figure 3**). The site is accessible via Great Northern Highway and Dewar Avenue, as the access road to Newman Airport.

The site is currently vacant and aside from some limited waste identified in locations across the site, the local drainage lines (and associated culverts/sumps) and the airport communication/navigation infrastructure and associated high-voltage power cables, there are no current land-uses of note that would preclude future development of the site.

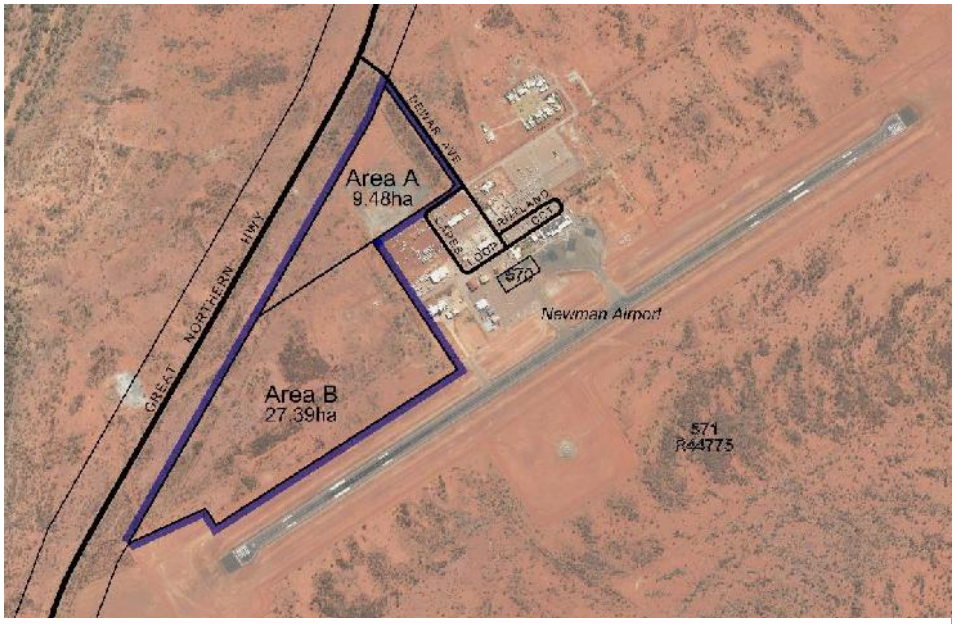


Figure 2: Local context for Subject Site.

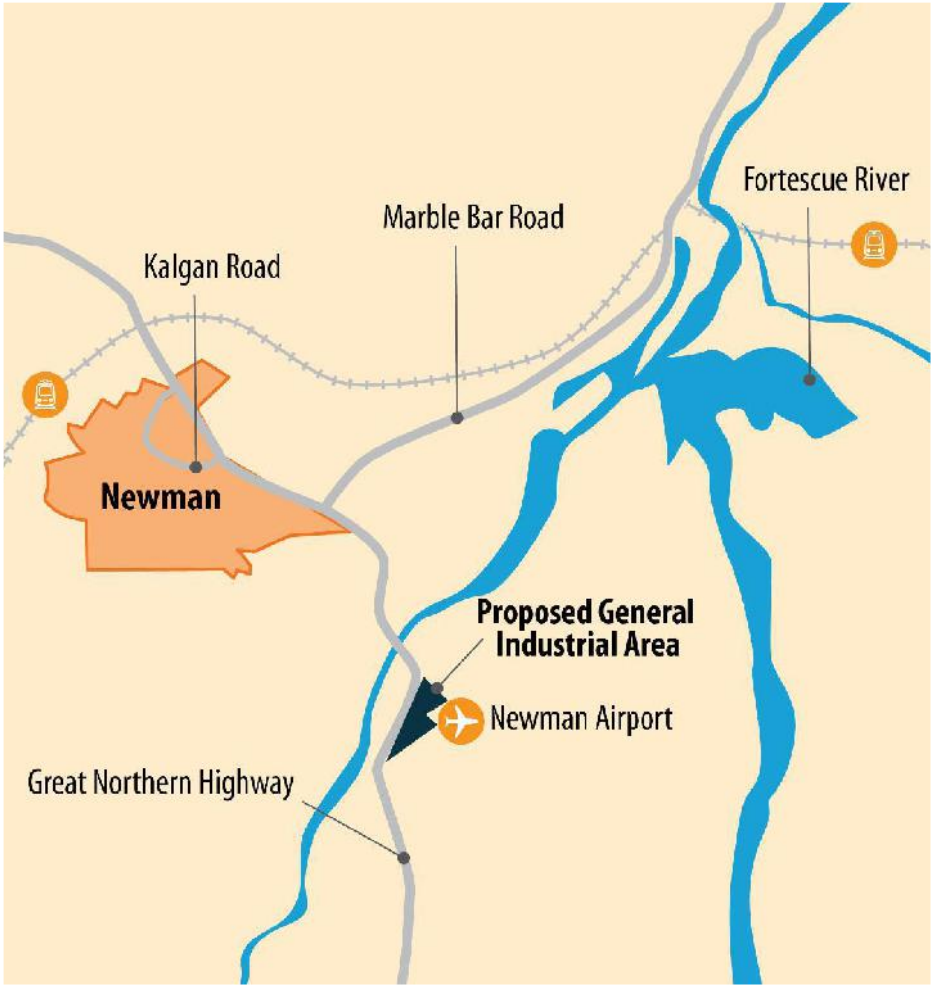


Figure 3: Regional context for Subject Site.

2.2 Environmental Considerations

As a component of preparation of this report the project team has undertaken a comprehensive review of all environmental considerations to ensure industrial development on the site is acceptable and appropriately managed. This assessment is broadly summarised below and outlined in detail in **Appendix B**.

2.2.1 Local Topography and Surface Water Drainage

Based on a review of the data available for the site, the site is broadly flat with no noticeable slope. This assessment was confirmed through the site inspection conducted on 9 February 2021 although there were some localised depressions/undulations identified.

In terms of hydrological features, surface water drainage mapping indicates that the subject site sits within a Surface Water Resource Area as proclaimed under the *Rights in Water and Irrigation Act 1914* (RIWI Act).

There are no local surface water features associated with the site and no evidence of surface water flow or infiltration was identified during the site visit. The nearest surface water feature is the Fortescue River which is located less than a kilometre from the southern portion of the site and flows in a north-south direction to the west of the site.

2.2.2 Geology

According to the Geological Series Mapping for Newman, the site sits within the Qw – Alluvium and colluvium; red-brown sandy and clayey soil geological unit and suggests that there is an extremely low probability of the site containing Acid Sulfate Soils (ASS).

2.2.3 Ecological Values

2.2.3.1 Environmentally Sensitive Areas

ESAs are declared in the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* (the Clearing Regulations) as areas of conservation significance.

The EP Act makes it an offence to clear native vegetation unless the clearing is done in accordance with a clearing permit, or where an exemption applies. Exemptions are not able to be used in areas covered by an ESA.

Based on available mapping in **Appendix B,** the site is located within an ESA and any clearing of native vegetation will require a Native Vegetation Clearing Permit (NVCP) to be issued.

2.2.3.2 DBCA Managed Lands

DBCA Managed Lands and Waters within WA are conservation areas which typically include:

- National Parks;
- Nature Reserves; and
- Crown Freehold identified as being of DBCA interest.

There are no DBCA managed lands located over or adjacent to the study area therefore there are no environmental constraints relating to DBCA managed lands for the Project.

2.2.3.3 Significant Flora

No significant flora was identified within the Study Area. The desktop assessment identified 52 significant flora taxa occurring within the vicinity of the Study Area, of which five were assigned pre-survey likelihood of occurrence of high or medium. All significant flora identified in the desktop assessment are summarised in the Spectrum report appended to this document (**Appendix B**).

The following significant flora were identified within the vicinity of the Survey Area and assigned a high or medium likelihood occurrence:

• High	P3	Aristida jerichoensis var. subspinulifera
• Medium	P1	Eremophila capricornica
• Medium	P3	Eremophila rigida
• Medium	P3	Rhagodia sp. Hamersley (M. Trudgen 17794)
• Medium	P4	Goodenia nuda

2.2.3.4 Threatened Ecological Communities (TEC)

The Department of Biodiversity, Conservation and Attractions defines an ecological community as *"a naturally occurring group of plants, animals and other organisms interacting in a unique habitat. The complex range of interactions between the component*

species provides an important level of biological diversity in addition to genetics and species."

Under previous legislation, the Minister for the Environment was able to list TECs through a non-statutory process if the community was presumed to be totally destroyed or at risk of becoming totally destroyed. The *Biodiversity Conservation Act 2016* (BC Act) provides for the statutory listing of TECs by the Minister.

The desktop assessment completed by Spectrum identified one TEC associated with the subject site, the Ethel Gorge aquifer stygobiont community. This is listed as Endangered (E), its current distribution is limited, and its known occurrences are very vulnerable to known threatening processes (B(ii)).

2.2.3.5 Conservation Significant Fauna

The desktop assessment identified 35 conservation significant fauna species including eight mammals, 23 birds and four reptiles that have the potential to occur within the Study Area. Sixteen species of migratory water birds have been excluded from the assessment due to the lack of wetland habitats occurring in the study site; those species are listed in the appended Spectrum report.

Based on the desktop assessment, three species of conservation significance were assigned a pre-survey Medium to High likelihood of occurrence. The remaining identified species were assigned having a Low to Very Low likelihood of occurrence.

The following significant fauna were identified within the vicinity of the Survey Area and assigned a high or medium likelihood occurrence:

- Medium VU Greater Bilby (Macrotis lagotis)
- Medium P2 Unpatterened Robust Slider (Roberston Range)

2.2.3.6 Short Range Endemic Invertebrates

The West Australian Museum database search identified 72 Arachnid, 23 Crustacean and three Mollusc species of potential short range endemic invertebrates. Twenty-six species of Arachnids and all 23 species of Crustaceans returned from the this SRE database search are subterranean and were excluded from this assessment. A further six species of Arachnids (mites) and two species of Molluscs are freshwater aquatic invertebrates and were also excluded.

Three species were assigned a High likelihood of occurrence and eight a Medium. All other species were assigned a Low likelihood of occurring in the Study Area. The following short-range endemic species were identified within the vicinity of the Survey Area and assigned a high or medium likelihood occurrence:

- High Euagridae Cethegus 'MYG299'
- High Idiopidae Idiosoma 'MYG384'
- Medium Paradoxosomatidae Antichiropus 'DIP051, pannawonica'
- Medium Desidae 'Forsterina grp. Genus' 1 'sp. 5'
- Medium Anamidae Kwonkan 'MYG651'
- Medium Barychelidae Aurecocrypta 'MYG315'
- Medium Halonoproctidae Conothele 'MYG575'
- Medium Idiopidae Gaius 'MYG286'
- Medium Geophilidae 'Zelanophilus?'
- Medium Olpiidae Beierolpium 'sp. 8/1'
- Medium Buthidae Lychas 'harveyi group' 'SCO038'

2.2.3.7 Subterranean Species

The Environmental Protection Authority (EPA) defines subterranean fauna as fauna which live their entire lives (obligate) below the surface of the earth.

They are divided into two groups:

- stygofauna – aquatic and living in groundwater; and
- troglofauna – air-breathing and living in caves and voids.

The EPA notes that subterranean fauna often display evolutionary adaptations to underground life, particularly reduced pigment and reduced, poorly functioning or non-existent eyes.

In this regard, the desktop mapping showed that one Threatened Ecological community (TEC) occurs within the Subject Site. Ethel Gorge Aquifer comprises a diverse assemblage of subterranean stygofaunal species.

In terms of potential impacts to these species, the EPA also notes that they fall under two key types:

- Direct impacts include the removal of habitat, drawdown of groundwater, inundation, and water quality changes. The main threats include excavation of geologies known to support subterranean fauna; groundwater extraction for process or domestic

purposes; dewatering for below water table excavation, and groundwater reinjection of waste or excess water.

- Indirect impacts include changes to hydrology, siltation, void collapse, alteration to nutrient balance and contamination. The main threats include changed surface topography due to compaction or creation of hard surfaces resulting in altered groundwater flow paths, increased runoff, and reduced infiltration and aquifer recharge; clearing of surface vegetation leading to sedimentation and changed nutrient inputs; potential leaks or leaching including tailings and waste water resulting in alterations to ground water chemistry and quality, and introduction of toxins or radiation; and salinisation due to intrusion of saline water into freshwater aquifers and leaching from pit voids.

2.2.3.8 Biological Fieldwork

As noted above and following the desktop work, the project team has conducted a field survey on 10 March 2021. The field survey timing was conducted in accordance with EPA recommended timing and following higher than average rainfall. A total of seven flora relevés, 13 fauna sites, and traverses covering the Survey Area were sampled.

A copy of their report is provided in **Appendix B.**

2.2.4 Groundwater

The subject site sits within the Pilbara Groundwater Area and immediately north of the East Murchison Groundwater Area, both of which are proclaimed under the RIWI Act (see Figure 8). It is illegal to take water from a watercourse or groundwater aquifer without a licence in a proclaimed area under the RIWI Act.

It should also be noted that site is located immediately to the south of the Newman Water Reserve, a Priority 1 (P1) area. Whilst not seen to be a significant risk to the development of the site, P1 areas are defined and managed to ensure there is no degradation of the quality of the drinking water source with the objective of risk avoidance. The Department of Water and Environment Regulation (DWER) notes that industrial land-uses are incompatible uses within a P1 area.

2.2.5 Site Contamination

DWER currently records information of contaminated sites within WA on a Contaminated Sites Database in accordance with the Contaminated Sites Act, 2003. All sites of known or suspected contamination reported to the DWER are classified under the Act as one of the following:

- Report not substantiated;
- Possibly contaminated – investigation required;
- Not contaminated – unrestricted use;
- Contaminated – restricted use;
- Contaminated – remediation required;
- Remediated for restricted use; or
- Decontaminated.

Of the above, only the last three bullet points are publicly displayed on the DWER Contaminated Sites Database. The study area contained no listed sites on the contaminated sites database and there were no listed sites within the direct vicinity the study area (see **Appendix B**). There are no anticipated constraints to the project regarding contaminated sites.

2.2.6 Bushfire Considerations

The project team has prepared a Bushfire Management Plan to best practice standard compliant with the requirements of *State Planning Policy 3.7 (Planning in Bushfire Prone Areas),* the associated Guidelines and relevant Position Statements and relevant to the land use and planning stage.

This has been included as **Appendix B.**

2.2.7 Aboriginal and European Heritage

2.2.7.1 Native Title

Based on mapping supplied by the National Native Title Tribunal the site is contained in an area where Native Title has been found not to exist (WCD2018/008).

2.2.7.2 Aboriginal Heritage

A search for mapped Aboriginal Heritage Sites was conducted by using the data from the Department of Planning, Lands and Heritage (DPLH) online Aboriginal Heritage Inquiry System, which incorporates both the Heritage Site Register and Heritage Survey Database. These databases list the following sites:

- Registered Aboriginal Sites;
- Other Heritage Places; and
- Heritage Study sites.

Under the *Aboriginal Heritage Act 1972*, it is an offence to remove, damage or destroy an Aboriginal Heritage Site (whether known or otherwise) without specific approval being granted.

Whilst there is minimal risk in this regard given that there are no sites located within the subject site, it is recommended that appropriate consultation is held with local indigenous groups where appropriate. Furthermore, appropriate measures should be implemented to minimise any risk of disturbing an Aboriginal Heritage Site during construction activities.

2.2.7.3 European Heritage

An online search of the following records was undertaken;

- State register;
- National heritage list;
- Commonwealth heritage list; and
- The InHerit database.

The nearest site which has been registered is shown in **Appendix B** and is the Opthalmia Dam site to the north-east.

2.3 Servicing Considerations

As a component of preparation of this report the project team has undertaken a comprehensive review of all servicing considerations to ensure industrial development on the site can be appropriately serviced and the considerations relevant to the rezoning.

A summary of the current available information is outlined in the following sections, and further detailed in **Appendix C** and **Appendix D.**

2.3.1 Earthworks

The Site for the proposed industrial development is relatively flat. The south-west of the Site is at approximately 525mAHD and falls to 523.5mAHD at the north-east of the Site, over a distance of 1.4 kilometres. There are a couple of small mounds which will have to be removed to enable development, but overall, there will be minimal earthworks across the Site.

2.3.2 Power

New electrical services infrastructure is required to support the development of the site and the following has been considered by ETC in preparing this report:

- Power distribution infrastructure;
- Telecommunications infrastructure;
- Road lighting.

The full ETC Electrical Infrastructure Servicing Report is attached as **Appendix C**.

2.3.3 Water

Information on the potable water supply has been provided by both the Shire and its consultants Permeate Partners.

The current water supply to Newman Airport is via a raw water feed line provided off the BHP supply immediately to the north of the airport. Whilst there is ample water supply off this main, the water quality is quite poor, and the supply can be intermittent and unreliable.

The raw water is treated by reverse osmosis (RO) at the existing water treatment plant located adjacent to, and immediately north of the existing airport terminal. The water is then chlorinated and stored in a 70kL storage tank. The Newman Airport is then reticulated with potable water aided by distribution pumps located at the 70kL storage tank.

The RO water treatment plant is composed of 4 RO plants being RO1, RO2, RO3 and RO4. Information provided suggests that RO1 and RO2 have been decommissioned, and RO3 is proposed to be decommissioned soon. The remaining RO4 plant is a dual train 2 x 45kL/day system which could supply up to a maximum of 90kL/d. This RO treatment plant is controlled remotely.

The Shire has recently drilled two new bores to the south east of the runway. The water quality is much improved on that being provided from the BHP raw water feed and provides a reliable source which is under the control of the Shire.

The Shire of East Pilbara has provided the system curves suggesting that the max capacity of each new bore with the current pumps and proposed DN125 PE 100 main is in the order of 5 l/s. Whilst the ultimate water demand of the GIA development has not yet been determined, there is an expectation by the Shire of East Pilbara that the supply quantity is adequate for both the current Newman Airport demand and the proposed GIA expansion.

To provide the 90kL/d to achieve the capacity of the RO4 water treatment plant, based on the system curves the bore pumps would need to pump approximately 5 hrs/day working alternatively. Based on this there is ample supply from the two bores to service both the existing Newman Airport facilities, and the 11 industrial lots at the proposed GIA development.

The Shire of East Pilbara currently propose to link the two new bores into the current water treatment system as the main supply/feed water, whilst maintaining the connection to the BHP feed line as an emergency backup.

Water usage graphs for the Newman Airport provided by Permeate Partners shows average daily usage in the order of 30kL/day. This does not include irrigation water which uses untreated bore water and is on a separate irrigation main system.

The RO4 plant is a dual train 2 x 45kL/day system which could supply up to a maximum of 90kL/d. Water usage graphs have been obtained from Permeate Partners. The water usage graphs indicate that the current maximum daily draw is in the order of 30kL/d, suggesting that there is existing capacity in the order of up to 60kL/day supply that could be provided to the proposed GIA development from the existing RO4 water treatment plant.

A concept potable water supply design has been undertaken by Serling Consulting as part of this services review, and is outlined in **Appendix C**.

The concept potable water supply includes the following components: -

- Connection of the two new bores by feeder pipe to the RO water treatment plant site, as per the Porter Engineering concept design;
- There is an isolation valve on the BHP raw water feeder pipe – close the valve and keep the existing feeder pipe connected to the feed water at the RO4 plant as a backup on the system;
- Install new DN150 PE100 reticulation pipe system to service the proposed 11 GIA lease hold industrial lots and connect to the existing 70kL tank and reticulation pump system.
- This DN150 PE100 reticulation pipe would have hydrants along the main, and each industrial lot would have a dedicated fire service off the main in addition to the potable supply required to satisfy the industrial operations for each of the lots.

Should the current system not satisfy the ultimate water demand required to service the proposed 15 industrial lots in the GIA, then duplication may be required of the following components: -

- Duplication of the of the RO4 plant immediately adjacent to the existing RO4 plant for efficiencies/ maintenance / flexibility of system;
- Duplicate the existing 70kL tank as necessary to provide a minimum of 1-day potable water supply; and
- Duplicate or upgrade the reticulation pump system as necessary.

The existing RO water treatment system has the capacity of 90kL/d, whilst the current potable water daily demand draw is in the order of 30kL/d. That means that there is a spare capacity (approximately 60kL/d) in the existing potable system to service at least the initial stage of the development.

2.3.3.1 Fire Reticulation and Hydrants

Hydrants will be installed as a matter of course on the reticulation main proposed for the industrial lots. Each of the lots would also have a fire service off the reticulation main.

2.3.3.2 Irrigation

The irrigation at the existing Newman Airport is separate to the potable water system and is serviced off the BHP raw water main/bores. Any extension into the industrial area should be connected to the existing irrigation system.

2.3.4 Wastewater

Details of the existing grey water infrastructure has been obtained from the Shire. Currently both the old and the new facility at the airport are serviced by septic tanks and leech drains.

These are not performing well, anecdotally this is due to lack of maintenance (rather than due to soil permeability). The approach currently proposed by the Shire is for the proposed industrial leasehold lots to all have their own on-site septic tanks and leech drains.

Given the remoteness of the Site, the relatively large industrial lots proposed and the uncertainty on the specific leasehold land uses, this is considered to be the most appropriate approach.

2.3.5 Telecommunications

The telecommunications servicing is proposed to consist of underground fibre ready conduits and access pits that provide a cable pathway between existing telecommunications presence on site to the development lots. This will enable third party telecommunications providers such as Telstra to install their cabling and provide services connections to prospective tenants on application or request by said tenants to their chosen third-party provider.

It is not proposed to extend the Airport or the Shire private telecommunications infrastructure to the development lots as it is not expected the Airport or the Shire will require network presence there.

Due to the above, no requirement to install any cabling or networking equipment as part of these works is envisaged as they will be installed by third party providers and so only cable access (conduit and pit infrastructure) is required.

2.3.6 Stormwater Drainage

There is an existing open drain, and culverts, that runs along the southern and eastern boundaries of the proposed leasehold sites. The open drain services the Airport and conveys stormwater to the Airport's entrance on Dewar Avenue. From there, it travels north to discharge into the Fortescue River.

The existing swale and culverts fall within the land denoted for the proposed development of industrial lots and road infrastructure. Therefore, the existing open drain and culverts will have to be realigned. When the open drain and culverts are realigned, they could be resized to allow for increased flows from the proposed development.

Based on the results of the investigations and laboratory testing it is unlikely that on-site soakage systems would be appropriate for this development.

The following stormwater management tools are recommended to be implemented at the Site:

- Biofilters, tree pits and/or vegetated swales in car parks and internal roads;
- Pervious paving for footpaths; and
- Roof runoff managed by above or below ground tank to capture roof runoff for reuse, or with a below ground infiltration system.

It is recommended that each developed lot, at the very least, uses attenuation ponds to control the stormwater runoff on its lot to reduce the peak flows through the drainage system. This is further outlined in the Stormwater Management Plan included as **Appendix D.**

2.3.7 Traffic and Transport

The proposed GIA lot layout has one main access road which runs through the middle of the proposed lots. This access road runs from Lot 09 and ends at Lot 03. However, it is unclear from the lot layout where this proposed road connects to existing road infrastructure, and how Lot 01 and Lot 02 will be accessed. It is acknowledged that the current lot layout is under review by the Shire, and the road layout may also be amended.

It is recommended that the proposed access road be connected to the existing Dewar Avenue. Access to the existing Newman Airport and to the proposed GIA is via Dewar Avenue off Great Northern Highway.

Great Northern Highway is a Primary Distributer and is permitted for Restricted Access Vehicles (RAV) Category 10 without conditions. However, Dewar Avenue has is not categorised for any RAV vehicles and will need to be upgraded if any of the tenants require access for vehicles larger than a semi-trailer.

For the purposes of this stage of the study RAV 10 access (up to 36.5m long vehicles) has been assumed in the design of the GIA road and the connections to Great Northern Highway.

To achieve this, the intersection of Great Northern Highway and Dewar Avenue will have to be upgraded to allow correct turning movements from RAV vehicles. Dewar Avenue, and other public roads in the development, will have to be upgraded for RAV classification.

2.3.8 Solid Waste Management

The nearest waste management facility to the proposed industrial area is the Newman Landfill and Septage Pond. Newman Landfill is a Class 2 facility and is located on Yates Road in Newman.

The landfill can accept the waste streams as stipulated on its licence (L7059/1997/12), which includes aqueous based wastes; solvent based wastes; waste mineral oils; waste from grease traps; sewage waste from reticulated sewerage systems; septage wastes; asbestos; ceramic based fibres; clinical waste; and used tyres.

Design and development must include adequate space to accommodate sufficient room for storage of waste within each Lot.

Identification of waste types during design and development will allow for the appropriate waste collection services to be accommodated and provide opportunities to reduce or phase out use of hazardous or unnecessary materials from operations at the Site.

Section

3.0

Planning Framework

3.0 Planning Framework

3.1 State Planning Framework

3.1.1 State Planning Strategy 2050

The State Planning Strategy 2050 is the State Government's strategic planning response to the challenges Western Australia is likely to face. The Strategy proposes that diversity, liveability, connectedness and collaboration must be central to the vision of sustained growth and prosperity.

The Strategy takes into account what is known about the future and the expectations of Western Australians to provide a guide for future land-use planning and development, and establishes five interrelated strategic goals as follows:

- **Global competitiveness** - building on and strengthening the state's diverse economic base
- **Strong and resilient regions** - developing regional resources through economic expansion and inter-regional collaboration
- **Sustainable communities** - creating resilient communities enhanced by investment in infrastructure and social capital
- **Infrastructure planning and coordination** - integrating infrastructure networks to achieve efficiencies and synergy in pursuit of economic growth
- **Conservation** - conserving the natural environment through sustainable development and prudent use of resources.

The Pilbara region (and Newman specifically) have been classified in the 'Northern Sector' which is rapidly gaining importance in national and global trade, investment, and commerce, and is currently driven by increasing resourcing demand.

Expansion of industrial development, particularly in strategic locations adjacent to major transport infrastructure, will be particularly important in economic expansion and diversification.

3.1.2 State Planning Policies

There are a number of State Planning Policies which require consideration in the context of the proposed rezoning and future development of the precinct for industrial purposes.

These are briefly outlined as follows:

- **SPP2 – Environment and Natural Resources Policy:** SPP2 provides guidance for greenfield development in the context of the natural environment and the potential impacts the proposed development could have on the continued ecological function of this environment. As the subject area is largely undeveloped, careful consideration of any environmental attributes is required as a component of this amendment.
- **SPP3.7 – Planning for Bushfire Prone Area:** SPP3.7 provides guidance for development in the context of identified Bushfire Prone Areas of Western Australia, and puts in place management requirements for such development at different stages of the planning process. The bushfire risk for the subject area is further addressed at Section 2.2.8.
- **Draft SPP 4.1 – State Industrial Interface:** Draft SPP4.1 provides guidance for development within and adjacent to industrial precincts with the aim of protecting industrial land from encroachment of incompatible land uses. This is not considered to be a significant concern with the subject precinct, however, as the surrounding area is predominantly vacant rural land, and compatibility with the Airport Estate has been comprehensively considered in the Newman Airport Masterplan.

3.1.3 Development Control Policies

There are a number of Development Control Policies which will be relevant to the future development of the precinct for industrial purposes.

These are briefly outlined as follows:

- **Policy 1.1 - Subdivision of Land:** DC Policy 1.1 provides guidance on the subdivision of land, including for leasehold strata subdivision. Whilst the division of development sites has not yet been confirmed, the general principles of this policy

will assist in guiding the expectations on subdivision or leasehold strata proposals for the subject land in the future.

- **Draft Policy 1.2 - Development Control:** Draft DC Policy 1.2 provides guidance on the development of land through the establishment of base policy guidance on development within zoned land, reserved land and land governed by other relevant Acts and Schemes. The policy is relevant to all development within the Western Australian Planning system, and as such will be taken into account in future development within the precinct.
- **Draft Policy 1.7 - General Road Planning:** Draft DC Policy 1.7 provides policy guidance for contributions and construction of various categories of roads and outlines principles that apply to the provision of all types of roads. The subject area will require additional road infrastructure, and the design of these roads shall take guidance from DC Policy 1.7.
- **Policy 4.1: Industrial Subdivision:** DC Policy 4.1 provides guidance on the subdivision design for industrial estates, including lot size and shape, access and road layout and necessary services and amenities. Whilst a concept subdivision plan has been previously prepared for the industrial precinct, this will be further refined and progressed, and will take into account the provisions of DC Policy 4.1.

3.2 Regional Strategic Framework

3.2.1 Regional Freight Transport Network Plan

The Regional Freight Transport Network Plan was developed to establish the strategic directions for the Western Australian Government to manage future freight growth to 2031 and beyond. The Plan outlines various project investment priorities for the regional freight transport network including the upgrading of Marble Bar Road from Newman to Rippon Hills Road as follows:

- Upgrade Marble Bar Road with a sealed surface;
- Improve the road alignment; and
- Undertake flood-mitigation works including replacing the bridge over Fortescue River.

This project will improve access to and from Newman for freight vehicles and will greatly advantage the proposed industrial estate at Newman Airport.

3.2.2 Pilbara Planning and Infrastructure Framework

The Western Australian Planning Commission developed the Pilbara Planning and Infrastructure Framework in 2012 to guide the decision-making of relevant government agencies in the areas of planning, infrastructure and economic development.

Economic diversification was a major focus as the required increase in jobs to meet growing population is unlikely to be achieved through expansion of the minerals and petroleum sectors alone. Expansion of industrial development within the Newman area is one method of contributing to a widening of the economic diversity of the broader region.

3.3 Local Planning Framework

3.3.1 Strategic Community Plan

The Shire's Strategic Community Plan (2018-2022) is part of the regions integrated framework to assist with long-term objectives of the Shire and identifying the resourcing and long-term financial implications and strategies.

The key Result Areas / Strategies relevant to the subject amendment include:

- **Economic:** Support the diverse and sustainable economic development of the region through advocacy, and promotion of the region;
- **Built Environment:** Well-connected places and communities with safe roads, housing choice and well-maintained infrastructure to support an increasing population and economic growth.

3.3.2 Endorsed Local Planning Strategy (2004)

The current Local Planning Strategy for the Shire of East Pilbara was endorsed in 2004 as a component of the preparation of *Town Planning Scheme No. 4.*

The Strategy provides a comprehensive summary of the municipality and the planning issues and influences at this time, and provides strategic guidance on the entire local government area, in addition to more targeted guidance on the townsites of Newman, Nullagine and Marble Bar.

With respect to the Newman Airport and surrounds the Local Planning Strategy provides limited guidance, either for the airport estate generally or for industrial development within this vicinity.

3.3.3 Draft Local Planning Strategy (2020)

In 2013 the Shire of East Pilbara commenced preparation of an update to their Local Planning Strategy in recognition of the evolving socio-economic landscape and the impact this has on development and land use opportunities throughout the Shire.

The Strategy seeks to align with the Strategic Community Plan vision of *'A diverse community thriving in a vast landscape that offers a world of opportunity and rich heritage and culture'.*

There are two aspects of the draft LPS which are particularly relevant to industrial development within the Newman Airport Estate, being Section 3.4 (Industry) and Section 3.11.2.4 (Airport), with the key considerations noted as follows:

3.3.3.1 Industrial Considerations

Section 3.4 reinforces the need for the Shire to acknowledge the importance of industrial land supply to support the local economy, and to ensure supply of suitable, well located, well serviced land for industrial development. In particular the Strategy seeks *'to identify land for 'a broad range of industrial, service and storage activities which, by the nature of their operations, should be isolated from residential and other sensitive land uses.'*

The Strategy specifically references the subject site at Section 3.4.2 (4d) where it outlines a key strategic action to, subject to a feasibility assessment, consider:

'Ptn Airport Reserve 44775 to support Industrial and Freight/Logistics land uses, subject to further planning studies and an Airport Masterplan. Undertake a detailed assessment of the feasibility of the site including the prospective market and investment opportunities, infrastructure capacity and staging. Feasibility to consider the role of the hub and the desired land uses to define its function. (Short Term).'

The feasibility assessment for the subject area is well underway following the finalisation of the Airport Masterplan, and the initiation of this Scheme Amendment is the next logical step in achieving the strategic action outlined in the draft LPS.

3.3.3.2 Newman Airport Considerations

Section 3.11.2.4 outlines actions with respect to the Newman Airport, inclusive of the preparation of the Newman Airport Masterplan and the facilitation of land surplus to the needs of the Airport for alternative land use and development, and potential freehold tenure/leasehold. This is further considered in Section 3.3.5.

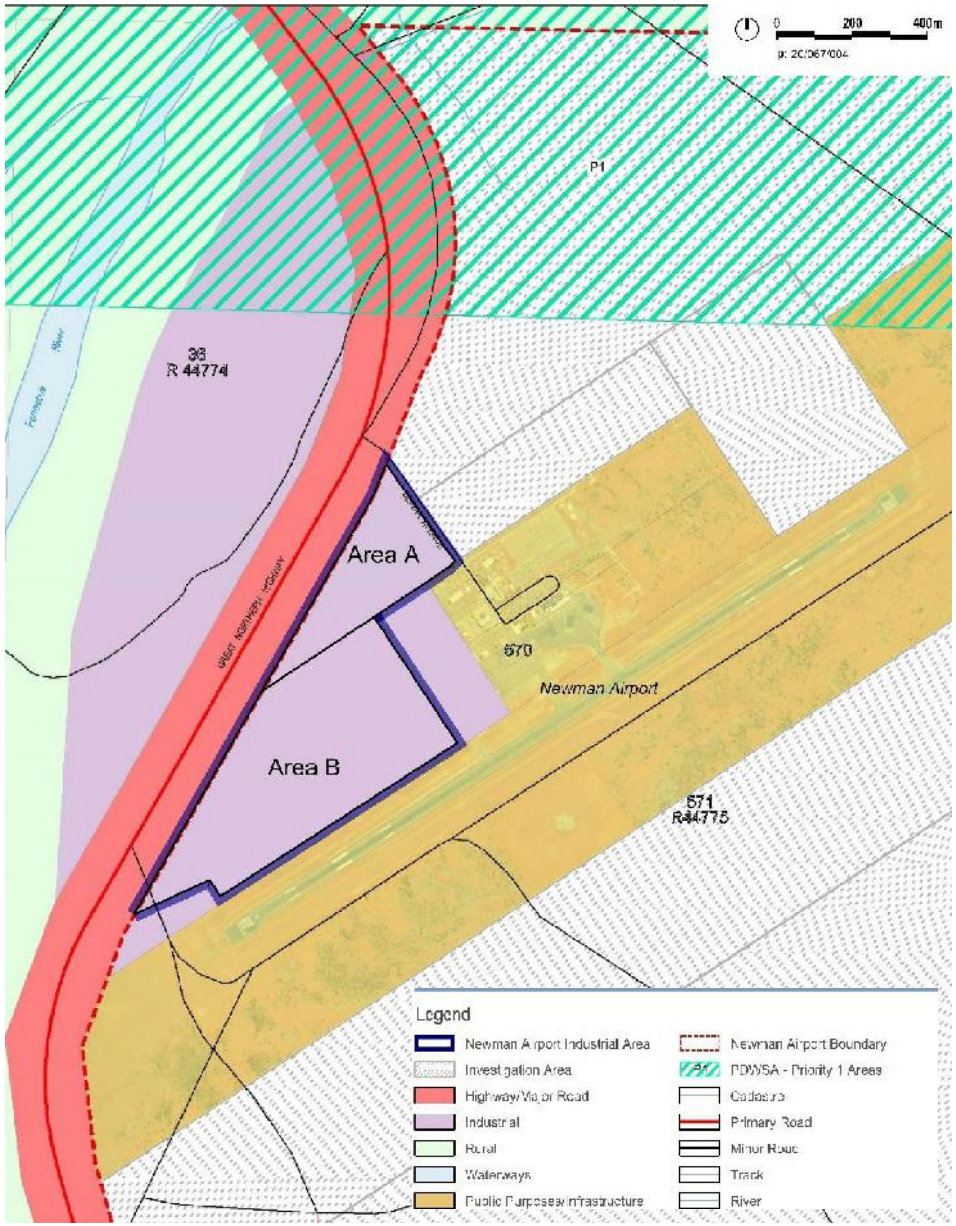


Figure 4: Extract of the draft Shire of East Pilbara Local Planning Strategy (2020) from the Newman Airport Development Plan.

3.3.4 Local Planning Scheme

The subject site is located within the 'Rural' zone of the Shire of East Pilbara Local Planning Scheme No. 4, as outlined in **Figure 5.**

The objectives of the Rural zone are:

- To ensure the continuation of rural use encouraging, where appropriate, the retention and expansion of rural activities and associated pursuits that are compatible with the capability of the land and the amenity of the locality;
- To provide for the orderly and proper planning of Aboriginal communities through the preparation of approved Settlement Plans.

As vacant land the current zoning is likely appropriate, but the strategic desire to make the land available for industrial purposes is inconsistent with the objectives of the zone, and as a result almost all traditional industrial uses are not permitted within the current zone.

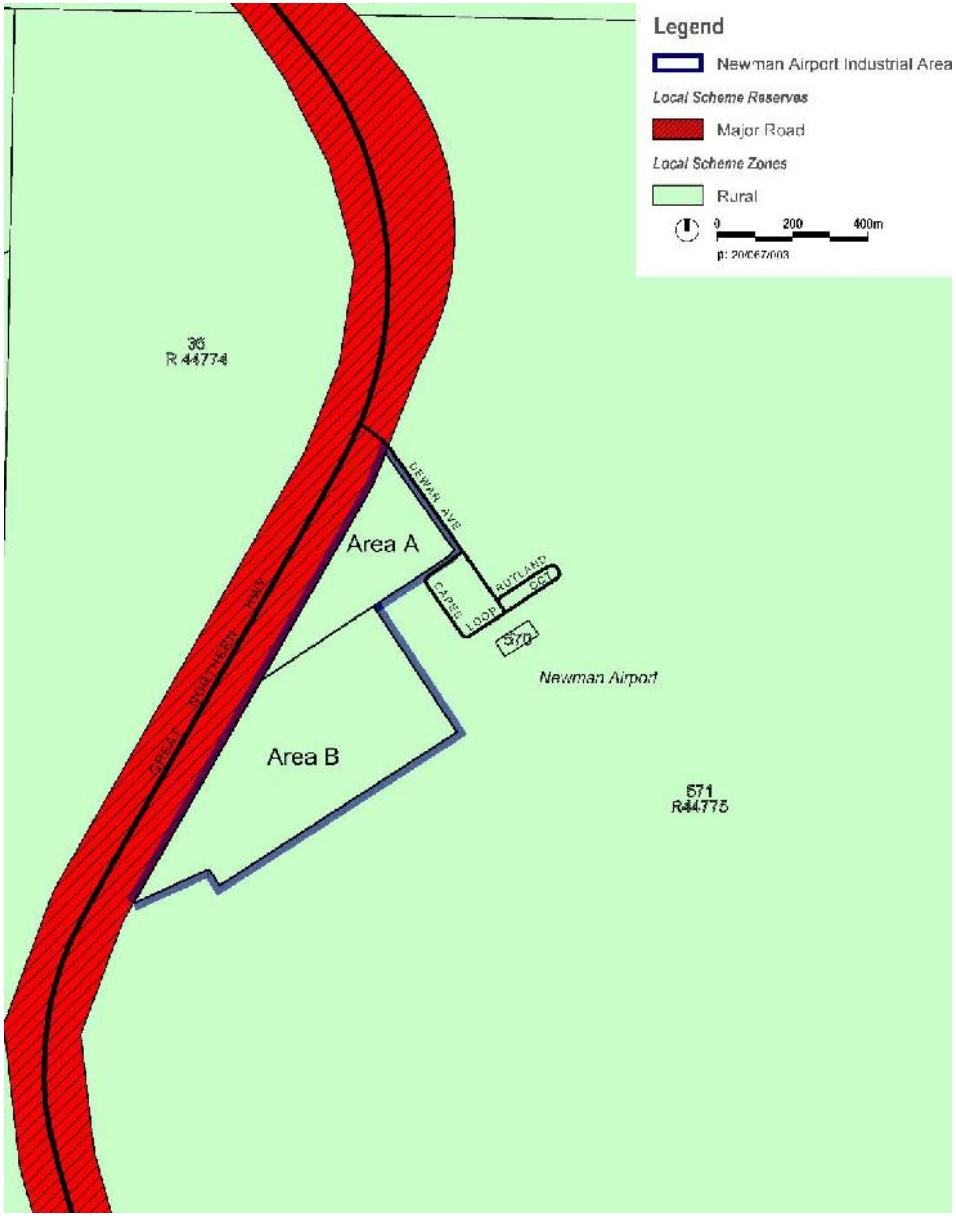


Figure 5: Extract of the Shire of East Pilbara Local Planning Scheme No. 4

3.3.5 Newman Airport Masterplan

In 2020 the Shire of East Pilbara commissioned the preparation of the Newman Airport Master Plan, which was an update to the previous 2013 Masterplan. The key objective of the Masterplan is to *'identify ways to maximize the use of competitive locally based businesses in the provision of goods or services purchased or contracted by the Shire of East Pilbara. This will be reviewed in consultation with the Shire and relevant stakeholders to provide a realistic framework for the development of Newman Airport.'*

The Masterplan provides a fairly comprehensive overview of the strategic context, current operations within the Airport Estate, stakeholder engagement, SWOT Analysis and critical planning considerations, in addition to the future needs of the airport and opportunities for future development. Of particular importance is the preparation of a Land Use Plan which is outlined in **Figure 6**, which identifies a series of land use precincts relevant to their existing and future operational use.

The Industrial Business Precinct, which encompasses the General Industrial – Stage 1 and Stage 2, is identified as an area proposed to provide for future development of the Airport for industrial and business purposes, consistent with the Shire's objective to diversity the local economy and reduce reliance on the mining sector. The Masterplan identifies a range of potential land uses for the Industrial Business Precinct which are outlined in **Table 1.**

The Masterplan also identifies a series of further considerations for land use planning within the airport which require resolution through the planning and development process. These include:

- **Land Tenure constraints:** The Airport Estate is located on Crown Land and is designated under the Management Order for 'Airport Use'. This is further addressed in Section 4.2.2.
- **Environmental and Heritage Constraints:** The Masterplan notes that development may be restricted due to environmental or heritage considerations that require further assessment. The information outlined in Section 2 is considered to satisfactorily address any environmental considerations applicable.
- **Airport Operational Constraints:** The Masterplan notes that there are several restrictions imposed on development adjacent to the airport to protect navigational equipment and safety procedures at the airport that require consideration in detailed site planning for adjacent precincts.
- **Infrastructure Demand:** The Masterplan notes that development will necessitate upgrades to utility infrastructure and road access which will require consideration at subdivision or development stage.

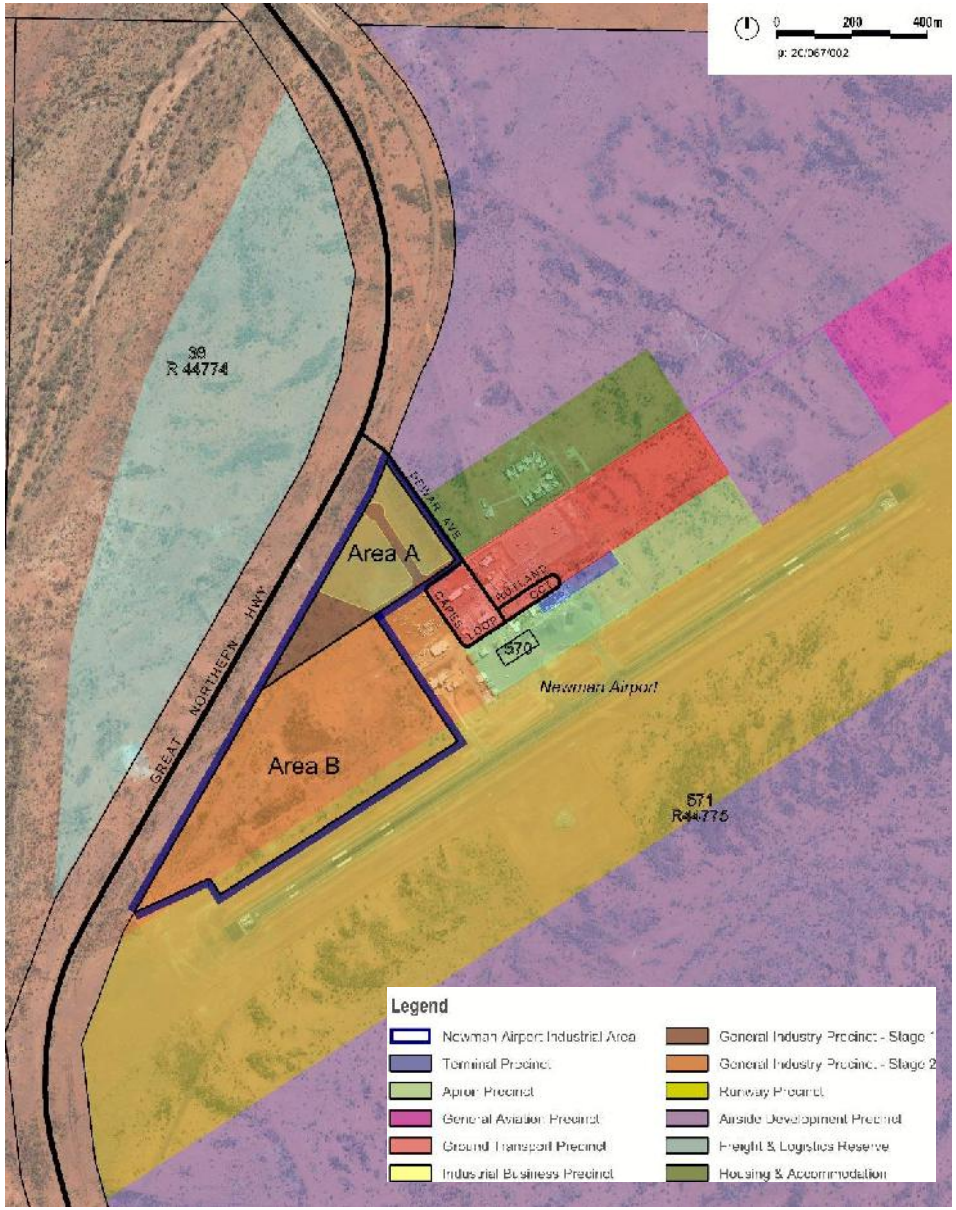


Figure 6: Extract of the Newman Airport Masterplan (2020).

Table 1: Extract of Newman Airport Masterplan outlining proposed land uses within Industrial Business Precinct

Special Use	Conditions
Light Industry	Small scale industrial operations and estates that typically involve the following activities: • Consumer oriented (i.e., household goods and clothing); • Local and district catchments; • Manufacturing; • Showroom and services; and • Small scale industrial.
General Industry	Small to moderate sized industries of local significance that typically involve the following activities: • Consumer and business orientation; • Regional, state and international catchments; • Can include business parks, offices, local services, fabrication and manufacturing; and • Limited retail / bulky goods.
Warehousing and Distribution	Large warehouses and distribution centres that typically involve the following activities: • Storage and display of goods (and potentially including wholesale); • Trend towards dedicated distribution parks; and • Sites to be as flat as possible, allowing for large buildings with maximum accessibility for handling vehicles.
Transport and Logistics (Freight)	Large scale transport and logistical operations including freight that typically involve the following activities: • Transport and courier depot and services; • Distribution centre; • Packaging, parts and services; • Disposal, recycling; • Material management; and • Air freight (potentially aligns with airside development as well).

Section

4.0

Proposed Amendment

4.0 Proposed Amendment

4.1 Rezoning of Subject Area

It is proposed that the subject site be rezoned from 'Rural' to 'Special Use' in recognition of the future development potential for the site for industrial purposes.

The 'Special Use' zone has been selected as a result of:

a) A desire to be selective on land use permissibility in recognition of the unique location of the proposed industrial precinct adjacent to the Newman Airport, and outside of any established urban area which would warrant the inclusion of land uses aimed at supporting surrounding residential areas (e.g., Place of Worship, Public Recreation, Educational Establishment).

b) The need to include conditions which require the preparation of a Local Development Plan which will outline the desired subdivision or leasehold design and outline development restrictions and requirements in recognition of the desired development pattern and the Airport operations adjacent.

The proposed modification to the Scheme Map is outlined in Section 4.1.2 and the proposed Special Use provisions are outlined in Section 4.1.3.

4.1.1 Rationale for Proposal

The proposed amendment is considered suitable for initiation by the Shire of East Pilbara based on the following rationale:

a) Consistent with Long Term Strategic Planning

The proposed amendment is consistent with the State and Regional objectives of diversifying the regional economy within the Pilbara area and contributing to the sustainability and self-sufficiency of the regional economy. It is also wholly consistent with the Shire of East Pilbara's strategic planning framework, and particularly with draft Shire of East Pilbara *Local Planning Strategy* (2020) and the *Newman Airport Masterplan* (2020).

b) Suitability of Location

The analysis included in this report has demonstrated that the subject site is suitable to accommodate industrial development. Its location adjacent to major freight road infrastructure and the Newman Airport provides a high degree of accessibility for freight traffic and highly efficient movement of primary and secondary products. The environmental analysis has demonstrated there are no significant environmental constraints which cannot be addressed in future detailed planning, and the infrastructure analysis demonstrates that the area can be appropriately serviced.

c) Demonstrated Need and Benefit

In considering the progression of the proposed amendment the Shire commissioned economic consultancy Pracsys to prepare a business case to establish the need for rezoning of the subject site to allow for industrial development.

The analysis is outlined as **Appendix D** and indicates that the case for rezoning the land is strong, based on both a need for industrial land in the region and the economic benefits the project is likely to produce.

The analysis notes that the need is evident based on the shortage of industrial land supply within the region and the latent demand identified through engagement with industrial operators. It also identifies that there are numerous benefits in facilitating development of the subject site, including:

- Increased Productivity;
- Increased Capacity Building;
- Inward Investment Attraction;
- Professional Pathways Development and Human Capital Uplift;
- Increased Economic Diversity and Sustainability;
- Increased Viability of Community Infrastructure and Regional Facilities.

The ultimate Cost-Benefit Analysis prepared by Pracsys quantifies these benefits where possible.

On the basis of the rationale outlined it is considered appropriate for the Shire of East Pilbara to initiate the amendment as proposed and progress the document to public advertising following consideration of the Environmental Protection Authority.

4.1.2 Scheme Map Amendment

Figure 7: Proposed Amendment to rezone the subject site Special Use (SU17)

4.1.3 Special Use Zone Provisions

The proposed Special use provisions for inclusion in Schedule 4 of *Local Planning Scheme No. 4*.

Table 1: Special Use provisions for inclusion in Schedule 4 of LPS4.

No	Description of Land	Special Use	Conditions
SU 17	Portion of Crown Land Reservation DP71045-571	**Commercial Uses** Caretaker Dwelling (D) Car Park (P) Fuel Filling Station (D) Hire Service (P) Lunch Bar (D) Local Shop (D) Machinery Sales (P) Motor Vehicle Hire (D) Motor Vehicle Repair (P) Motor Vehicle Wash (D) Motor Vehicle/Boat/Caravan Sales (P) Office (D) Open Air Display (P) Petrol Filling Station (A) Roadhouse (A) Service Station (A) Showroom (D) Trade Display (P) Warehouse (P) **Public and Community Uses** Civic Use (A) Community Service Depot (D) Public Utility (P) Radio/TV Installation (D) **Industrial Uses** Light Industry (P) Service Industry (P) General Industry (D) Hazardous Industry (A) Motor Vehicle Wrecking (D) Fuel Depot (D) Marine Dealer (D) Transport Depot (P) Storage Yard (P) Building Storage Yard (P) Contractors Yard (P) Salvage Yard (D) Factory Yard (P) Sawmill (D) Machinery Sales (D) **Rural Uses** Cattery (A) Kennels (A) Aquaculture (A) Farm Supply Centre (D) Produce Store (D)	1. All subdivision or leasehold design is to be in accordance with an approved Local Development Plan. 2. Land Use Permissibility is to be in accordance with the Special Use Zone Provisions. 3. All development is to be in accordance with the provisions of an approved Local Development Plan. 4. No building or structure is permitted to stand on or above the specified surface of the obstacle restriction area for Newman Airport, as outlined within the Newman Airport Masterplan, without the specific approval of the Civil Aviation Safety Authority (CASA). 5. Development within the Windshear Assessment Zone for Newman Airport, as outlined within the Newman Airport Masterplan, is to be designed in accordance with the *National Airports Safeguarding Framework (NASF) Guideline B: Managing Building Generated Windshear.* 6. Development within the Lighting Intensity Restriction Zones for Newman Airport, as outlined within the Newman Airport Masterplan, is to be designed in accordance with the *National Airports Safeguarding Framework (NASF) Guideline E: Managing Pilot Lighting Distraction.*

4.2 Procedural Considerations

The amendment is proposed as a 'Standard' Amendment under the provisions of Regulation 34 of the *Planning and Development (Local Planning Scheme) Regulations 2015* on the basis that it is considered to be consistent with the Shire's endorsed draft *Local Planning Strategy* currently under consideration of the WAPC, and consistent with the detailed planning for Newman Airport as outlined in the *Newman Airport Masterplan* (2020).

Preliminary consultation with the Department of Planning, Lands and Heritage has occurred on the classification of the amendment and confirmed their in-principle support for progression as a Standard amendment.

4.3 Local Development Plan

The Scheme Amendment proposal includes a requirement for development to be consistent with an approved Local Development Plan (LDP).

The LDP is intended to provide

a) Clear guidance to the proposed lot / leasehold layout of the industrial area;

b) Identify the capacity and design of the local road network and other public infrastructure; and

c) Provide guidance on site design and built form requirements to inform both the design of future industrial development.

The Shire of East Pilbara has progressed preparation and will seek endorsement of the LDP in conjunction with the Scheme Amendment, such that the two are finalised concurrently.

4.4 Land Tenure Considerations

One of the core considerations in progressing a development concept will be the tenure of the future industrial sites to be created. The Shire is investigating opportunities to:

a) Facilitate the sub-leasing of the future industrial sites to industrial operators on long-term lease arrangements and retain the land under its existing Crown Land classification, subject to a modification to the Management Order to amend the purpose for which the land may be used and provide for the Shire with the authority to sub-lease the land, and subject to approval of the WAPC where the lease period is proposed to exceed 20 years; or

b) Facilitate the transferral of the subject site to freehold land owned by the Shire or the State Government, the subdivision of the freehold land to create industrial sites and the sale or lease of the industrial sites to operators thereafter. Whilst this provides greater certainty for future industrial operators, it has the potential to restrict the flexibility of land use surrounding the airport in the future, and has implications with respect to the provision of utility servicing for the subject sites which requires further consideration.

The land tenure arrangements will be further considered in collaboration with the Department of Planning, Lands and Heritage as the planning framework progresses and prior to the finalisation of the development concept plan.

4.5 Conclusion

The proposal to amend a portion of Reserve 44775 adjacent to the Newman Airport from 'Rural' to 'Special Use' to facilitate industrial development of the subject site is considered suitable for initiation by the Shire of East Pilbara on the basis that:

a) It is consistent with the Shire's Strategic Planning Framework and overall direction for economic development within the broader region, and in particular consistent with the Shire's draft Local Planning Strategy and Newman Airport Masterplan;

b) The subject site has been demonstrated as suitable for industrial development based on its high accessibility to major freight infrastructure, lack of significant environmental constraints and ease of upgrades to utility infrastructure to facilitate development;

c) There is significant benefit to the local and regional economy which will be brought about by the expansion of industrial development opportunities within the Newman Airport estate.

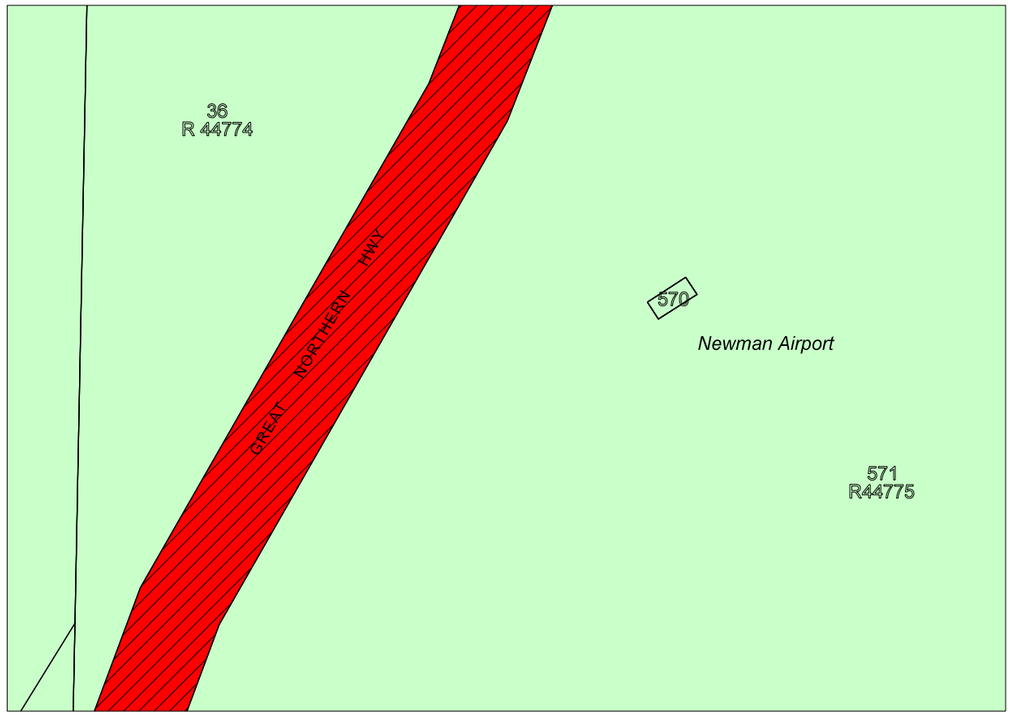
As a result, it is considered appropriate for Council to resolve to initiate the amendment and progress to formal advertising following consideration of the Environmental Protection Authority

APPENDIX A

Scheme Amendment Plan

SHIRE OF EAST PILBARA
Town Planning Scheme No.4
Amendment No. 27

EXISTING



PROPOSED

LEGEND

LOCAL SCHEME RESERVES	LOCAL SCHEME ZONES	OTHER CATEGORIES
MAJOR ROAD	RURAL	SU17 SPECIAL USE AREA

scale: 1:20000@A4 | 1:10000@A2

0 200 400m

plan: 20/067/005B

date: 12 July 2021

APPENDIX B

Environmental Assessment

Newman Airport Scheme Amendment

Environmental Assessment

Prepared for Shire of East Pilbara

9 June 2021

Project Number: TE20115

DOCUMENT CONTROL

Version	Description	Date	Author	Reviewer	Approver
0.1	Internal Draft	9/06/2021	AJM	SS	AJM
1.0	Released to Client	11/6/2021	AJM	SS	AJM

Approval for Release

Name	Position	File Reference
Andrew Mack	Associate Director	TE20115-NewmanAirport_Enviro_Assessment_1.0
Signature		

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APPENDIX D Bushfire Prone Planning Assessment

1 Introduction

This report supports a broader request from the Shire of East Pilbara (the Shire) to initiate an amendment to Local Planning Scheme No. 4 (LPS4) which will ultimately see an area of land associated with the Newman Airport Estate be rezoned for industrial purposes.

The subject land (referred to as 'the site)' constitutes an area of 36.87 hectares and is formed of two areas (Area A: 9.48 hectares. Area B: 27.39 hectares). It forms a portion of Crown Reservation R44775

Talis Consultants Pty Ltd (Talis) was engaged (amongst other things) to prepare an environmental assessment of the site to support the Scheme Amendment process to ensure that there were no environmental constraints that would preclude the Amendment from progressing. The details contained within this report outline our findings and also include those from an on-ground biological survey and bushfire assessment and management plan conducted earlier in the year.

Talis has previously supplied a Desktop Environmental Assessment (Talis 2021a) which provided a summary of initial findings without the inclusion of the biological or bushfire work (see **Appendix A**). A geotechnical report also prepared by Talis (Talis 2021b) has been provided under separate cover.

The location of the site is provided in **Figure 1** and its current zoning as **Figure 2**.

2 Site Inspection

As part of the geotechnical work carried out onsite (Talis 2021b), a site inspection of the environmental features of the site was completed on 9 February 2021. The photographs from this work are provided as **Appendix B** together with the locations and direction of each photo.

The site is generally flat with few notable features. There is little vegetation of note and little evidence of any rubbish left across the site.

There are a number of areas where mounds of material were identified. These are unlikely to be associated with buried waste and are more likely associated with extraction of borrow material and stockpiling of topsoil and vegetation 'trash' as a result.

There is a larger mound located in the Stage 2 area which runs parallel to the runway and is adjacent to an old fence line. Given that the area to the east of this mound was wetter than other areas of the site, it is assumed that this was used to prevent surface water flow towards the runway.

Of primary note on the site is a number of areas which have been demarcated as airport infrastructure. This includes two communication towers, a high-voltage transformer or similar associated with these, some other infrastructure delineated as being for airport navigation and locations which have been signed as having underground high-voltage cables. These infrastructure will obviously require careful management for any future development of the site.

Of note are the following features which were identified through a visual assessment of the site and should be considered as part of any redevelopment (as shown in Table 2-1).

Table 2-1: Photographs and Description

Photograph Location	Description
Various (e.g., 1 and 3)	Compacted 'hardstand' for vehicle movement/parking/laydown areas
2	Stormwater drainage line and culvert
4	Fenceline between Stage 1 and Stage 2
7	Bluemetal(?) stockpile
8	Track cleared of vegetation (vegetation trash pushed up against NE boundary)
11	Track and culvert
12	Stormwater sump
13	Communication towers
14	First fenced high-voltage area for airport navigation infrastructure
16	Second fenced high-voltage area for airport navigation infrastructure
17	Old fencing and poles associated with communication towers
24	Unknown large mound (drainage?)

Photograph Location	Description
26	Old fenceline running N/S along eastern boundary of Stage 2. Historic property boundary?
32	High-voltage underground power cables running along fenceline route along eastern boundary of Stage 2 (see 26)

3 Desktop

The proposed area which is the subject of this Scheme Amendment (referred to as 'the site') is located approximately 11 km south of the Newman townsite, adjacent to Newman Airport and consists of land approximately 36 hectares in area. **Figures 1 and 2** show the subject area. The site was originally constructed in 1968.

3.1 Climate

As identified within the Shire's draft Local Planning Strategy, the Shire experiences a variation in temperatures typical of a desert climate. Temperatures frequently exceed 40°C in summer with temperatures above 45°C in the inland areas not uncommon. Day time temperatures will fall to around 25°C during winter.

In terms of rainfall, the average is between 150-250 mm, dropping to 100 mm in the south-east of the Shire with greater falls generally experience in summer in the north whilst rain occurs in summer or winter in the south.

The Bureau of Meteorology has produced the following graphs in relation to the Newman Airport site:

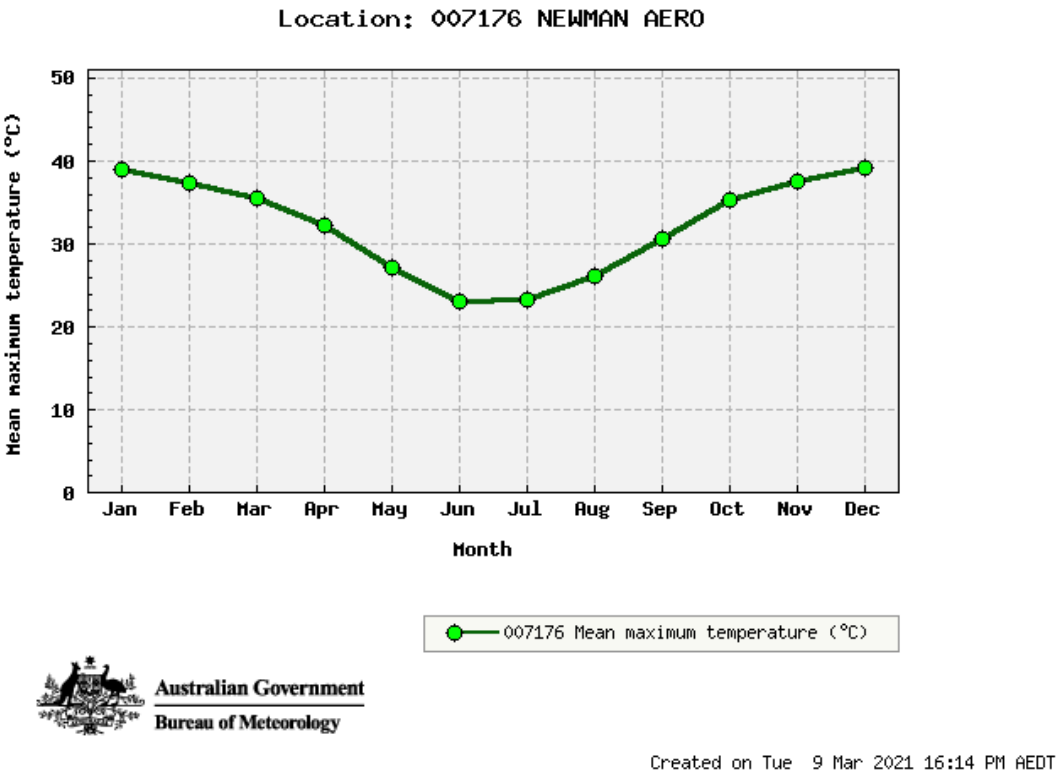

Plate 3-1: Mean Maximum Temperature (Newman Airport)

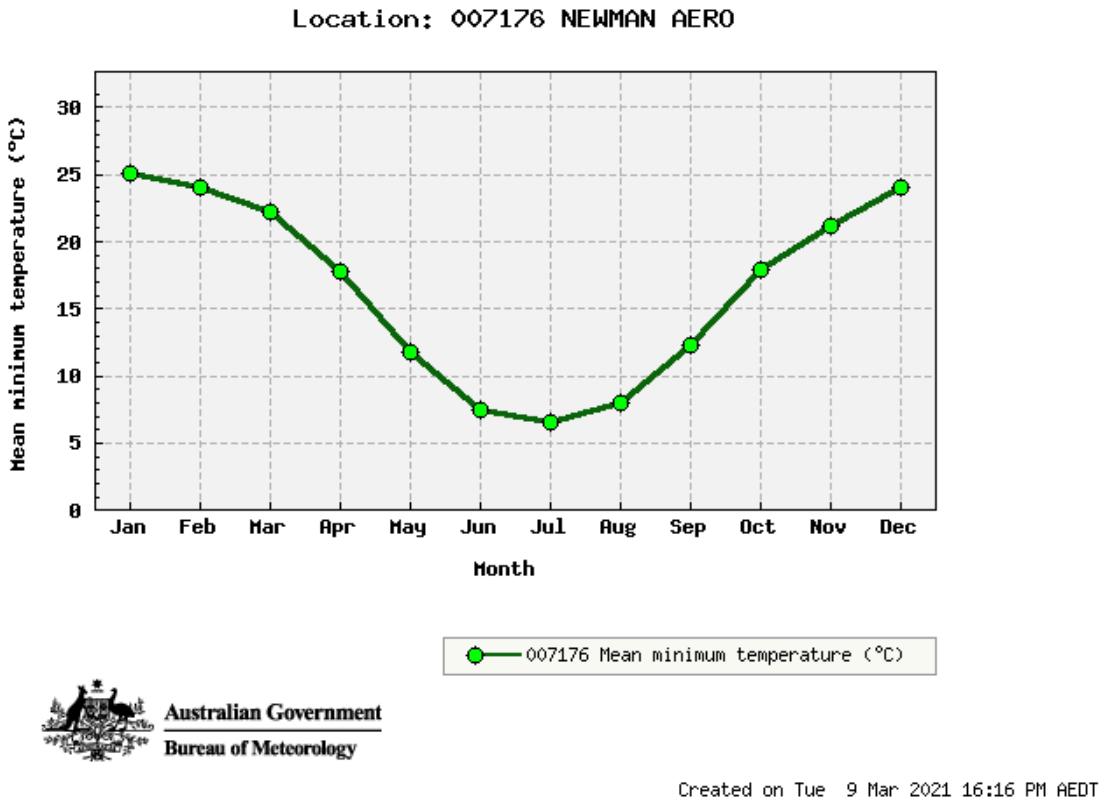

Plate 3-2: Mean Minimum Temperature (Newman Airport)

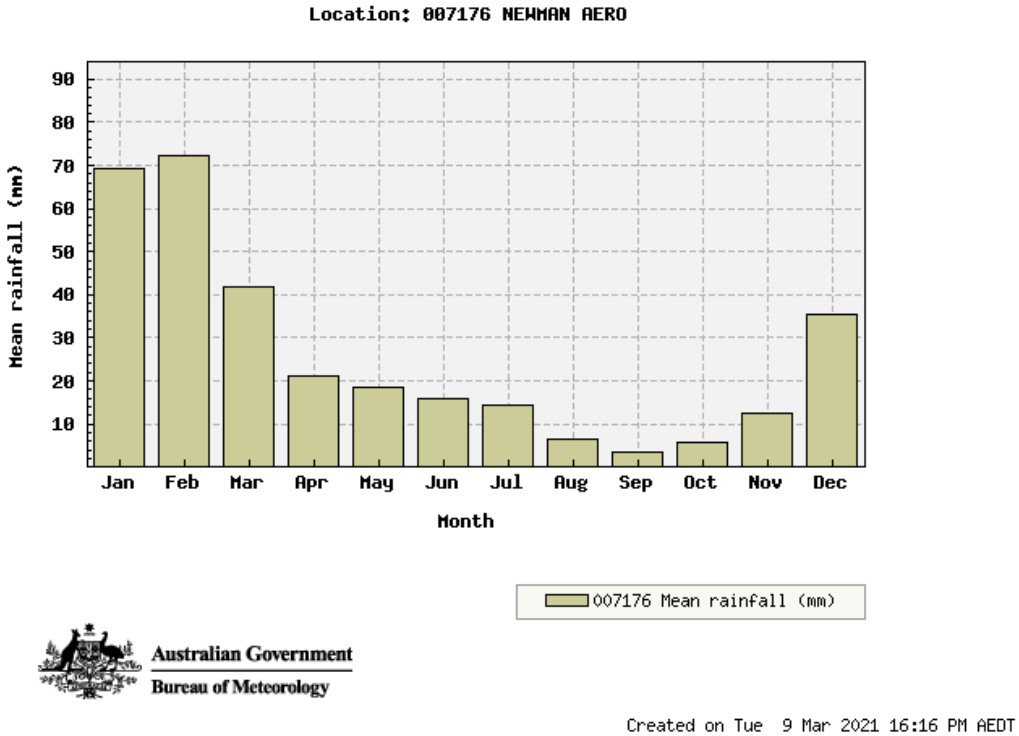

Plate 3-3: Mean Rainfall (Newman Airport)

3.2 Zoning

Newman Airport is managed by the Principal in terms of a Land Management Order issued by State Lands as the Airport is sited upon Crown Land. The site is currently zoned "Rural" under Shire of East Pilbara LPS4. The Principal is required, under the *Planning and Development Act 2005*, to amend the zone of the land from "rural' zone to "special use" zone to provide for industrial land development at the site.

3.3 Local Topography and Surface Water Drainage

Based on a review of the data available for the site as well as the site visit, the site is broadly flat with no noticeable slope. The topographical data for the site (see **Figure 3**) suggests a slope down to the east north-east. This assessment was confirmed through the site inspection conducted on 9 February 2021 although there were some localised depressions/undulations identified.

In terms of hydrological features, **Figure 4** indicates that the subject site sits within a Surface Water Resource Area as proclaimed under the *Rights in Water and Irrigation Act 1914* (RIWI Act).

There are no local surface water features associated with the site and no evidence of natural surface water flow or infiltration was identified during the site visit other than the drains that were noted. The nearest surface water feature is the Fortescue River which is located less than a kilometre from the southern portion of the site and flows in a north-south direction to the west of the site.

3.4 Geology

According to the Geological Series Mapping for Newman, the site sits within the Qw – Alluvium and colluvium; red-brown sandy and clayey soil geological unit (see **Figure 5**) and **Figure 6** suggests that there is an extremely low probability of the site containing Acid Sulfate Soils (ASS).

3.5 Environmentally Sensitive Areas (ESA)

ESAs are declared in the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* (the Clearing Regulations) as areas of conservation significance.

The EP Act makes it an offence to clear native vegetation unless the clearing is done in accordance with a clearing permit, or where an exemption applies. Exemptions are not able to be used in areas covered by an ESA.

Based on available mapping, the site is located within an ESA (see **Figure 7**) and any clearing of native vegetation will require a Native Vegetation Clearing Permit (NVCP) to be issued.

3.6 DBCA Managed Lands

Department of Biodiversity, Conservation and Attractions (DBCA) Managed Lands and Waters within WA are conservation areas which typically include:

- National Parks;
- Nature Reserves; and
- Crown Freehold identified as being of DBCA interest.

There are no DBCA managed lands located over or adjacent to the site therefore there are no environmental constraints relating to DBCA managed lands for the Scheme Amendment.

3.7 Groundwater

The subject site sits within the Pilbara Groundwater Area and immediately north of the East Murchison Groundwater Area, both of which are proclaimed under the RIWI Act (see **Figure 8**). It is illegal to take water from a watercourse or groundwater aquifer without a licence in a proclaimed area under the RIWI Act.

It should also be noted that site is located immediately to the south of the Newman Water Reserve, a Priority 1 (P1) area. Whilst not seen to be a significant risk to the development of the site, P1 areas are defined and managed to ensure there is no degradation of the quality of the drinking water source with the objective of risk avoidance. The Department of Water and Environment Regulation (DWER) notes that industrial land-uses are incompatible uses within a P1 area.

3.8 Contaminated Sites

3.8.1 Contaminated Sites Database and Register

DWER currently records information of contaminated sites within WA on a Contaminated Sites Database in accordance with the *Contaminated Sites Act, 2003*. All sites of known or suspected contamination reported to the DWER are classified under the Act as one of the following:

i) Report not substantiated;
ii) Possibly contaminated – investigation required;
iii) Not contaminated – unrestricted use;
iv) Contaminated – restricted use;
v) Contaminated – remediation required;
vi) Remediated for restricted use; or
vii) Decontaminated.

Of the above, only the last three bullet points are publicly displayed on the DWER Contaminated Sites Database.

The site contained no listed sites on the contaminated sites database and there were no listed sites within the direct vicinity the study area (see **Figure 9**). There are no anticipated constraints to the Scheme Amendment regarding contaminated sites.

3.9 Social/Cultural Attributes

3.9.1 Native Title

Based on mapping supplied by the National Native Title Tribunal (see **Figure 10**), the site is contained in an area where Native Title has been found not to exist (WCD2018/008).

3.9.2 Aboriginal Heritage

A search for mapped Aboriginal Heritage Sites was conducted by using the data from the Department of Planning, Lands and Heritage (DPLH) online Aboriginal Heritage Inquiry System, which incorporates both the Heritage Site Register and Heritage Survey Database. These databases list the following sites:

- Registered Aboriginal Sites;
- Other Heritage Places; and
- Heritage Study sites.

Under the *Aboriginal Heritage Act 1972*, it is an offence to remove, damage or destroy an Aboriginal Heritage Site (whether known or otherwise) without specific approval being granted.

Whilst we suggest there is minimal risk in this regard given that there are no sites located within the subject site (see **Figure 11**), we recommend that appropriate consultation is held with local indigenous groups where appropriate. Furthermore, appropriate measures should be implemented to minimise any risk of disturbing an Aboriginal Heritage Site during construction activities.

3.9.3 European Heritage

An online search of the following records was undertaken;

- State register;
- National heritage list;
- Commonwealth heritage list; and
- The InHerit database.

The nearest site which has been registered is shown in **Figure 12** and is the Opthalmia Dam site to the north-east.

3.10 Historic land uses

Based on a review of the historical aerial imagery from the last 18 years (see **Figure 13**), there has been little, if any change associated with the site's use.

Talis is therefore of the view that, aligning with the site visit and current land use, the historical uses of the site are unlikely to present a risk in relation to the proposed Scheme Amendment progressing.

3.11 Current land uses

Based on the site visit and our understanding of the current situation, the site is currently vacant and aside from some limited waste identified in locations across the site, the local drainage lines (and associated culverts/sumps) and the airport communication/navigation infrastructure and associated high-voltage power cables. There are no current land-uses of note that would preclude future development of the site.

3.12 Nearest Receptors

The nearest receptors to the subject site are located on the Newman Airport site. The nearest sensitive receptors are a roadhouse/accommodation facility located approximately 3 km to the south and Rivergums Village, approximately 2 km to the north.

Neither of these will be affected by the rezoning of the subject land.

4 Desktop Biological

Ahead of a field-effort undertaken in March 2021, a desktop assessment of the potential biological values of the site (also referred to as the Study Area) was conducted by Spectrum Ecology. This is provided as part of the Talis desktop report in **Appendix A**.

4.1 Significant Flora

No significant flora were identified within the Study Area. The desktop assessment identified 52 significant flora taxa occurring within the vicinity of the Study Area, of which five were assigned pre-survey likelihood of occurrence of high or medium. All significant flora identified in the desktop assessment are summarised in the Spectrum report appended to this document.

The following significant flora were identified within the vicinity of the Survey Area and assigned a high or medium likelihood occurrence:

- High P3 *Aristida jerichoensis* var. *subspinulifera*
- Medium P1 *Eremophila capricornica*
- Medium P3 *Eremophila rigida*
- Medium P3 *Rhagodia sp. Hamersley* (M. Trudgen 17794)
- Medium P4 *Goodenia nuda*

4.2 Threatened Ecological Communities (TEC)

The Department of Biodiversity, Conservation and Attractions defines an ecological community as "a naturally occurring group of plants, animals and other organisms interacting in a unique habitat. The complex range of interactions between the component species provides an important level of biological diversity in addition to genetics and species."

Under previous legislation, the Minister for the Environment was able to list TECs through a non-statutory process if the community was presumed to be totally destroyed or at risk of becoming totally destroyed. The *Biodiversity Conservation Act 2016* (BC Act) provides for the statutory listing of TECs by the Minister.

The desktop assessment completed by Spectrum identified one TEC associated with the subject site, the Ethel Gorge aquifer stygobiont community. This is listed as Endangered (E), its current distribution is limited, and its known occurrences are very vulnerable to known threatening processes (B(ii)).

4.3 Conservation Significant Fauna

The desktop assessment identified 35 conservation significant fauna species including eight mammals, 23 birds and four reptiles that have the potential to occur within the Study Area. Sixteen species of migratory water birds have been excluded from the assessment due to the lack of wetland habitats occurring in the study site; those species are listed in the appended Spectrum report.

Based on the desktop assessment, three species of conservation significance were assigned a pre-survey Medium to High likelihood of occurrence. The remaining identified species were assigned having a Low to Very Low likelihood of occurrence.

The following significant fauna were identified within the vicinity of the Survey Area and assigned a high or medium likelihood occurrence:

- Medium VU Greater Bilby (*Macrotis lagotis*)
- Medium P2 Unpatterned Robust Slider (Robertson Range)

4.4 Short Range Endemic Invertebrates

Spectrum (2021) notes that the Western Australian Museum database search identified 72 Arachnid, 23 Crustacean and three Mollusc species of potential short range endemic invertebrates. Twenty-six species of Arachnids and all 23 species of Crustaceans returned from SRE database search are subterranean and were excluded from this assessment. A further six species of Arachnids (mites) and two species of Molluscs are freshwater aquatic invertebrates and were also excluded.

Three species were assigned a High likelihood of occurrence and eight a Medium. All other species were assigned a Low likelihood of occurring in the Study Area. The following short-range endemic species were identified within the vicinity of the Survey Area and assigned a high or medium likelihood occurrence:

- High *Euagridae Cethegus* 'MYG299'
- High *Idiopidae Idiosoma* 'MYG384'
- Medium *Paradoxosomatidae Antichiropus* 'DIP051, *pannawonica'*
- Medium *Desidae 'Forsterina* grp. Genus' 1 'sp. 5'
- Medium *Anamidae Kwonkan* 'MYG651'
- Medium *Barychelidae Aurecocrypta* 'MYG315'
- Medium *Halonoproctidae Conothele* 'MYG575'
- Medium *Idiopidae Gaius* 'MYG286'
- Medium *Geophilidae 'Zelanophilus*?'
- Medium *Olpiidae Beierolpium* 'sp. 8/1'
- Medium *Buthidae Lychas* 'harveyi group' 'SCO038'

4.5 Subterranean Species

The Environmental Protection Authority (EPA) defines subterranean fauna as fauna which live their entire lives (obligate) below the surface of the earth.

They are divided into two groups:

- stygofauna – aquatic and living in groundwater; and
- troglofauna – air-breathing and living in caves and voids.

The EPA notes that subterranean fauna often display evolutionary adaptations to underground life, particularly reduced pigment and reduced, poorly functioning or non-existent eyes.

In this regard and as noted above, the desktop assessment showed that one TEC occurs within the Subject Site. Ethel Gorge Aquifer comprises a diverse assemblage of subterranean stygofaunal species.

In terms of potential impacts to these species, the EPA also notes that they fall under two key types:

- Direct impacts include the removal of habitat, drawdown of groundwater, inundation, and water quality changes. The main threats include excavation of geologies known to support subterranean fauna; groundwater extraction for process or domestic purposes; dewatering for below water table excavation, and groundwater reinjection of waste or excess water.

- Indirect impacts include changes to hydrology, siltation, void collapse, alteration to nutrient balance and contamination. The main threats include changed surface topography due to compaction or creation of hard surfaces resulting in altered groundwater flow paths, increased runoff, and reduced infiltration and aquifer recharge; clearing of surface vegetation leading to sedimentation and changed nutrient inputs; potential leaks or leaching including tailings and waste water resulting in alterations to ground water chemistry and quality, and introduction of toxins or radiation; and salinisation due to intrusion of saline water into freshwater aquifers and leaching from pit voids.

This matter is discussed further in the following sections.

5 Biological Fieldwork

As noted above and following their desktop work, Spectrum conducted a field survey on 10 March 2021. The field survey timing was conducted in accordance with EPA recommended timing and following higher than average rainfall. A total of seven flora relevés, 13 fauna sites, and traverses covering the Survey Area were sampled.

A copy of their report is provided in **Appendix C**.

5.1 Flora and Vegetation Assessment

5.1.1 Methods

A one-phase reconnaissance flora and vegetation assessment and targeted significant flora survey was completed on the 10 March 2021. The methodology included sampling seven relevés to describe the vegetation and a targeted survey for significant flora species at 100 m spacings across the Survey Area. This approach aligned with the expectations for a reconnaissance level survey as stipulated in the technical guidance (Environmental Protection Authority,2016c)

The data collected from relevés, opportunistic collections, as well as general field notes and observations was used to map the vegetation across the Survey Area. Vegetation was classified structurally based on the dominant species and the vegetation classification is consistent with NVIS Level V – association vegetation descriptions. This level of description provides information on the dominant growth form, height and cover for up to three species for each of the upper, mid and ground strata (ESCAVI, 2003).

Vegetation condition was recorded at relevés and where areas of different vegetation condition were observed. The vegetation condition was mapped across the Survey Area at the same scale as the vegetation mapping. Vegetation condition ratings follow the scale recommended for the Eremaean botanical province as detailed by the EPA (Environmental Protection Authority, 2016c).

5.1.2 Results

52 significant flora taxa were identified during the flora desktop searches of which two were assigned a High likelihood of occurrence. No significant flora taxa were recorded within the Survey Area and the two species with a High likelihood of occurrence were reassessed post-survey to have a Low likelihood of occurrence.

One Threatened Ecological Community (TEC) was recorded during the desktop assessment. The Survey Area contains the buffer of Ethel Gorge Aquifer Stygobiont community but not the actual TEC itself. This community is known for its diverse assemblage of stygofaunal species, assessment of these species and this community does not fall within the scope of a reconnaissance flora or basic fauna assessment.

84 taxa from 23 families and 56 genera were recorded during the survey and are listed in Appendix E of the Spectrum report. Of the taxa recorded five were introduced species. Poaceae was the most species rich family (23 taxa), followed by Fabaceae (16 taxa), and Chenopodiaceae and Malvaceae (7 taxa each). The most species rich genera were *Acacia* (8 taxa), *Senna* (6 taxa), and *Maireana* (4 taxa).

No Threatened, Priority, or other significant flora taxa were recorded at the Survey Area during the current assessment. Both significant flora taxa assigned a High likelihood of occurrence prior to the

survey (*Aristida jerichoensis* var. *subspinulifera* – Priority 3, *Seringia exastia* - Threatened), were assigned a Low likelihood of occurrence post survey

Five introduced species were recorded at the Survey Area, none of which are Declared Pests in WA (Table 3.3, Map 3.3 of the Spectrum report). **Cenchrus ciliaris* was the most common weed and was recorded across the Survey Area, from six of the seven relevés.

The Survey Area was comprised of mostly flat sandy clay plains with small areas of sandy clay depressions. Two vegetation types were recorded from the Survey Area.

Table 5-1: Vegetation Types Recorded Onsite

Code	Description	Landform, Soil and Geology	Area
P1	*Acacia* ?*macraneura* low open woodland to isolated trees, over *Senna glutinosa* subsp. ×*luerssenii*, +/- *Eremophila cuneifolia*, and *Acacia tetragonophylla* mid to tall sparse shrubland, over +/-**Cenchrus ciliaris, Aristida latifolia* and *Eragrostis* ?*xerophila* low sparse grassland.	Flat, orange-red, sandy-clay plain	33.0 ha 64.6%
P2	*Acacia* ?*macraneura* (+/- *Acacia paraneura*) mid woodland over +/- *Eremophila platycalyx* and *Senna glutinosa* subsp. ×*luerssenii* mid to tall sparse shrubland, over *Ptilotus obovatus* low sparse shrubland and +/- **Cenchrus ciliaris* and *Aristida contorta* or low sparse grassland.	Depression on flat, orange red, sandy-clay plain.	6.6 ha 12.9%

No vegetation types were recorded at the Survey Area that resemble any known TEC or Priority Ecological Communities (PEC) or were significant due to having a restricted distribution, degree of historical impact from threatening processes, provide a role as a refuge, or provide a function to maintain ecological integrity of a significant ecosystem.

Using aerial imagery, the vegetation communities surrounding the Survey Area show a weak Banded Mulga patterning. Banded Mulga is a Sheet Flow Dependent Vegetation (SFDV) community and may be suspectable to impacts associated with alteration to surface water flow. The Mulga communities within the Survey Area do not show the same patterning and does not appear to match the surrounding communities. This is likely due to historical disturbance at the Survey Area. Both vegetation types identified during the field survey align with the Pre-European vegetation association unit 29, a widespread Beard vegetation unit, indicating that these vegetation types are widespread throughout the region and not significant locally or regionally.

Vegetation condition at the Survey Area is presented in the table below and mapping within the Spectrum report. The majority of the Survey Area was rated Very Good, 51.1%, with disturbances noted as low to moderate weed presence. The remainder of the vegetation was rated as Good (26.9%) with a higher percentage weed cover due to the proximity to cleared areas and roads. There was 21.9% of the Survey Area rated as Completely Degraded due to extensive clearing.

Table 5-2: Vegetation Condition Recorded Onsite

Condition	Area	% of Survey Area	Disturbance Details
Excellent	-	-	-
Very Good	26.1	51.1	Low to moderate covers of weeds; evidence of tracks and partial clearing. Potentially historical clearing undertaken in area.

Condition	Area	% of Survey Area	Disturbance Details
Good	13.7	26.9	Moderate to high presence of weeds; litter; evidence of tracks, roads, and partial clearing
Poor	-	-	-
Degraded	-	-	-
Completely Degraded	11.2	21.9	Clearing; tracks, and high weed cover

5.2 Fauna Assessment

5.2.1 Methods

In conjunction with the flora assessment, Spectrum also conducted a one-phase basic terrestrial vertebrate fauna assessment on the 10 March 2021. A total of 13 fauna habitat sites were assessed within the Survey Area (see mapping within Spectrum 2021). At each survey site, a variety of survey techniques was used for fauna assessment.

The terrestrial vertebrate fauna survey was consistent with Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA 2020) and Technical Guidance: Sampling Methods for Terrestrial Vertebrate Fauna (EPA 2016d). The guidance suggests selective low-intensity sampling of the fauna and fauna habitats to verify the accuracy of the desktop assessment. An assessment was undertaken to map the fauna habitat across the Survey Area and ensure appropriate targeted conservation significant fauna surveys were completed.

The techniques utilised included:

- Mammals - Direct sightings and indirect evidence such as tracks, scats and diggings were recorded across the Survey Area;
- Birds - Direct sightings and calls, as well as indirect evidence such as feathers, pellets and nests were recorded across the Survey Area; and
- Reptiles and Amphibians - Direct sightings and indirect evidence such as calls, tracks, diggings, skins, and latrines were recorded across the Survey Area and targeted searches were undertaken in areas with suitable habitat, including raking of suitable leaf litter, if present.

Fauna habitat mapping identifies areas of vegetation and land features that are distinguishable from other areas. Typically, each fauna habitat supports a characteristic fauna assemblage that is adapted to the features of the fauna habitat. Fauna habitat types are identified and mapped based on the following information:

- General vegetation type (Shepherd, Beeston and Hopkins, 2001);
- Vegetation mapped within the Survey Area;
- Vegetation structure;
- Landforms;

- Geological units;
- Soil substrate;
- Aerial imagery;
- Fauna assemblage; and
- Field observations.

The fauna habitats are recorded at each survey site, opportunistically while traversing the Survey Area on foot, and when travelling between sites.

5.2.2 Results

A total of 13 vertebrate fauna species were recorded during the survey: one introduced mammal species and 12 bird species although none of these species are listed as conservation significant.

The fauna habitats within the Survey Area were mapped into four categories: Acacia Shrubland, Open Stoney Plain, Mulga Woodland, and Cleared/Disturbed (see Table below and Spectrum (2021)).

Each habitat was determined by using their potential to support different fauna assemblages, and the habitat throughout the Survey Area was extrapolated from observations during the field survey. All fauna habitats recorded during this assessment occur extensively throughout the surrounding region (Astron, 2015). Fauna typically subsists in very low numbers within the Open Stoney Plain habitat due to the lack of cover provided. The Acacia Shrubland and Mulga Woodland has the potential to provide habitat for conservation significant species.

Table 5-3: Fauna Habitat Types

Habitat Type	Survey Area Extent (ha)	% of Survey Area
Acacia Shrubland	16	31.4
Open Stoney Plain	15.4	30.4
Mulga Woodland	6.8	13.4
Cleared/Disturbed	12.6	24.8
Total	**51**	**100**

Descriptions of each of the habitat types are provided in Spectrum's report (Appendix C).

Despite not being identified during the survey effort, three conservation significant species identified in the desktop assessment have been assigned a Medium likelihood of the occurring in the Survey Area: Ghost Bat (*Macroderma gigas*), Peregrine Falcon (*Falco peregrinus*) and Unpatterned Robust Slider (*Lerista macropisthopus* subsp. *remota).* The remaining fifteen species have been assigned a Low or Very Low likelihood of occurring in the Survey Area as suitable habitat does occur within the Survey Area.

In terms of the three species referred to above, the following comments are made:

- Ghost Bat (*Macroderma gigas*)

Recent research has identified that Ghost Bats in the Pilbara travel further for foraging, without the strong association with watercourses as previously thought with nightly travelling distances of up to 21 km recorded (Knuckey, 2021). With records of Ghost Bats in 2016 less than 14 km from Survey Area it is possible the species uses the Survey Area for foraging. As there is no roosting habitat in the Survey Area, the species occurrence would be limited to flying over for dispersal and foraging.

- Peregrine Falcon (*Falco peregrinus*)

  The Peregrine Falcon has been assigned a Medium likelihood of occurring within the Survey Area as the species is wide-ranging species, the Survey Area is in close proximity to a major drainage line (Coondiner Creek) and there are several recent species records in the vicinity. However,the lack of nesting or roosting habitat limits the species use of the Survey Area to flying over for foraging and dispersal

- Unpatterned Robust Slider (*Lerista macropisthopus* subsp. *remota).*

  With its sandy loam soils, the Mulga Woodland may support this species. This habitat type is limited within the Survey Area (6.8 ha) but found extensively throughout the region (Astron, 2015) and thus any occurrence of the species is unlikely to be limited to the Survey Area.

5.2.2.1 *Short Range Endemic Invertebrates*

Based on habitats they have previously been recorded from, habitats recorded in the Survey Area, and distance of records from the Survey Area, three species of potential SRE invertebrates were assigned a High likelihood of occurring the Survey Area.

Six species were assigned a Medium likelihood of occurrence while all other species were assigned a Low likelihood of occurring in the Survey Area.

Despite the above, Spectrum (2021) indicated that the likelihood of SRE taxa being restricted to within the Survey is low as SRE invertebrates are typically associated with habitats that support their primitive biology and ecology, such as moist sheltered areas on the southern slopes of hills and ranges and in protected gullies and gorges, none of which occur in the Survey Area.

Dense Mulga woodland habitat can potentially provide suitable habitat for SRE taxa, particularly along drainage lines. Some Mulga Woodland exists within the Survey Area (13.4%), but it is not considered particularly suitable as leaf litter is sparse and it does not occur on drainage lines. Furthermore, this habitat is found extensively throughout the surrounding region (Astron, 2015).

6 Bushfire Assessment

A Bushfire Assessment and Management Plan (BAMP) was prepared by Bushfire Prone Planning Pty Ltd (BPP) and is provided as Appendix D of this report.

The BAMP is predicated on the intent to create 15 industrial lots.

BPP notes in their report that the subject site is vegetated with Scrub, Shrubland and Grassland type vegetation with occasional non-vegetated areas. The topography is flat and will not affect the intensity and rate of spread of a bushfire. BPP states that the Newman Airport abuts the southern and a portion of the eastern boundaries of the proposed development. This area is managed to a low bushfire threat state and the main bushfire threat from this direction would be ember attack.

Land adjoining to the west, north and east consists of Scrub, Shrubland and Grassland type vegetation. The topography of the neighbouring land is generally flat but slopes down to the Fortescue River further west. The potential exists for intense bushfire behaviour to occur within these areas of bushfire prone vegetation. The potential bushfire impact on persons and property within the proposed lots will be to increase the level of ember attack in the event of a bushfire.

This ember threat can be mitigated by the application of appropriate building design, bushfire construction standards and the ongoing maintenance of a minimum BAL-29 dimensioned Asset Protection Zone (APZ), to ensure the buildings will not be impacted by consequential fire within combustible materials used, stored or accumulated inside the APZ.

Based on the work completed by BPP, the proposed development site currently has a moderate to extreme bushfire hazard level as shown in the plate below. However, an area is able to be established within each lot where buildings can be constructed to a BAL rating of BAL-29 or lower.

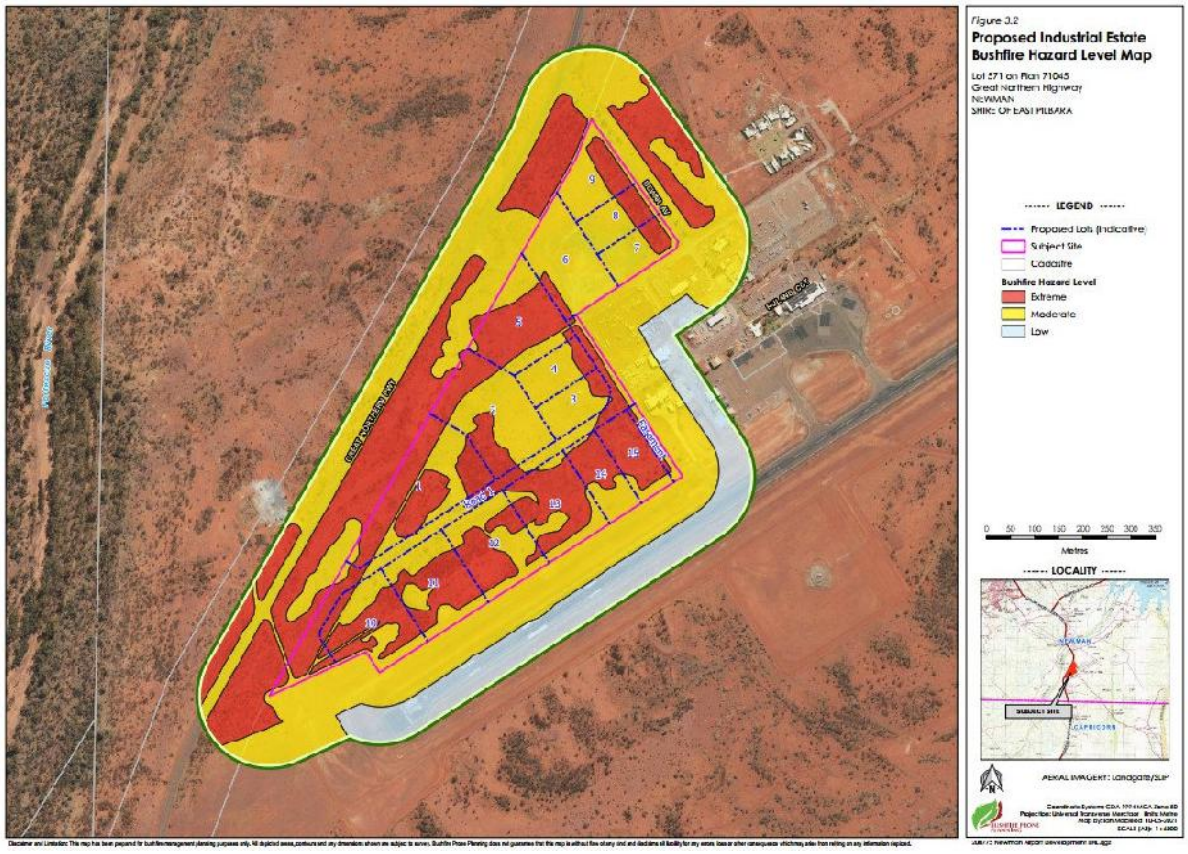

Plate 6-1: Bushfire Hazard Level Map (BPP 2021)

In terms of the assessment, the ability to establish a BAL-29 dimensioned APZ, as a minimum, within each proposed lot's boundaries removes the threat of greater levels of radiant heat or flame contact upon a future building.

The primary bushfire threat from bushfire prone vegetation remaining within the proposed lot will be embers. This threat will be mitigated by the application of appropriate building design, bushfire construction standards and the ongoing maintenance of the APZ to ensure the buildings will not be impacted by consequential fire within combustible materials used, stored or accumulated within the APZ.

APZ are able to be established within each lot, but this will be dependent upon the size and location of future buildings on the lots.

Given that it is assumed that the majority of vegetation onsite will be removed as part of the redevelopment (subject to appropriate approvals being granted), this management of onsite vegetation will achieve areas having a BAL rating of BAL-29 or lower for each proposed lot as shown in the following figure (BPP 2021).

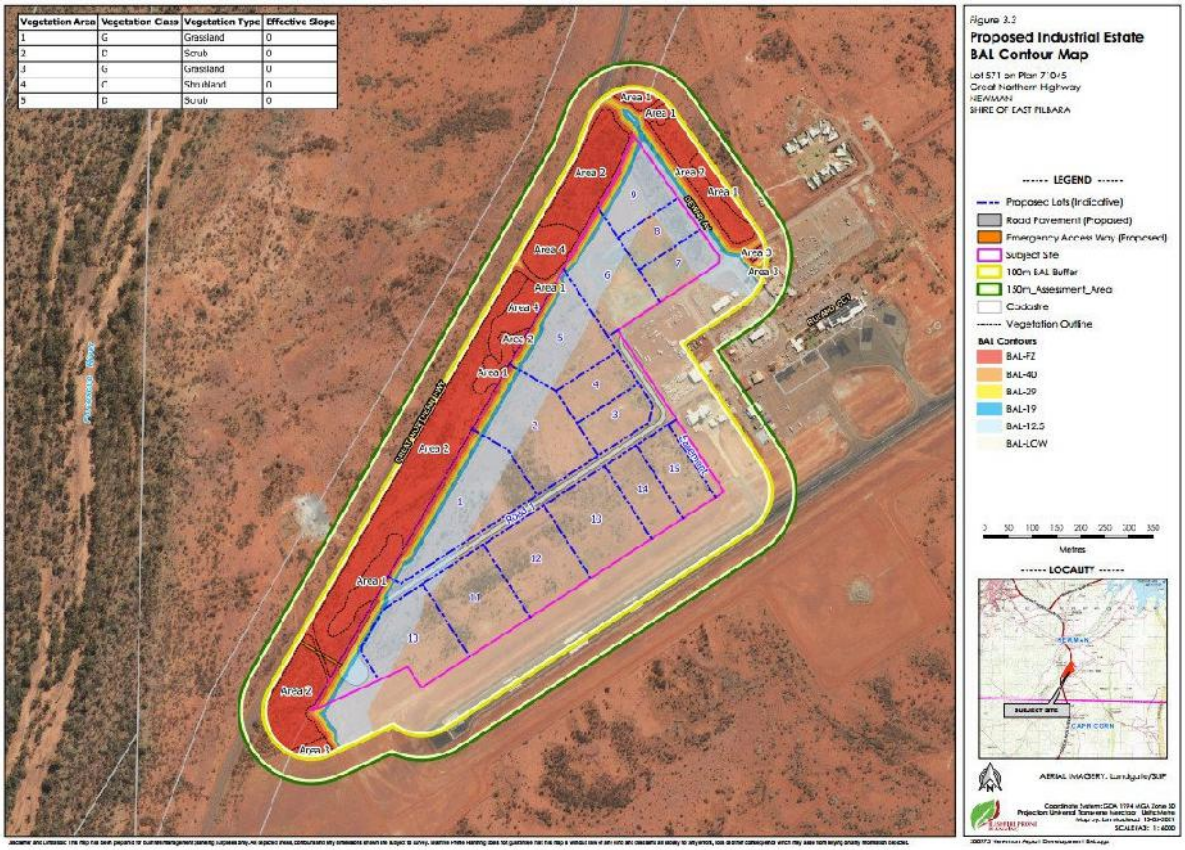

Plate 6-2: BAL Contour Map (BPP 2021)

Having noted the above however, it is also realised that it is unlikely that all proposed lots will be developed at the same time, and that vegetation on the balance or vacant lot(s) may adversely affect the indicative BAL ratings of buildings on lots being developed.

Such considerations should be assessed prior to the sale of the lots and the required vegetation on the balance or vacant lot managed and maintained until developed, or the indicative BAL ratings for the affected lots amended.

Whilst BPP identifies that future buildings on all proposed lots will be able to achieve a BAL rating of BAL-29 or lower, there may be some restrictions to the size and location of future buildings to achieve this outcome on lots with respect to:

- Required separation distances from existing vegetation within the Great Northern Highway road reserve;
- Required separation distances from existing vegetation within undeveloped neighbouring lots in the development; and
- Remnant vegetation within the proposed easement and road reserve.

BPP also identifies that the main access/egress route from the development will be from Road 1 via Dewar Avenue to Great Northern Highway. Proposed Road 1 will be a cul-de-sac of approximately 1.2 kms in length, which is greater than the minimum of 200 metres as stated in the Guidelines for Planning in Bushfire Prone Areas (the Guidelines).

BPP does point out that an Emergency Access Way is planned to join the southern end of Road 1 with the Great Northern Highway, providing a secondary access/egress route but states that where a building site is greater than 50 metres from a public road, the driveway to that building must comply with the construction technical requirements established by the Guidelines.

The proposed lots will comply with the requirements of the local government annual firebreak notice issued under s33 of the Bush Fires Act 1954 with firebreaks to be installed prior to subdivision clearance. A reticulated water supply will be made available to the subject site and hydrants will be installed in locations as required by the relevant authority.

7 Summary and Recommendations

In terms of the overall desktop assessment of the site, it is our view that there are no constraints that would preclude the Scheme Amendment from progressing.

We draw attention to the various infrastructure, both under- and above-ground, relating to airport navigation. It is likely that management of this will require careful consideration in terms of the future development of the site.

From a groundwater perspective, given the site's location within a proclaimed groundwater area and being immediately to the south of the Newman Water Reserve (being a P1 area), we suggest that specific controls and put in place as part of any development to minimise any risk to groundwater. We do not see this as a constraint in terms of the progression of the Scheme Amendment, rather that appropriate consideration is given to this aspect as part of the site's future development. Similarly, the site is also located within a proclaimed surface water protection area and future development will require consideration of this regard, including hardstands, bunds, above-ground tanks (where practicable), spill management and appropriate management measures/protocols to minimise any risk. A 'precinct' level water management plan should be considered to ensure that all parties are subject to an appropriate level of control.

In relation to the biological values of the site and based on the desktop assessment completed by Spectrum Ecology, there is the potential for a number of significant flora and fauna species to be present onsite. The fieldwork completed by Spectrum earlier this year found that no Threatened or Priority Flora were recorded or considered likely to occur within the Survey Area and that both significant flora taxa assigned a High likelihood of occurrence prior to the survey, were assigned a Low likelihood of occurrence post survey. Spectrum also noted that of the two vegetation types recorded at the Survey Area, neither were considered significant, or were considered to be locally or regionally significant.

From a fauna perspective they did not identify any conservation significant vertebrate or SRE invertebrate fauna species that are restricted to the Survey Area. The three vertebrate fauna species identified as having a Medium likelihood of occurrence in the Survey Area are not restricted to any of the habitats there and use of the Survey Area is likely to be limited to flying over for foraging or dispersal. In addition, the disturbance within the Survey Area such as vehicle use and aircraft noise, limit the propensity for fauna to utilise the habitats that occur within. The fauna habitats identified are also not restricted to the Survey Area and are widespread in the region.

As noted in the desktop work, Talis did have some concerns regarding the potential presence of the TEC, Ethel Gorge aquifer stygobiont. Spectrum's work in this regard did however confirm that only the buffer for this TEC was located within the project boundary and that the TEC itself was located elsewhere. This is therefore unlikely to preclude future development of the site, but any clearing of native vegetation will require to be progressed through a Native Vegetation Clearing Permit (NVCP). We note that our conclusions remain the same in that we are still of the view that there is unlikely to be any unacceptable risk to these species if they are present and that the presence of this TEC (or at least its buffer) is not likely to present a restriction to the future development of the site.

The work completed by BPP in relation to bushfire management also suggests that there are no significant concerns associated with the site in terms of its development. Whilst BPP indicates that the proposed development site has a moderate to extreme bushfire hazard level, they conclude that an area is able to be established within each lot where buildings can be constructed to a BAL rating of BAL-29 or lower. This would be subject to a number of recommendations/requirements in terms of vegetation clearing for the lots and separation distances for the future buildings on site from existing

vegetation within the Great Northern Highway road reserve and any undeveloped neighbouring lots. Further details regarding management requirements are provided in their report, but again are unlikely to prevent development of the subject site from proceeding.

Given the above and the details contained within this report, Talis is of the view that there are no issues/impacts that would present a constraint that would preclude the proposed Scheme Amendment from progressing, subject to the comments provided in this report and its appendices and the normal statutory processes from being pursued.

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Figures

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LEGEND

Site Bounday

LOCALITY

0 100 200 300 400 500 km

AERIAL
Newman Airport
Scheme Redevelopment

Shire of East Pilbara

N

0 100 200 300 400 metres

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:10,000

Prepared: W Robertson	Date: 10/03/2021
Reviewed: A Mack	Revision: A
Project: TE20115	

talis consultants

Figure 01

Data source: Imagery - Landgate, 2020.

Document Path: \\server\talis\SECTIONS\Environment\Projects\TE2020\TE20115 - Newman Airport\GIS\Maps\DesktopAssessment\TE20115_01_Aerial_RevA.mxd

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Data source: Local Planning Schemes - DPLH, 2020.

LEGEND

- Site Boundary
- **Shire of East Pilbara LPS No. 4**
- Rural
- Major Road

LOCALITY

ZONING
Newman Airport Scheme Redevelopment

Shire of East Pilbara

N
0 100 200 300 400 m

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:10,000

Prepared: W Robertson	Date: 10/03/2021
Reviewed: A Mack	Revision: A
Project: TE20115	

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Figure 02

Document Path: \\server\talis\SECTIONS\Environment\Projects\TE2020\TE20115 - Newman Airport\GIS\Maps\DesktopAssessment\TE20115_02_Zoning_RevA.mxd

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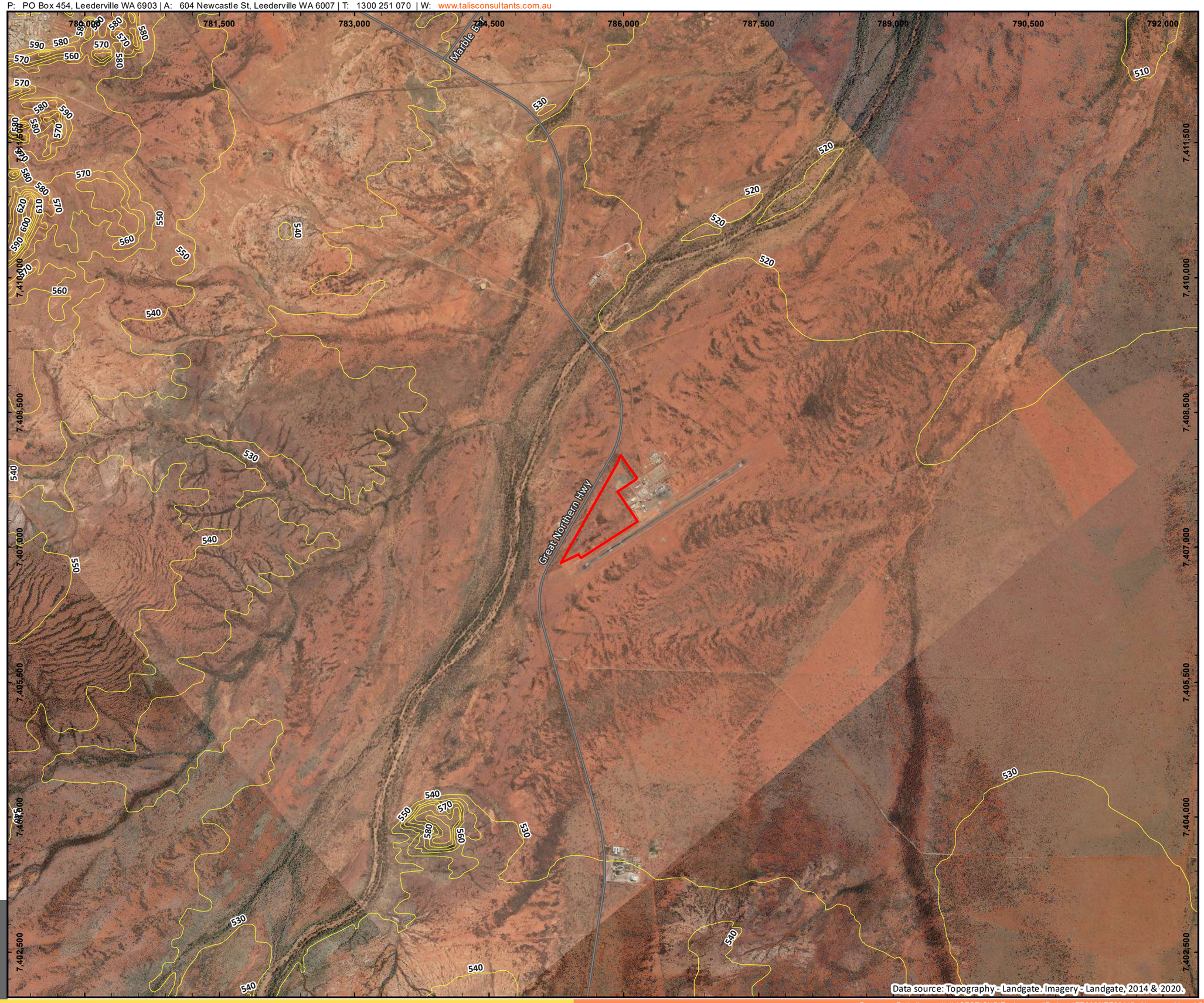

LEGEND

- Site Boundary
- Elevation (mAHD)

LOCALITY

0 100 200 300 400 km

TOPOGRAPHY
Newman Airport Scheme Redevelopment

Shire of East Pilbara

N

0 410 820 1,230 1,640 m

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:40,000

Prepared:	W Robertson	Date:	10/03/2021
Reviewed:	A Mack	Revision:	A
Project:	TE20115		

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Figure 03

Data source: Topography - Landgate. Imagery - Landgate, 2014 & 2020.

Document Path: \\server\talis\SECTIONS\Environment\Projects\TE2020\TE20115 - Newman Airport\GIS\Maps\DesktopAssessment\TE20115_03_Topography_RevA.mxd

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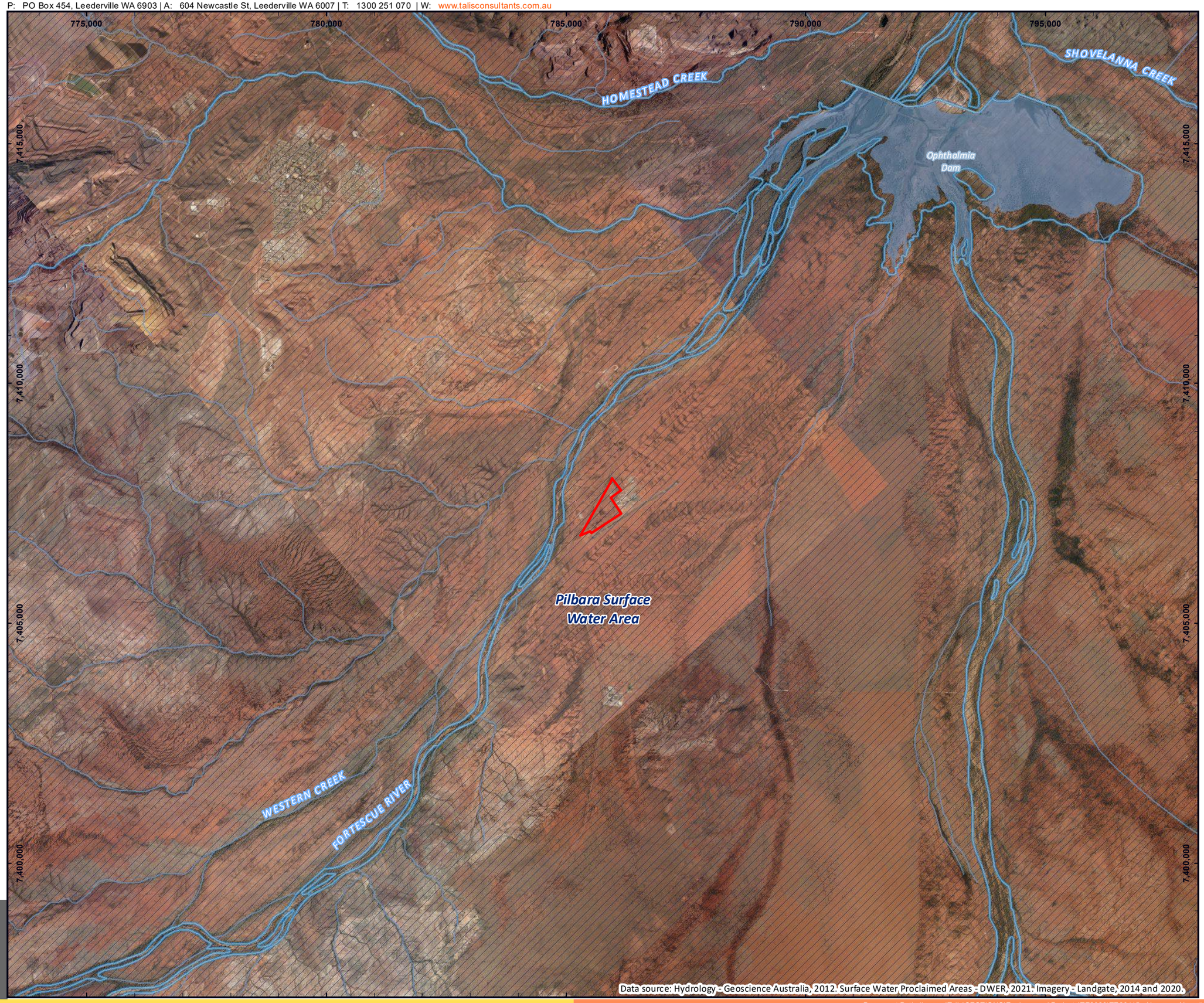

LEGEND

- Site Boundary
- Major Water Course
- Minor Water Course
- Surface Water Resource Proclaimed Area (RIWI Act)
- Non-perennial Waterbody

LOCALITY

0 100 200 300 400 km

HYDROLOGY
Newman Airport Scheme Redevelopment

Shire of East Pilbara

N

0 1 2 3 km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:75,000

Prepared: W Robertson	Date: 10/03/2021
Reviewed: A Mack	Revision: A
Project: TE20115	

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Figure 04

Data source: Hydrology - Geoscience Australia, 2012. Surface Water Proclaimed Areas - DWER, 2021. Imagery - Landgate, 2014 and 2020.

Document Path: \\server\Talis\SECTIONS\Environment\Projects\TE2020\TE20115 - Newman Airport\GIS\Maps\DesktopAssessment\TE20115_04_Hydrology_RevA.mxd

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782,000 784,000 786,000 788,000

7,410,000 7,408,000 7,406,000

Czk Qc q Qw Qs Czr Qa Qg Qx Qd Qb Qt

520 95 30

Newman Aerodrome

Minderoo Well

FORTESCUE

Round Hill

LEGEND

- Site Boundary
- Qa - Alluvium - unconsolidated silt, sand and gravel
- Qs - Eolian sand - in sheets and dunes
- Qw - Alluvium and colluvium; red-brown sandy and clayey soil
- Qc - Colluvium - unconsolidated quartz and rock fragments in soil
- Czr - Laterite including surficial hematite-geothite deposits over banded iron-formation
- Czk - Calcrete - sheet carbonate usually formed in major drainage channels
- q - Quartz vein
- ge - Granitoid rocks, undifferentiated, deeply weathered

LOCALITY

0 100 200 300 400 km

GEOLOGY
Newman Airport
Scheme Redevelopment

Shire of East Pilbara

N 0 200 400 600 800 m

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:25,000

Prepared: W Robertson	Date: 10/03/2021
Reviewed: A Mack	Revision: A
Project: TE20115	

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Figure 05

Data source: Geology - 1:100K Geological Series Newman, GSWA, 1989.

Document Path: \\server\talis\SECTIONS\Environment\Projects\TE2020\TE20115 - Newman Airport\GIS\Maps\DesktopAssessment\TE20115_05_Geology_RevA.mxd

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780,000
785,000
790,000
7,410,000
7,405,000

LEGEND

Site Boundary

Acid Sulfate Soils

- A4 - High Probablilty / Very Low Confidence
- B4 - Low Probablilty / Very Low Confidence
- C4 - Extremely Low Probablilty / Very Low Confidence

LOCALITY

0 100 200 300 400 km

ACID SULFATE SOILS

Newman Airport Scheme Redevelopment

Shire of East Pilbara

N

0 0.5 1 1.5 2 km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:50,000

Prepared: W Robertson	Date: 10/03/2021
Reviewed: A Mack	Revision: A
Project: TE20115	

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Figure 06

Data source: Acid Sulfate Soils - CSIRO ASRIS, 2014. Imagery - Landgate, 2014 & 2020.

Document Path: \\server\talis\SECTIONS\Environment\Projects\TE2020\TE20115 - Newman Airport\GIS\Maps\DesktopAssessment\TE20115_06_AcidSulfateSoils_RevA.mxd

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777,500 780,000 782,500 785,000 787,500 790,000 792,500

7,412,500
7,410,000
7,407,500
7,405,000
7,402,500

Data source: ESAs - DWER, 2020. Imagery - Landgate, 2014 & 2020.

LEGEND

- Site Boundary
- Environmentally Sensitive Area
- Threatened Ecological Community

LOCALITY

0 100 200 300 400 km

ENVIRONMENTALLY SENSITIVE AREAS

Newman Airport Scheme Redevelopment

Shire of Pilbara

N

0 0.5 1 1.5 2 km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:50,000

Prepared: W Robertson	Date: 10/03/2021
Reviewed: A Mack	Revision: A
Project: TE20115	

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Figure 07

Document Path: \\server\Talis\SECTIONS\Environment\Projects\TE2020\TE20115 - Newman Airport\GIS\Maps\DesktopAssessment\TE20115_07_ESA_RevA.mxd

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777,500 780,000 782,500 785,000 787,500 790,000 792,500

7,412,500 7,410,000 7,407,500 7,405,000 7,402,500

Pilbara Groundwater Area

East Murchison Groundwater Area

Data source: WIN Sites, Groundwater Areas, PDWSAs - DWER, 2021.

LEGEND

- Site Boundary
- WIN Monitoring Sites within 1km
- WIN Monitoring Site
- Proclaimed Groundwater Area (RIWI Act)

Public Drinking Water Source Area

- Priority 1
- Priority 3

LOCALITY

0 100 200 300 400 km

HYDROGEOLOGY
Newman Airport Scheme Redevelopment

Shire of East Pilbara

N

0 0.5 1 1.5 2 km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:50,000

Prepared:	W Robertson	Date:	10/03/2021
Reviewed:	A Mack	Revision:	A
Project:	TE20115		

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Figure 08

Document Path: \\server\talis\SECTIONS\Environment\Projects\TE2020\TE20115 - Newman Airport\GIS\Maps\DesktopAssessment\TE20115_08_Hydrogeology_RevA.mxd

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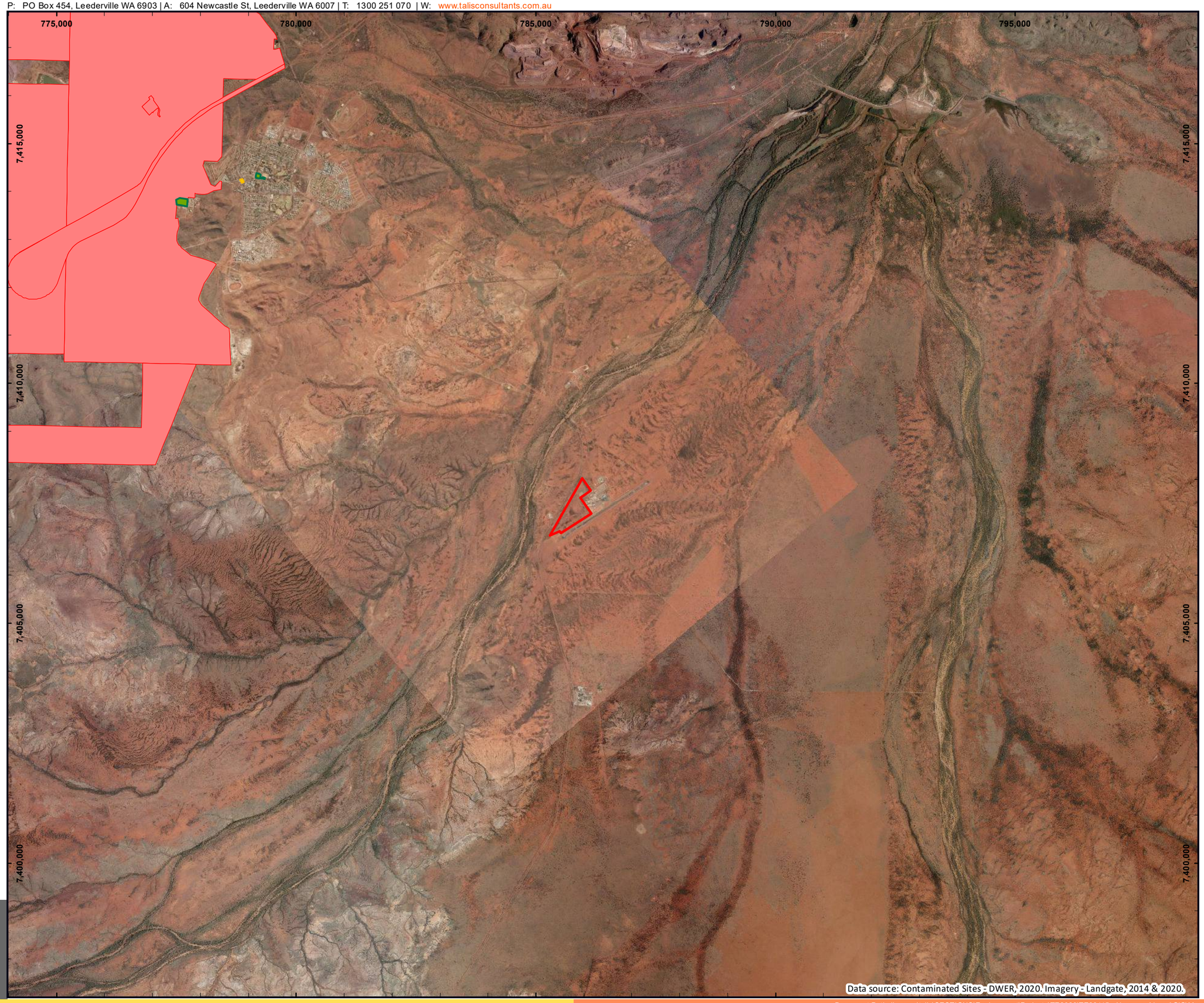

LEGEND

- Site Boundary

Contaminated Site

- Remediated for restricted use
- Contaminated - restricted use
- Contaminated - remediation required

LOCALITY

0 100 200 300 400 km

CONTAMINATED SITES

Newman Airport Scheme Redevelopment

Shire of East Pilbara

N

0 1 2 3 km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:75,000

Prepared: W Robertson	Date: 10/03/2021
Reviewed: A Mack	Revision: A
Project: TE20115	

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Figure 09

Data source: Contaminated Sites - DWER, 2020. Imagery - Landgate, 2014 & 2020.

Document Path: \\server\talis\SECTIONS\Environment\Projects\TE2020\TE20115 - Newman Airport\GIS\Maps\DesktopAssessment\TE20115_09_ContaminatedSites_RevA.mxd

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777,500 780,000 782,500 785,000 787,500 790,000 792,500

7,412,500 7,410,000 7,407,500 7,405,000 7,402,500

WCD2018/008

WCD2018/008

WCD2018/008

Data source: Native Title - National Native Title Tribunal, 2021.

LEGEND

Site Boundary

Native Title Determination Outcomes

Native title exists (non-exclusive)

Native title does not exist

LOCALITY

0 100 200 300 400 km

NATIVE TITLE

Newman Airport Scheme Redevelopment

Shire of East Pilbara

N

0 0.5 1 1.5 2 km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:50,000

Prepared:	F Walker	Date:	10/03/2021
Reviewed:	A Mack	Revision:	A
Project:	TE20115		

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Figure 10

Document Path: \\server\talis\SECTIONS\Environment\Projects\TE2020\TE20115 - Newman Airport\GIS\Maps\DesktopAssessment\TE20115_10_NativeTitle_RevA.mxd

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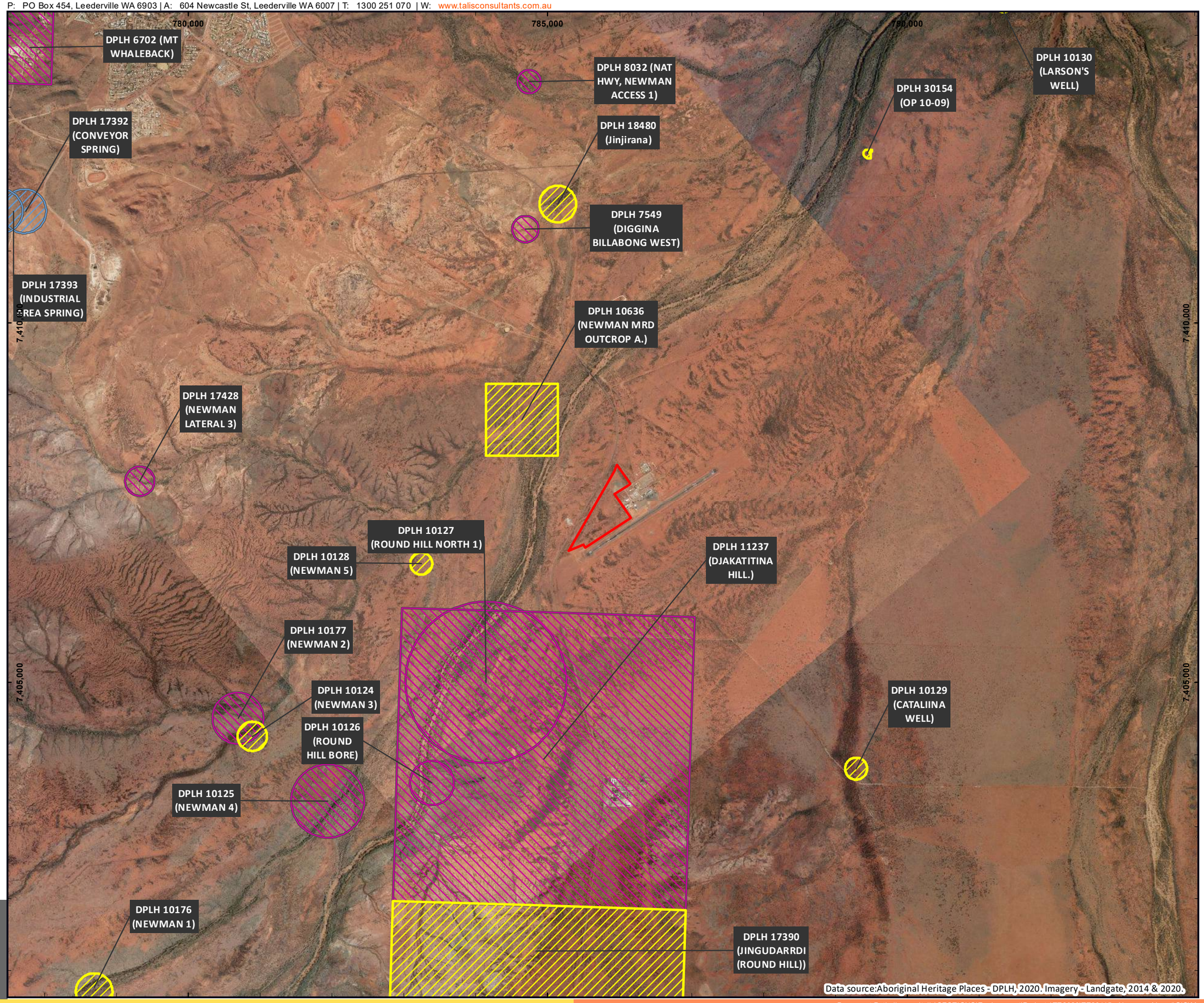

LEGEND

Site Boundary

Aboriginal Heritage Places

STATUS

- Registered Site
- Stored Data / Not a Site
- Lodged

LOCALITY

ABORIGINAL HERITAGE

Newman Airport Scheme Redevelopment

Shire of East Pilbara

N

0 0.5 1 1.5 2 km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:50,000

Prepared: W Robertson	Date: 10/03/2021
Reviewed: A Mack	Revision: A
Project: TE20115	

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Figure 11

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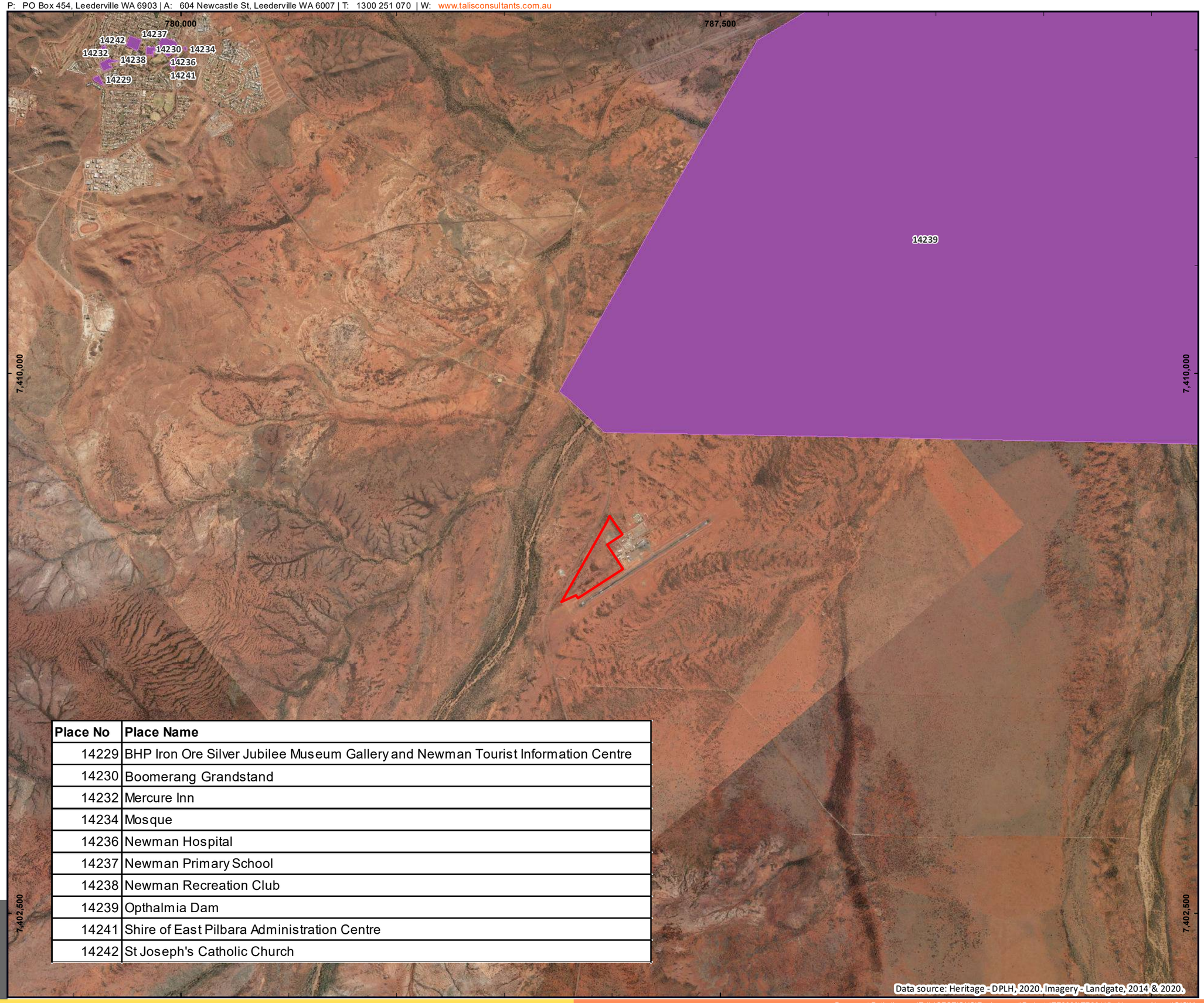

Place No	Place Name
14229	BHP Iron Ore Silver Jubilee Museum Gallery and Newman Tourist Information Centre
14230	Boomerang Grandstand
14232	Mercure Inn
14234	Mosque
14236	Newman Hospital
14237	Newman Primary School
14238	Newman Recreation Club
14239	Opthalmia Dam
14241	Shire of East Pilbara Administration Centre
14242	St Joseph's Catholic Church

Data source: Heritage - DPLH, 2020. Imagery - Landgate, 2014 & 2020.

LEGEND

- Site Boundary
- European Heritage - Local Survey

LOCALITY

0 100 200 300 400 km

AUSTRALIAN HERITAGE

Newman Airport Scheme Redevelopment

Shire of East Pilbara

N

0 0.5 1 1.5 2 km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:50,000

Prepared: W Robertson	Date: 10/03/2021
Reviewed: A Mack	Revision: A
Project: TE20115	

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Figure 12

Document Path: \\server\Talis\SECTIONS\Environment\Projects\TE2020\TE20115 - Newman Airport\GIS\Maps\DesktopAssessment\TE20115_12_AustralianHeritage_RevA.mxd

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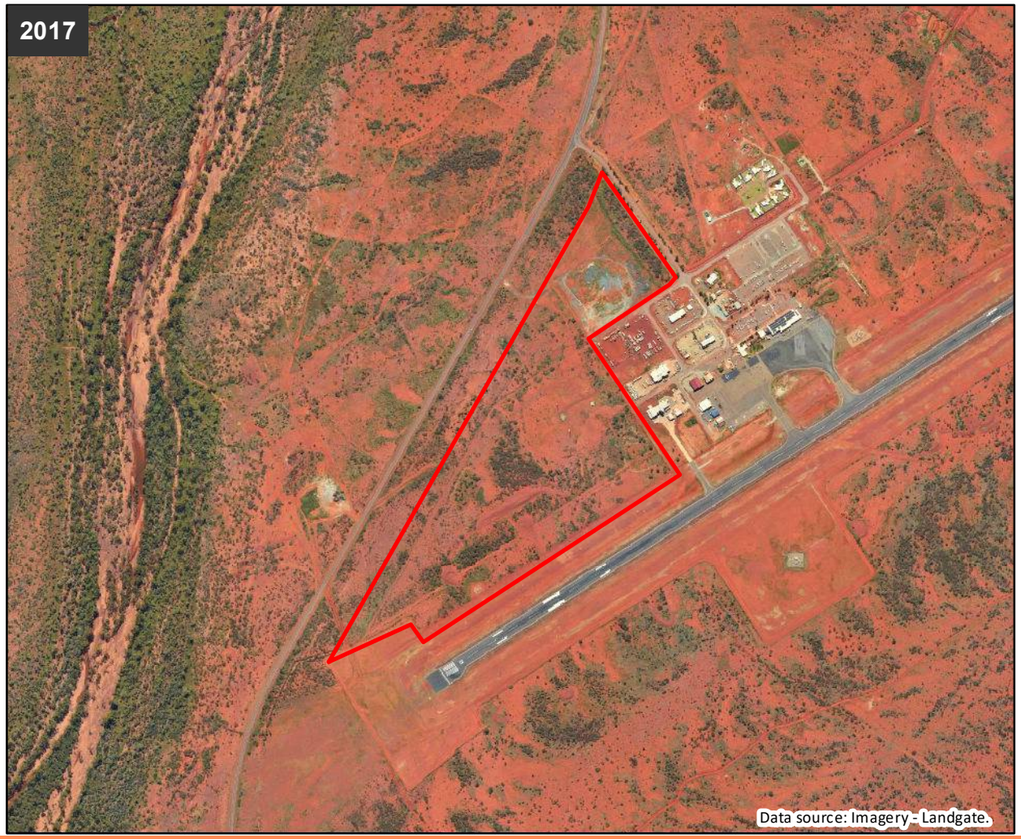

Data source: Imagery - Landgate.

LEGEND

Site Boundary

LOCALITY

0 100 200 300 400 km

HISTORICAL IMAGERY

Newman Airport Scheme Redevelopment

Shire of Pilbara

N

0 200 400 600 m

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:15,000

Prepared: W Robertson	Date: 10/03/2021
Reviewed: A Mack	Revision: A
Project: TE20115	

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Figure 13

Document Path: \\server\Talis\SECTIONS\Environment\Projects\TE2020\TE20115 - Newman Airport\GIS\Maps\DesktopAssessment\TE20115_13_HistoricalImagery_RevA.mxd

APPENDIX A
Talis Desktop Report

Newman Airport Scheme Amendment

Desktop Environmental Assessment

Prepared for Shire of East Pilbara

11 March 2021

Project Number: TE20115

DOCUMENT CONTROL					
Version	**Description**	**Date**	**Author**	**Reviewer**	**Approver**
01	Internal Draft	10/03/2021	AJM	SS	AJM
02	Update	11/3/2021	AJM	SS	AJM
10	Released to client	11/3/2021	AJM	SS	AJM

Approval for Release		
Name	**Position**	**File Reference**
Andrew Mack	Associate Director	TE20115-NewmanAirport_Desktop_Enviro.10
Signature		

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Tables

Plates

Appendices

1 Introduction

This report supports a broader request from the Shire of East Pilbara (the Shire) to initiate an amendment to Local Planning Scheme No. 3 (LPS3) which will ultimately see an area of land associated with the Newman Airport Estate be rezoned for industrial purposes.

The subject land (referred to as 'the site)' constitutes an area of 36.87 hectares and is formed of two areas (Area A: 9.48 hectares. Area B: 27.39 hectares). It forms a portion of Crown Reservation R44775

The report outlines the justification, including the policy and legislative framework, environmental conditions and service infrastructure availability relevant to the zoning and Scheme provisions for the site.

Talis Consultants Pty Ltd (Talis) was engaged (amongst other things) to prepare a desktop environmental assessment of the site to support the Scheme Amendment process to ensure that there were no environmental constraints that would preclude the Amendment from progressing. The details contained within this report outline our findings and will be supported by an on-ground biological survey to be conducted later in March 2021.

The location of the site is provided in **Figure 1** and its current zoning as **Figure 2**.

2 Site Inspection

As part of the geotechnical work carried out onsite, a site inspection of the environmental features of the site was completed on 9 February 2021. The photographs from this work are provided as **Appendix A** together with the locations and direction of each photo.

The site is generally flat with few notable features. There is little vegetation of note and little evidence of any rubbish left across the site.

There are a number of areas where mounds of material were identified. These are unlikely to be associated with buried waste and are more likely associated with extraction of borrow material and stockpiling of topsoil and vegetation 'trash' as a result.

There is a larger mound located in the Stage 2 area which runs parallel to the runway and is adjacent to an old fenceline. Given that the area to the east of this mound was wetter than other areas of the site, it is assumed that this was used to prevent surface water flow towards the runway.

Of primary note on the site is a number of areas which have been demarcated as airport infrastructure. This includes two communication towers, a high-voltage transformer or similar associated with these, some other infrastructure delineated as being for airport navigation and locations which have been signed as having underground high-voltage cables. These infrastructure will obviously require careful management for any future development of the site.

Of note are the following features which were identified through a visual assessment of the site and should be considered as part of any redevelopment (as shown in Table 2-1).

Table 2-1: Photographs and Description

Photograph Location	Description
Various (e.g., 1 and 3)	Compacted 'hardstand' for vehicle movement/parking/laydown areas
2	Stormwater drainage line and culvert
4	Fenceline between Stage 1 and Stage 2
7	Bluemetal(?) stockpile
8	Track cleared of vegetation (vegetation trash pushed up against NE boundary)
11	Track and culvert
12	Stormwater sump
13	Communication towers
14	First fenced high-voltage area for airport navigation infrastructure
16	Second fenced high-voltage area for airport navigation infrastructure
17	Old fencing and poles associated with communication towers
24	Unknown large mound (drainage?)

Photograph Location	Description
26	Old fenceline running N/S along eastern boundary of Stage 2. Historic property boundary?
32	High-voltage underground power cables running along fenceline route along eastern boundary of Stage 2 (see 26)

3 Desktop

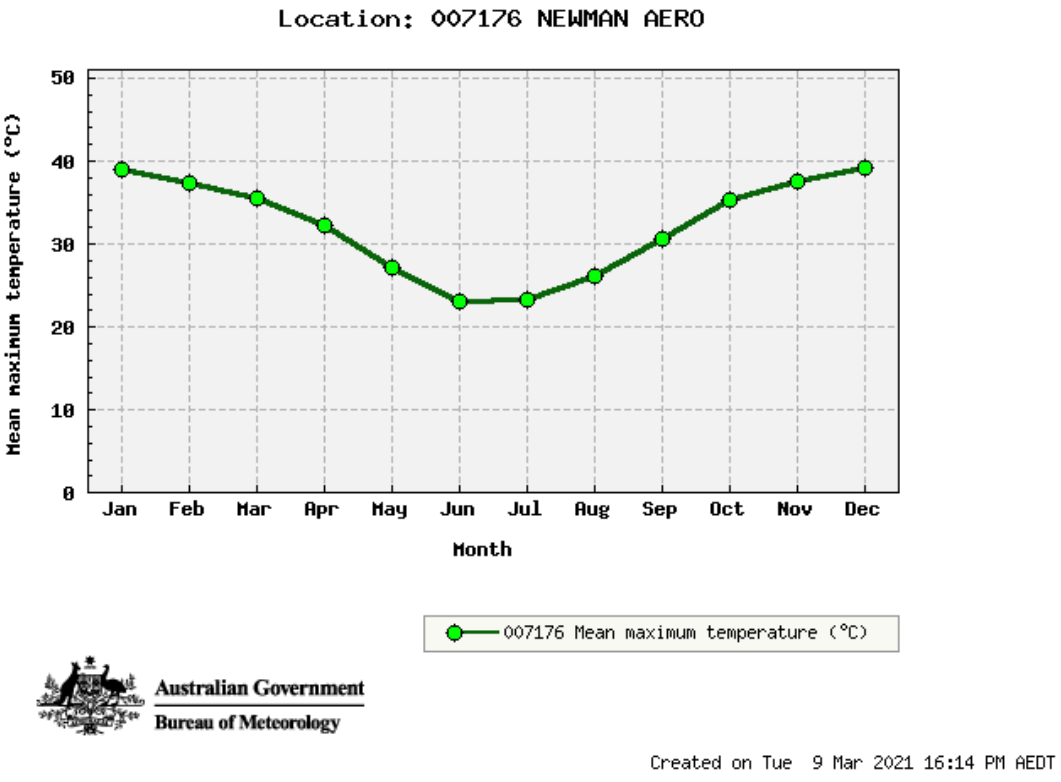
The proposed area which is the subject of this Scheme Amendment (referred to as 'the site') is located approximately 11 km south of the Newman townsite, adjacent to Newman Airport and consists of land approximately 36 hectares in area. Figures 1 and 2 show the subject area. The site was originally constructed in 1968.

3.1 Climate

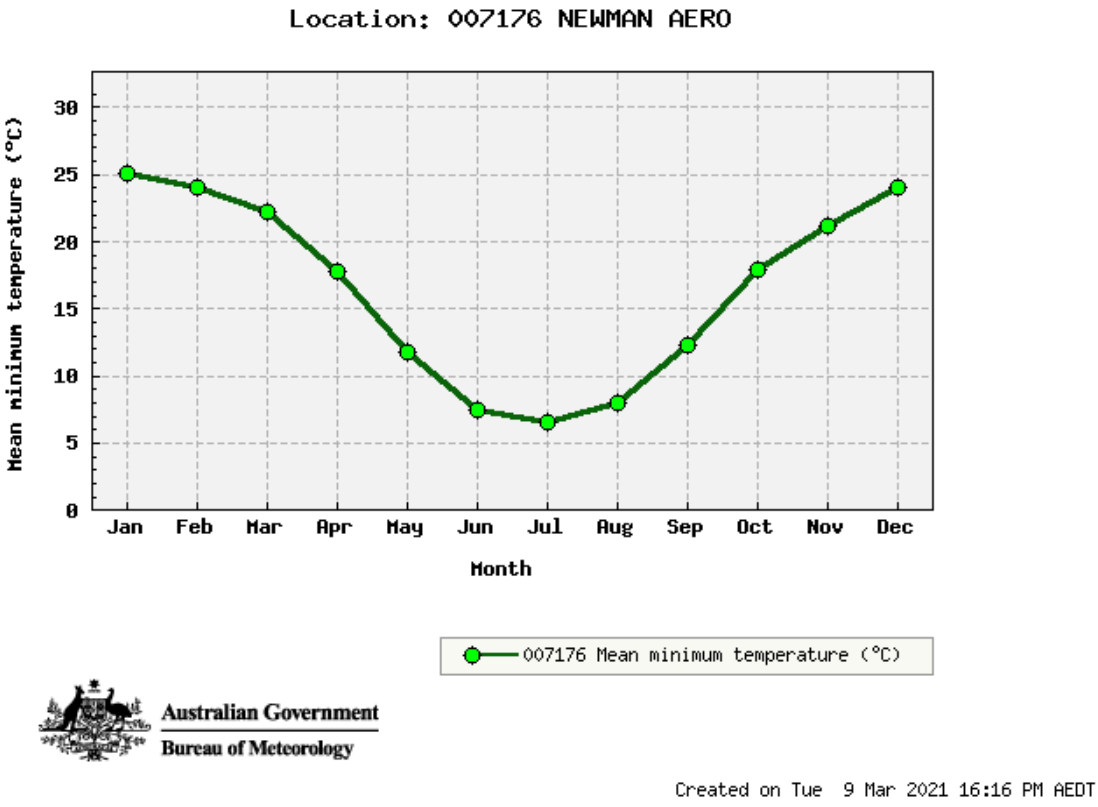
As identified within the Shire's draft Local Planning Strategy, the Shire experiences a variation in temperatures typical of a desert climate. Temperatures frequently exceed 40°C in summer with temperatures above 45°C in the inland areas not uncommon. Day time temperatures will fall to around 25°C during winter.

In terms of rainfall, the average is between 150-250 mm, dropping to 100 mm in the south-east of the Shire with greater falls generally experience in summer in the north whilst rain occurs in summer or winter in the south.

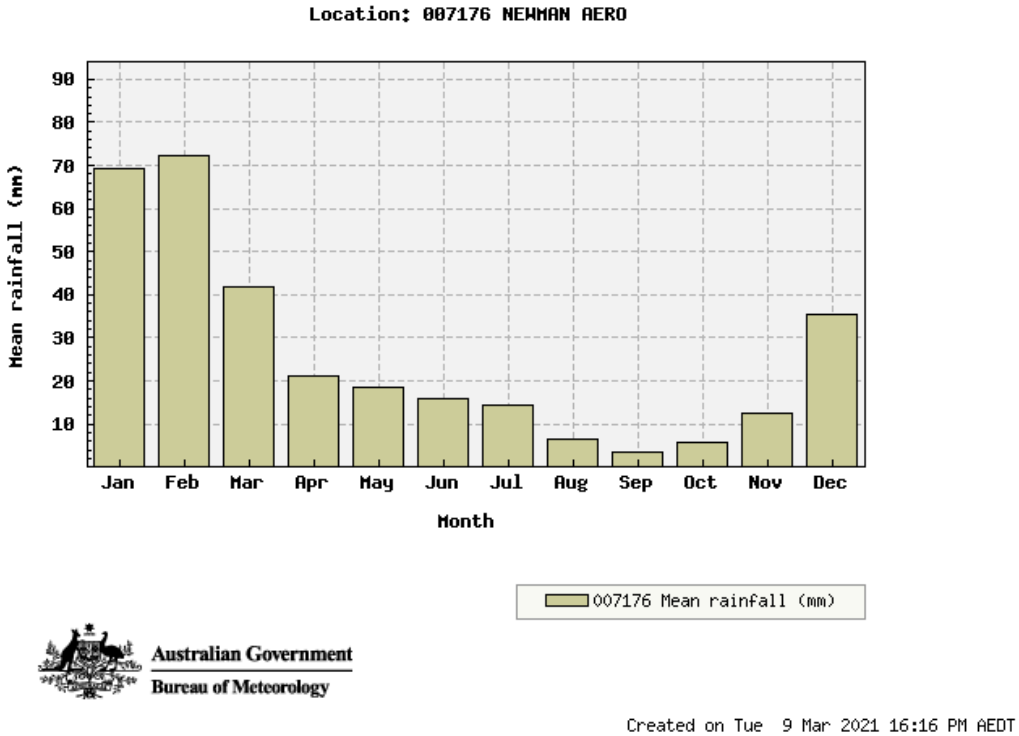
The Bureau of Meteorology has produced the following graphs in relation to the Newman Airport site:



Plates 3-1: Mean Maximum Temperature (Newman Airport)



Plates 3-2: Mean Minimum Temperature (Newman Airport)



Plates 3-3: Mean Rainfall (Newman Airport)

3.2 Zoning

Newman Airport is managed by the Principal in terms of a Land Management Order issued by State Lands as the Airport is sited upon Crown Land. The site is currently zoned "Rural" under Shire of East Pilbara Local Planning Scheme No.4. The Principal is required, under the *Planning and Development Act 2005*, to amend the zone of the land from "rural' zone to "special use" zone to provide for industrial land development at the site.

3.3 Local Topography and Surface Water Drainage

Based on a review of the data available for the site as well as the site visit, the site is broadly flat with no noticeable slope. The topographical data for the site (see **Figure 3**) suggests a slope down to the east north-east. This assessment was confirmed through the site inspection conducted on 9 February 2021 although there were some localised depressions/undulations identified.

In terms of hydrological features, **Figure 4** indicates that the subject site sits within a Surface Water Resource Area as proclaimed under the *Rights in Water and Irrigation Act 1914* (RIWI Act).

There are no local surface water features associated with the site and no evidence of natural surface water flow or infiltration was identified during the site visit other than the drains that were noted. The nearest surface water feature is the Fortescue River which is located less than a kilometre from the southern portion of the site and flows in a north-south direction to the west of the site.

3.4 Geology

According to the Geological Series Mapping for Newman, the site sits within the Qw – Alluvium and colluvium; red-brown sandy and clayey soil geological unit (see **Figure 5**) and **Figure 6** suggests that there is an extremely low probability of the site containing Acid Sulfate Soils (ASS).

3.5 Environmentally Sensitive Areas (ESA)

ESAs are declared in the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* (the Clearing Regulations) as areas of conservation significance.

The EP Act makes it an offence to clear native vegetation unless the clearing is done in accordance with a clearing permit, or where an exemption applies. Exemptions are not able to be used in areas covered by an ESA.

Based on available mapping, the site is located within an ESA (see **Figure 7**) and any clearing of native vegetation will require a Native Vegetation Clearing Permit (NVCP) to be issued.

3.6 DBCA Managed Lands

Department of Biodiversity, Conservation and Attractions (DBCA) Managed Lands and Waters within WA are conservation areas which typically include:

- National Parks;
- Nature Reserves; and
- Crown Freehold identified as being of DBCA interest.

There are no DBCA managed lands located over or adjacent to the site therefore there are no environmental constraints relating to DBCA managed lands for the Scheme Amendment.

3.7 Groundwater

The subject site sits within the Pilbara Groundwater Area and immediately north of the East Murchison Groundwater Area, both of which are proclaimed under the RIWI Act (see **Figure 8**). It is illegal to take water from a watercourse or groundwater aquifer without a licence in a proclaimed area under the RIWI Act.

It should also be noted that site is located immediately to the south of the Newman Water Reserve, a Priority 1 (P1) area. Whilst not seen to be a significant risk to the development of the site, P1 areas are defined and managed to ensure there is no degradation of the quality of the drinking water source with the objective of risk avoidance. The Department of Water and Environment Regulation (DWER) notes that industrial land-uses are incompatible uses within a P1 area.

3.8 Contaminated Sites

3.8.1 Contaminated Sites Database and Register

DWER currently records information of contaminated sites within WA on a Contaminated Sites Database in accordance with the *Contaminated Sites Act, 2003*. All sites of known or suspected contamination reported to the DWER are classified under the Act as one of the following:

i) Report not substantiated;
ii) Possibly contaminated – investigation required;
iii) Not contaminated – unrestricted use;
iv) Contaminated – restricted use;
v) Contaminated – remediation required;
vi) Remediated for restricted use; or
vii) Decontaminated.

Of the above, only the last three bullet points are publicly displayed on the DWER Contaminated Sites Database.

The site contained no listed sites on the contaminated sites database and there were no listed sites within the direct vicinity the study area (see **Figure 9**). There are no anticipated constraints to the Scheme Amendment regarding contaminated sites.

3.9 Social/Cultural Attributes

3.9.1 Native Title

Based on mapping supplied by the National Native Title Tribunal (see **Figure 10**), the site is contained in an area where Native Title has been found not to exist (WCD2018/008).

3.9.2 Aboriginal Heritage

A search for mapped Aboriginal Heritage Sites was conducted by using the data from the Department of Planning, Lands and Heritage (DPLH) online Aboriginal Heritage Inquiry System, which incorporates both the Heritage Site Register and Heritage Survey Database. These databases list the following sites:

- Registered Aboriginal Sites;
- Other Heritage Places; and
- Heritage Study sites.

Under the *Aboriginal Heritage Act 1972*, it is an offence to remove, damage or destroy an Aboriginal Heritage Site (whether known or otherwise) without specific approval being granted.

Whilst we suggest there is minimal risk in this regard given that there are no sites located within the subject site (see **Figure 11**), we recommend that appropriate consultation is held with local indigenous groups where appropriate. Furthermore, appropriate measures should be implemented to minimise any risk of disturbing an Aboriginal Heritage Site during construction activities.

3.9.3 European Heritage

An online search of the following records was undertaken;

- State register;
- National heritage list;
- Commonwealth heritage list; and
- The InHerit database.

The nearest site which has been registered is shown in **Figure 12** and is the Opthalmia Dam site to the north-east.

3.10 Historic land uses

Based on a review of the historical aerial imagery from the last 18 years (see **Figure 13**), there has been little, if any change associated with the site's use.

Talis is therefore of the view that, aligning with the site visit and current land use, the historical uses of the site are unlikely to present a risk in relation to the proposed Scheme Amendment progressing.

3.11 Current land uses

Based on the site visit and our understanding of the current situation, the site is currently vacant and aside from some limited waste identified in locations across the site, the local drainage lines (and associated culverts/sumps) and the airport communication/navigation infrastructure and associated high-voltage power cables. there are no current land-uses of note that would preclude future development of the site.

3.12 Nearest Receptors

The nearest receptors to the subject site are located on the Newman Airport site. The nearest sensitive receptors are a roadhouse/accommodation facility located approximately 3 km to the south and Rivergums Village, approximately 2 km to the north.

Neither of these will be affected by the rezoning of the subject land.

4 Biological

Ahead of a field-effort to be undertaken in March 2021, a desktop assessment of the potential biological values of the site (also referred to as the Study Area) was conducted by Spectrum Ecology. This is provided as **Appendix B**.

4.1 Significant Flora

No significant flora were identified within the Study Area. The desktop assessment identified 52 significant flora taxa occurring within the vicinity of the Study Area, of which five were assigned pre-survey likelihood of occurrence of high or medium. All significant flora identified in the desktop assessment are summarised in the Spectrum report appended to this document.

The following significant flora were identified within the vicinity of the Survey Area and assigned a high or medium likelihood occurrence:

- High P3 *Aristida jerichoensis* var. *subspinulifera*
- Medium P1 *Eremophila capricornica*
- Medium P3 *Eremophila rigida*
- Medium P3 *Rhagodia sp. Hamersley* (M. Trudgen 17794)
- Medium P4 *Goodenia nuda*

4.2 Threatened Ecological Communities (TEC)

The Department of Biodiversity, Conservation and Attractions defines an ecological community as "a naturally occurring group of plants, animals and other organisms interacting in a unique habitat. The complex range of interactions between the component species provides an important level of biological diversity in addition to genetics and species."

Under previous legislation, the Minister for the Environment was able to list TECs through a non-statutory process if the community was presumed to be totally destroyed or at risk of becoming totally destroyed. The *Biodiversity Conservation Act 2016* (BC Act) provides for the statutory listing of TECs by the Minister.

The desktop assessment completed by Spectrum identified one TEC associated with the subject site, the Ethel Gorge aquifer stygobiont community. This is listed as Endangered (E), its current distribution is limited, and its known occurrences are very vulnerable to known threatening processes (B(ii)).

4.3 Conservation Significant Fauna

The desktop assessment identified 35 conservation significant fauna species including eight mammals, 23 birds and four reptiles that have the potential to occur within the Study Area. Sixteen species of migratory water birds have been excluded from the assessment due to the lack of wetland habitats occurring in the study site; those species are listed in the appended Spectrum report.

Based on the desktop assessment, three species of conservation significance were assigned a pre-survey Medium to High likelihood of occurrence. The remaining identified species were assigned having a Low to Very Low likelihood of occurrence.

The following significant fauna were identified within the vicinity of the Survey Area and assigned a high or medium likelihood occurrence:

- Medium VU Greater Bilby (*Macrotis lagotis*)
- Medium P2 Unpatterned Robust Slider (Robertson Range)

4.4 Short Range Endemic Invertebrates

Spectrum (2021) notes that the Western Australian Museum database search identified 72 Arachnid, 23 Crustacean and three Mollusc species of potential short range endemic invertebrates. Twenty-six species of Arachnids and all 23 species of Crustaceans returned from SRE database search are subterranean and were excluded from this assessment. A further six species of Arachnids (mites) and two species of Molluscs are freshwater aquatic invertebrates and were also excluded.

Three species were assigned a High likelihood of occurrence and eight a Medium. All other species were assigned a Low likelihood of occurring in the Study Area. The following short-range endemic species were identified within the vicinity of the Survey Area and assigned a high or medium likelihood occurrence:

- High *Euagridae Cethegus* 'MYG299'
- High *Idiopidae Idiosoma* 'MYG384'
- Medium *Paradoxosomatidae Antichiropus* 'DIP051, *pannawonica'*
- Medium *Desidae 'Forsterina* grp. Genus' 1 'sp. 5'
- Medium *Anamidae Kwonkan* 'MYG651'
- Medium *Barychelidae Aurecocrypta* 'MYG315'
- Medium *Halonoproctidae Conothele* 'MYG575'
- Medium *Idiopidae Gaius* 'MYG286'
- Medium *Geophilidae 'Zelanophilus*?'
- Medium *Olpiidae Beierolpium* 'sp. 8/1'
- Medium *Buthidae Lychas* 'harveyi group' 'SCO038'

4.5 Subterranean Species

The Environmental Protection Authority (EPA) defines subterranean fauna as fauna which live their entire lives (obligate) below the surface of the earth.

They are divided into two groups:

- stygofauna – aquatic and living in groundwater; and
- troglofauna – air-breathing and living in caves and voids.

The EPA notes that subterranean fauna often display evolutionary adaptations to underground life, particularly reduced pigment and reduced, poorly functioning or non-existent eyes.

In this regard and as noted above, the desktop assessment showed that one TEC occurs within the Subject Site. Ethel Gorge Aquifer comprises a diverse assemblage of subterranean stygofaunal species.

It should be noted that an assessment of subterranean fauna is not included in the current scope of works and fall outside of the EPA Terrestrial Fauna Survey Technical Guidance.

In terms of potential impacts to these species, the EPA also notes that they fall under two key types:

- Direct impacts include the removal of habitat, drawdown of groundwater, inundation, and water quality changes. The main threats include excavation of geologies known to support

subterranean fauna; groundwater extraction for process or domestic purposes; dewatering for below water table excavation, and groundwater reinjection of waste or excess water.

- Indirect impacts include changes to hydrology, siltation, void collapse, alteration to nutrient balance and contamination. The main threats include changed surface topography due to compaction or creation of hard surfaces resulting in altered groundwater flow paths, increased runoff, and reduced infiltration and aquifer recharge; clearing of surface vegetation leading to sedimentation and changed nutrient inputs; potential leaks or leaching including tailings and waste water resulting in alterations to ground water chemistry and quality, and introduction of toxins or radiation; and salinisation due to intrusion of saline water into freshwater aquifers and leaching from pit voids.

Given the above and the fact that the subject site has already been subject to significant alteration, assuming that future development does not impact the underlying geology of the site or its associated aquifer, then we are of the view that there is unlikely to be any unacceptable risk to these species if they are present.

We would suggest that further work is required as part of the development of the site to ensure that this risk is appropriately managed, but we do not see a constraint for this aspect in terms of the proposed Scheme Amendment.

5 Summary and Recommendations

In terms of the overall desktop assessment of the site, it is our view that there are no constraints that would preclude the Scheme Amendment from progressing.

We draw attention to the various infrastructure, both under- and above-ground, relating to airport navigation. It is likely that management of this will require careful consideration in terms of the future development of the site.

From a groundwater perspective, given the site's location within a proclaimed groundwater area and being immediately to the south of the Newman Water Reserve (being a P1 area), we suggest that specific controls and put in place as part of any development to minimise any risk to groundwater. We do not see this as a constraint in terms of the progression of the Scheme Amendment, rather that appropriate consideration is given to this aspect as part of the site's future development. Similarly, the site is also located within a proclaimed surface water protection area and future development will require consideration of this regard, including hardstands, bunds, above-ground tanks (where practicable), spill management and appropriate management measures/protocols to minimise any risk. A 'precinct' level water management plan should be considered to ensure that all parties are subject to an appropriate level of control.

In relation to the biological values of the site and based on the desktop assessment completed by Spectrum Ecology, there is the potential for a number of significant flora and fauna species to be present onsite. Whilst not presenting a constraint to the Scheme Amendment progressing, further work will be required through a field survey to determine the actual presence/absence of these species. Given the disturbance that has already occurred across the site, we are of the view that it would be unlikely for it to retain any significant biological values.

Of particular note in his regard is the potential presence of the TEC, Ethel Gorge aquifer stygobiont. Where present, this will require careful management, although as noted above, given that the site has already been subject to significant alteration and assuming that future development does not impact the underlying geology of the site or its associated aquifer, then we are of the view that there is unlikely to be any unacceptable risk to these species if they are present.

As we have already noted, a field survey will be conducted in March 2021 to confirm the presence/absence of any biological values.

6 References

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LEGEND

Site Bounday

LOCALITY

0 100 200 300 400 500 km

AERIAL
Newman Airport
Scheme Redevelopment

Shire of East Pilbara

N
0 100 200 300 400 metres

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:10,000

Prepared: W Robertson	Date: 10/03/2021
Reviewed: A Mack	Revision: A
Project: TE20115	

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Figure 01

Data source: Imagery - Landgate, 2020.

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Data source: Local Planning Schemes - DPLH, 2020.

LEGEND

Site Boundary

Shire of East Pilbara LPS No. 4

Rural

Major Road

LOCALITY

ZONING

Newman Airport Scheme Redevelopment

Shire of East Pilbara

N

0 100 200 300 400 m

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:10,000

Prepared: W Robertson	Date: 10/03/2021
Reviewed: A Mack	Revision: A
Project: TE20115	

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Figure 02

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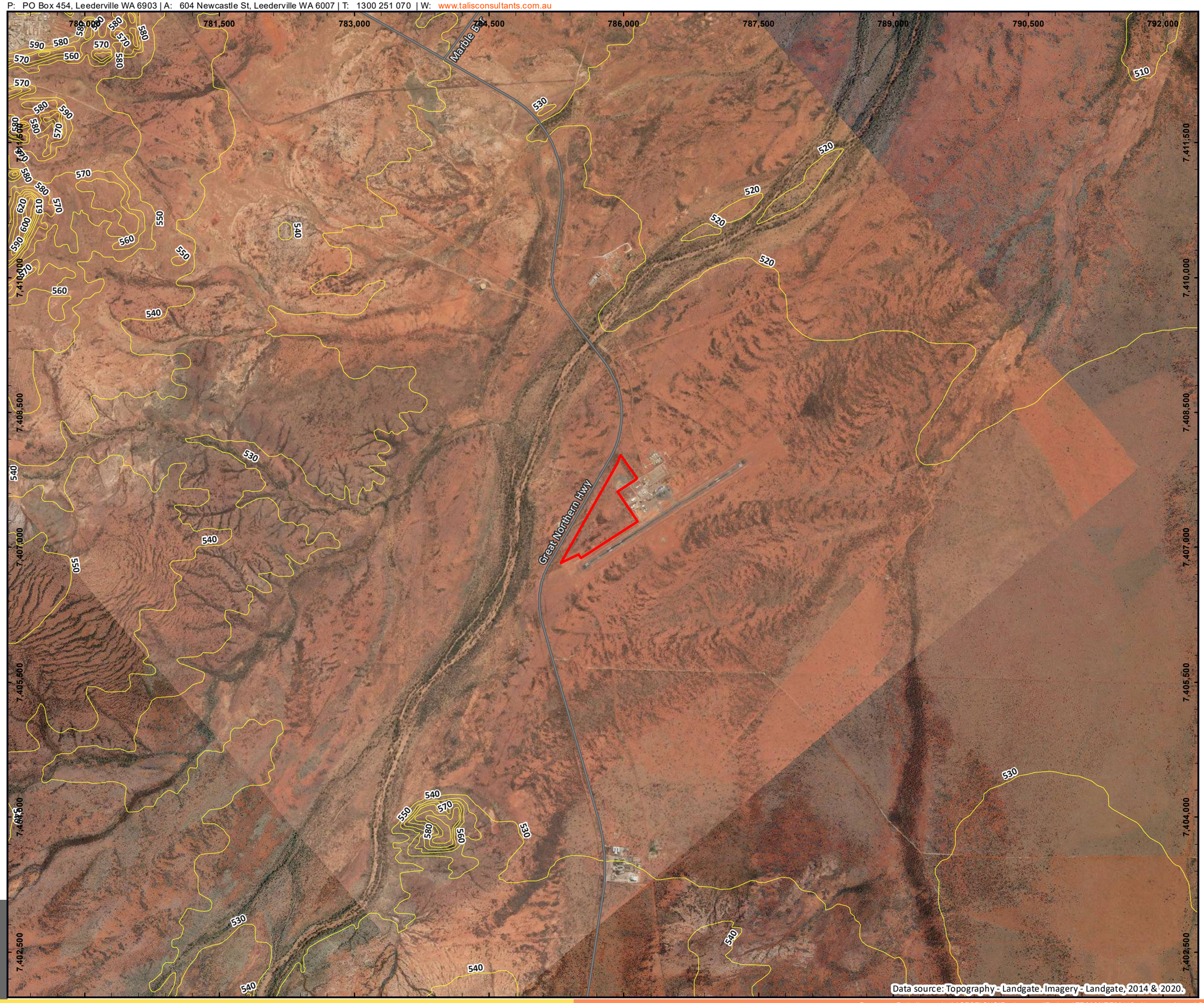

LEGEND

- Site Boundary
- Elevation (mAHD)

LOCALITY

0 100 200 300 400 km

TOPOGRAPHY
Newman Airport Scheme Redevelopment

Shire of East Pilbara

N

0 410 820 1,230 1,640 m

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:40,000

Prepared:	W Robertson	Date:	10/03/2021
Reviewed:	A Mack	Revision:	A
Project:	TE20115		

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Figure 03

Data source: Topography - Landgate. Imagery - Landgate, 2014 & 2020.

Document Path: \\server\talis\SECTIONS\Environment\Projects\TE2020\TE20115 - Newman Airport\GIS\Maps\DesktopAssessment\TE20115_03_Topography_RevA.mxd

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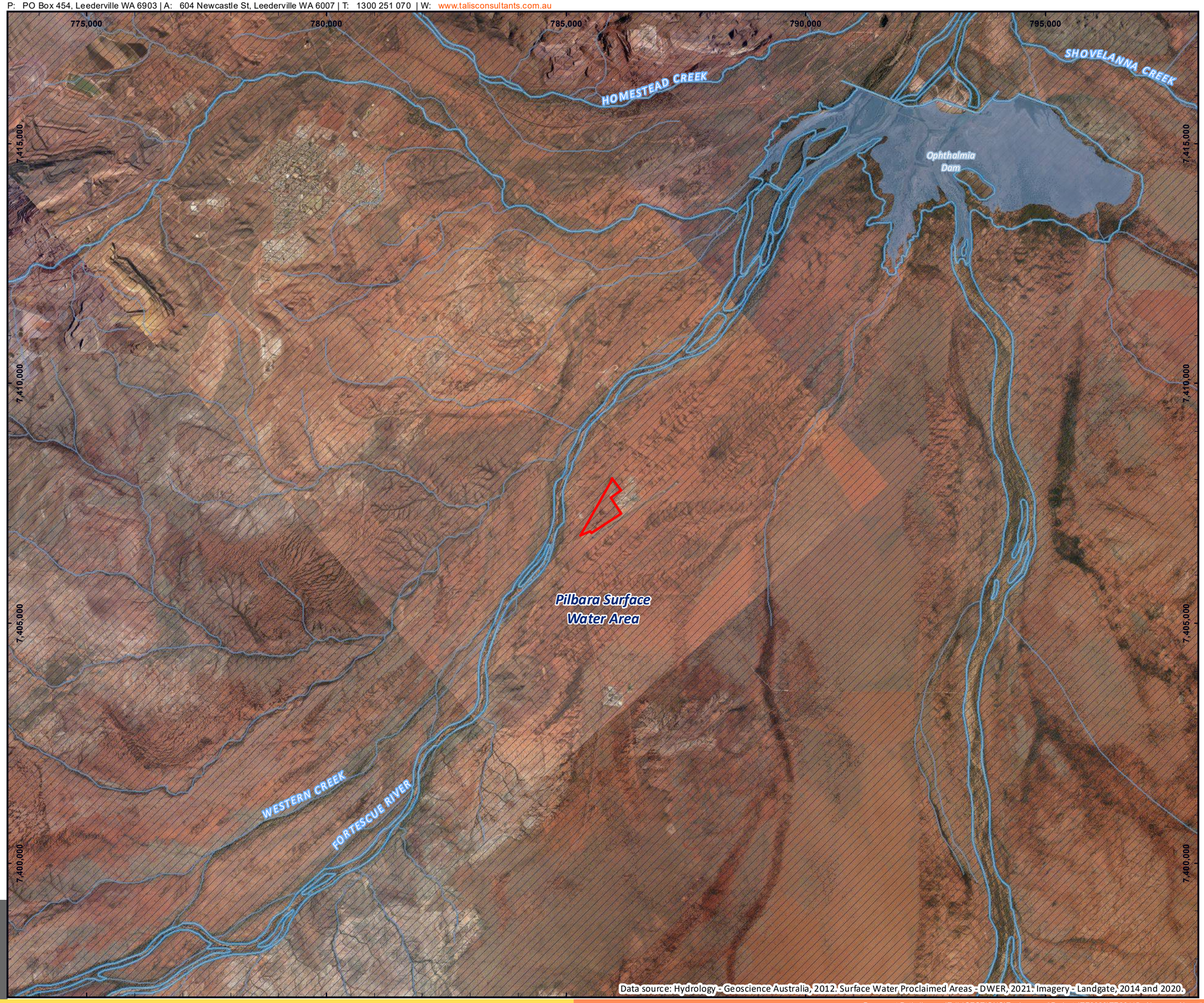

LEGEND

- Site Boundary
- Major Water Course
- Minor Water Course
- Surface Water Resource Proclaimed Area (RIWI Act)
- Non-perennial Waterbody

LOCALITY

0 100 200 300 400 km

HYDROLOGY
Newman Airport Scheme Redevelopment

Shire of East Pilbara

N

0 1 2 3 km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:75,000

Prepared: W Robertson	Date: 10/03/2021
Reviewed: A Mack	Revision: A
Project: TE20115	

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Figure 04

Data source: Hydrology - Geoscience Australia, 2012. Surface Water Proclaimed Areas - DWER, 2021. Imagery - Landgate, 2014 and 2020.

Document Path: \\server\Talis\SECTIONS\Environment\Projects\TE2020\TE20115 - Newman Airport\GIS\Maps\DesktopAssessment\TE20115_04_Hydrology_RevA.mxd

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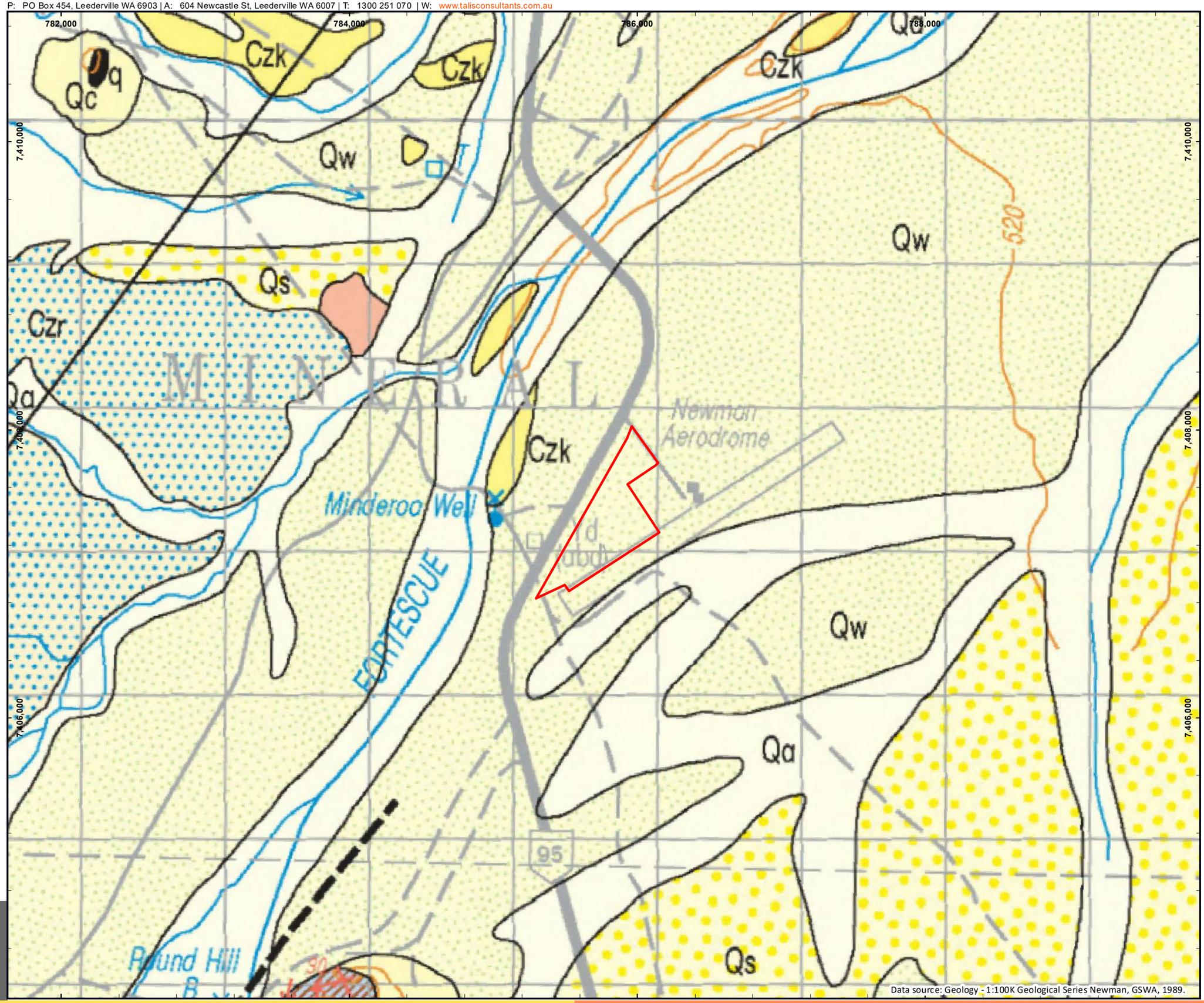

LEGEND

- Site Boundary
- Qa - Alluvium - unconsolidated silt, sand and gravel
- Qs - Eolian sand - in sheets and dunes
- Qw - Alluvium and colluvium; red-brown sandy and clayey soil
- Qc - Colluvium - unconsolidated quartz and rock fragments in soil
- Czr - Laterite including surficial hematite-geothite deposits over banded iron-formation
- Czk - Calcrete - sheet carbonate usually formed in major drainage channels
- q - Quartz vein
- ge - Granitoid rocks, undifferentiated, deeply weathered

GEOLOGY
Newman Airport Scheme Redevelopment

Shire of East Pilbara

N
0 200 400 600 800 m

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:25,000

Prepared: W Robertson	Date: 10/03/2021
Reviewed: A Mack	Revision: A
Project: TE20115	

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Figure 05

Data source: Geology - 1:100K Geological Series Newman, GSWA, 1989.

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780,000
785,000
790,000
7,410,000
7,405,000

LEGEND

Site Boundary

Acid Sulfate Soils

- A4 - High Probablilty / Very Low Confidence
- B4 - Low Probablilty / Very Low Confidence
- C4 - Extremely Low Probablilty / Very Low Confidence

LOCALITY

0 100 200 300 400 km

ACID SULFATE SOILS
Newman Airport Scheme Redevelopment

Shire of East Pilbara

N

0 0.5 1 1.5 2 km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:50,000

Prepared: W Robertson	Date: 10/03/2021
Reviewed: A Mack	Revision: A
Project: TE20115	

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Figure 06

Data source: Acid Sulfate Soils - CSIRO ASRIS, 2014. Imagery - Landgate, 2014 & 2020.

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777,500 780,000 782,500 785,000 787,500 790,000 792,500

7,412,500 7,410,000 7,407,500 7,405,000 7,402,500

Data source: ESAs - DWER, 2020. Imagery - Landgate, 2014 & 2020.

LEGEND

- Site Boundary
- Environmentally Sensitive Area
- Threatened Ecological Community

LOCALITY

ENVIRONMENTALLY SENSITIVE AREAS

Newman Airport Scheme Redevelopment

Shire of Pilbara

N

0 0.5 1 1.5 2 km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:50,000

Prepared: W Robertson	Date: 10/03/2021
Reviewed: A Mack	Revision: A
Project: TE20115	

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Figure 07

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777,500 780,000 782,500 785,000 787,500 790,000 792,500

7,412,500 7,410,000 7,407,500 7,405,000 7,402,500

Pilbara Groundwater Area

East Murchison Groundwater Area

Data source: WIN Sites, Groundwater Areas, PDWSAs - DWER, 2021.

LEGEND

- Site Boundary
- WIN Monitoring Site
- Proclaimed Groundwater Area (RIWI Act)

Public Drinking Water Source Area

- Priority 1
- Priority 3

LOCALITY

0 100 200 300 400 km

HYDROGEOLOGY
Newman Airport Scheme Redevelopment

Shire of East Pilbara

N

0 0.5 1 1.5 2 km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:50,000

Prepared:	W Robertson	Date:	10/03/2021
Reviewed:	A Mack	Revision:	A
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Figure 08

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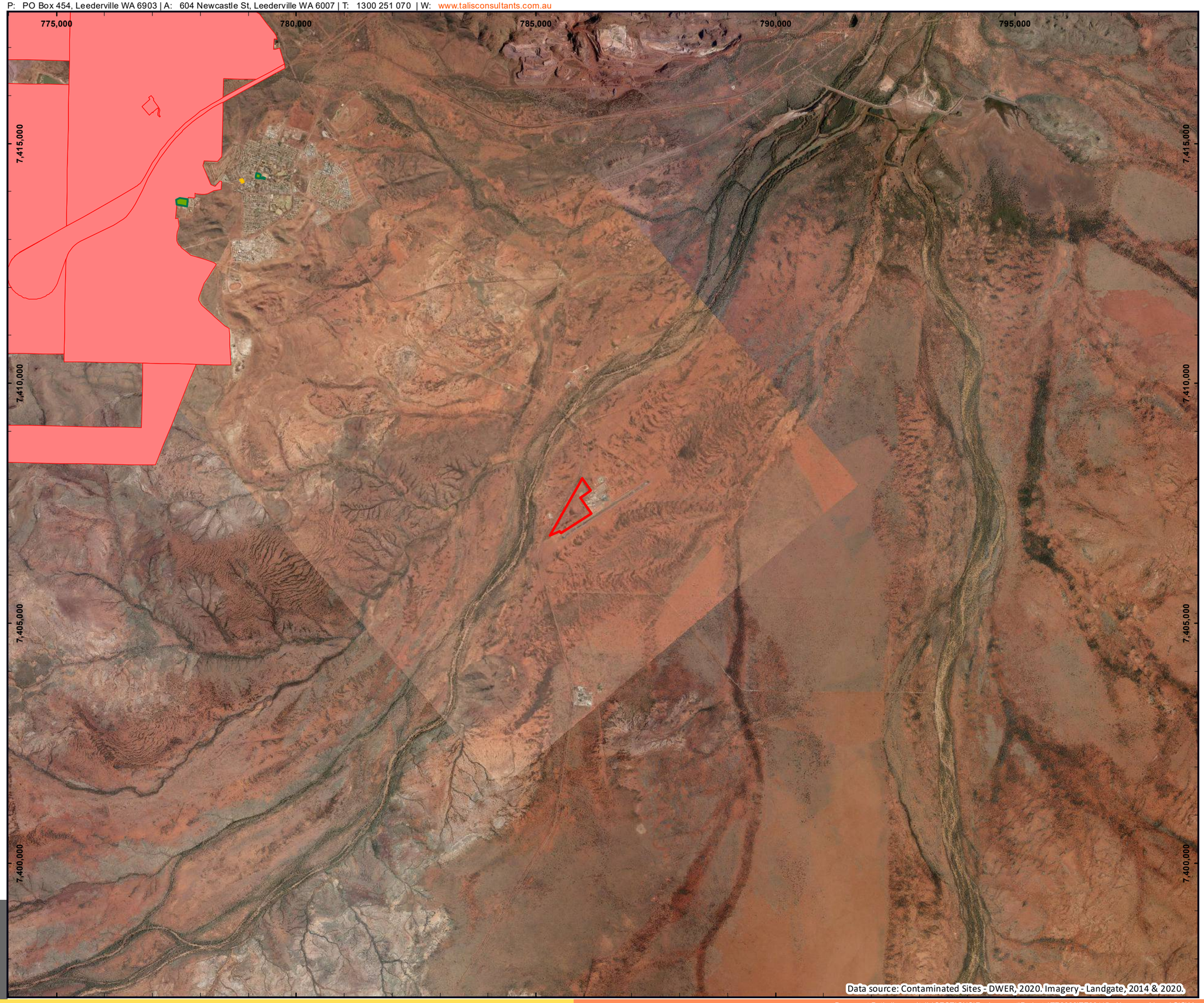

LEGEND

- Site Boundary

Contaminated Site

- Remediated for restricted use
- Contaminated - restricted use
- Contaminated - remediation required

LOCALITY

0 100 200 300 400 km

CONTAMINATED SITES

Newman Airport Scheme Redevelopment

Shire of East Pilbara

N

0 1 2 3 km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:75,000

Prepared: W Robertson	Date: 10/03/2021
Reviewed: A Mack	Revision: A
Project: TE20115	

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Figure 09

Data source: Contaminated Sites - DWER, 2020. Imagery - Landgate, 2014 & 2020.

Document Path: \\server\talis\SECTIONS\Environment\Projects\TE2020\TE20115 - Newman Airport\GIS\Maps\DesktopAssessment\TE20115_09_ContaminatedSites_RevA.mxd

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777,500 780,000 782,500 785,000 787,500 790,000 792,500

7,412,500 7,410,000 7,407,500 7,405,000 7,402,500

WCD2018/008

WCD2018/008

WCD2018/008

Data source: Native Title - National Native Title Tribunal, 2021.

LEGEND

Site Boundary

Native Title Determination Outcomes

Native title exists (non-exclusive)

Native title does not exist

LOCALITY

0 100 200 300 400 km

NATIVE TITLE

Newman Airport Scheme Redevelopment

Shire of East Pilbara

N

0 0.5 1 1.5 2 km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:50,000

Prepared:	F Walker	Date:	10/03/2021
Reviewed:	A Mack	Revision:	A
Project:	TE20115		

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Figure 10

Document Path: \\server\talis\SECTIONS\Environment\Projects\TE2020\TE20115 - Newman Airport\GIS\Maps\DesktopAssessment\TE20115_10_NativeTitle_RevA.mxd

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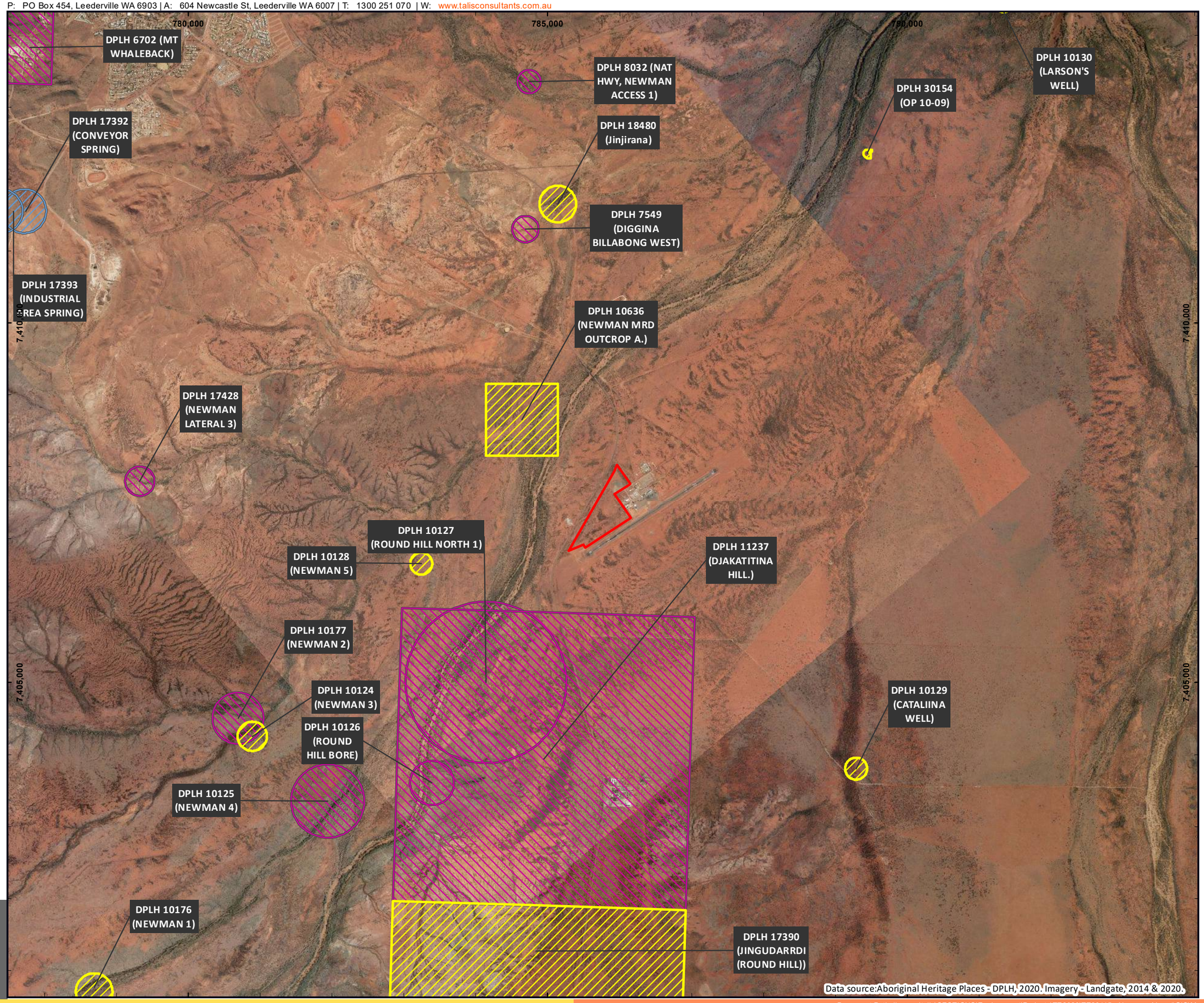

LEGEND

Site Boundary

Aboriginal Heritage Places

STATUS

- Registered Site
- Stored Data / Not a Site
- Lodged

LOCALITY

ABORIGINAL HERITAGE

Newman Airport Scheme Redevelopment

Shire of East Pilbara

N

0 0.5 1 1.5 2 km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:50,000

Prepared: W Robertson	Date: 10/03/2021
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Figure 11

Document Path: \\server\talis\SECTIONS\Environment\Projects\TE2020\TE20115 - Newman Airport\GIS\Maps\DesktopAssessment\TE20115_11_AboriginalHeritage_RevA.mxd

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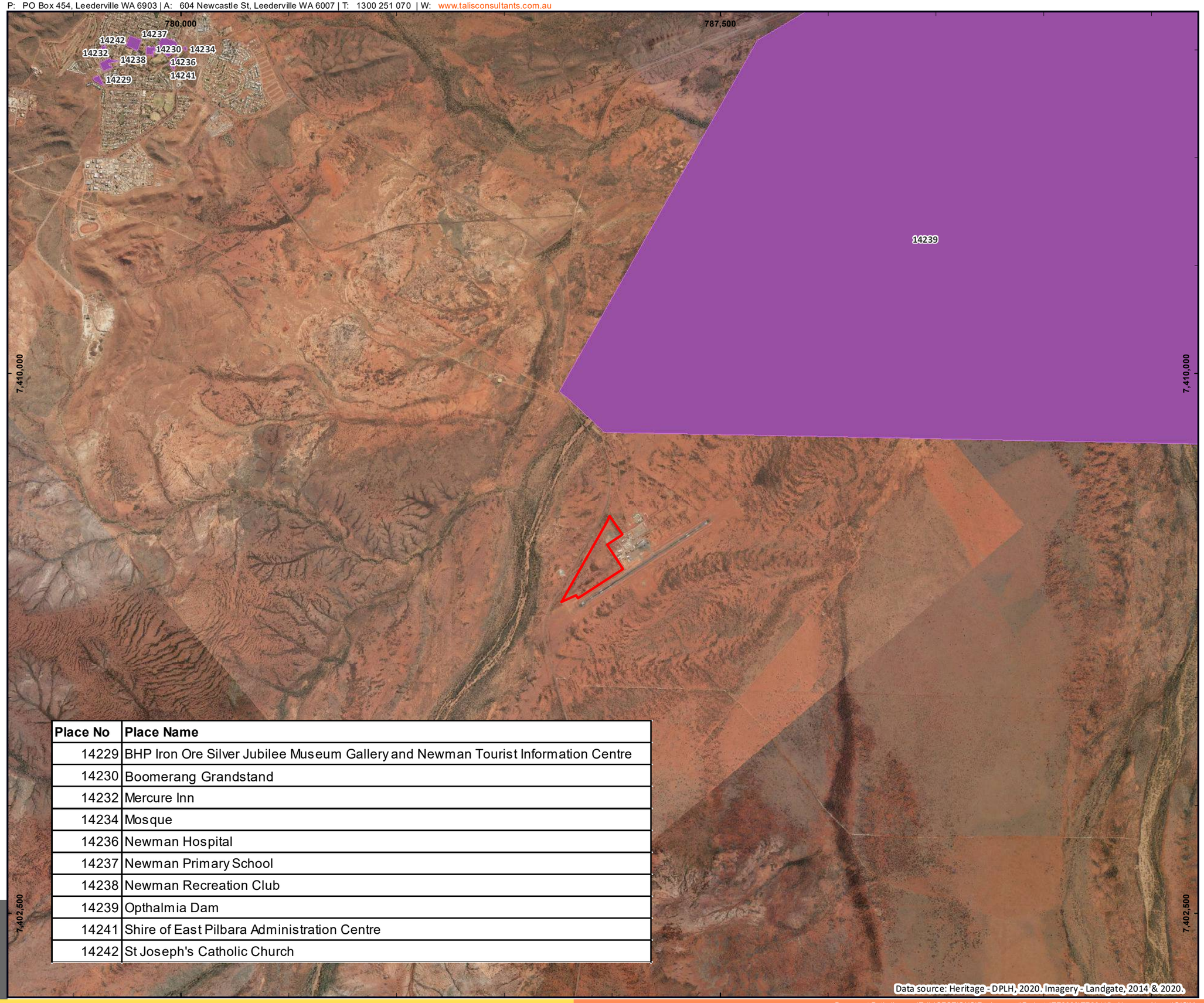

Place No	Place Name
14229	BHP Iron Ore Silver Jubilee Museum Gallery and Newman Tourist Information Centre
14230	Boomerang Grandstand
14232	Mercure Inn
14234	Mosque
14236	Newman Hospital
14237	Newman Primary School
14238	Newman Recreation Club
14239	Opthalmia Dam
14241	Shire of East Pilbara Administration Centre
14242	St Joseph's Catholic Church

Data source: Heritage - DPLH, 2020. Imagery - Landgate, 2014 & 2020.

LEGEND

- Site Boundary
- European Heritage - Local Survey

LOCALITY

0 100 200 300 400 km

AUSTRALIAN HERITAGE

Newman Airport Scheme Redevelopment

Shire of East Pilbara

N

0 0.5 1 1.5 2 km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:50,000

Prepared: W Robertson	Date: 10/03/2021
Reviewed: A Mack	Revision: A
Project: TE20115	

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Figure 12

Document Path: \\server\Talis\SECTIONS\Environment\Projects\TE2020\TE20115 - Newman Airport\GIS\Maps\DesktopAssessment\TE20115_12_AustralianHeritage_RevA.mxd

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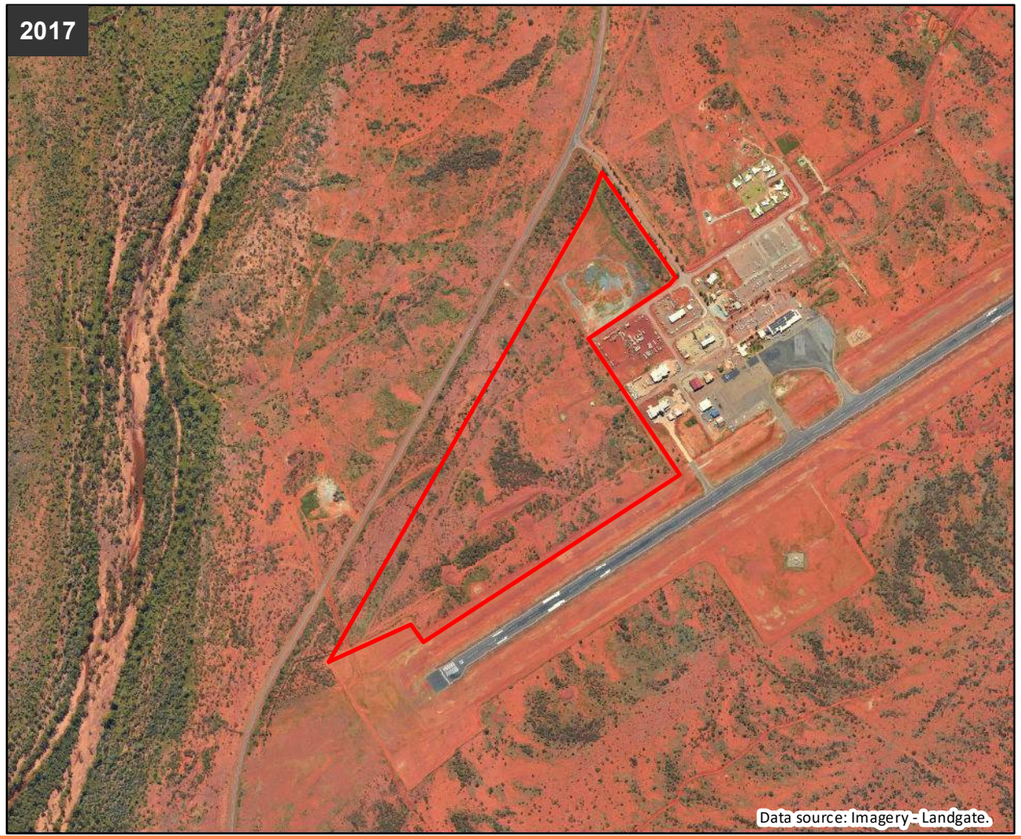

Data source: Imagery - Landgate.

LEGEND

Site Boundary

LOCALITY

0 100 200 300 400 km

HISTORICAL IMAGERY

Newman Airport
Scheme Redevelopment

Shire of Pilbara

N

0 200 400 600 m

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:15,000

Prepared: W Robertson	Date: 10/03/2021
Reviewed: A Mack	Revision: A
Project: TE20115	

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Figure 13

Document Path: \\server\Talis\SECTIONS\Environment\Projects\TE2020\TE20115 - Newman Airport\GIS\Maps\DesktopAssessment\TE20115_13_HistoricalImagery_RevA.mxd

APPENDIX A
Photo Log and Locations

Photo 1 – Stage 1 Area

Photo 2– Stage 1 Area

Photo 3– Stage 1 Area

Photo 4– Stage 1 Area

Photo 5– Stage 1 Area

Photo 6– Stage 1 Area

Photo 7– Stage 1 Area

Photo 8– Stage 1 Area

Photo 9– Stage 1 Area

Photo 10 – Stage 2 Area

Photo 11– Stage 2 Area

Photo 12 – Stage 2 Area

Photo 13 - Stage 2 Area

Photo 14 - Stage 2 Area

Photo 15 - Stage 2 Area

Photo 16 - Stage 2 Area

Photo 17 - Stage 2 Area

Photo 18 - Stage 2 Area

Photo 19 - Stage 2 Area

Photo 20 - Stage 2 Area

Photo 21 - Stage 2 Area

Photo 22 - Stage 2 Area

Photo 23 - Stage 2 Area

Photo 24 - Stage 2 Area

Photo 25 - Stage 2 Area

Photo 26 - Stage 2 Area

Photo 27 - Stage 2 Area

Photo 28 - Stage 2 Area

Photo 29 - Stage 2 Area

Photo 30 - Stage 2 Area

Photo 31 - Stage 2 Area

Photo 32 - Stage 2 Area

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785,000

786,000

7,408,000

7,408,000

7,407,000

7,407,000

Great Northern Hwy

Data source: Imagery - Landgate, 2020.

LEGEND

Site Bounday

Photo Location and Direction

LOCALITY

0 100 200 300 400 500 km

AERIAL

Newman Airport Scheme Redevelopment

Shire of East Pilbara

N

0 50 100 150 200 metres

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:5,000

Prepared: W Robertson	Date: 15/02/2021
Reviewed: H Royce	Revision: A
Project: TE20115	

talis consultants

Figure 02

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APPENDIX B

Spectrum Ecology Desktop Assessment

NEWMAN AIRPORT
DESKTOP ASSESSMENT
PREPARED FOR: TALIS

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Report Details			
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1. RESULTS

1.1. Desktop Assessment

1.1.1. Conservation Significant Fauna

The desktop assessment identified 35 conservation significant fauna species including eight mammals, 23 birds and four reptiles that have the potential to occur within the Study Area. Sixteen species of migratory water birds have been excluded from the assessment due to the lack of wetland habitats occurring in the study site; those species are listed in Appendix A.

Based on the desktop assessment, three species of conservation significance were assigned a pre-survey Medium to High likelihood of occurrence. The remaining identified species were assigned having a Low to Very Low likelihood of occurrence.

1.1.2. Significant Flora

No significant flora were identifed within the Study Area. The desktop assessment identified 52 significant flora taxa occuring within the vacinity of the Study Area, of which five were assigned pre-survey likelihood of occurance of high or medium. All significant flora identified in the desktop assessment are summarised in Table 1.2.

Table 1.1: Significant Vertebrate Fauna Recorded in the Desktop Assessment

Species	Conservation Status			Nature Map	DBCA	PMST	Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA						
Mammals									
Black-flanked Rock-wallaby (*Petrogale lateralis* subsp. *lateralis*)	EN	EN		•	•		Complex rocky substrates with multi-entranced caves, rock piles and crevices with surrounding seasonal grasses and herbs for foraging (Pearson, 2012).	Five records from 1975 25 km north of the Study Area.	**Low:** No suitable habitat within the Study Area.

Species	Conservation Status			Nature Map	DBCA	PMST	Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA						
Northern Quoll (*Dasyurus hallucatus*)	EN	EN				•	Critical denning habitats include rocky gorges, basalt hills, escarpments, mesas, boulder piles, caves and adjacent cliff faces. Foraging occurs in adjacent habitat with suitable cover and food resources (Department of the Environment, 2016).	No regional observations have been recorded. Potential habitat is listed as present in the area by the Protected Matter Search Tool (PMST).	**Low:** No suitable habitat within the Study Area and no nearby records.

Species	Conservation Status			Nature Map	DBCA	PMST	Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA						
Greater Bilby (*Macrotis lagotis*)	VU	VU		•	•	•	A variety of habitats including spinifex hummock grasslands, acacia shrublands, open woodlands and cracking clays (Dziminski and Carpenter, 2018).	One single record of the species in the vicinity is from 1979.	**Medium:** Suitable habitat may occur in the Study Area however the only record of the species in the vicinity is from 1979.
Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia (Pilbara)*)	VU	VU		•	•	•	Dissected rocky escarpments with suitable roost caves with high humidity and stable temperatures. Forages in a variety of habitats, particularly along water bodies and riparian vegetation (Armstrong, 2001; Cramer *et al.*, 2016).	153 records of the species within 34 km of the Study Area. All records are from Kalgan Creek or Ophthalmia Range.	**Low:** No suitable roosting or foraging habitat within the Study Area.

Species	Conservation Status			Nature Map	DBCA	PMST	Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA						
Ghost Bat (*Macroderma gigas*)	VU	VU		•	•	•	Use a range of strutures including caves, rock piles and abandoned mines for transient and feeding roosts. Foraging can occur up to 2 km from roosting sites. Maternity roosts require caves with specific warm, dark and humid microclimates (Armstrong and Anstee, 2000).	Eleven records of the species within 30 km of the Study Area.	**Low:** No suitable roosting or foraging habitat within the Survey Area.
Brush-tailed Mulgara (*Dasycercus blythi*)			P4	•	•		Sandy and loamy flats vegetated with hummock and/or tussock grasses, stony gibber plains where wind-blown soil or sand has accumulated (Pavey *et al.*, 2011).	Two records of the species within 20 km of the Study Area.	**Low:** Suitable habitat is unlikely to occur within the Study Area.
Western Pebble-mound Mouse (*Pseudomys chapmani*)			P4	•	•		Rocky ranges and hills with pebbled soil for mound construction. More common on the lower slopes of ridges with spinifex hummock grassland (Dunlop and Pound, 1981).	36 records of the species from between 8 - 37 km of the Study Area.	**Low:** No suitable habitat within the Study Area.
Long-tailed Dunnart (*Sminthopsis longicaudata*)			P4	•	•		Rocky hills, ranges and escarpments with open woodland and/or shrubland over spinifex (Pavey, 2006).	Four records within 16 km of the Study Area.	**Low:** No suitable habitat within the Study Area.
Birds									

Species	Conservation Status			Nature Map	DBCA	PMST	Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA						
Night Parrot (*Pezoporus occidentalis*)	CR	EN				•	Recorded from long unburnt, ring forming *Triodia* grasslands in association with low lying saline lakes and drainages hosting chenopods/samphire (Jackett *et al.*, 2017).	No regional observations have been recorded. Potential habitat is listed as present in the area by the Protected Matter Search Tool (PMST).	**Low:** No suitable habitat within the Study Area.
Australian Painted Snipe (*Rostratula australis*)	EN	EN				•	Shallow terrestrial freshwater wetlands, lakes and swamps, typically with low, dense fringing vegetation. Favours sites with shallow water and exposed mud (Menkhorst *et al.*, 2019).	No regional observations have been recorded. Potential habitat is listed as present in the area by the Protected Matter Search Tool (PMST).	**Low:** Suitable habitat does not occur in the Study Area; no nearby records.
Grey Falcon (*Falco hypoleucos*)	VU	VU				•	Likely a nomadic species in the arid and semi-arid zones. Does not appear to be assocaited with any particular vegetation types (Schoenjahn, Pavey and Walter, 2020).	No regional observations have been recorded. Potential habitat is listed as present in the area by the Protected Matter Search Tool (PMST).	**Low:** Foraging habitat may occur in the Study Area but no records in the vicinity.
Princess Parrot (*Polytelis alexandrae*)	VU		P4			•	Swales between sand dunes. Associated sites usually have a variety of shrubs among scattered trees and a ground cover of *Triodia* species. In the arid zone of western and central Australia (Department of the Environment, 2018).	No regional observations have been recorded. Potential habitat is listed as present in the area by the Protected Matter Search Tool (PMST).	**Low:** Suitable habitat does not occur in the Study Area. No nearby records.

Species	Conservation Status			Nature Map	DBCA	PMST	Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA						
Fork-tailed Swift (*Apus pacificus)*	MI	MI				•	Nomadic, almost entirely aerial lifestyle over a variety of habitats; associated with storm fronts (Australian Government 2020).	No regional observations have been recorded. Potential habitat is listed as present in the area by the Protected Matter Search Tool (PMST).	**Low:** Always a possibility due to association with storm fronts.
Barn Swallow (*Hirundo rustica*)	MI	MI				•	Open country with low vegetation, farmlands and meadows (Department of the Environment, 2020).	No regional observations have been recorded. Potential habitat is listed as present in the area by the Protected Matter Search Tool (PMST).	**Low:** No suitable habitat in the Study Area; no nearby records.
Peregrine Falcon (*Falco peregrinus*)		OS		•	•		Occur across much of Australia inhabiting cliffs, coastal habitats, rivers, wooded water courses and lakes (Bird Life Australia, 2012).	Six records from between 8 - 28 km of the Study Area.	**High:** Foraging habitat is likely to occur in the Study Area; several records of the species from nearby.
Reptiles									
Pilbara Olive Python (*Liasis olivaceus* subsp. *barroni*)	VU	VU		•	•	•	Inhabits gorges, gullies, stony ranges, rock piles and along watercourses. Often associated with permanent and temporary water bodies thoguh is not restricted to them. Habitat requirements are likely to vary throughout the year (DSEWPaC 2011).	Eight records from beteween 13 - 30 km of the Study Area.	**Low:** No suitable habitat in the Study Area.
Ganes Blind Snake (Pilbara) (*Anilios ganei*)			P1	•	•		A variety of habitats, thought to prefer moist gorges though habitat data is limited (Aplin, 1998).	Ten records of the species within 36 km of the Study Area.	**Low:** Suitable habitat is unlikely to occur in the Study Area.

Species	Conservation Status			Nature Map	DBCA	PMST	Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA						
Spotted Ctenotus (northeast) (*Ctenotus uber* subsp. *johnstonei*)			P2	•			Known primarily from chenopod shrubland at the base of sandstone hills. Often associated with small rock outcrops on open sandy and stony plains (Cogger, 2014).	Four records within 24 km of the Study Area.	**Low:** Suitable habitat is unlikely to occur in the Study Area.
Unpatterened Robust Slider (Roberston Range) (*Lerista macropisthopus* subsp. *remota*)			P2	•			Woodlands and semi-arid shrublands with sandy to sandy loam soils (Cogger, 2014).	Three records from between 17 - 23 km fo the the Study Area.	**Medium:** Suitable habitat may occur in the survey area; nearby records from 18 km west of the Study Area.

Table 1.2: Significant Flora Recorded in the Desktop Assessment

Likelihood of Occurrence	Status	Taxon	Description	Habitat	Distance from Survey Area (km)	Flowering Time	AVH	TPFL	WAHerb	Ecoscape	Nature Map	Onshore Environmental
High	P3	*Aristida jerichoensis var. subspinulifera*	Compactly tufted perennial, grass-like or herb, 0.3-0.8 m high, lemma groove muricate.	Flat terrain. Red clay loam, low in landscape. Hardpan plains.	8.8	Apr.	X		X			
Medium	P1	*Eremophila capricornica*	A small shrub 50–75 cm high, 50–75 cm wide. Branches terete, with woolly dendritic hairs	Found from east of Newman across to Jigalong, growing in sandy clay loams in open mulga shrubland with an understory of Triodia spp. and other grasses	33.5	June-August		X	X		X	
Medium	P3	*Eremophila rigida*	Bushy shrub, 0.3-4 m high. Fl. cream, Sep.	Red sand alluvium. Hardpan plains, stony clay depressions.	13.9	Sept.		X	X		X	
Medium	P3	*Rhagodia sp. Hamersley (M. Trudgen 17794)*	Erect shrub to 1.5m.	Flat plain. Floodplain. Hillslope. Red sandy loam with surface cobbles.	22.9	May		X	X	X	X	X
Medium	P4	*Goodenia nuda*	Erect to ascending herb, to 0.5 m high. Fl. Yellow.	Drainage line. Red/brown clay loam soils. Floodplains. Brown loam/ironstone.	12.4	Apr to Aug.	X		X	X	X	X
Low	T	*Seringia exastia*	Rounded shrub to 30 cm tall, in full flower.	Ridge top. Brown/red loam. Collection site: mining tenement. Recently burnt: 2-5 years.	23.7	April to Dec.	X		X			
Low	P1	*Acacia corusca*	Rounded to broadly rounded, robust, multi-stemmed shrub or small tree 1.5-4.0 (-5.0) m high, 1.5-5 (-6.0) m wide	Grows on red-brown sandy-loam soils on hill crests, ridges, slopes and minor drainage lines upon low, subdued and undulating stony hills	31.6	April-Aug.			X		X	
Low	P1	*Eremophila pilosa*	Shrub, ca 0.8 m high. Fl. Purple	Grows in red-brown clay loam on sandy plains between Jigalong and Roy Hill	51.1	Sep	X	X	X	X		
Low	P1	*Eremophila rhegos*	Erect shrub, ca 1 m high. Fl. blue-purple-white	Skeletal stony loam over granite.	34.8	Sept.			X		X	
Low	P1	*Eremophila sp. Hamersley Range (K. Walker KW 136)*	Shrub to 2m tall. Rounded crowded canopy. Flowers white-cream-yellow-pink-purple.	Hill crest. Creek embankments. Gullies.	10.7	Aug.			X		X	

Likelihood of Occurrence	Status	Taxon	Description	Habitat	Distance from Survey Area (km)	Flowering Time	AVH	TPFL	WAHerb	Ecoscape	Nature Map	Onshore Environmental
Low	P1	*Eremophila sp. West Angelas (S. van Leeuwen 4068)*	Spindly shrub to 3 m high.	Summits of hills. Slopes.	48.3	Sept. to Oct.			X			
Low	P1	*Hibiscus campanulatus*	Shrub or tree. Stems hairy.	-	unknown	Aug.		X				
Low	P1	*Lindernia sp. Pilbara (M.N. Lyons & L. Lewis FV 1069)*	-	Low open forest of Eucalyptus victrix over low open shrubland of Duma florulenta	77.2	Unknown.			X			
Low	P1	*Myriocephalus scalpellus*	Semi-erect herb, 0.03-0.08 m high.	Clay. Depression on flood plain.	76.8	Unknown		X	X			
Low	P1	*Rorippa sp. Fortescue Valley (M.N. Lyons & R.A. Coppen FV 0760)*	-	Low open forest of Eucalyptus victrix over low open shrubland of Duma florulenta	77.2	Unknown			X			
Low	P1	*Tecticornia globulifera*	Perennial shrub to 0.3–0.5 m high. Vegetative articles globular to obovoid, not compressed green or pink to red.	Moderately saline flats on red-brown gritty clay.	71.6	Unknown			X			
Low	P1	*Triodia pascoeana*	Dense, tussock-forming perennial, grass-like or herb, 1-3 m high, non-resinous, panicle long-linear, extremely scabrous, lemma 3-lobed, awnless.	Limestone ranges & gorges, floodplains.	9.6	Jan to Apr	X					
Low	P1	*Vallisneria sp. Weelarrana (M.N. Lyons & S.D. Lyons 3050)*	-	Flat/plain to very broad open drainage depression. Dry, well-drained, brown clay loam.	71.7	Unknown			X			
Low	P1	*Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684)*	Tall daisy to 1 m , open canopy, in late flower and dehiscing fruit, cream/white flowers.	Flat terrain, low in landscape. Red clay loam with some stone. Gilgai. Drainage lines.	25.0	Jul.			X		X	
Low	P2	*Aristida lazaridis*	Tufted perennial, grass-like or herb, 0.4-1.5 m high. Fl. green/purple, Apr.	Clay plains of an ephemeral lake. Floodplain/drainage zone. Sand or loam.	41.1	Apr.			X			

Likelihood of Occurrence	Status	Taxon	Description	Habitat	Distance from Survey Area (km)	Flowering Time	AVH	TPFL	WAHerb	Ecoscape	Nature Map	Onshore Environmental
Low	P2	*Euphorbia inappendiculata var. inappendiculata*	Herb to 2 cm.	Flat, red brown loam. Cracking clay.	26.5	Unknown.			X		X	
Low	P2	*Goodenia hartiana*	Erect to spreading, multistemmed perennial, herb or shrub (sub-shrub).	Sand. Sand dune swales, sandhills.	24.1	Aug. to Sept.	X	X	X		X	
Low	P2	*Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)*	Spindly upright shrub to 3 m tall, purple flower.	Rocky (boulder) slope below low cliffs. Gully. Gravelly, pebbly red-brown loam.	50.2	May & July			X			
Low	P2	*Ipomoea racemigera*	Creeping annual, herb or climber. Fl. white.	Fringing vegetation of river.	9.6	Unknown.	X		X		X	
Low	P2	*Isotropis parviflora*	Shrub, 0.1 m high. Fl. white/pink, Mar.	Low rocky hill. Red-brown loam soils and ironstone gravel.	21.7	Feb. to Mar., May	X		X		X	
Low	P2	*Oxalis sp. Pilbara (M.E. Trudgen 12725)*	Small herb to 10 cm tall. Leaves green above, purple below; yellow flowers.	Gully. Brown-red loam.	54.9	May			X			
Low	P3	*Acacia subtiliformis*	Spindly, slender, erect shrub, to 3.5 m high, phyllodes green, new growth slightly viscid, resinous, aromatic; inflorescence in heads to 6 mm diameter; peduncles red	Rocky calcrete plateau.	39.6	June, yellow		X	X		X	
Low	P3	*Amaranthus centralis*	Erect, to 60 cm high. Stems angular, sometimes reddish, sparsely hairy	Red sand in ephemeral watercourses. Sandy to clayey loam. River banks. Edges of permanent pools in eucalypt lined channels.	47.4	Flowers throughout the year		X	X			
Low	P3	*Calotis latiuscula*	Erect herb, to 0.5 m high. Fl. yellow,	Sand, loam. Rocky hillsides, floodplains, rocky creeks or river beds.	15.9	Jun to Oct.	X					
Low	P3	*Crotalaria smithiana*	Annual, herb, to 0.4 m high. Fl. yellow,	Regeneration site on floodplain.	29.0	Jun.	X		X		X	

Likelihood of Occurrence	Status	Taxon	Description	Habitat	Distance from Survey Area (km)	Flowering Time	AVH	TPFL	WAHerb	Ecoscape	Nature Map	Onshore Environmental
Low	P3	*Dampiera metallorum*	Rounded, multi-stemmed perennial, herb, to 0.5 m high. Fl. blue, Apr or Jun to Oct.	Skeletal red-brown gravelly soil over banded ironstone. Steep slopes. Summits of hills.	63.4	April/June - Oct.		X	X			
Low	P3	*Eremophila magnifica subsp. velutina*	Shrub, 0.5-1.5 m high. Fl. blue-purple, Aug to Sep.	Skeletal soils over ironstone. Summits.	26.8	Aug.-Sept.			X		X	
Low	P3	*Eucalyptus rowleyi*	Mallee to 4 m high. Smooth whitish bark to base.	On flat red soil	70.9	Unknown.			X			
Low	P3	*Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)*	Open, erect annual or biennial, herb, to 0.2 m high. Fl. yellow.	Red-brown clay soil. Calcrete pebbles. Low undulating plain, swampy plains.	7.1	Feb. March & May		X	X		X	
Low	P3	*Grevillea saxicola*	Tall shrub to 2.5 m.	Breakaway. Scree slope.	64.8	Nov. to Mar.			X			
Low	P3	*Gymnanthera cunninghamii*	Erect shrub, 1-2 m high. Fl. cream-yellow-green	Sandy soils. Drainage lines.	13.2	Jan to Dec.	X	X	X		X	
Low	P3	*Indigofera gilesii*	Shrub, to 1.5 m high. Fl. purple-pink, May or Aug.	Pebbly loam. Amongst boulders & outcrops, hills.	22.0	May or August	X	X	X		X	
Low	P3	*Iotasperma sessilifolium*	Erect herb. Fl. pink.	Cracking clay, black loam. Edges of waterholes, plains.	74.9	Jul. to Sept.			X			
Low	P3	*Maireana prosthecochaeta*	Open, densely-leaved shrub, 0.3-0.6 m high.	Laterite. Hills, salty places.	42.7	June to Sept.?		X	X			
Low	P3	*Sida sp. Barlee Range (S. van Leeuwen 1642)*	Spreading shrub, to 0.5 m high. Fl. Yellow.	Skeletal red soils pockets. Steep slope.	50.3	Aug.			X			
Low	P3	*Stylidium weeliwolli*	Annual, herb, 0.1-0.25 m high, throat appendages 4, rod-shaped. Fl. pink & red.	Gritty sand soil, sandy clay. Edge of watercourses.	67.1	Aug to Sep.			X			
Low	P3	*Swainsona thompsoniana*	Erect, herb. Stems terete, not spiny, glabrous.	Flat crabhole plain.	8.9	Apr. Jun. & Aug.	X		X			
Low	P3	*Tecticornia medusa*	Shrub 0.4 m. Bright green utricles.	Edge of large saltlake.	71.6	July & Nov.			X			
Low	P3	*Themeda sp. Hamersley Station (M.E. Trudgen 11431)*	Tussock grass.	Flat terrain, low in landscape. Red loamy soil with some alluvial sand material and stones.	32.2	Unknown						
Low	P3	*Triodia sp. Mt Ella (M.E. Trudgen 12739)*	Perennial, grass-like or herb, 0.4 m high.	Gullies. Hill slopes. Drainage lines.	23.0	Jan. to Apr.?			X			

Likelihood of Occurrence	Status	Taxon	Description	Habitat	Distance from Survey Area (km)	Flowering Time	AVH	TPFL	WAHerb	Ecoscape	Nature Map	Onshore Environmental
Low	P3	*Xerochrysum boreale*	Erect perennial, branched herb to 50 cm high. Stems glandular-hirtellus.	Stony surface. Red brown clay loam.	52.8	Unknown			X			
Low	P4	*Acacia bromilowiana*	Tree or shrub, to 12 m high, bark dark grey, fibrous; phyllodes more or less glaucous & slightly pruinose; inflorescence in spikes. Fl. yellow/pink, Jul to Aug.	High in landscape. Edge of cliff. Rocky ironstone scree. Skeletal soil.	48.3	July - Aug. yellow/pink	X					
Low	P4	*Eremophila magnifica subsp. magnifica*	Shrub, 0.5-1.5 m high. Fl. blue, Aug to Nov.	Skeletal soils over ironstone. Rocky screes.	13.0	Aug.-Nov.	X		X		X	
Low	P4	*Eremophila youngii subsp. lepidota*	Eremophila youngii is an erect, highly-branched, shrub which grows to a height of between 1 and 4 m.	Stony red sandy loam. Flats plains. Floodplains, sometimes semi-saline. Clay flats.	20.3	Unknown.	X		X	X	X	
Low	P4	*Goodenia berringbinensis*	Ascending annual, herb, 0.1-0.3 m high. Fl. yellow,	Red sandy loam. Along watercourses.	20.3	Oct.			X		X	
Low	P4	*Lepidium catapycnon*	Open, woody perennial, herb or shrub, 0.2-0.3 m high, stems zigzag. Fl. white, Oct.	Skeletal soils. Hillsides.	15.9	Oct.-Jan.	X	X	X		X	
Low	P4	*Ptilotus trichocephalus*	Prostrate, spreading perennial, herb. Fl. white,	Sandy soils. Colluvial plains.	67.1	Sep.			X			

1.1.3. Short Range Endemic Invertebrates

The West Australian Musuem database search identified 72 Arachnid, 23 Crustacean and three Mollusc species of potential short range endmic invertebrates. Twenty-six species of Arachnids and all 23 species of Crustaceans returned from the this SRE database search are subterranean and were excluded from this assessment. A further six species of Arachnids (mites) and two species of Molluscs are freshwater aquatic invertebrates and were also excluded.

Three species were assigned a High likelihood of occurrence and eight a Medium. All other species were assigned a Low likelihood of occurring in the Study Area.

Table 1.3: Western Australian Museum Invertebrate Database Results

Class/ Order/ Family	Species	Distance and Direction of Nearest Record from Study Area	Likelihood of Occurrence
ARACHNIDA			
Araneomorphae			
Desidae	'Forsterina grp. Genus' 1 'sp. 5'	9 km NW	**Medium:** Records are from an area that has been cleared so habitat cannot be assessed from imagery; however habitat described in database (tree and saltbush) may occur in Study Area.
Lamponidae	Asadipus 'areyonga'	39 km E	**Low:** Single record is from a hill slope; similar habitat does not occur in the Study Area.
Lycosidae	Venator 'sp. (VWF1244)'	49 km SE	**Low:** Two records 49 km away in habitat unlikely to occur in the Study Area. A further six records over 1,000 km away appear to be a mapping error (wrong coordinates).
Oonopidae	Myrmopopaea 'sp. 10'	37 km E	**Low:** Record is from a creekline; similar habitat is unlikely to occur within the Study Area.
Salticidae	'Neon' 'PBS sp. 3'	39 km E	**Low:** Single record is from a hill slope; similar habitat does not occur in the Study Area.
Selenopidae	Karaops 'sp. indet. (juvenile)'	24 km NE	**Low:** Records are from rocky gorge/ breakaway habitats not found in the Study Area.
Selenopidae	Karaops 'ARA003'	21 km NE	**Low:** Most records are from under rocks on southern slopes. Similar habitat does not occur in the Study Area.
Selenopidae	Karaops 'ARA004'	33 km NE	**Low:** Records are from under rocks on southern slopes. Similar habitat does not occur in the Study Area.
Selenopidae	Karaops 'ARA005'	10 km N	**Low:** Records are from slopes, gorges or gullies. Similar habitat does not occur in the Study Area.
Zodariidae	Spinasteron 'leeuweni'	11 km W	**Low:** Nearby records are from areas that have been cleared so unable to assess habitat from imagery; further records are from spinifex plains; similar habitat does not occur in the Study Area. **Unlikely to be an SRE due to distribution.**

Class/ Order/ Family	Species	Distance and Direction of Nearest Record from Study Area	Likelihood of Occurrence
Mygalomorphae			
Anamidae	Aname watsoni	14 km W	**Low:** Specimens recorded from open floodplains; similar habitat does not occur in the study area.
Anamidae	Kwonkan 'MYG098'	14 km W	**Low:** Records from gullies and open floodplains. Similar habitat does not occur in the Study Area.
Anamidae	Kwonkan 'MYG651'	18 km W	**Medium:** One record in similar habitat to the Study Area. Two other records from a gully and ridge; similar habitat does not occur in the Study Area.
Barychelidae	Aurecocrypta 'MYG315'	12 km N	**Medium:** Records are from flat, open habitats across a wide distance. **Unlikley to be an SRE due to distribution.**
Euagridae	Cethegus 'MYG299'	13 km N	**High:** Records appear to be from flat, open shrubland. Similar habitat occurs in the Study Area.
Halonoproctidae	Conothele 'MYG385'	9 km N	**Low:** Single record is from a gully; similar habitat does not occur in the Study Area.
Halonoproctidae	Conothele 'MYG558'	15 km N	**Low:** Three records are from shallow or deep gullies; similar habitat does not occur in the Study Area.
Halonoproctidae	Conothele 'MYG575'	12 km N	**Medium:** Single record is from a vegetation grove in open woodland; similar habitat may occur in the Study Area.
Idiopidae	Gaius 'MYG286'	25 km E	**Medium:** Records from a variety of habitats including a plain, mulga woodlands and a gully. Suitable habitat may occur in the Study Area.
Idiopidae	Idiosoma 'MYG384'	34 km NE	**High:** Records are from a variety of habitats including flat, open shrublands similar to that occurring in the Study Area.
Geophilida			
Geophilidae	'Zelanophilus?'	31 km E	**Medium:** Location of the single record has been cleared so habitat cannot be assessed from imagery, however surrounding area may have similar habitat to Study Area.
Polydesmida			
Paradoxosomatidae	Antichiropus 'DIP042, wheelarra'	39 km E	**Low:** One record from a hillslope; similar habitat does not occur in the Study Area.
Paradoxosomatidae	Antichiropus 'DIP051, pannawonica'	14 km N	**High:** Single specimen is in similar habitat to the Study Area
Paradoxosomatidae	Antichiropus 'OB35_1? (female)'	16 km W	**Low:** Single specimen is from a densely vegetated gully. No similar habitat occurs in the Study Area.
Paradoxosomatidae	Antichiropus 'OB35_2? (female)'	19 km W	**Low:** Single specimen is from a densely vegetated gully. No similar habitat occurs in the Study Area.
Paradoxosomatidae	Antichiropus cristatus	22 km W	**Low**: Specimens are from slopes with spinifex. No similar habitat occurs in the Study Area.

Class/ Order/ Family	Species	Distance and Direction of Nearest Record from Study Area	Likelihood of Occurrence
Paradoxosomatidae	Antichiropus verutus	16 km W	**Low:** Records are from rocky slopes, gullies and ridgebases. No similar habitat occurs within the Study Area.
Polyxenida			
Polyxenidae	Unixenus 'mjoebergi'	14 km W	**Low:** Single record is from an open floodplain. Similar habitat does not occur in the Study Area.
Pseudoscorpines			
Garypidae	Synsphyronus 'PSE086'	33 km N	**Low:** Single record is from a deep gully. Similar habitat does not occur in the Study Area.
Garypidae	Synsphyronus 'PSE129'	13 km N	**Low:** Single records is from under rocks on a hill side. Similar habitat does not occur in the Study Area.
Olpiidae	Beierolpium 'sp. 8/1'	14 km N	**Medium:** Single record from habitat similar to that that may occur in the Study Area.
Olpiidae	Xenolpium 'PSE079'	30 km NE	**Low:** Records appear associated with heavily vegetated habitats unlikely to occur in the Study Area.
Feaellidae	Feaella callani	15 km N	**Low:** Records are from under rocks in a hilly area; similar habitat does not occur within the Study Area.
Scolopendrida			
Scolopendridae	Scolopendra 'sp. indet. (juvenile)'	23 km E	**Low:** Most records are from flood plains, gullies or creeklines. Spatial variation in habitats indicates records may not all be the same species.
Scorpiones			
Buthidae	Lychas 'harveyi group' 'SCO038'	43 km NW	**Medium:** Two of three records are from similar habitat to the Study Area, however these are located over 60 km away.
Buthidae	Lychas 'pilbara 1' SCO041'	41 km NW	**Low:** Two records are over 40 km from the Study Area in habitats unlikely to occur in the Study Area.
Buthidae	Lychas 'Pilbara sp. 2'	14 km N	**Low:** One record from a ridge line. Similar habitat does not occur in the Study Area.
Buthidae	Lychas bituberculatus 'SCO042'	41 km NW	**Low:** Records are from open Eucalypt woodlands; similar habitat is unlikely to occur in the Study Area.
Urodacidae	Urodacus 'pilbara 12'	16 km W	**Low:** Records are from habitats such as gullies, ridges and rocky slopes. Similar habitats do not occur in the Study Area.
Spirobolida			
Trigoniulidae	Austrostrophus 'sp. (fragment)'	41 km N	**Low:** Records are all from moist habitats e.g. creek margins that do not occur in the Study Area.
GASTROPODA			
Charopidae	Discocharpa sp.	27 km N	**Low:** Two records from a rock scree slope in gully. Similar habitat does not occur in the Study Area.

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Appendix A: Migratory Water Birds

Table 2.1: Migratory Water Birds Recorded in the Database Search

Species	Conservation Status			Nature Map	DBCA	PMST	Preferred Habitats	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA					
Migratory Shorebirds								
Common Sandpiper (*Actitis hypoleucos*)	MI	MI		•	•	•	Coastal habitats include wetlands, estuaries, mudflats, rocky inlets, reefs and sandy beaches. Inland habitats include wetlands, floodplains and grassland areas, ephemeral water sources (Reference EPBC Act Policy Statement 3.21).	**Very Low:** No suitable habitat occurs in the Study Area.
Sharp-tailed Sandpiper (*Calidris acuminata*)	MI	MI		•	•	•		
Curlew Sandpiper (*Calidris ferruginea*)	CR	CR		•	•	•		
Pectoral Sandpiper (*Calidris melanotos*)	MI	MI		•	•	•		
Red-necked Stint (*Calidris ruficollis*)	MI	MI		•	•			
Long-toed Stint (*Calidris subminuta*)	MI	MI		•	•			
Oriental Plover (*Charadrius veredus*)	MI	MI			•	•		
Wood Sandpiper (*Tringa glareola*)	MI	MI		•	•			
Common Greenshank (*Tringa nebularia*)	MI	MI		•	•			
Marsh Sandpiper (*Tringa stagnatillis*)	MI	MI		•	•			
Common Redshank (*Tringa totanus*)	MI	MI		•	•			

Species	Conservation Status			Nature Map	DBCA	PMST	Preferred Habitats	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA					
Other Migratory Water Birds								
Gull-billed Tern (*Gelochiledon nilotica*)	MI	MI		•	•		Primarily on tidal flats but also occurs inland on large ephemeral lakes and wetlands (Menkhorst *et al.*, 2019).	**Very Low:** No suitable habitat occurs in the Study Area.
Caspian Tern (*Hydroprogne caspia*)	MI	MI		•	•		Coastal waters. Inland occurs in large rivers, lakes of varying salinity, resevoirs and temporary wetlands (Menkhorst *et al.*, 2019).	**Very Low:** No suitable habitat occurs in the Study Area.
Glossy Ibis (*Plegadis falcinellus*)	MI	MI		•	•		Lakes, rivers, lagoons, flood-plains, swamps, resevoirs and sewage ponds. Forages in fringing freshwater marshes (Australian Government & Department of Agriculture Water and the Environment, 2021).	**Very Low:** No suitable habitat occurs in the Study Area.
Grey Wagtail (*Motacilla cinerea*)	MI	MI				•	Fast-flowing watercourses, lakes ploughed fields and creeks (Pizzey and Knight, 2012).	**Very Low:** Rare visitor to Australia, no nearby records. Potential habitat is listed as present in the area by the Protected Matter Search Tool (PMST). No regional observations have been recorded.
Yellow Wagtail (*Motacilla flava*)	MI	MI				•	Damp and wet habitats with low vegetation including meadows, marshes and waterside pastures (Birdlife International, 2020).	**Very Low:** Rare visitor to Australia, no nearby records. Potential habitat is listed as present in the area by the Protected Matter Search Tool (PMST). No regional observations have been recorded.

Assets | Engineering | Environment | Noise | Spatial | Waste

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APPENDIX B
Photo Log and Locations

Photo 1 – Stage 1 Area

Photo 2– Stage 1 Area

Photo 3– Stage 1 Area

Photo 4– Stage 1 Area

Photo 5– Stage 1 Area

Photo 6– Stage 1 Area

Photo 7– Stage 1 Area

Photo 8– Stage 1 Area

Photo 9– Stage 1 Area

Photo 10 – Stage 2 Area

Photo 11– Stage 2 Area

Photo 12 – Stage 2 Area

Photo 13 - Stage 2 Area

Photo 14 - Stage 2 Area

Photo 15 - Stage 2 Area

Photo 16 - Stage 2 Area

Photo 17 - Stage 2 Area

Photo 18 - Stage 2 Area

Photo 19 - Stage 2 Area

Photo 20 - Stage 2 Area

Photo 21 - Stage 2 Area

Photo 22 - Stage 2 Area

Photo 23 - Stage 2 Area

Photo 24 - Stage 2 Area

Photo 25 - Stage 2 Area

Photo 26 - Stage 2 Area

Photo 27 - Stage 2 Area

Photo 28 - Stage 2 Area

Photo 29 - Stage 2 Area

Photo 30 - Stage 2 Area

Photo 31 - Stage 2 Area

Photo 32 - Stage 2 Area

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785,000

786,000

7,408,000

7,407,000

Great Northern Hwy

Data source: Imagery - Landgate, 2020.

LEGEND

- Site Bounday
- Photo Location and Direction

LOCALITY

0 100 200 300 400 500 km

AERIAL
Newman Airport
Scheme Redevelopment

Shire of East Pilbara

N

0 50 100 150 200 metres

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3: 1:5,000

Prepared: W Robertson	Date: 15/02/2021
Reviewed: H Royce	Revision: A
Project: TE20115	

talis consultants

Figure 02

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APPENDIX C

Spectrum Ecology Assessment

NEWMAN AIRPORT RECONNAISSANCE FLORA & BASIC FAUNA ASSESSMENT

PREPARED FOR: TALIS CONSULTANTS / SHIRE OF EAST PILBARA

Spectrum ECOLOGY & SPATIAL

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Report Details			
Project Description:	Newman Airport Reconnaissance Flora & Basic Fauna Assessment		
Prepared For:	Talis Consultants / Shire of East Pilbara		
Project ID:	2042		
Version History	**Author**	**Reviewer**	**Date of Issue**
V1	Flora – Sarah Gosney, Susan Murrey Fauna – Nicola Palmer, Melinda Henderson	Melissa Hay	31-05-2021

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EXECUTIVE SUMMARY

The Shire of Pilbara is exploring the possibility of rezoning and developing a 51-ha parcel of land located adjacent to Newman Airport. Spectrum Ecology & Spatial (Spectrum) was engaged to conduct a basic flora and fauna assessment to clarify if the vegetation in this area could potentially support any significant flora, vegetation, fauna, or fauna habitats.

The field survey was conducted on 10 March 2021 by Principal Botanist Melissa Hay and Zoologist Melinda Henderson. The field survey timing was conducted in accordance with EPA recommended timing and following higher than average rainfall. A total of seven flora relevés, 13 fauna sites, and traverses covering the Survey Area were sampled.

Flora

Eighty-four flora taxa from 23 families and 56 genera were recorded during the survey. Of the taxa recorded, five were introduced species and none were considered significant.

Fifty-two significant flora taxa were identified during the flora desktop assessment, none of which were recorded within the Survey Area. Two significant flora taxa recorded during the desktop assessment were assigned a High likelihood of occurrence at the Survey Area prior to the field survey: the Priority 3 taxon *Aristida jerichoensis* var. *subspinulifera* and the Threatened species *Seringia exastia*. This Threatened species is in the process of being reclassified to a non - Threatened or Priority species. Both taxa were assigned a Low likelihood of occurrence post survey.

Vegetation

Two vegetation types were mapped within the Survey Area:

- P1: *Acacia ?macraneura* low open woodland, over *Senna glutinosa* subsp. ×*luerssenii*, +/-*Eremophila cuneifolia*, and *Acacia tetragonophylla* mid to tall sparse shrubland, over +/-**Cenchrus ciliaris*, *Aristida latifolia* and *Eragrostis ?xerophila* low sparse grassland; and
- P2: *Acacia ?macraneura* (+/-*Acacia paraneura*) mid woodland over +/-*Eremophila platycalyx* and *Senna glutinosa* subsp. ×*luerssenii* mid to tall sparse shrubland, over *Ptilotus obovatus* low sparse shrubland and +/-**Cenchrus ciliaris* and *Aristida contorta* or low sparse grassland.

No vegetation types were recorded at the Survey Area that resemble any known TEC or PEC communities or were considered significant due to having a restricted distribution, degree of historical impact from threatening processes, provide a role as a refuge, or provide a function to maintain ecological integrity of a significant ecosystem.

Fauna

Four fauna habitat types were mapped at the Survey Area: Acacia Shrubland, Open Stoney Plain, Mulga Woodland, and Cleared / Developed. The desktop assessment identified the potential presence of 35 conservation significant fauna species including eight mammals, 23 birds, and four reptiles. Three species were assessed to have a Medium likelihood of occurring in the Survey Area – Ghost Bat (*Macroderma gigas*), Peregrine Falcon (*Falco peregrinus*) and Unpatterned Robust Slider (*Lerista macropisthopus* subsp. *remota)*. None of these species are restricted to the habitats within the Survey Area. The Ghost Bat and Peregrine Falcon are wide ranging species that may utilise the Survey Area occasionally to forage however no suitable roosting or nesting habitat was recorded, while the Mulga Woodland may provide suitable habitat for the Unpattered Robust Slider.

The likelihood of Short-Range Endemic (SRE) taxa being restricted to the Survey Area was assessed to be Low as there is an absence of suitable habitats such as sheltered areas on southern slopes of hills and ranges, and protected gullies and gorges.

1. INTRODUCTION

1.1. Project Background

Newman airport is located approximately 10 km south of Newman along the northern edge of the Gascoyne region of Western Australia. The Shire of East Pilbara is seeking to rezone the land located directly adjacent to the currently developed areas at Newman Airport.

Talis Consultants commissioned Spectrum Ecology & Spatial (Spectrum) to undertake a reconnaissance level flora and basic level fauna survey to inform the rezoning process and to support any subsequent clearing permits. The Survey Area is approximately 51 ha and is shown in Map 1.1.

1.2. Project Scope

Talis Consultants require a biological survey to delineate key flora and fauna values and determine the potential sensitivity of vegetation within the Survey Area. The outcomes of the survey and information supplied in the biological survey report will be used to inform the environmental assessment and approvals processes. The objectives of the reconnaissance flora & basic fauna assessment are:

- To verify the information obtained from the desktop assessment and characterise the flora, vegetation, fauna, and fauna habitats present; and
- To clarify whether the Survey Area may potentially support any significant flora, vegetation, fauna, or fauna habitats.

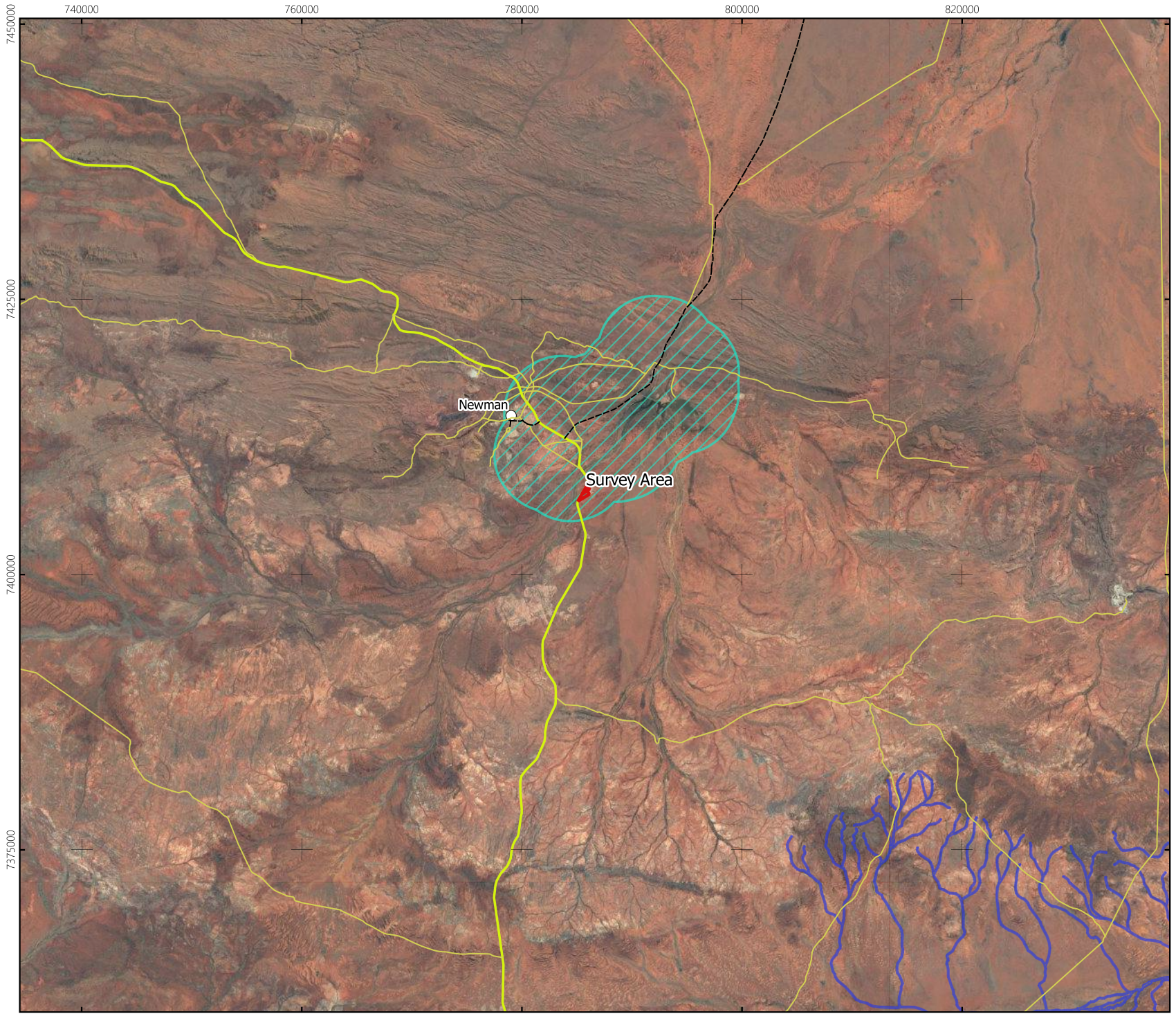
1.3. Legislation & Guidelines

Flora and fauna in Western Australia are protected by various legislation, including:

- *Biodiversity Conservation Act 2016* (BC Act, WA Gov, 2016);
- *Environmental Protection Act 1986* (EP Act, WA Gov, 1986); and
- *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act, DoEE, 2016b).

The surveys are compliant with reconnaissance flora and basic fauna survey guidelines, as outlined in:

- EPA Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016c);
- EPA Technical Guidance: Terrestrial Fauna Surveys (EPA 2016e); and
- EPA Technical Guidance: Sampling Methods for Terrestrial Vertebrate Fauna (EPA 2016d).
- EPA Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002);
- EPA Environmental Factor Guideline: Flora and Vegetation (EPA 2016b);
- DBCA Threatened and Priority Flora Report Form – Field Manual (DBCA 2017);
- National Vegetation Information System (NVIS) Australian Vegetation Attribute Manual (ESCAVI, 2003); and
- EPA Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (EPA 2004).



Legend

- Survey Area
- Minor Road
- Principal Road
- Secondary Road

Significant Lands

- Ethel Gorge Aquifer Stygobiont TEC Buffer
- Wetlands

N

0 5 10 15 km

Scale 1:475,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum ECOLOGY & SPATIAL

Author: SG Approved: NP Date: 26-05-2021

Newman Airport Survey Area and Significant Lands

Newman Airport

MAP 1.1

Prepared for
Talis Consultants

1.4. Bioregion & Climate

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies Australia into bioregions based on dominant landscape, climate, lithology, geology, landform, and vegetation (Thackway and Cresswell, 1995).

The Survey Area is in the Gascoyne IBRA Bioregion (Figure 1.1). The climate is classified as arid with predominantly winter rainfall in the west, and summer rainfall in the east (Bastin, 2008). The landscape of the Gascoyne bioregion has low, rugged ranges and broad, flat valleys. The vegetation is dominated by open Mulga low woodlands. Extensive sheep and cattle grazing is the main land use on pastoral leasehold (Bastin, 2008).

The Gascoyne IBRA Bioregion is made up of three subregions: Ashburton, Carnegie, and Augustus. The Survey Area is in the north eastern extent of the Gascoyne within the Augustus IBRA subregion (Figure 1.1). The Augustus subregion is characterised by rugged low Proterozoic sedimentary and granite ranges divided by broad flat valleys. The Gascoyne River System provides the main drainage of this subregion, which also contains the headwaters of the Ashburton and Fortescue Rivers. Mulga woodland with *Triodia* occur on shallow stony loams on rises, while the shallow earthy loams over hardpan on the plains are characterised by Mulga woodland. The subregion has a desert climate with bimodal rainfall (Kendrick, 2001).

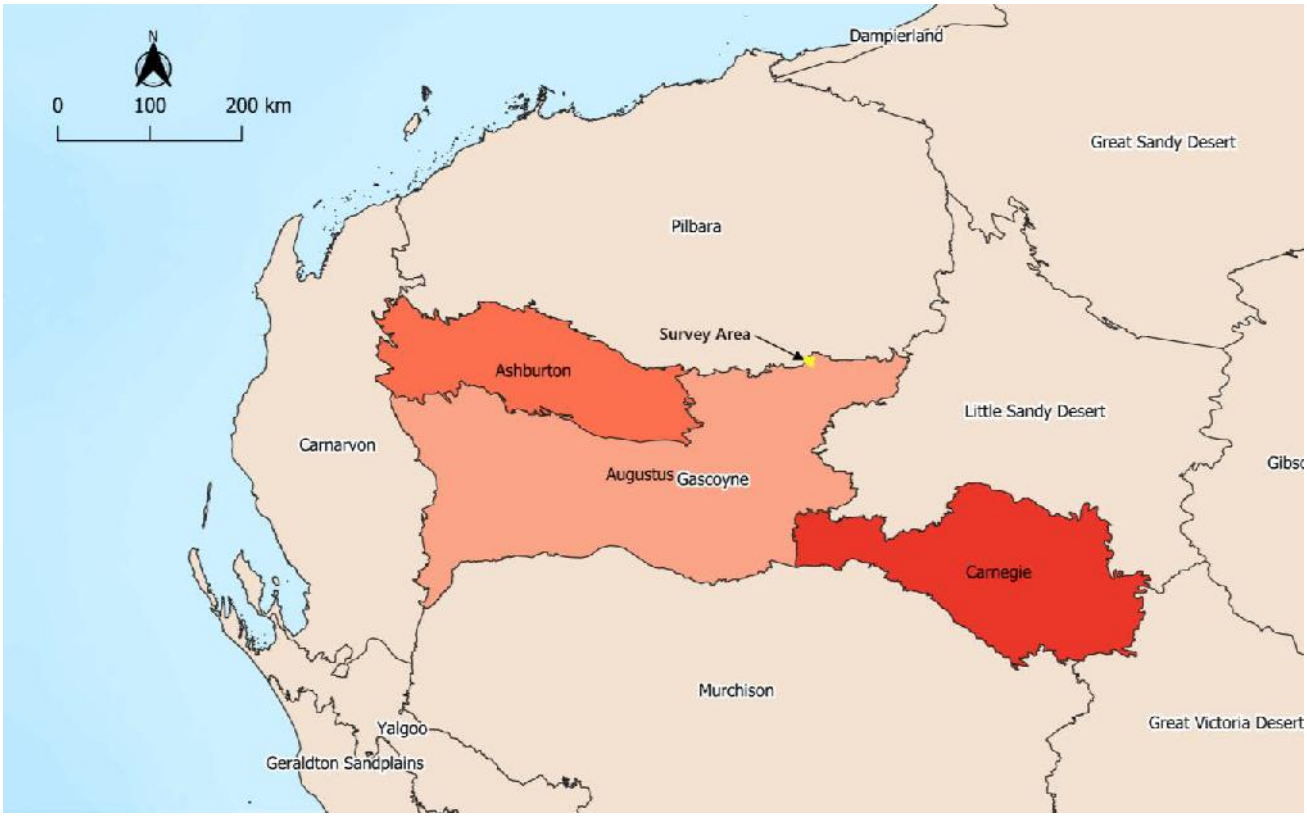


Figure 1.1: IBRA Classification of the Survey Area

1.5. Disturbance History

The Augustus subregion is mainly used for native pasture grazing (84.2%), with lesser areas of Unclassified Crown Land and Crown Reserves (9.76%), Aboriginal reserves (3.37%), and conservation (2.5%). Land use is dominated by pastoralism occupying nearly 85% of the region, with mining common throughout. The level of degradation of much of the subregion is significant due to pastoral practices and the impacts of feral herbivores (McKenzie, May and McKenna, 2003).

1.6. Geology

The survey geology of the Survey Area and Western Australia has been mapped at a scale of 1:500,000 (Geological Survey of Western Australia, 2016). The Survey Area is entirely located on unit A-g-PYV (Map 1.2, Table 1.1). This unit is restricted to the Gascoyne region, but is widespread, and has less than 0.1% of its extent occurring within the Survey Area.

Table 1.1: Surface Geology (1:500,000)

Formation	Unit	Description	Area in Survey Area (ha)	% of Survey Area	Total WA Extent (ha)	Total Gascoyne Extent (ha)	% of Gascoyne Extent Within Survey Area
Sylvania Inlier granitic unit	A-g-PYV	Granite to granodiorite; metamorphosed and variably foliated	51	100	426,642	426,642	<0.1

1.7. Land Systems

The Survey Area occurs on one land system: the Washplain land system (Map 1.3, Table 1.2). This is a widespread system with clustered occurrences in the north eastern Gascoyne and south eastern Pilbara IBRA regions. This land system is characterised by hardpan plains which support Mulga shrublands. Of the total Gascoyne extent, less than 0.1% occurs within the Survey Area.

Table 1.2: Land Systems

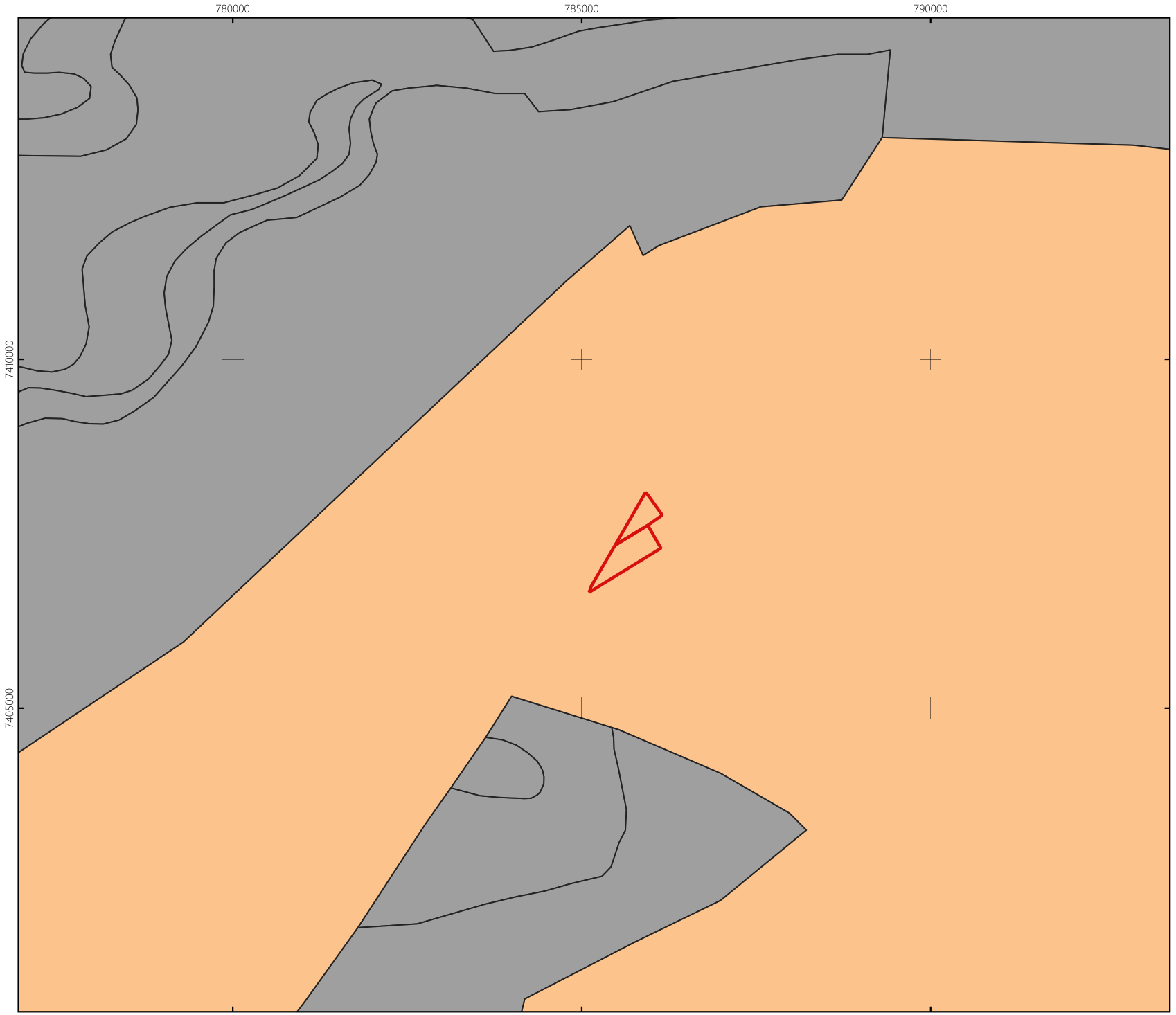
Land System	Description	Location & Description of Occurrence	Area in Survey Area (ha)	% of Survey Area	Total WA Extent (ha)	Total Gascoyne Extent (ha)	% of Gascoyne Extent Within Survey Area
Washplain Land System	Hardpan plains supporting groved mulga shrublands	Common and clustered occurrences around the North Eastern Gascoyne and South Eastern Pilbara IBRA regions.	51	100	91,602	25,326	<0.1

1.8. Beard Vegetation

Pre-European vegetation mapping was originally undertaken by Beard at various scales across the state and has since been updated to be consistent with the NVIS descriptions at a scale of 1:250,000 (Department of Primary Industry and Regional Development, 2019). One sub-association has been mapped within the Survey Area (Table 1.3). State-wide vegetation statistics are available for this unit which list pre-European extent, current extent, area in DBCA managed lands etc., and is a useful tool to determine if a vegetation community is rare or otherwise significant (Government of Western Australia, 2019). The beard sub-association 29.0 mapped at the Survey Area is a widespread sub-association with over 99.9% of its pre-European extent remaining and less than 0.1% occurs within the Survey Area (Map 1.4).

Table 1.3: Beard Vegetation Sub-association

Sub-Assoc.	Description	Area in Survey Area (ha)	% of Survey Area	Pre-European Extent WA	Current Extent WA	% Remaining	% of Current Extent in Survey Area
29.0	Sparse low woodland consisting of Mulga Acacia aneura in discontinuous scattered groups with isolated clumps of associated shrubs.	51	100.0	780,621	780,428	99.9	<0.1



Legend

Newman Airport Survey Area

Geology

A-g-PYV

Units not in Survey Area

N

0 1 2 km

Scale 1:75,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum ECOLOGY & SPATIAL

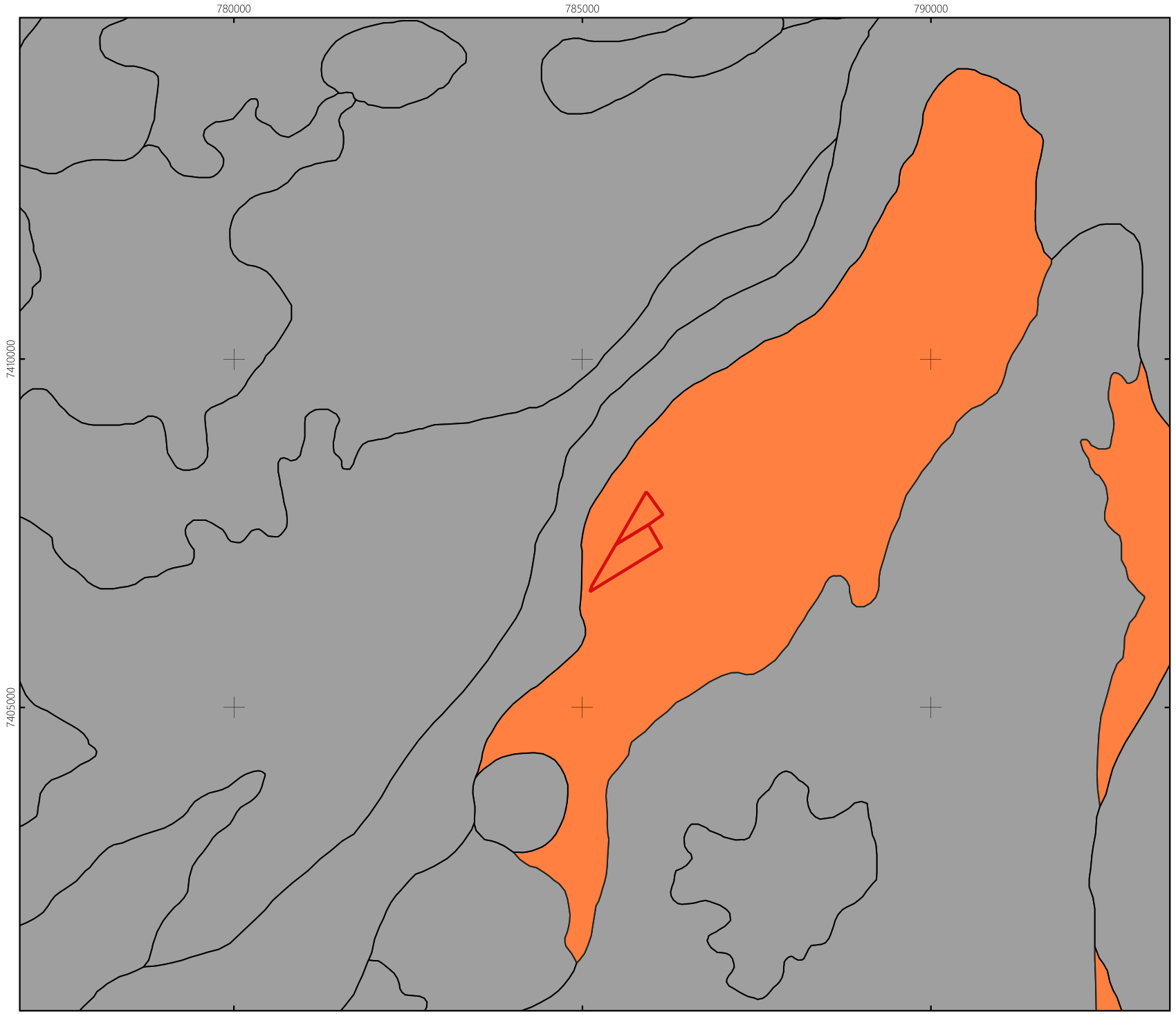
Author: SG Approved: NP Date: 26-05-2021

Geology

Newman Airport

MAP 1.2

Prepared for
Talis Consultants



Legend

Newman Airport Survey Area

Land Systems

Washplain Land System

Land Systems outside of Survey Area

N

0 1 2 km

Scale 1:75,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum ECOLOGY & SPATIAL

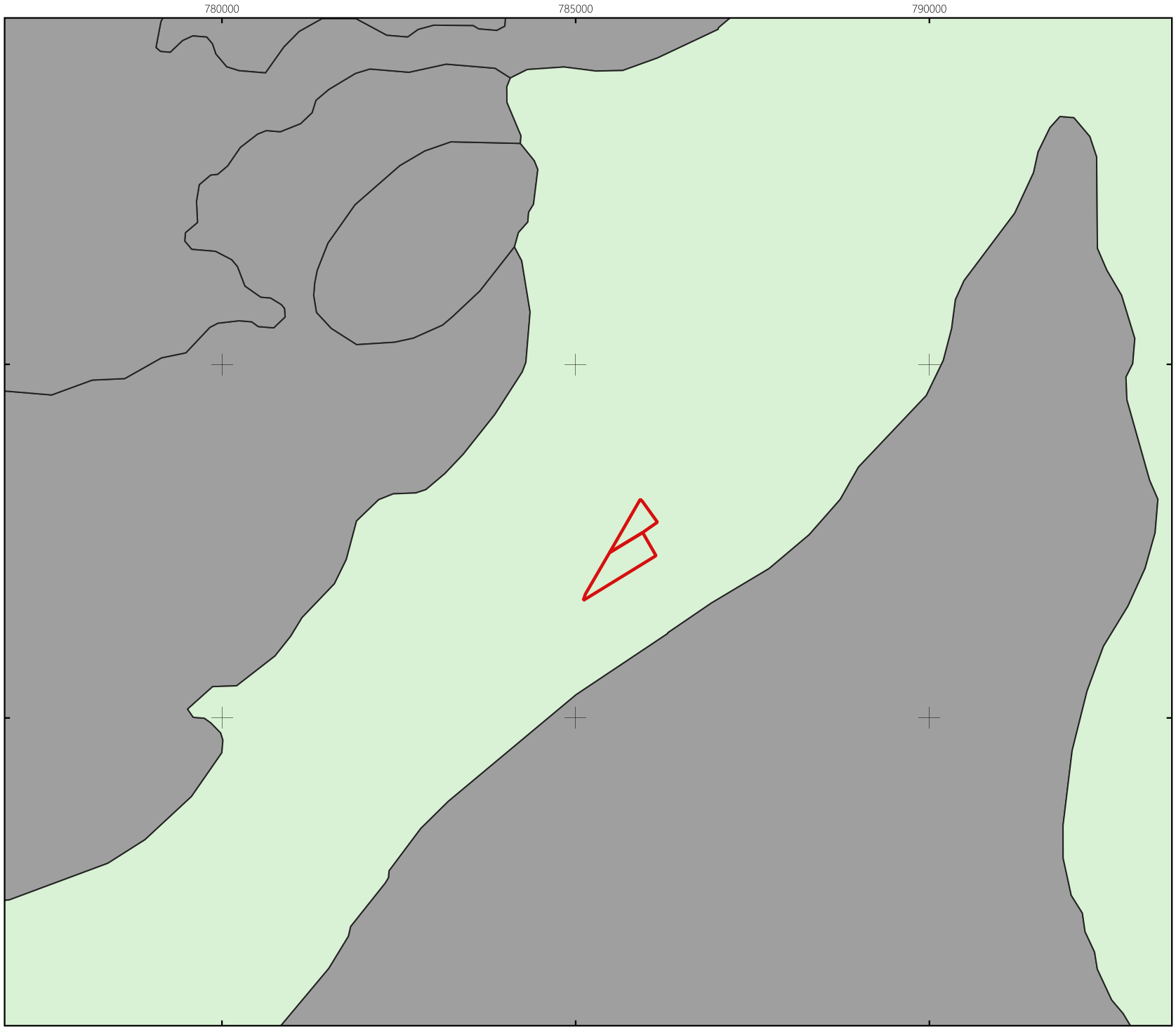
Author: SG Approved: NP Date: 26-05-2021

Land Systems

Newman Airport

MAP 1.3

Prepared for
Talis Consultants



Legend

Newman Airport Survey Area

Beard Vegetation Units

29.0

Vegetation Units not in Survey Area

N

0 1 2 km

Scale 1:75,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum ECOLOGY & SPATIAL

Author: SG Approved: NP Date: 26-05-2021

Beard Vegetation

Newman Airport

MAP 1.4

Prepared for
Talis Consultants

1.9. Significant Lands

1.9.1. Conservation Estate & Environmentally Sensitive Areas

The Western Australian conservation estate includes land and waters vested in the Conservation and Parks Commission under the Conservation and Land Management Act (1984). The conservation estate is generally managed by the Department of Biodiversity, Conservations, and Attractions (DBCA) to protect Western Australia's biodiversity and includes National Parks, Nature Reserves, Conservation Reserves, and other areas managed primarily for biodiversity conservation (DoEE 2016a). There are no conservation estates occurring within 100 km of the Survey Area.

1.9.2. Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESA) that are associated with flora and vegetation are defined by the Department of Water and Environmental Regulation (DWER 2019) as:

- A defined wetland and the area within 50 m of a wetland;
- The area covered by vegetation within 50 m of Threatened flora, to the extent to which the vegetation is continuous with the vegetation in which the Threatened flora is located;
- The area covered by a Threatened Ecological Community (TEC);
- A Bush Forever site;
- Areas covered by the Gnangara Mound Crown Land Policy and Western Swamp Tortoise Policy; and
- Areas covered by lakes, wetlands, and fringing vegetation of the Swan Coastal Plain Lakes Policy, including South West Agricultural Zone Wetlands Policy and Swan and Canning Rivers Policy.

There is one ESA located within 30 km of the Survey Area. The Ethel Gorge aquifer stygobiont Threatened Ecological Community (TEC) is an alluvium calcrete aquifer on the Fortescue River and the Survey Area is within the buffer (Map 1.1). The main threats to this community include dewatering and salinisation of the aquifer that supports the community (DBCA 2020a).

1.9.3. Australian Wetlands Database

The Australian Wetlands Database includes nationally significant wetlands (as listed in the directory of important wetlands), wetlands listed under the Ramsar convention, wetlands that are representative, rare, or unique, or wetlands that are considered of international importance (DoEE 2019).

No nationally significant wetlands, including Ramsar wetlands, were mapped within the Survey Area. The closest wetland of significance are the tributaries to Lake Disappointment which are located 39 km to the southeast (Map 1.1).

2. METHODS

2.1. Field Survey Timing

The field survey was conducted on the 10 March 2021. Rainfall preceding a field survey influences the number and type of flora and fauna species recorded during the survey. To characterise the prevailing conditions of the survey, monthly rainfall data was sourced from the nearest Bureau of Meteorology (BOM) station (Newman Aero BOM station #007176, located directly adjacent to the Survey Area), for the 12 and three months prior to the survey and compared to the sum of the median rainfall (1971-2020; BOM 2021). This is displayed in Figure 2.1.

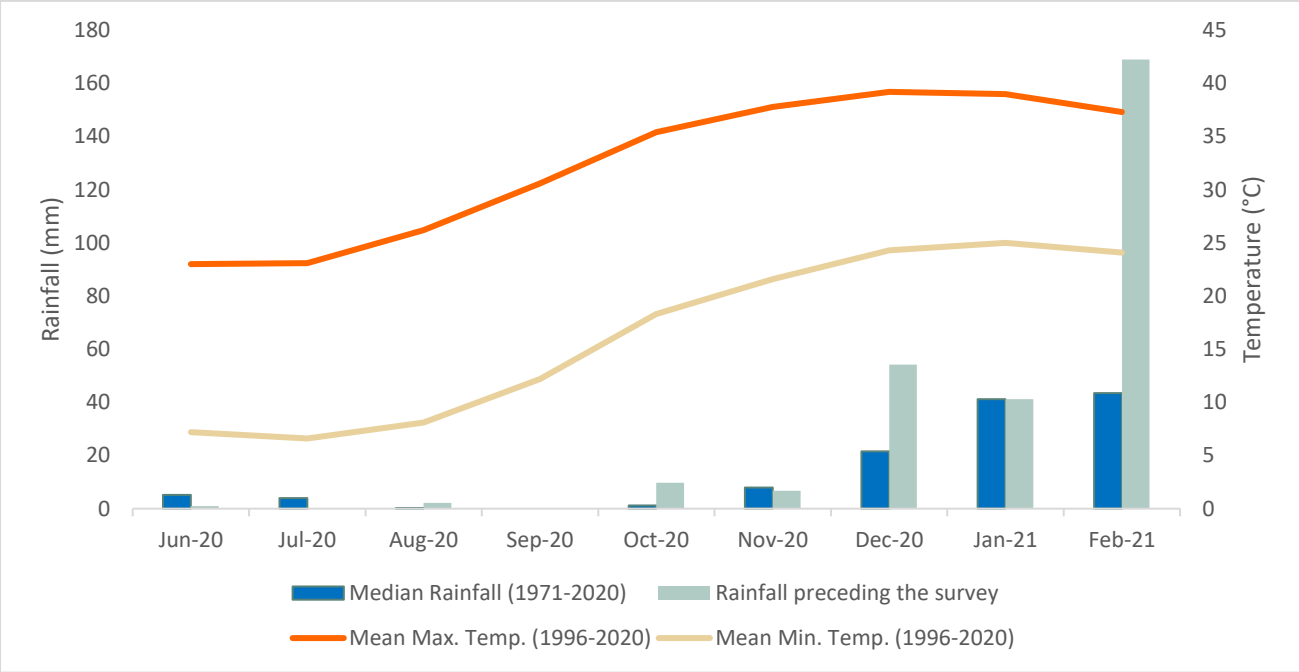


Figure 2.1: Rainfall 12 Months Preceding the Survey at Newman Airport Weather Station

The following rainfall was recorded at Newman Airport (BOM 2021):

- In the 12 months preceding the 2021 field survey (March 2020 to February 2021), 338.5 mm of rainfall was recorded, which is 199.2 mm more than the sum of the long-term median of 139.3 mm;
- The three months or wet season prior to the survey (December 2020 to February 2021), made up more than 75% of rainfall recorded in the 12 months prior to the field survey, with 264.4 mm of rainfall. This is 158.1 mm higher than the sum of the long-term median for the same three months (106.3 mm)

The Gascoyne bioregion is considered part of the Eremaean Botanical province and recommendations are to conduct biological surveys 6-8 weeks after the wet season between March and June (EPA 2016e). The recommended timing for fauna surveys in the Eremaean Botanical province is September to April for reptiles or immediately following rainfall events for amphibians and birds. There is no preferred timing for mammals (EPA 2020). The field survey was conducted in accordance with EPA recommended timing, with more than sufficient rainfall prior to the survey (BOM 2021).

2.2. Project Team & Licences

Spectrum personnel involved with this assessment are listed in Table 2.1, along with their role, years of experience, and relevant licences.

Table 2.1: Project Team & Licences

Staff	Role & Project Tasks	Years of Experience	Licences
Melissa Hay	Principal Botanist – field survey, report review	15	FB62000006-2
Astrid Heidrich	Principal Zoologist – report review	13	-
Susan Murrey	Botanist – reporting flora	2	-
Sarah Gosney	Botanist – reporting flora	5	-
Melinda Henderson	Zoologist – field survey, reporting fauna	2	-
Nicola Palmer	Zoologist – reporting fauna	6	-

2.3. Significant Flora, Vegetation & Fauna Definitions

Significant flora can include (EPA 2016b):

- Being identified as Threatened: Critically Endangered, Endangered, or Vulnerable (state listed BC Act and/or nationally listed EPBC Act);
- Being identified as Priority Flora species: Priority 1 to 4, provided in Appendix A (Department of Biodiversity Conservation and Attractions, 2019);
- Locally endemic or association with a restricted habitat type (e.g., surface water or groundwater dependent ecosystems);
- New species or anomalous features that indicate a potential new species;
- Representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- Unusual species, including restricted subspecies, varieties or naturally occurring hybrids; or
- Relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

Significant vegetation can include (Environmental Protection Authority, 2016b):

- Threatened Ecological Community (TEC): Critically Endangered, Endangered or Vulnerable (state listed BC Act and/or nationally listed EPBC Act);
- Priority Ecological Community (PEC): Priority 1 to 5 (DBCA 2020b);
- Restricted distribution;
- Degree of historical impact from threatening processes;
- A role as a refuge; or
- Providing an important function required to maintain ecological integrity of a significant ecosystem.

Significant fauna can include (EPA 2016a):

- Being identified as a Threatened or Priority species;
- Species with restricted distribution;
- Degree of historical impact from threatening processes; or
- Providing an important function required to maintain the ecological integrity of a significant ecosystem.

2.4. Introduced Flora & Declared Plant Categories

The Department of Primary Industries and Regional Development (DPIRD) keeps a database of organisms that are Declared Pests in Western Australia. This database is regulated under the Biosecurity and Agricultural Management Act (Government of Western Australia, 2007). The legal status and control requirements for these environmentally significant pests are provided in Appendix A.

2.5. Nomenclature

2.5.1. Flora

Flora nomenclature used in this report is consistent with the DBCA Census of Western Australian Plants database, provided through FloraBase (Western Australian Herbarium, 2020). All species are current at the time of report preparation (May 2021).

2.5.2. Fauna

Nomenclature for mammals, birds, reptiles, and amphibians followed the Western Australian Museum (WAM) Checklist of the Vertebrates of Western Australia (November 2020). Fauna species identifications were completed based on information provided in references listed in Table 2.2. Nomenclature for Short Range Endemic (SRE) invertebrates is based on data provided by the WAM and relevant experts.

Table 2.2: References Used for Identification of Fauna Species

Fauna Group	Reference
Mammals	Churchill (2009), Menkhorst and Knight (2001), Van Dyck and Strahan (2008)
Birds	Menkhorst *et al.* (2019)
Reptiles & Amphibians	Wilson and Swan (2017), Cogger (2014), Tyler and Doughty (2009)

2.5.3. Determination of SRE Status

The SRE status of invertebrates is based on categories which were developed by the WAM. The classifications listed in Table 2.3 are based on known information of the species group such as distribution, representation of records in collections, and distinct morphological features. Information gaps lead to classifying taxa as potential SRE, which is a requirement under the precautionary principle.

Table 2.3: Western Australian Museum SRE Categories (2013)

Distribution	Taxonomic Certainty	Taxonomic Uncertainty
Distribution <10,000km^2	• Known distribution of <10,000km^2 • Taxonomy is well known • Group is well represented in collections and /or via comprehensive sampling Confirmed SRE	• Patchy sampling has resulted in incomplete knowledge of the geographic distribution of the group • There is incomplete taxonomic knowledge • The group is not well represented in collections This category is most applicable to situations where there are gaps in knowledge of the taxon Potential SRE
Distribution >10,000km^2	• Known distribution of >10,000km^2 • Taxonomy is well known • Group is well represented in collections and /or via comprehensive sampling Widespread (not SRE)	

2.6. Data Provision

The EPA has given instruction that all biological surveys collecting data on biodiversity must submit the report and associated raw data as an Index of Biodiversity Surveys for Assessments (IBSA) data package. All survey data has been provided electronically with this report to comply with IBSA Standards.

2.7. Desktop Assessment

2.7.1. Biological Database Searches

A desktop review of all relevant and available biological data sources was undertaken prior to the field survey to assess the flora, vegetation, and fauna likely to occur in the Survey Area (Table 2.4).

Table 2.4: Database Searches

Data Source	Custodian	Details
Commonwealth Protected Matter Search Tool (PMST)	Department of the Environment and Energy (DoEE)	Buffer: 40 km Centre Point: -23.41833 11979722
NatureMap	Department of Parks and Wildlife / Western Australian Museum (WAM)	Buffer: 40 km Centre Point: 119°47'46"E, 23°25'04"S
DBCA Threatened & Priority Flora Databases (TPFL / WA Herbarium)	Department of Biodiversity Conservation and Attraction (DBCA)	Buffer: 80 km Reference: 05-0121FL
DBCA Communities Database	DBCA	Buffer: 80 km Reference: n/a
DBCA Threatened Fauna Database	DBCA	Buffer: 40 km Reference: 2020/000669 #6576
Invertebrate Fauna Databases	WAM	Arachnida & Myriapoda/ Mollusca/ Crustacea: 06/01/2021 Buffer: 40 km
Index of Biodiversity Surveys and Assessments (IBSA) Database	Department of Water and Environmental Regulation (DWER)	Buffer: 70 km

2.7.2. Previously Conducted Biological Assessments

Previously conducted biological assessments that were publicly available and conducted within 70 km of the Survey Area are listed in Table 2.5.

Table 2.5: Previously Conducted Assessments

Source	Survey Type	Author
Newman-Roy Hill Transmission Line Survey	Reconnaissance	Ecoscape (2013)
Targeted Significant Flora Survey	Targeted	Onshore Environmental for BHP Western Australia Iron Ore (2014)

2.7.3. Likelihood of Occurrence Assessment

The following information was collated for each significant flora/fauna taxon or vegetation community identified during the desktop assessment:

- Conservation status (EPBC Act, BC Act, DBCA listing);
- Description of species and flowering period (flora only);
- Description of habitat requirements and presence within the Survey Areas;
- Source of record (DBCA, previous report etc.); and
- Distance of record to the Survey Area.

A likelihood of occurrence assessment was then conducted using the criteria listed in Table 2.6. This included assessing the distance of the record from the project (historical database records considered not accurate were excluded if required), presence of appropriate habitats within the project (using land systems, geology, vegetation mapping, and/or aerial imagery), and the age of the record (fauna only). During the field survey, the preliminary assessment of the likelihood of occurrence of significant fauna species occurring within the Survey Area was reviewed and amended.

Table 2.6: Likelihood of Occurrence Assessment Criteria

Likelihood	Flora & Vegetation	Fauna
Recorded	Species or vegetation community accurately recorded within the Survey Area during the literature review (includes TEC/PEC buffers that intersect).	Species recorded within the Survey Area within the previous ten years.
High	Species or vegetation community recorded near the Survey Area, and suitable habitat does, or is likely, to occur.	Species recorded within or near the Survey Area within the previous 20 years. Suitable habitat occurs in the Survey Area.
Medium	Species or vegetation community recorded outside the Survey Area but within 20 km and suitable habitat may occur.	Species recorded within or in proximity to the Survey Area more than 20 years ago. Species recorded outside the Survey Area but within 40 km. Suitable habitat occurs in the Survey Area.
Low	Species or vegetation community rarely or not recorded within 40 km of the Survey Area and suitable habitat does not likely occur within the Survey Area.	Species rarely or not recorded within 40 km of the Survey Area. Suitable habitat does not occur within or in proximity to the Survey Area.
Very Low	n/a	Species not recorded within 40 km despite multiple recent surveys. Suitable habitat does not occur within the Survey Area. Species considered locally extinct.

2.8. Reconnaissance Flora & Vegetation Assessment

2.8.1. Field Methods & Sampling Effort

Spectrum conducted a one-phase reconnaissance flora and vegetation assessment and targeted significant flora survey on the 10 March 2021. The survey was competed by one botanist over a one-day period.

The methodology included sampling seven relevés to describe the vegetation and a targeted survey for significant flora species at 100 m spacings across the Survey Area. This was considered appropriate for a reconnaissance level survey as stipulated in the technical guidance (Environmental Protection Authority, 2016c); these techniques are described in Table 2.7. Comprehensive relevé data collection information is included in Appendix C. The Survey effort is mapped in Map 2.1.

Table 2.7: Reconnaissance Flora & Vegetation Survey Technique

Survey Technique	Application & Purpose
Relevés	Relevés are a survey technique for gathering information for low-intensity reconnaissance flora and vegetation surveys. Information collected at each relevé includes: • Site code, date, location, botanist; • A photograph; • Vegetation condition and disturbances (including fire); • Landform including; slope, soil, rock type, aspect; • Flora and vegetation information including; dominant species cover and structure; and • Significant and introduced flora species and counts.
Opportunistic Sampling	Flora species not recorded through other sampling methods was opportunistically sampled as encountered in the Survey Area. Opportunistic sampling also included recording locations of significant, introduced (weed) and unknown species.

Survey Technique	Application & Purpose
Targeted Sampling	Areas likely to support significant flora or vegetation were targeted during the survey. Including areas with existing records of significant flora (see Section 2.7.1). Areas were selected based on existing records from database searches, geology, vegetation mapping and known ESAs. Where possible, unusual, and restricted geological features within the Survey Area were sampled. When potentially significant flora taxa were encountered during the survey, sufficient information was recorded to complete a Threatened and Priority Flora Report Form (TPRF).

2.8.2. Vegetation Mapping

The data collected from relevés, opportunistic collections, as well as general field notes and observations was used to map the vegetation across the Survey Area. Vegetation was classified structurally based on the dominant species. The vegetation classification is consistent with NVIS Level V – association vegetation descriptions (referred to as a 'vegetation type' for the local scale in this report). This level of description provides information on the dominant growth form, height and cover for up to three species for each of the upper, mid and ground strata (ESCAVI, 2003).

2.8.3. Vegetation Condition

Vegetation condition was recorded at relevés and where areas of different vegetation condition were observed. The vegetation condition was mapped across the Survey Area at the same scale as the vegetation mapping. Vegetation condition ratings follow the scale recommended for the Eremaean botanical province (Environmental Protection Authority, 2016c), summarised in Table 2.8.

Table 2.8: Vegetation & Condition Scale

Condition	Disturbance Criteria
Excellent	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
Very Good	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
Good	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
Poor	Still retains basic vegetation structure or ability to regenerate it after very obvious impact of human activities since European settlement, such as grazing, partial clearing, frequent fires, or aggressive weeds.
Degraded	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.
Completely Degraded	Areas that are completely or almost completely without native species in the structure of their vegetation; i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

2.8.4. Specimen Identification & Lodgement

Flora specimens were collected of any suspected or known significant flora and to confirm species recorded during the relevés for vegetation mapping. Specimens were identified using the appropriate taxonomic keys and where required, relevant taxonomic experts at the Western Australian Herbarium. Specimens are vouchered with the Western Australian Herbarium as per guidance; when they represent new populations of Threatened or Priority Flora, new occurrences of TECs or PECs, individuals that have atypical characteristics, or bioregional range extensions. No specimens were vouchered from the current survey.

2.9. Basic Fauna Assessment

2.9.1. Field Methods & Sampling Effort

Spectrum conducted a one-phase basic terrestrial vertebrate fauna assessment on the 10 March 2021. The survey was competed by one zoologist over a one-day period.

A total of 13 fauna habitat sites were assessed within the Survey Area (Map 2.1). At each survey site, a variety of survey techniques was used for fauna as outlined in Table 2.9.

The terrestrial vertebrate fauna survey was consistent with Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA 2020) and Technical Guidance: Sampling Methods for Terrestrial Vertebrate Fauna (EPA 2016d). The guidance suggests selective low-intensity sampling of the fauna and fauna habitats to verify the accuracy of the desktop assessment. An assessment was undertaken to map the fauna habitat across the Survey Area and ensure appropriate targeted conservation significant fauna surveys were completed.

Table 2.9: Fauna Survey Techniques

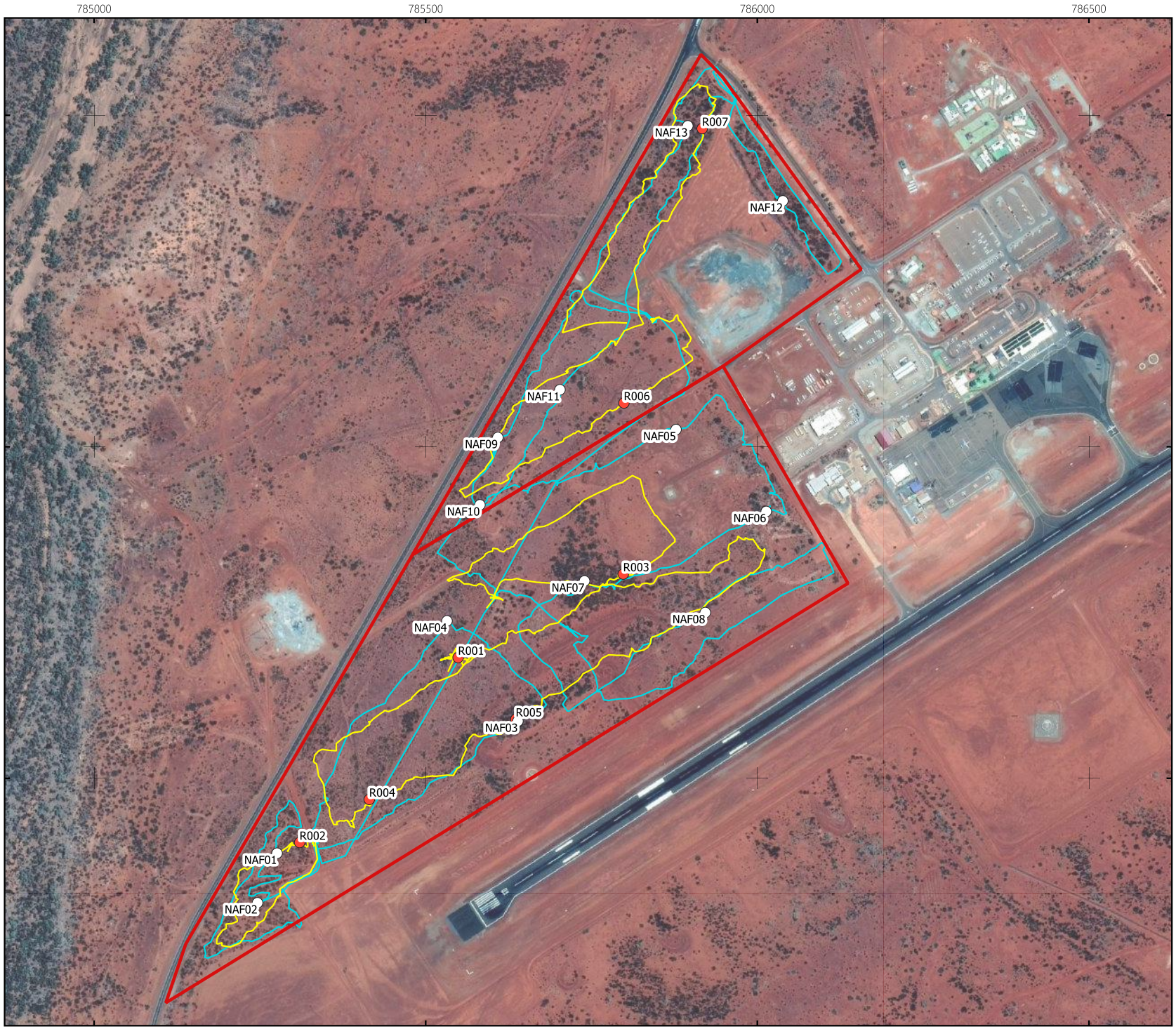
Fauna	Survey Technique
Mammals	Direct sightings and indirect evidence such as tracks, scats and diggings were recorded across the Survey Area.
Birds	Direct sightings and calls, as well as indirect evidence such as feathers, pellets and nests were recorded across the Survey Area.
Reptiles & Amphibians	Direct sightings and indirect evidence such as calls, tracks, diggings, skins, and latrines were recorded across the Survey Area and targeted searches were undertaken in areas with suitable habitat, including raking of suitable leaf litter, if present.

2.9.2. Fauna Habitat Mapping

Fauna habitat mapping identifies areas of vegetation and land features that are distinguishable from other areas. Typically, each fauna habitat supports a characteristic fauna assemblage that is adapted to the features of the fauna habitat. Fauna habitat types are identified and mapped based on the following information:

- General vegetation type (Shepherd, Beeston and Hopkins, 2001);
- Vegetation mapped within the Survey Area;
- Vegetation structure;
- Landforms;
- Geological units;
- Soil substrate;
- Aerial imagery;
- Fauna assemblage; and
- Field observations.

The fauna habitats are recorded at each survey site, opportunistically while traversing the Survey Area on foot, and when travelling between sites.



Legend

- Newman Airport Survey Area
- Flora survey sites
- Fauna survey sites
- Flora survey tracks
- Fauna survey tracks

N

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Scale 1:8,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum ECOLOGY & SPATIAL

Author: MH Approved: SM Date: 26-05-2021

Sampling Effort of the Survey Area

Newman Airport

MAP 2.1

Prepared for
Talis Consultants

2.10. Limitations & Constraints

Survey specific limitations and constraints are discussed in Table 2.10.

Table 2.10: Limitations & Constraints

Limitation	Constraint	Comment
Availability of the contextual information at a regional and local scale.	No	Beard vegetation, geology and land system mapping were used to determine regional significance of vegetation types. Database searches provided detailed information, adequate to guide field survey design and effort for the flora and fauna survey.
Competency/experience of the consultant carrying out the survey including experience in bioregion surveyed.	No	The Principal Botanist and Zoologist involved in the field survey have more than 17 years combined experience in flora, vegetation, and fauna surveys throughout Western Australia and are Pilbara specialists.
Timing/weather/season/cycle.	No	The field survey was conducted during the optimal timing for flora and fauna surveys conducted in the Gascoyne region and Eremaean Botanical Province. Seasonal conditions were excellent, and rainfall was well above the long-term median rainfall.
Disturbances (e.g., fire, flood, accidental human intervention) which affected results of survey.	No	No disturbances were recorded at the Survey Area that have affected the results of the flora and fauna assessment.
Remoteness and/or access problems.	No	There were no access restrictions at the Survey Area
Flora Specific		
Survey effort and extent.	No	Relevés were selected to represent the diversity of vegetation and geology present at the Survey Area. The seven relevés recorded from the Survey Area were sufficient to map and classify the vegetation for a reconnaissance level survey. Traverses were conducted across the Survey Area at 100 m spacings to target significant flora taxa.
Proportion of flora recorded and/or collected, any identification issues.	No	Only suspected significant or introduced, or flora that was part of vegetation communities need to be collected for a reconnaissance level survey, however all flora taxa encountered were recorded and a comprehensive flora species list has been presented for the Survey Area. Five species were unable to be conclusively identified attributed to insufficient material and plants being sterile.
Fauna Specific		
Scope (what faunal groups were sampled and were some sampling methods not able to be employed because of constraints such as weather conditions).	No	Sampling techniques were adequate for a basic terrestrial fauna survey. All fauna groups were sampled, and no survey constraints were experienced.
Proportion of fauna identified, recorded, and/or collected.	No	All vertebrate fauna species encountered were identified in the field. Basic survey methods do not require the identification of all fauna species present within the project.
The proportion of the task achieved and further work which might be needed.	No	All components of a basic fauna assessment were completed.

Limitation	Constraint	Comment
Resources (degree of expertise available in animal identification to taxon level).	No	Fauna resources available were adequate and did not compromise the outcome of the survey.
Intensity (in retrospect, was the intensity adequate).	No	A basic assessment was adequate to identify faunal assemblages and fauna habitat present within the Survey Area. Targeted searches for significant fauna species were completed within areas of suitable habitat.
Completeness (was the relevant area fully surveyed.	No	All major fauna habitat types were sampled and defined. Habitat types that may host significant fauna species were surveyed.

3. RESULTS & DISCUSSION

3.1. Flora & Vegetation Desktop Assessment

3.1.1. Conservation Significant Flora

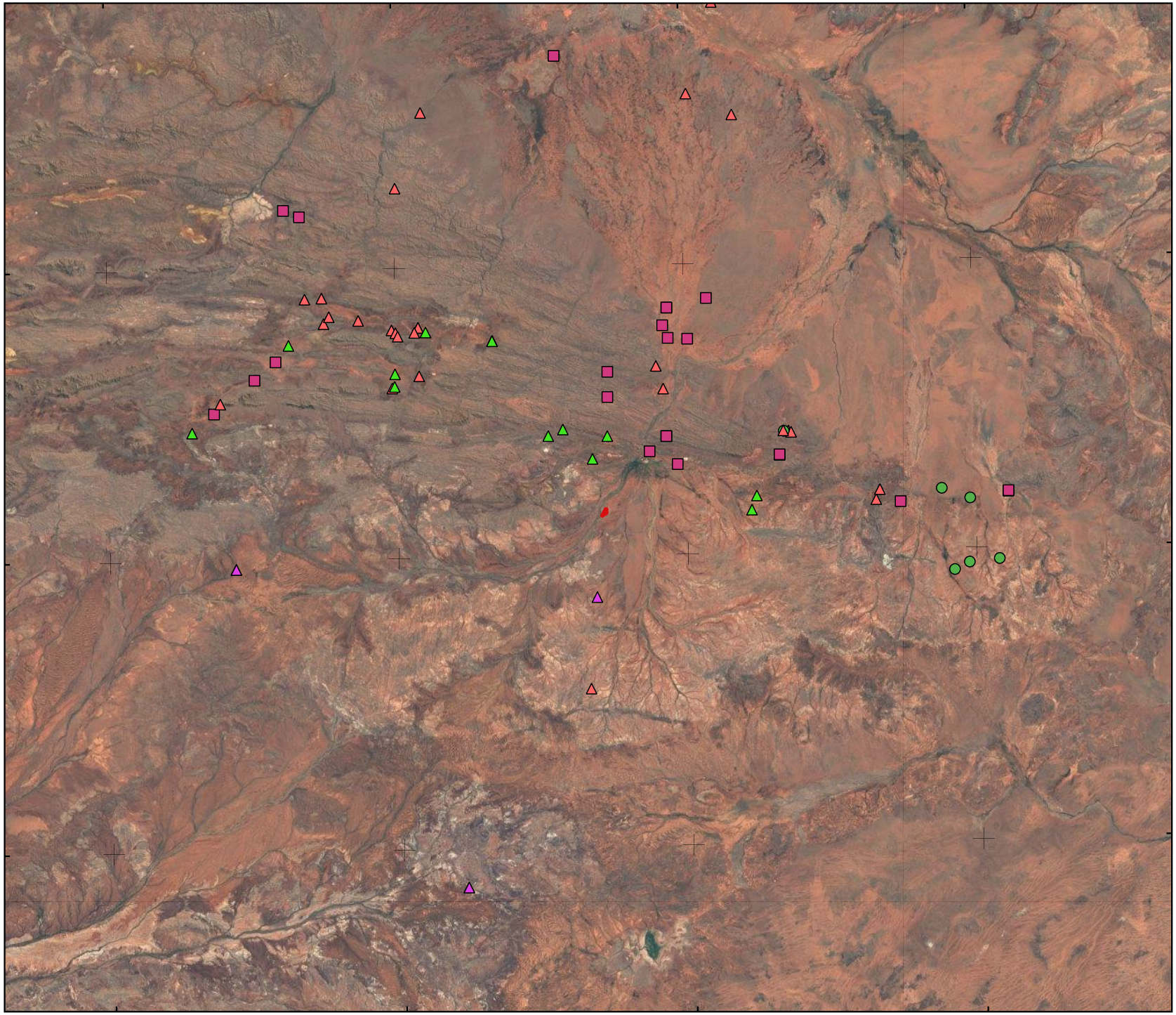
Fifty-two significant flora taxa were identified during the flora desktop searches of which two were assigned a High likelihood of occurrence. No significant flora taxa were recorded within the Survey Area and the two species with a High likelihood of occurrence were reassessed post-survey to have a Low likelihood of occurrence.

The likelihood of each significant flora taxon, habitat, proximity to Survey Area, and general description is listed at Appendix D. Significant flora locations are presented on Map 3.1 and Map 3.2.

Table 3.1: Significant Flora Results of the Desktop Assessment

Pre-survey Likelihood	Status	Taxon
High	Priority 3	*Aristida jerichoensis* var. *subspinulifera*
	Threatened	*Seringia exastia*^
Medium	Priority 1	*Eremophila capricornica*
	Priority 3	*Eremophila rigida, Eremophila fasciata, Rhagodia* sp. Hamersley (M. Trudgen 17794)
	Priority 4	*Goodenia nuda*
Low	Priority 1	*Acacia corusca, Eremophila pilosa, Eremophila rhegos, Eremophila* sp. Hamersley Range (K. Walker KW 136), *Eremophila* sp. West Angelas (S. van Leeuwen 4068), *Hibiscus campanulatus, Lindernia* sp. Pilbara (M.N. Lyons & L. Lewis FV 1069), *Myriocephalus scalpellus, Rorippa* sp. Fortescue Valley (M.N. Lyons & R.A. Coppen FV 0760), *Tecticornia globulifera, Triodia pascoeana, Vallisneria* sp. Weelarrana (M.N. Lyons & S.D. Lyons 3050), *Vittadinia* sp. Coondewanna Flats (S. van Leeuwen 4684)
	Priority 2	*Aristida lazaridis, Euphorbia inappendiculata* var. *inappendiculata, Goodenia hartiana, Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708), *Ipomoea racemigera, Isotropis parviflora, Oxalis* sp. Pilbara (M.E. Trudgen 12725)
	Priority 3	*Acacia subtiliformis, Amaranthus centralis, Calotis latiuscula, Crotalaria smithiana, Dampiera metallorum, Eremophila magnifica* subsp. *velutina, Eucalyptus rowleyi, Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727), *Grevillea saxicola, Gymnanthera cunninghamii, Indigofera gilesii, Iotasperma sessilifolium, Maireana prosthecochaeta, Sida* sp. Barlee Range (S. van Leeuwen 1642), *Stylidium weeliwolli, Swainsona thompsoniana, Tecticornia medusa, Themeda* sp. Hamersley Station (M.E. Trudgen 11431), *Triodia* sp. Mt Ella (M.E. Trudgen 12739), *Xerochrysum boreale*
	Priority 4	*Acacia bromilowiana, Eremophila magnifica* subsp. *magnifica, Eremophila youngii* subsp. *lepidota, Goodenia berringbinensis, Lepidium catapycnon, Ptilotus trichocephalus*

^ *Seringia exastia* is in the process of delisting to a non-significant species and is not considered Threatened.



Legend

Newman Airport Survey Area

Desktop Flora

High Likelihood

- P3 - Aristida jerichoensis var. subspinulifera

Medium Likelihood

- P1 - Eremophila capricornica
- P3 - Eremophila rigida
- P3 - Rhagodia sp. Hamersley (M. Trudgen 17794)
- P4 - Goodenia nuda

N

0 10 20 30 km

Scale 1:1,000,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum ECOLOGY & SPATIAL

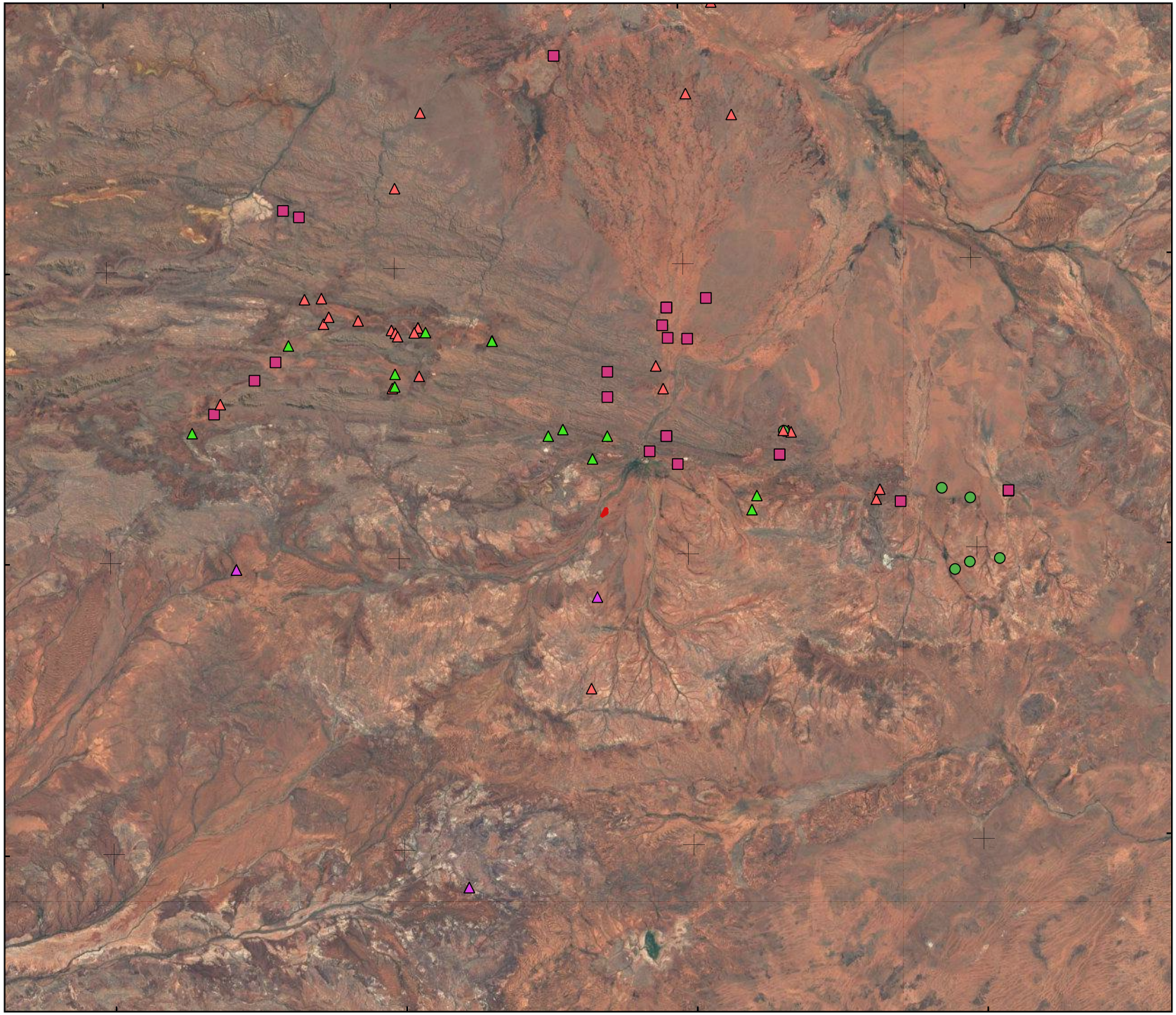
Author: SG Approved: NP Date: 26-05-2021

Desktop Assessment Significant Flora - High and Medium Likelihood

Newman Airport

MAP 3.1

Prepared for
Talis Consulting



Legend

Newman Airport Survey Area

Desktop Flora

High Likelihood

- P3 - Aristida jerichoensis var. subspinulifera

Medium Likelihood

- P1 - Eremophila capricornica
- P3 - Eremophila rigida
- P3 - Rhagodia sp. Hamersley (M. Trudgen 17794)
- P4 - Goodenia nuda

N

0 10 20 30 km

Scale 1:1000000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum ECOLOGY & SPATIAL

Author: SG Approved: NP Date: 31-05-2021

Desktop Assessment Significant Flora - High and Medium Likelihood

Newman Airport

MAP

Prepared for
Talis Consultants

3.1

3.1.2. TEC & PEC Desktop Assessment

One Threatened Ecological Community (TEC) was recorded during the desktop assessment. The buffer of Ethel Gorge Aquifer Stoyibiont community overlaps the Survey Area, however the actual TEC does not occur within (Table 3.2; Map 1.1). This community is known for its diverse assemblage of stygofaunal species, assessment of these species and this community does not fall within the scope of a reconnaissance flora or basic fauna assessment.

Table 3.2: TEC Results of the Desktop Assessment

Likelihood	Status	Name	Description	Proximity to the Survey Area
Recorded	Endangered	Ethel Gorge Aquifer Stoyibiont Community	The community is known from the Ethel Gorge (Ophthalmia Basin) alluvium calcrete aquifer on the Fortescue River in the vicinity of the town of Newman. It comprises a diverse assemblage of stygofaunal species. At least one species is endemic to this gorge. (DBCA 2020a)	Survey Area is within buffer of TEC

3.2. Flora

Eighty-four taxa from 23 families and 56 genera were recorded during the survey, these are listed in Appendix E. Of the taxa recorded five were introduced species. Poaceae was the most species rich family (23 taxa), followed by Fabaceae (16 taxa), and Chenopodiaceae and Malvaceae (7 taxa each). The most species rich genera were *Acacia* (8 taxa), *Senna* (6 taxa), and *Maireana* (4 taxa).

3.2.1. Conservation Significant Flora

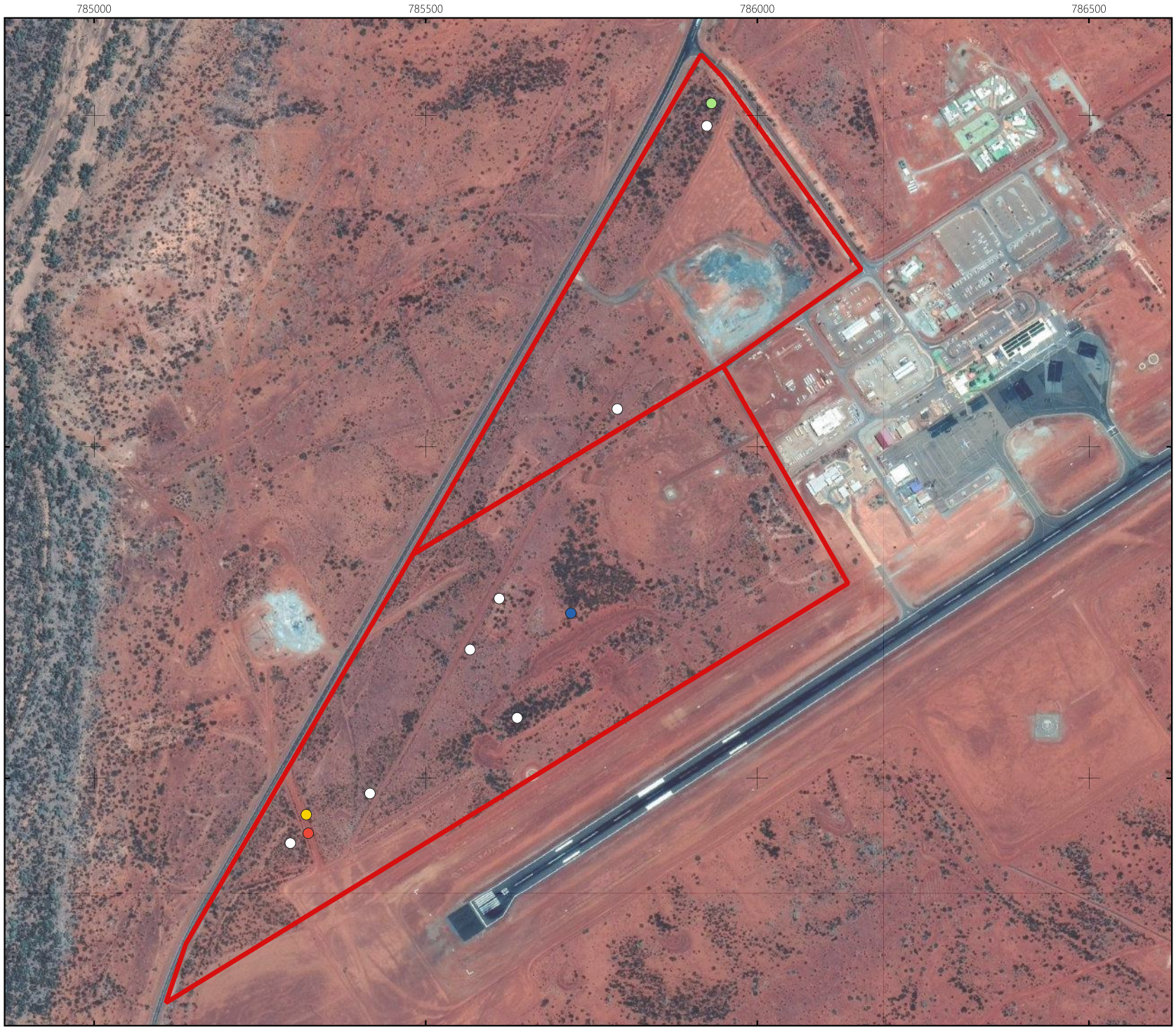
No Threatened, Priority, or other significant flora taxa were recorded at the Survey Area during the current assessment. Both significant flora taxa assigned a High likelihood of occurrence prior to the survey (*Aristida jerichoensis* var. *subspinulifera* – Priority 3, *Seringia exastia* - Threatened), were assigned a Low likelihood of occurrence post survey.

3.2.2. Introduced Flora

Five introduced species were recorded at the Survey Area, none of which are Declared Pests in Western Australia (Table 3.3, Map 3.3). **Cenchrus ciliaris* was the most common weed and was recorded across the Survey Area, from six of the seven relevés.

Table 3.3: Introduced Flora Recorded

Taxon	Common Name	Location	Environmental Significance
**Cenchrus ciliaris*	Buffel Grass	R001, R002, R004, R005, R006, R007 Opportunistic Collection	Permitted - s11
**Cenchrus setiger*	Birdwood Grass	Opportunistic Collection	Permitted - s11
**Cynodon dactylon*	Couch	Opportunistic Collection	Permitted - s11
**Malvastrum americanum*	Spiked Malvastrum	Opportunistic Collection	Permitted - s11
**Setaria verticillata*	Whorled Pigeon Grass	Opportunistic Collection	Permitted - s11



Legend

Newman Airport Survey Area

Introduced Flora

- *Cenchrus ciliaris
- *Cenchrus setiger
- *Cynodon dactylon
- *Malvastrum americanum
- *Setaria verticillata

N

0 0.1 0.2 km

Scale 1:8,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum ECOLOGY & SPATIAL

Author: MH Approved: SM Date: 26-05-2021

Introduced Flora Recorded

Newman Airport

MAP 3.3

Prepared for
Talis Consultants

3.3. Vegetation

3.3.1. Vegetation Types

The Survey Area was comprised of mostly flat sandy clay plains with small areas of sandy clay depressions. Two vegetation types were recorded from the Survey Area (Table 3.4, Map 3.4).

Table 3.4: Vegetation Types Recorded at the Survey Area

Code	Description	Landform, Soil & Geology	Sites	Area & %	Representative Photograph
P1	*Acacia ?macraneura* low open woodland to isolated trees, over *Senna glutinosa* subsp. ×*luerssenii*, +/- *Eremophila cuneifolia*, and *Acacia tetragonophylla* mid to tall sparse shrubland, over +/-**Cenchrus ciliaris*, *Aristida latifolia* and *Eragrostis ?xerophila* low sparse grassland.	Flat, orange-red, sandy-clay plain.	R001, R002, R004, R006	33.0 ha 64.6%	
P2	*Acacia ?macraneura* (+/- *Acacia paraneura*) mid woodland over +/- *Eremophila platycalyx* and *Senna glutinosa* subsp. ×*luerssenii* mid to tall sparse shrubland, over *Ptilotus obovatus* low sparse shrubland and +/- **Cenchrus ciliaris* and *Aristida contorta* or low sparse grassland.	Depression on flat, orange red, sandy-clay plain.	R003, R005, R007	6.6 ha 12.9%	

3.3.2. Significant Vegetation

No vegetation types were recorded at the Survey Area that resemble any known TEC or PEC communities or were significant due to having a restricted distribution, degree of historical impact from threatening processes, provide a role as a refuge, or provide a function to maintain ecological integrity of a significant ecosystem.

Using aerial imagery, the vegetation communities surrounding the Survey Area show a weak Banded Mulga patterning. Banded Mulga is a Sheet Flow Dependent Vegetation (SFDV) community and may be suspectable to impacts associated with alteration to surface water flow. The Mulga communities within the Survey Area do not show the same patterning and does not appear to match the surrounding communities. This is likely due to historical disturbance at the Survey Area.

Pre-European vegetation mapping, originally undertaken by Beard (Department of Primary Industry and Regional Development, 2019) can be used to assess regional significance of vegetation types mapped in the Survey Area. Both vegetation types align with the Pre-European vegetation association unit 29, a widespread Beard vegetation unit, indicating that these vegetation types are widespread throughout the region and not significant locally or regionally.

Legend

Newman Airport Survey Area

Vegetation Types

- P1
- P2
- Cleared/Disturbed

N

0 0.1 0.2 km

Scale 1:8,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum ECOLOGY & SPATIAL

Author: SM Approved: MH Date: 26-05-2021

Vegetation Types of the Survey Area

Newman Airport

MAP 3.4

Prepared for
Talis Consultants

3.3.3. Vegetation Condition

Vegetation condition at the Survey Area is presented in Table 3.5 and Map 3.5. The majority of the Survey Area was rated Very Good, 51.1%, with disturbances noted as low to moderate weed presence. The remainder of the vegetation was rated as Good (26.9%) with a higher percentage weed cover due to the proximity to cleared areas and roads. There was 21.9% of the Survey Area rated as Completely Degraded due to extensive clearing. The Mulga communities within the Survey Area do not appear to match the surrounding communities which are slightly banded, and this is likely due to historical disturbance at the Survey Area.

Table 3.5: Vegetation Condition at the Survey Area

Condition	Area (ha)	% of Survey Area	Disturbance Details
Excellent	-	-	-
Very Good	26.1	51.1	Low to moderate covers of weeds; evidence of tracks and partial clearing. Potentially historical clearing undertaken in area.
Good	13.7	26.9	Moderate to high presence of weeds; litter; evidence of tracks, roads, and partial clearing.
Poor	-	-	-
Degraded	-	-	-
Completely Degraded	11.2	21.9	Clearing; tracks, and high weed cover

Legend

Survey Area

Vegetation Condition

- Very Good
- Good
- Completely degraded

N

0 0.1 0.2 km

Scale 1:8,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum ECOLOGY & SPATIAL

Author: SM Approved: MH Date: 26-05-2021

Vegetation Condition of the Survey Area

Newman Airport

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MAP
3.5

3.4. Fauna Desktop Assessment

Four public databases were accessed as part of the desktop assessment. One reconnaissance invertebrate fauna survey was reviewed to provide information to support the current assessment. Details of the completed database searches are listed in Table 3.6 and Map 3.6.

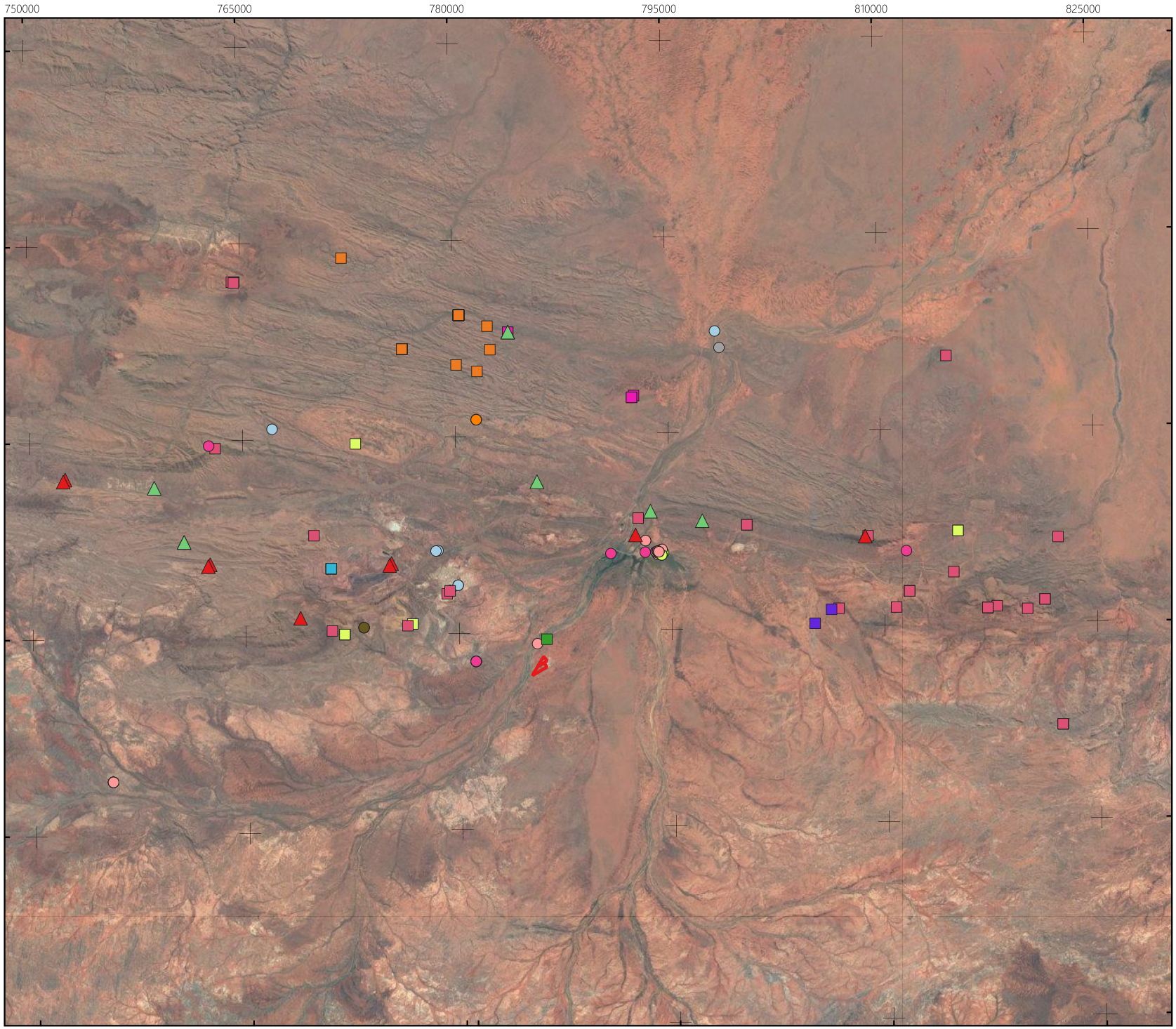
The literature review and database searches identified 16 non-volant native mammals, nine introduced mammals, eight bats, 180 birds, 92 reptiles and nine amphibians in the region surrounding the Survey Area. A summary of the total number of species identified during the desktop assessment is presented in Table 3.6. Obligate marine species and seabirds have been excluded from the assessment due to the absence of coastal or marine habitat within the Survey Area.

There were 35 conservation significant fauna species identified in the desktop assessment including eight mammals, 23 birds and four reptiles that have the potential to occur within the Survey Area. Sixteen species of migratory water birds have been excluded from further assessment due to the lack of wetland habitats occurring in the study site; those species are listed in Appendix G.

Table 3.6: Summary of Vertebrate Fauna Species Previously Recorded

Data Source	Level of Survey	Mammals (Native/ Introduced)	Birds	Bats	Reptiles	Amphibians	Total
Within Survey Area							
Newman-Roy Hill Transmission Line Survey	Reconnaissance	3/5	31	-	8	-	**48**
DBCA Threatened Fauna Database	-	5	15	2	2	-	**24**
NatureMap	-	14/6	176	8	92	9	**305**
PMST	-	2/8	5	2	1	-	**18**
Total		**16/9**	**180**	**8**	**92**	**9**	**346**

The West Australian Museum database search identified 72 Arachnid, 23 Crustacean, and three Mollusc species of potential short range endemic invertebrates. Twenty-six species of Arachnids and all 23 species of Crustaceans returned from this SRE database search are subterranean and were excluded from this assessment. A further six species of Arachnids (mites) and two species of Molluscs are freshwater aquatic invertebrates and were also excluded (Map 3.7).



Legend

- Newman Airport Survey Area
- Black-flanked rock-wallaby
- Brush-tailed mulgara
- Ghost bat
- Greater Bilby
- Long-tailed dunnart
- Pilbara leaf-nosed bat
- Western pebble-mound mouse
- Caspian Tern
- Common greenshank
- Common redshank
- Common Sandpiper
- Curlew sandpiper
- Glossy ibis
- Gull-billed tern
- Long-toed Stint
- Marsh sandpiper
- Oriental plover
- Pectoral sandpiper
- Peregrine falcon
- Red-necked stint
- Sharp-tailed sandpiper
- Wood sandpiper
- Gane's blind snake (Pilbara)
- Pilbara olive python

N

0 3 6 9 km

Scale 1:300,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum ECOLOGY & SPATIAL

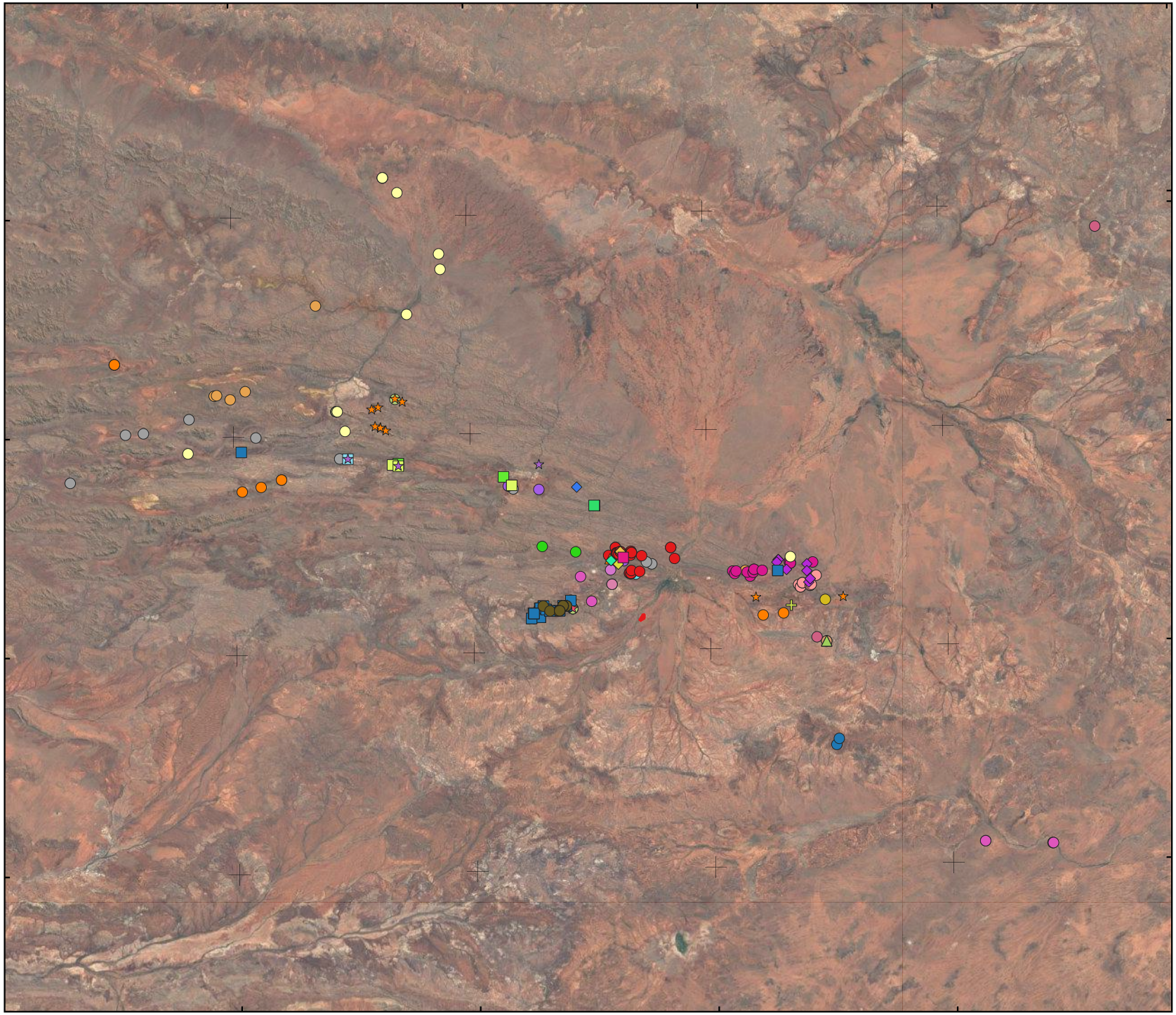
Author: NP Approved: SM Date: 28-05-2021

Desktop Assessment Significant Fauna

Newman Airport

Prepared for
Talis Consultants

MAP
3.6



Legend

Survey Area

Arachnida

- `Forsterina grp. Genus 1` `sp. 5`
- `Karaops?` `sp. indet. (juvenile)`
- `Neon` `PBS sp. 3`
- Aname watsoni
- Asadipus `areyonga`
- Aurecocrypta `MYG315`
- Cethegus `MYG299`
- Conothele `MYG385`
- Conothele `MYG558`
- Conothele `MYG575`
- Gaius `MYG286`
- Idiosoma `MYG384`
- Karaops `ARA003`
- Karaops `ARA004`
- Karaops `ARA005`
- Kwonkan `MYG098`
- Kwonkan `MYG651`
- Myrmopopaea `sp. 10`
- Spinasteron `leeuweni`
- Venator `sp. (VWF1244)`
- `Zelanophilus?`
- Antichiropus `DIP042, wheelarra`
- Antichiropus `DIP051, pannawonica`
- Antichiropus `OB35_1? (female)`
- Antichiropus `OB35_2? (female)`
- Antichiropus cristatus
- Antichiropus verutus
- Unixenus `mjoebergi?`
- Beierolpium `sp. 8 1`
- Feaella callani
- Synsphyronus `PSE086`
- Synsphyronus `PSE129`
- Xenolpium `PSE079`
- Scolopendra `sp. indet. (juvenile)`
- Lychas `harveyi group` `SCO038`
- Lychas `pilbara 1` `SCO041`
- Lychas `Pilbara sp. 2`
- Lychas bituberculatus `SCO042`
- Urodacus `pilbara 12`
- Austrostrophus `sp. (fragment)`

Gastropoda

- Discocharopa sp.

N

0 10 20 30 km

Scale 1:900,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum ECOLOGY & SPATIAL

Author: NP Approved: MH Date: 26-05-2021

Results of the WAM SRE Invertebrate Database Search

Newman Airport

MAP 3.7

Prepared for
Talis Consultants

3.5. Terrestrial Fauna Assessment

3.5.1. Vertebrate Fauna

A total of 13 vertebrate fauna species were recorded during the survey: one introduced mammal species and 12 bird species (Table 3.7). None of these species are listed as conservation significant. The desktop assessment identified 16 non-volant native mammals, nine introduced mammals, eight bats, 180 birds, 92 reptiles, and nine amphibian species potentially occurring at the Survey Area (Appendix F).

Table 3.7: Vertebrate Fauna Species Recorded

Common Name	Scientific Name	Conservation Status	Comments/Details
Mammals			
*European Cattle	*Bos taurus*	-	Scats
Birds			
Crested Pigeon	*Ocyphaps lophotes*	-	Observation/Call
Variegated Fairy-wren	*Malurus lamberti*	-	Observation/Call
Singing Honeyeater	*Gavicalis virescens*	-	Observation/Call
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	-	Observation/Call
Australian Ringneck	*Platycercus zonarius*	-	Observation/Call
Budgerigar	*Melopsittacus undulatus*	-	Observation/Call
Black Kite	*Milvus migrans*	-	Observation/Call
Magpie-lark	*Grallina cyanoleuca*	-	Observation/Call
Yellow-throated Miner	*Manorina flavigula*	-	Observation/Call
Peaceful Dove	*Geopelia striata*	-	Observation/Call
Australian Pratincole	*Stiltia isabella*	-	Observation/Call
Zebra Finch	*Taeniopygia guttata*	-	Observation/Call

*Introduced species

3.5.2. Fauna Habitat Types

The fauna habitats within the Survey Area were mapped into four categories: Acacia Shrubland, Open Stoney Plain, Mulga Woodland, and Cleared/Disturbed (Table 3.8, Map 3.8):

Each habitat was determined by using their potential to support different fauna assemblages, which are described in greater detail below. The habitat throughout the Survey Area was extrapolated from observations during the field survey. The associated flora relevés are described in Table 3.4.

All fauna habitats recorded during this assessment occur extensively throughout the surrounding region (Astron, 2015). Fauna typically subsists in very low numbers within the Open Stoney Plain habitat due to the lack of cover provided. The Acacia Shrubland and Mulga Woodland has the potential to provide habitat for conservation significant species.

Table 3.8: Fauna Habitat Types

Habitat Type	Survey Area Extent (ha)	% of Survey Area	Associated Flora Relevé
Acacia Shrubland	16	31.4	R002, R004
Open Stoney Plain	15.4	30.4	R001, R006
Mulga Woodland	6.8	13.4	R003, R005, R007
Cleared/Disturbed	12.6	24.8	-
Total	51	100	-

3.5.2.1. Acacia Shrubland

The Acacia Shrubland habitat type is the most common habitat within the Survey Area (16 ha, 31.4%). This habitat occurs on the outer extent of the Survey Area along the Great Northern Highway and the airstrip. The Survey Area consists of flat plains with loam clay to sandy clay soils with pebbles and rocks present in some areas.

The Acacia Shrubland habitat is the most densely vegetated habitat type dominated by *Acacia macraneura* and *Acacia paraneura* over *Senna* sp., *Eremophila* sp. and *Acacia tetragonophylla* shrubs over low sparse grassland. Ground cover was generally sparse with some fallen timber. Leaf litter was minimal and restricted to the base of some shrubs.

This habitat type occurs in small patches and is unlikely to support conservation significant species such as the Unpatterned Robust Slider (*Lerista macropisthopus* subsp. *remota)* due to the lack of leaf litter accumulation observed during the survey.

Figure 3.1: Acacia Shrubland Fauna Habitat

3.5.2.2. Open Stoney Plain

The Open Stoney Plain habitat type covers 15.4 ha (30.4%) of the Survey Area. Swathes of open flat cobblestoned ground exist in the centre of the Survey Area which gives way to shrubland on the outer edges. The substrate comprises of orange to brown loamy clay soils with cobbles of mostly ironstone and quartz.

The Open Stoney Plain habitat type is sparsely vegetated with shrubs of *Senna glutinosa*, *Eremophila cuneifolia* and *Acacia tetragonophylla*, over low sparse grassland of **Cenchrus ciliaris*, *Aristida latifolia* and *Eragrostis xerophila*. Fauna density is typically lower in this habitat type due to the lack of shelter and food resources available. Degradation associated with vehicle tracks and previous land use was regularly encountered.

No conservation significant species are expected utilise this habitat.

Figure 3.2: Open Stoney Plain Fauna Habitat

3.5.2.3. Mulga Woodland

The Mulga woodland habitat type has the smallest extent, making up 6.8 ha (13.4%) of the Survey Area. Most of this habitat occurs in the centre of the Survey Area with two strips occurring along the northern extent. The soil typically consists of light orange to brown sandy loam, with a low abundance of small to medium sized gravel.

The vegetation in this habitat is typically dominated by *Acacia macraneura* and *A. paraneura* over low sparse grassland of **Cenchrus ciliaris* and *Aristida contorta*. The Mulga Woodland habitat generally has a sparse understory resulting in limited habitat for terrestrial fauna species.

Figure 3.3: Mulga Woodland Fauna Habitat

3.5.2.4. Cleared/Developed

The Cleared/Developed areas cover 12.6 ha (24.8%) of the Survey Area. These areas include cleared vehicle tracks and rubble piles as well as areas of ripped revegetation on the western edge of the Survey Area and along the track which runs parallel to The Great Northern Highway. Two large, cleared sections occur at the northern and southern ends of the Survey Area.

The Survey Area displays numerous disturbances throughout including vehicle tracks, rubble piles revegetation, weeds, rubbish, cattle, and noise due to its proximity to the Great Northern Highway and the airstrip. No vegetation or fauna assemblages are associated with these areas.

Legend

Newman Airport Survey Area

Fauna Habitats

- Acacia Shrubland
- Open Stoney Plain
- Mulga Woodland
- Cleared/Disturbed

N

0 0.1 0.2 km

Scale 1:8,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Spectrum ECOLOGY & SPATIAL

Author: MH Approved: NP Date: 26-05-2021

Fauna Habitat Mapping of the Study Area

Newman Airport

Prepared for
Talis Consultants

MAP
3.8

3.5.3. Conservation Significant Vertebrate Fauna

Three conservation significant species identified in the desktop assessment have been assigned a Medium likelihood of the occurring in the Survey Area: Ghost Bat (*Macroderma gigas*), Peregrine Falcon (*Falco peregrinus*) and Unpatterned Robust Slider (*Lerista macropisthopus* subsp. *remota)*. The remaining fifteen species have been assigned a Low or Very Low likelihood of occurring in the Survey Area as suitable habitat does occur within the Survey Area (Table 3.9).

Table 3.9: Significant Vertebrate Fauna Potentially Occurring in the Survey Area

Species	Conservation Status			Nature Map	DBCA	PMST	Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA						
Mammals									
Black-flanked Rock-wallaby (*Petrogale lateralis* subsp. *lateralis*)	EN	EN	-	●	●	-	Complex rocky substrates with multi-entranced caves, rock piles and crevices with surrounding seasonal grasses and herbs for foraging (Pearson, 2012).	Five records from 1975 25 km north of the Survey Area.	**Low:** No suitable habitat within the Survey Area.
Northern Quoll (*Dasyurus hallucatus*)	EN	EN	-	-	-	●	Critical denning habitats include rocky gorges, basalt hills, escarpments, mesas, boulder piles, caves, and adjacent cliff faces. Foraging occurs in adjacent habitat with suitable cover and food resources (Department of the Environment, 2016).	No regional observations have been recorded. Potential habitat is listed as present in the area by the Protected Matter Search Tool (PMST).	**Low:** No suitable habitat within the Survey Area and no nearby records.
Greater Bilby (*Macrotis lagotis*)	VU	VU	-	●	●	●	A variety of habitats including spinifex hummock grasslands, acacia shrublands, open woodlands and cracking clays (Dziminski and Carpenter, 2018).	A single record of the species in the vicinity is from 1979.	**Low:** Suitable habitat is present in the Survey Area however the only record of the species in the vicinity is from 1979.
Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia (Pilbara)*)	VU	VU	-	●	●	●	Dissected rocky escarpments with suitable roost caves with high humidity and stable temperatures. Forages in a variety of habitats, particularly along water bodies and riparian vegetation (Armstrong, 2001; Cramer *et al.*, 2016).	153 records of the species within 34 km of the Survey Area. All records are from Kalgan Creek or Ophthalmia Range.	**Low:** No suitable roosting or foraging habitat within the Survey Area.

Species	Conservation Status			Nature Map	DBCA	PMST	Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA						
Ghost Bat (*Macroderma gigas*)	VU	VU	-	●	●	●	Use a range of structures including caves, rock piles and abandoned mines for transient and feeding roosts. Foraging can occur up to 2 km from roosting sites. Maternity roosts require caves with specific warm, dark and humid microclimates (Armstrong and Anstee, 2000).	Eleven records of the species within 30 km of the Survey Area.	**Medium:** Due to recent research identifying a gap in the knowledge associated with this species it is possible that foraging habitat occurs within the Survey Area. No potential roosting habitat is present, and the species is likely to only forage occasionally inside the Survey Area.
Brush-tailed Mulgara (*Dasycercus blythi*)	-	-	P4	●	●	-	Sandy and loamy flats vegetated with hummock and/or tussock grasses, stony gibber plains where wind-blown soil or sand has accumulated (Pavey *et al.*, 2011).	Two records of the species within 20 km of the Survey Area.	**Low:** Suitable habitat does not occur within the Survey Area.
Western Pebble-mound Mouse (*Pseudomys chapmani*)	-	-	P4	●	●	-	Rocky ranges and hills with pebbled soil for mound construction. More common on the lower slopes of ridges with spinifex hummock grassland (Dunlop and Pound, 1981).	36 records of the species from between 8 - 37 km of the Survey Area.	**Low:** No suitable habitat within the Survey Area.
Long-tailed Dunnart (*Sminthopsis longicaudata*)	-	-	P4	●	●	-	Rocky hills, ranges and escarpments with open woodland and/or shrubland over spinifex (Pavey, 2006).	Four records within 16 km of the Survey Area.	**Low:** No suitable habitat within the Survey Area.
Birds									

Species	Conservation Status			Nature Map	DBCA	PMST	Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA						
Night Parrot (*Pezoporus occidentalis*)	CR	EN	-	-	-	●	Recorded from long unburnt, ring forming *Triodia* grasslands in association with low lying saline lakes and drainages hosting chenopods/samphire (Jackett *et al.*, 2017).	No regional observations have been recorded. Potential habitat is listed as present in the area by the Protected Matter Search Tool (PMST).	**Low:** No suitable habitat within the Survey Area.
Australian Painted Snipe (*Rostratula australis*)	EN	EN	-	-	-	●	Shallow terrestrial freshwater wetlands, lakes, and swamps, typically with low, dense fringing vegetation. Favours sites with shallow water and exposed mud (Menkhorst *et al.*, 2019).	No regional observations have been recorded. Potential habitat is listed as present in the area by the Protected Matter Search Tool (PMST).	**Low:** Suitable habitat does not occur in the Survey Area; no nearby records.
Grey Falcon (*Falco hypoleucos*)	VU	VU	-	-	-	●	Likely a nomadic species in the arid and semi-arid zones. Does not appear to be associated with any particular vegetation types (Schoenjahn, Pavey and Walter, 2020).	No regional observations have been recorded. Potential habitat is listed as present in the area by the Protected Matter Search Tool (PMST).	**Low:** Wide ranging species that forages over a range of habitats. However an absence of regional observations of the species indicate a low likelihood of occurrence.
Princess Parrot (*Polytelis alexandrae*)	VU	-	P4	-	-	●	Swales between sand dunes. Associated sites usually have a variety of shrubs among scattered trees and a ground cover of *Triodia* species. In the arid zone of western and central Australia (Department of the Environment, 2018a).	No regional observations have been recorded. Potential habitat is listed as present in the area by the Protected Matter Search Tool (PMST).	**Low:** Suitable habitat does not occur in the Survey Area. No nearby records.

Species	Conservation Status			Nature Map	DBCA	PMST	Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA						
Fork-tailed Swift (*Apus pacificus)*	MI	MI	-	-	-	●	Nomadic, almost entirely aerial lifestyle over a variety of habitats; associated with storm fronts (Australian Government & Department of Agriculture Water and the Environment, 2020).	No regional observations have been recorded. Potential habitat is listed as present in the area by the Protected Matter Search Tool (PMST).	**Low:** Always a possibility due to association with storm fronts, and the species' almost entirely aerial lifestyle. No habitat utilised.
Barn Swallow (*Hirundo rustica*)	MI	MI	-	-	-	●	Open country with low vegetation, farmlands and meadows (Department of the Environment, 2020).	No regional observations have been recorded. Potential habitat is listed as present in the area by the Protected Matter Search Tool (PMST).	**Low:** No suitable habitat in the Survey Area; no nearby records.
Peregrine Falcon (*Falco peregrinus*)	-	OS	-	●	●	-	Occur across much of Australia inhabiting cliffs, coastal habitats, rivers, wooded water courses and lakes (Birdlife Australia, 2012).	Six records from between 8 - 28 km of the Survey Area.	**Medium:** Foraging habitat is likely to occur in the Survey Area; several records of the species from nearby. No roost or nest habitat present.
Reptiles									
Pilbara Olive Python (*Liasis olivaceus* subsp. *barroni*)	VU	VU	-	●	●	●	Inhabits gorges, gullies, stony ranges, rock piles and along watercourses. Often associated with permanent and temporary water bodies though is not restricted to them. Habitat requirements are likely to vary throughout the year (Department of Sustainability Environment Water Population and Communities, 2011).	Eight records from between 13 - 30 km of the Survey Area.	**Low:** No suitable habitat in the Survey Area.

Species	Conservation Status			Nature Map	DBCA	PMST	Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA						
Ganes Blind Snake (Pilbara) (*Anilios ganei*)	-	-	P1	●	●	-	A variety of habitats, thought to prefer moist gorges though habitat data is limited (Aplin, 1998).	Ten records of the species within 36 km of the Survey Area.	**Low:** No suitable habitat in the Survey Area.
Spotted Ctenotus (northeast) (*Ctenotus uber* subsp. *johnstonei*)	-	-	P2	●	-	-	Known primarily from chenopod shrubland at the base of sandstone hills. Often associated with small rock outcrops on open sandy and stony plains (Cogger, 2014).	Four records within 24 km of the Survey Area.	**Low:** No suitable habitat in the Survey Area.
Unpatterned Robust Slider (Robertson Range) (*Lerista macropisthopus* subsp. *remota*)	-	-	P2	●	-	-	Woodlands and semi-arid shrublands with sandy to sandy loam soils (Cogger, 2014).	Three records from between 17 - 23 km from the Survey Area.	**Medium:** Areas of sandy loam were recorded in the Mulga Woodland habitat of the Survey Area; nearby records from 18 km west of the Survey Area.

3.5.3.1. Ghost Bat (*Macroderma gigas*)

Conservation Status

- EPBC Act: Vulnerable
- BC Act: Vulnerable

Distribution, Habitat and Ecology: The Ghost Bat is a large, specialist carnivorous bat and is the sole survivor of its genus (Hoyle, Pople and Toop, 2001; Worthington Wilmer *et al.*, 2008). Historically it was widely distributed across Australia but the species is now only recorded from isolated locations across northern Australia, including the Pilbara region (Armstrong and Anstee, 2000).

Ghost Bats use a range of cave structures for a variety of purposes ranging from short-term transient feeding roosts through to maternity roosts (DotE 2018b). Short-term transient feeding roosts can include overhangs, small shallow caves, granite boulders, and even rail culverts (Armstrong and Anstee, 2000; Ecoscape 2017, 2018). These sites have microclimates similar to ambient conditions. Maternity roosts however require a more stable, warm, and humid climate with a relative humidity over 80%. They are usually deep complex or large domed caves (or mine adits) with an ideal isothermal zone (23-26°C) and a cavern size large enough for the species to manoeuvre in (Pettigrew *et al.*, 1986; Hall *et al.*, 1997). Medium-sized caves with suitable microclimates are used for a variety of activities from brief visits to consume prey to long-term roosting. Caves that provide complete darkness are reported to be preferred for roosting (Schulz and Menkhorst, 1986).

The Ghost Bat is a predator and feeds on other bats, rodents, and birds. Prey detection is completed by a combination of passive listening, vision, and some echolocation, where the detection through movement is thought to be the primary stimulus (Pettigrew et al 1988). Studies undertaken by Boles (1999) have shown that Ghost Bats often take roosting birds and small rodents which was also observed along the Main Line Rail where Ghost Bat scats and remains of prey (Fairy Martins and Budgerigar wings and rodent carcasses) were collected from inside the culverts (Ecoscape 2018). During the wet season grasshoppers, beetles and cicadas are heavily preyed upon (Toop, 1985; Pettigrew *et al.*, 1986).

Occurrence in the Survey Area: Recent research has identified that Ghost Bats in the Pilbara travel further for foraging, without the strong association with watercourses as previously thought with nightly travelling distances of up to 21 km recorded (Knuckey, 2021). With records of Ghost Bats in 2016 less than 14 km from Survey Area it is possible the species uses the Survey Area for foraging. As there is no roosting habitat in the Survey Area, the species occurrence would be limited to flying over for dispersal and foraging.

3.5.3.2. Peregrine Falcon (*Falco peregrinus*)

Conservation Status:

- BC Act: Specially protected fauna

Distribution, Habitat and Ecology: The Peregrine Falcon is one of the most widespread birds in the world, breeding on all continents except Antarctica (Olsen *et al.*, 2006). It occurs across most of Australia, although it is an uncommon species and is rare across all states and territories (Birdlife Australia, 2012). They are known to be both a nomadic and sedentary species. They inhabit cliffs, coastal habitats, rivers, wooded water courses and lakes, as well as urban environments. Peregrine Falcons usually nest by making a scrape on a high cliff-edge but will also use stick nests of other large birds and tree hollows in some areas (Olsen *et al.*, 2006). Hunting is mainly done during the day and feeding is primarily on small- to medium-sized birds caught in flight, often above drainage lines and rivers. Favoured prey species include the Galah (*Eolophus roseicapilla*) and Sulphur-crested Cockatoo (*Cacatua galerita*) (Birdlife Australia, 2012).

Occurrence in the Survey Area: The Peregrine Falcon has been assigned a Medium likelihood of occurring within the Survey Area as the species is wide-ranging species, the Survey Area is in close proximity to a major drainage line (Coondiner Creek) and there are several recent species records in the vicinity. However, the lack of nesting or roosting habitat limits the species use of the Survey Area to flying over for foraging and dispersal.

3.5.3.3. Unpatterned Robust Slider (*Lerista macropisthopus* subsp. *remota*)

Conservation Status

- DBCA: Priority 2

Distribution, Habitat and Ecology: The Unpatterned Robust Slider is a burrowing skink inhabiting loose soil of semi-arid woodlands and scrubs where it feeds on ants, termites and other small insects (Cogger, 2014). It is found from a small number of localities in the central interior of Western Australia (DBCA 2021). Separation to subspecies level is based on the paler coloration and geographic distribution of individuals (Storr, 1991).

Occurrence in the Survey Area: With its sandy loam soils, the Mulga Woodland may support this species. This habitat type is limited within the Survey Area (6.8 ha) but found extensively throughout the region (Astron, 2015) and thus any occurrence of the species is unlikely to be limited to the Survey Area.

3.5.4. Short Range Endemic Invertebrates

Three species of potential SRE invertebrates were assigned a High likelihood of occurring the Survey Area based on habitats they have previously been recorded from, habitats recorded in the Survey Area, and distance of records from the Survey Area. Six species were assigned a Medium likelihood of occurrence while all other species were assigned a Low likelihood of occurring in the Survey Area (Table 3.10).

The likelihood of SRE taxa being restricted to within the Survey is low. SRE invertebrates are typically associated with habitats that support their primitive biology and ecology, such as moist sheltered areas on the southern slopes of hills and ranges and in protected gullies and gorges, none of which occur in the Survey Area. Dense Mulga woodland habitat can potentially provide suitable habitat for SRE taxa, particularly along drainage lines. Some Mulga Woodland exists within the Survey Area (13.4%), but it is not considered particularly suitable as leaf litter is sparse and it does not occur on drainage lines. Furthermore, this habitat is found extensively throughout the surrounding region (Astron, 2015).

Table 3.10: Western Australian Museum Invertebrate Database Results

Class/ Order/ Family	Species	Distance & Direction of Nearest Record from Survey Area	Likelihood of Occurrence
ARACHNIDA			
Araneomorphae			
Desidae	*'Forsterina* grp. Genus' 1 'sp. 5'	9 km NW	**Low:** Records are from an area that has been cleared so habitat cannot be assessed from imagery; however, habitat described in database (tree and saltbush) does not occur in the Survey Area.
Lamponidae	*Asadipus* 'areyonga'	39 km E	**Low:** Single record is from a hill slope; similar habitat does not occur in the Survey Area.
Lycosidae	*Venator* 'sp. (VWF1244)'	49 km SE	**Low:** Two records 49 km away in habitat that does not occur in the Survey Area. A further six records over 1,000 km away appear to be a mapping error (wrong coordinates).
Oonopidae	*Myrmopopaea* 'sp. 10'	37 km E	**Low:** Record is from a creekline; similar habitat is not found within the Survey Area.
Salticidae	'Neon' 'PBS sp. 3'	39 km E	**Low:** Single record is from a hill slope; similar habitat does is not found in the Survey Area.
Selenopidae	*Karaops* 'sp. indet. (juvenile)'	24 km NE	**Low:** Records are from rocky gorge/ breakaway habitats not found in the Survey Area.
Selenopidae	*Karaops* 'ARA003'	21 km NE	**Low:** Most records are from under rocks on southern slopes. Similar habitat does not occur in the Survey Area.
Selenopidae	*Karaops* 'ARA004'	33 km NE	**Low:** Records are from under rocks on southern slopes. Similar habitat does not occur in the Survey Area.
Selenopidae	*Karaops* 'ARA005'	10 km N	**Low:** Records are from slopes, gorges, or gullies. Similar habitat does not occur in the Survey Area.
Zodariidae	*Spinasteron* 'leeuweni'	11 km W	**Low:** Nearby records are from areas that have been cleared so unable to assess habitat from imagery; further records are from spinifex plains; similar habitat does not occur in the Survey Area. **Unlikely to be an SRE due to distribution.**
Mygalomorphae			
Anamidae	*Aname watsoni*	14 km W	**Low:** Specimens recorded from open floodplains; similar habitat does not occur in the Survey Area.
Anamidae	*Kwonkan* 'MYG098'	14 km W	**Low:** Records from gullies and open floodplains. Similar habitat does not occur in the Survey Area.
Anamidae	*Kwonkan* 'MYG651'	18 km W	**Medium:** One record in similar habitat to the Survey Area. Two other records from a gully and ridge; similar habitat does not occur in the Survey Area.
Barychelidae	*Aurecocrypta* 'MYG315'	12 km N	**Medium:** Records are from flat, open habitats across a wide distance. **Unlikely to be an SRE due to distribution.**

Class/ Order/ Family	Species	Distance & Direction of Nearest Record from Survey Area	Likelihood of Occurrence
Euagridae	*Cethegus* 'MYG299'	13 km N	**High:** Records appear to be from flat, open shrubland similar to the Open Stoney Plain habitat recorded in the Survey Area.
Halonoproctidae	*Conothele* 'MYG385'	9 km N	**Low:** Single record is from a gully; similar habitat is not found in the Survey Area.
Halonoproctidae	*Conothele* 'MYG558'	15 km N	**Low:** Three records are from shallow or deep gullies; similar habitat does not occur in the Survey Area.
Halonoproctidae	*Conothele* 'MYG575'	12 km N	**Low:** Single record is from a vegetation grove in open woodland; similar habitat does not occur in the Survey Area.
Idiopidae	*Gaius* 'MYG286'	25 km E	**Medium:** Records from a variety of habitats including a plain, creek line, mulga woodlands and a gully.
Idiopidae	*Idiosoma* 'MYG384'	34 km NE	**High:** Records are from a variety of habitats including flat, open shrublands similar to the Open Stoney Plain habitat recorded in the Survey Area
Geophilida			
Geophilidae	*'Zelanophilus?'*	31 km E	**Medium:** Location of the single record has been cleared so habitat cannot be assessed from imagery.
Polydesmida			
Paradoxosomatidae	*Antichiropus* 'DIP042, wheelarra'	39 km E	**Low:** One record from a hillslope; similar habitat does not occur in the Survey Area.
Paradoxosomatidae	*Antichiropus* 'DIP051, pannawonica'	14 km N	**High:** Single specimen is in similar habitat to the Open Stoney Plain habitat recorded in the Survey Area
Paradoxosomatidae	*Antichiropus* 'OB35_1? (female)'	16 km W	**Low:** Single specimen is from a densely vegetated gully. No similar habitat occurs in the Survey Area.
Paradoxosomatidae	*Antichiropus* 'OB35_2? (female)'	19 km W	**Low:** Single specimen is from a densely vegetated gully. No similar habitat occurs in the Survey Area.
Paradoxosomatidae	*Antichiropus cristatus*	22 km W	**Low**: Specimens are from slopes with spinifex. No similar habitat occurs in the Survey Area.
Paradoxosomatidae	*Antichiropus verutus*	16 km W	**Low:** Records are from rocky slopes, gullies, and ridge bases. No similar habitat occurs within the Survey Area.
Polyxenida			
Polyxenidae	*Unixenus* 'mjoebergi'	14 km W	**Low:** Single record is from an open floodplain. Similar habitat does not occur in the Survey Area.
Pseudoscorpines			

Class/ Order/ Family	Species	Distance & Direction of Nearest Record from Survey Area	Likelihood of Occurrence
Garypidae	*Synsphyronus* 'PSE086'	33 km N	**Low:** Single record is from a deep gully. Similar habitat does not occur in the Survey Area.
Garypidae	*Synsphyronus* 'PSE129'	13 km N	**Low:** Single records is from under rocks on a hill side. Similar habitat does not occur in the Survey Area.
Olpiidae	*Beierolpium* 'sp. 8/1'	14 km N	**Medium:** Single record from under rocks in open shrubland. While similar habitat occurs in the Survey Area there are not suitable rocks to sustain the species.
Olpiidae	*Xenolpium* 'PSE079'	30 km NE	**Low:** Records appear associated with heavily vegetated habitats that do not occur in the Survey Area.
Feaellidae	*Feaella callani*	15 km N	**Low:** Records are from under rocks in a hilly area; similar habitat does not occur within the Survey Area.
Scolopendrida			
Scolopendridae	*Scolopendra* 'sp. indet. (juvenile)'	23 km E	**Low:** Most records are from flood plains, gullies or creek lines not occurring within the Survey Area.
Scorpiones			
Buthidae	*Lychas* 'harveyi group' 'SCO038'	43 km NW	**Medium:** Two of three records are from similar habitat to the Survey Area; however, these are located over 60 km away.
Buthidae	*Lychas* 'pilbara 1' SCO041'	41 km NW	**Low:** Two records are over 40 km from the Survey Area in habitats that do not to occur in the Survey Area.
Buthidae	*Lychas* 'Pilbara sp. 2'	14 km N	**Low:** One record from a ridge line. Similar habitat does not occur in the Survey Area.
Buthidae	*Lychas bituberculatus* 'SCO042'	41 km NW	**Low:** Records are from open Eucalypt woodlands; similar habitat does not occur in the Survey Area.
Urodacidae	*Urodacus* 'pilbara 12'	16 km W	**Low:** Records are from habitats such as gullies, ridges, and rocky slopes. Similar habitats do not occur in the Survey Area.
Spirobolida			
Trigoniulidae	*Austrostrophus* 'sp. (fragment)'	41 km N	**Low:** Records are all from moist habitats e.g. creek margins that are not found in the Survey Area.
GASTROPODA			
Charopidae	*Discocharpa* sp.	27 km N	**Low:** Two records from a rock scree slope in gully. Similar habitat does not occur in the Survey Area.

4. CONCLUSION

4.1. Flora

No Threatened or Priority Flora were recorded or considered likely to occur within the Survey Area following the field assessment.

Both significant flora taxa assigned a High likelihood of occurrence prior to the survey (*Aristida jerichoensis* var. *subspinulifera* – Priority 3, *Seringia exastia* - Threatened), were assigned a Low likelihood of occurrence post survey.

4.2. Vegetation

Of the two vegetation types recorded at the Survey Area, neither were considered significant, or were considered to be locally or regionally significant.

4.3. Terrestrial Fauna

The basic fauna survey and desktop assessment did not identify any conservation significant vertebrate or SRE invertebrate fauna species that are restricted to the Survey Area. The three vertebrate fauna species identified as having a Medium likelihood of occurrence in the Survey Area are not restricted to any of the habitats there, and use of the Survey Area is likely to be limited to flying over for foraging or dispersal. In addition, the disturbance within the Survey Area such as vehicle use and aircraft noise, limit the propensity for fauna to utilise the habitats that occur within.

The fauna habitats identified are not restricted to the Survey Area and are widespread in the region.

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Appendix A: Conservation Codes

Appendix A1: Definitions of Conservation Categories under the EPBC Act

Category	Definition
Extinct	A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time: (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered	A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	A native species is eligible to be included in the endangered category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable	A native species is eligible to be included in the vulnerable category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
Conservation Dependent	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time: (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered, or critically endangered; or (b) the following subparagraphs are satisfied: (i) the species is a species of fish; (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long-term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species.

Appendix A2: Definitions of Conservation Categories under the BC Act (DBCA 2019)

Threatened Species: Listed by order of the Minister as Threatened in the category of critically endangered, endangered, or vulnerable under section 19(1), or is a rediscovered species to be regarded as Threatened species under section 26(2) of the Biodiversity Conservation Act 2016 (BC Act).
Threatened fauna s that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for Threatened Fauna.
Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the Wildlife Conservation (Rare Flora) Notice 2018 for Threatened Flora.
The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

Category	Definition
CR	**Critically endangered species** Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for critically endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for critically endangered flora.
EN	**Endangered species** Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for endangered flora.
VU	**Vulnerable species** Threatened species considered to be "facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for vulnerable fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for vulnerable flora.

Extinct species: Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.

Category	Definition
EX	**Extinct species** Species where "there is no reasonable doubt that the last member of the species has died", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act). Published as presumed extinct under schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for extinct fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for extinct flora.
EW	**Extinct in the wild species** Species that "is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act). Currently there are no Threatened fauna or Threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.

Specially protected species: Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.
Species that are listed as Threatened species (critically endangered, endangered, or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.

MI	Migratory species Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species. Published as migratory birds protected under an international agreement under schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
CD	Species of special conservation interest (Conservation dependant fauna) Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as Threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act). Published as conservation dependent fauna under schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
OS	Other specially protected species Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act). Published as other specially protected fauna under schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
[1] The definition of flora includes algae, fungi, and lichens. [2] Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).	

Appendix A3: Definitions of Priority Species Classification (DBCA 2019)

Priority species: Possibly Threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as Threatened fauna or flora.
Species that are adequately known, are rare but not Threatened, or meet criteria for near Threatened, or that have been recently removed from the Threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.
Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

Category	Definition
P1	**Priority 1: Poorly-known species** Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
P2	**Priority 2: Poorly-known species** Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
P3	**Priority 3: Poorly-known species** Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
P4	**Priority 4: Rare, Near Threatened and other species in need of monitoring** (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently Threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of Threatened species during the past five years for reasons other than taxonomy

Appendix A4: Legal Status Definition of Listed Plants in Western Australia

Legal Status	Definition
Declared Pest, Prohibited – s12	Prohibited organisms are declared pests by virtue of section 22(1) and may only be imported and kept subject to permits.
Declared Pest – s22(2)	Declared pests must satisfy any applicable import requirements when imported and may be subject to control keeping requirements.
Permitted – s11	Permitted organisms must satisfy applicable import requirements and import permits (where required).
Permitted, Requires Permit – r73	Regulation 73 permitted organisms may be subject to restriction under legislation other than the BAM Act (2007).
Unlisted	Unlisted organisms are prohibited in WA.
Control Categories	Definition
C1 Exclusion	Organisms should be excluded from parts or all of WA.
C2 Eradication	Organisms should be eradicated from all or parts of WA.
C3 Management	Organisms should have some form of management applied that will alleviate the harmful impact of the organism, reduce the numbers or distribution of the organism, or prevent or contain the spread of the organism.
Unassigned	Declared pest that are recognised as having a harmful impact under certain circumstances where their subsequent control requirements are determined by a plan or other legislative arrangements under the Act.
Keeping Categories	Definition
Prohibited keeping	Can only be kept under a permit for public display, education, or scientific purposes.
Restricted keeping	Kept under a permit by private individuals due to a low risk of becoming a problem for the environment.
Exempt keeping	No permit or conditions are required for keeping. Organism may be subject to restrictions under the Wildlife Conservation Act (WCA, 1950).

Appendix B: Site Data Collection Sheet

Details Included in Relevé Sampling

- Site code, date; location;
- Botanist;
- Photograph;
- Vegetation condition (as defined in Table 2.2);
- Disturbances (grazing, weeds, tracks, mounds, litter, erosion, clearing etc.);
- Time since fire (<1 year, 1-2 years, 2-5 years, >5 years); and
- Landform, geology, and soils, consistent with the Australian soils and land survey field handbook (National Committee on Soil and Terrain, 2009), including:
  - Flat: plain
  - Flat: valley floor
  - Flat: tidal
  - Slope: lower, mid, upper
  - Slope: cliff
  - Slope: simple
  - Slope: simple dune
  - Hillock
  - Crest: hill
  - Crest: dune
  - Crest: mesa
  - Ridge: hill
  - Ridge: dune
  - Open depression: drainage line
  - Open depression: creek/river
  - Open depression: floodplain
  - Closed depression: Lake edge
  - Closed depression: Swamp edge
  - Drainage line on slope: lower, mid, upper
  - Slope: Level <1°, Very gentle 1°, Gentle 3°, Moderate 10°, Steep 23°, Very steep 37°, Precipitous 60° and Cliff 80°;
  - Aspect: North, South, East, West;
  - Soil: Sand, Clay, Loam, Sandy-clay, Hard-clay, Cracking-clay, and Saline;
  - Soil Colour: Dark, Light, Red, Orange, White, Grey, Brown, Black and Yellow;
  - Rock Type: BIF, Calcrete, Creek stones, Dolerite, Granite, Ironstone, Shale, Quartz and Other;
  - Rock Abundance: No rocks, Very few (<2%), Few (2-10%), Common (10-20%), Many (20-50%), Abundant (50-90%) and Continuous (>90%); and
  - Rock Size: Fine gravel (<6 mm), Medium gravel (6-20 mm), Coarse gravel (20-60 mm), Cobbles (60-200 mm), Stones (200-600 mm) and Boulders (>600 mm).
- Dominant species – Crown cover (%) and Height (m); and
- Vegetation structure - NVIS Level V: three dominant species in three strata: upper, middle, and ground (ESCAVI, 2003).

Appendix C: Relevé Site Data

Site: R001	Type: Relevé	Size: n/a	Date: 10/03/2021	Botanist: Melissa Hay
Landform:	Flat, Plain			
Slope, aspect:	1°- Very Gentle			
Soil:	Sandy clay, red, orange			
Rocks:	Ironstone & quartz			
Abundance:	>90% - Abundant			
Size:	20-60 mm – Coarse gravel			
Fire:	>5 years			
Condition:	Very good			
Notes:				
Veg Unit:	P01			
Location:	50 785549 7407182			

Species	Height	Cover	Species	Height	Cover
Maireana triptera	0.2	0.1	*Eremophila cuneifolia*	1	0.1
Ptilotus exaltatus	0.2	0.1	*Acacia synchronicia*	1.5	2
**Cenchrus ciliaris*	0.3	0.5	*Senna glutinosa subsp. luerssenii*	1.6	10
Senna sp. Meekatharra (E. Bailey 1-26)	0.3	0.1	*Acacia macraneura*	4	2

Site: R002	Type: Relevé	Size: n/a	Date: 10/03/2021	Botanist: Melissa Hay
Landform:	Flat, Plain			
Slope, aspect:	<1° - Level			
Soil:	Sandy clay loam, Red-orange			
Rocks:	Ironstone			
Abundance:	20-50% Many			
Size:	20-60 mm - Coarse gravel			
Fire:	>5 years			
Condition:	Very Good			
Notes:	Weeds (medium)			
Veg Unit:	P01			
Location:	50 785310 7406903			

Species	Height	Cover	Species	Height	Cover
Portulaca oleracea	*0.1*	*0.1*	*Eremophila cuneifolia*	*1.2*	*5*
**Cenchrus ciliaris*	*0.3*	*10*	*Acacia synchronicia*	*1.5*	*2*
Eragrostis xerophila	*0.3*	*10*	*Senna glutinosa subsp. ×luerssenii*	*1.5*	*15*
Ipomea calobra	*1*	*0.1*	*Acacia macraneura*	*4*	*6*
Senna sp. Meekatharra (E. Bailey 1-26)	*1*	*0.5*			

Site: R003	Type: Relevé	Size: n/a	Date: 10/03/2021	Botanist: Melissa Hay
Landform:	Drainage, depression			
Slope, aspect:	<1° - Level			
Soil:	Clay, Sandy clay, Red, Orange			
Rocks:	None			
Abundance:	-			
Size:	-			
Fire:	> 5 yrs			
Condition:	Very good			
Notes:	Weeds (low)			
Veg Unit:	P02			
Location:	50 785798 7407308			

Species	Height	Cover	Species	Height	Cover
Corchorus tridens	*0.1*	*0.1*	*Abutilon otocarpum*	*0.5*	*0.1*
Enneapogon polyphyllus	*0.2*	*0.5*	*Ptilotus obovatus*	*0.8*	*1*
Paspalidium clementii	*0.3*	*0.5*	*Eremophila platycalyx*	*3*	*0.1*
Eriachne mucronata	*0.4*	*1*	*Acacia macraneura*	*4*	*50*
Indigofera monophylla	*0.4*	*0.1*	*Acacia paraneura*	*5*	*5*

Site: R004	Type: Relevé	Size: n/a	Date: 10/03/2021	Botanist: Melissa Hay
Landform:	Drainage, depression			
Slope, aspect:	<1° - Level			
Soil:	Clay, Sandy clay, Red-orange			
Rocks:	none			
Abundance:	-			
Size:	-			
Fire:	> 5 yrs			
Condition:	Good			
Notes:	Clearing, weeds (medium)			
Veg Unit:	P01			
Location:	50 785415 7406968			

Species	Height	Cover	Species	Height	Cover
**Cenchrus ciliaris*	*0.6*	*10*	*Senna glutinosa subsp. ×luerssenii*	*1.5*	*3*
Aristida latifolia	*1*	*60*	*Amyema fitzgeraldii*	*2*	*0.1*
Senna sp Meekatharra (E. Bailey 1-26)	*1*	*0.5*	*Acacia ?macraneura*	*4*	*8*

Site: R005	Type: Relevé	Size: n/a	Date: 10/03/2021	Botanist: Melissa Hay
Landform:	Drainage, depression			
Slope, aspect:	<1° - Level			
Soil:	Clay, Sandy clay, Red-orange			
Rocks:	none			
Abundance:	-			
Size:	-			
Fire:	> 5 yrs			
Condition:	Good			
Notes:	weeds (medium)			
Veg Unit:	P02			
Location:	50S 785636 7407089			

Species	Height	Cover	Species	Height	Cover
Aristida contorta	*0.2*	*2*	*Senna glutinosa subsp. ×luerssenii*	*1.5*	*2*
Cenchrus ciliaris	*0.3*	*10*	*Eremophila platycalyx*	*2*	*0.2*
Aristida latifolia	*0.5*	*10*	*Eremophila latrobei subsp. filiformis*	*2.3*	*0.1*
Ptilotus obovatus	*1.2*	*0.5*	*Acacia macraneura*	*6*	*60*

Site: R006	Type: Relevé	Size: n/a	Date: 10/03/2021	Botanist: Melissa Hay
Landform:	Flat, plain			
Slope, aspect:	<1° - Level			
Soil:	Clay, Sandy clay, Red-orange			
Rocks:	Ironstone			
Abundance:	>90% Continuous			
Size:	60-200 mm - Cobbles			
Fire:	> 5 yrs			
Condition:	Very Good			
Notes:	weeds (low)			
Veg Unit:	P01			
Location:	50S 785799 7407566			

Species	Height	Cover	Species	Height	Cover
Eriachne pulchella subsp. pulchella	*0.2*	*0.1*	*Senna sp. Meekatharra (E. Bailey 1-26)*	*1.1*	*2*
Goodenia microptera	*0.2*	*0.1*	*Eremophila cuneifolia*	*1.2*	*3*
**Cenchrus ciliaris*	*0.3*	*0.1*	*Acacia macraneura*	*5*	*4*
Senna glutinosa subsp. ×luerssenii	*1.1*	*3*			

Site: R007	Type: Relevé	Size: n/a	Date: 10/03/2021	Botanist: Melissa Hay
Landform:	Flat, Plain			
Slope, aspect:	<1° - Level			
Soil:	Clay, Sandy clay, Red, Orange			
Rocks:	None			
Abundance:	20-50% Many			
Size:	20-60 mm - Coarse gravel			
Fire:	> 5 yrs			
Condition:	Good			
Notes:	Weeds (medium)			
Veg Unit:	P01			
Location:	50S 785917 7407980			

Species	Height	Cover	Species	Height	Cover
**Cenchrus ciliaris*	*0.3*	*2*	*Acacia tetragonophylla*	*4*	*5*
Aristida latifolia	*1*	*0.5*	*Acacia macraneura*	*5*	*15*
Senna glutinosa subsp. ×luerssenii	*1.2*	*1*			

Appendix D: Likelihood of Occurrence of Significant Flora

Likelihood of Occurrence	Status	Taxon	Description	Habitat	Distance from Survey Area (km)	Flowering Time	AVH	TPFL	WAHerb	Ecoscape	Nature	Onshore Environm
High	P3	*Aristida jerichoensis var. subspinulifera*	Compactly tufted perennial, grass-like or herb, 0.3-0.8 m high, lemma groove muricate.	Flat terrain. Red clay loam, low in landscape. Hardpan plains.	8.8	Apr.	X		X			
Medium	P1	*Eremophila capricornica*	A small shrub 50–75 cm high, 50–75 cm wide. Branches terete, with woolly dendritic hairs	Found from east of Newman across to Jigalong, growing in sandy clay loams in open mulga shrubland with an understory of Triodia spp. and other grasses	33.5	June-August		X	X		X	
Medium	P3	*Eremophila rigida*	Bushy shrub, 0.3-4 m high. Fl. cream, Sep.	Red sand alluvium. Hardpan plains, stony clay depressions.	13.9	Sept.		X	X		X	
Medium	P3	*Rhagodia sp. Hamersley (M. Trudgen 17794)*	Erect shrub to 1.5m.	Flat plain. Floodplain. Hillslope. Red sandy loam with surface cobbles.	22.9	May		X	X	X	X	X
Medium	P4	*Goodenia nuda*	Erect to ascending herb, to 0.5 m high. Fl. Yellow.	Drainage line. Red/brown clay loam soils. Floodplains. Brown loam/ironstone.	12.4	Apr to Aug.	X		X	X	X	X
Low	T	*Seringia exastia*	Rounded shrub to 30 cm tall, in full flower.	Ridge top. Brown/red loam. Collection site: mining tenement. Recently burnt: 2-5 years.	23.7	April to Dec.	X		X			
Low	P1	*Acacia corusca*	Rounded to broadly rounded, robust, multi-stemmed shrub or small tree 1.5-4.0 (-5.0) m high, 1.5-5 (-6.0) m wide	Grows on red-brown sandy-loam soils on hill crests, ridges, slopes, and minor drainage lines upon low, subdued and undulating stony hills	31.6	April-Aug.			X		X	
Low	P1	*Eremophila pilosa*	Shrub, ca 0.8 m high. Fl. Purple	Grows in red-brown clay loam on sandy plains between Jigalong and Roy Hill	51.1	Sep	X	X	X	X		
Low	P1	*Eremophila rhegos*	Erect shrub, ca 1 m high. Fl. blue-purple-white	Skeletal stony loam over granite.	34.8	Sept.			X		X	
Low	P1	*Eremophila sp. Hamersley Range (K. Walker KW 136)*	Shrub to 2m tall. Rounded crowded canopy. Fl. white-cream-yellow-pink-purple.	Hill crest. Creek embankments. Gullies.	10.7	Aug.			X		X	
Low	P1	*Eremophila sp. West Angelas (S. van Leeuwen 4068)*	Spindly shrub to 3 m high.	Summits of hills. Slopes.	48.3	Sept. to Oct.			X			
Low	P1	*Hibiscus campanulatus*	Shrub or tree. Stems hairy.	-	unknown	Aug.		X				

Likelihood of Occurrence	Status	Taxon	Description	Habitat	Distance from Survey Area (km)	Flowering Time	AVH	TPFL	WAHerb	Ecoscape	Nature	Onshore Environm
Low	P1	*Lindernia sp. Pilbara (M.N. Lyons & L. Lewis FV 1069)*	-	Low open forest of Eucalyptus victrix over low open shrubland of Duma florulenta	77.2	Unknown.			X			
Low	P1	*Myriocephalus scalpellus*	Semi-erect herb, 0.03-0.08 m high.	Clay. Depression on flood plain.	76.8	Unknown		X	X			
Low	P1	*Rorippa sp. Fortescue Valley (M.N. Lyons & R.A. Coppen FV 0760)*	-	Low open forest of Eucalyptus victrix over low open shrubland of Duma florulenta	77.2	Unknown			X			
Low	P1	*Tecticornia globulifera*	Perennial shrub to 0.3–0.5 m high. Vegetative articles globular to obovoid, not compressed green or pink to red.	Moderately saline flats on red-brown gritty clay.	71.6	Unknown			X			
Low	P1	*Triodia pascoeana*	Dense, tussock-forming perennial, grass-like or herb, 1-3 m high, non-resinous, panicle long-linear, extremely scabrous, lemma 3-lobed, awnless.	Limestone ranges & gorges, floodplains.	9.6	Jan to Apr	X					
Low	P1	*Vallisneria sp. Weelarrana (M.N. Lyons & S.D. Lyons 3050)*	-	Flat/plain to very broad open drainage depression. Dry, well-drained, brown clay loam.	71.7	Unknown			X			
Low	P1	*Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684)*	Tall daisy to 1 m , open canopy, in late flower and dehiscing fruit, cream/white flowers.	Flat terrain, low in landscape. Red clay loam with some stone. Gilgai. Drainage lines.	25.0	Jul.			X		X	
Low	P2	*Aristida lazaridis*	Tufted perennial, grass-like or herb, 0.4-1.5 m high. Fl. green/purple, Apr.	Clay plains of an ephemeral lake. Floodplain/drainage zone. Sand or loam.	41.1	Apr.			X			
Low	P2	*Euphorbia inappendiculata var. inappendiculata*	Herb to 2 cm.	Flat, red brown loam. Cracking clay.	26.5	Unknown.			X		X	
Low	P2	*Goodenia hartiana*	Erect to spreading, multistemmed perennial, herb or shrub (sub-shrub).	Sand. Sand dune swales, sandhills.	24.1	Aug. to Sept.	X	X	X		X	
Low	P2	*Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)*	Spindly upright shrub to 3 m tall, purple flower.	Rocky (boulder) slope below low cliffs. Gully. Gravelly, pebbly red-brown loam.	50.2	May & July			X			
Low	P2	*Ipomoea racemigera*	Creeping annual, herb or climber. Fl. white.	Fringing vegetation of river.	9.6	Unknown.	X		X		X	
Low	P2	*Isotropis parviflora*	Shrub, 0.1 m high. Fl. white/pink, Mar.	Low rocky hill. Red-brown loam soils and ironstone gravel.	21.7	Feb. to Mar., May	X		X		X	

Likelihood of Occurrence	Status	Taxon	Description	Habitat	Distance from Survey Area (km)	Flowering Time	AVH	TPFL	WAHerb	Ecoscape	Nature	Onshore Environm
Low	P2	*Oxalis sp. Pilbara (M.E. Trudgen 12725)*	Small herb to 10 cm tall. Leaves green above, purple below; yellow flowers.	Gully. Brown-red loam.	54.9	May			X			
Low	P3	*Acacia subtiliformis*	Spindly, slender, erect shrub, to 3.5 m high, phyllodes green, new growth slightly viscid, resinous, aromatic; inflorescence in heads to 6 mm diameter; peduncles red	Rocky calcrete plateau.	39.6	June, yellow		X	X		X	
Low	P3	*Amaranthus centralis*	Erect, to 60 cm high. Stems angular, sometimes reddish, sparsely hairy	Red sand in ephemeral watercourses. Sandy to clayey loam. Riverbanks. Edges of permanent pools in eucalypt lined channels.	47.4	Flowers throughout the year		X	X			
Low	P3	*Calotis latiuscula*	Erect herb, to 0.5 m high. Fl. yellow,	Sand, loam. Rocky hillsides, floodplains, rocky creeks, or riverbeds.	15.9	Jun to Oct.	X					
Low	P3	*Crotalaria smithiana*	Annual, herb, to 0.4 m high. Fl. yellow,	Regeneration site on floodplain.	29.0	Jun.	X		X		X	
Low	P3	*Dampiera metallorum*	Rounded, multi-stemmed perennial, herb, to 0.5 m high. Fl. blue, Apr, or Jun to Oct.	Skeletal red-brown gravelly soil over banded ironstone. Steep slopes. Summits of hills.	63.4	April/June - Oct.		X	X			
Low	P3	*Eremophila magnifica subsp. velutina*	Shrub, 0.5-1.5 m high. Fl. blue-purple, Aug to Sep.	Skeletal soils over ironstone. Summits.	26.8	Aug.-Sept.			X		X	
Low	P3	*Eucalyptus rowleyi*	Mallee to 4 m high. Smooth whitish bark to base.	On flat red soil	70.9	Unknown.			X			
Low	P3	*Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)*	Open, erect annual or biennial, herb, to 0.2 m high. Fl. yellow.	Red-brown clay soil. Calcrete pebbles. Low undulating plain, swampy plains.	7.1	Feb. March & May		X	X		X	
Low	P3	*Grevillea saxicola*	Tall shrub to 2.5 m.	Breakaway. Scree slope.	64.8	Nov. to Mar.			X			
Low	P3	*Gymnanthera cunninghamii*	Erect shrub, 1-2 m high. Fl. cream-yellow-green	Sandy soils. Drainage lines.	13.2	Jan to Dec.	X	X	X		X	
Low	P3	*Indigofera gilesii*	Shrub, to 1.5 m high. Fl. purple-pink, May or Aug.	Pebbly loam. Amongst boulders & outcrops, hills.	22.0	May or August	X	X	X		X	
Low	P3	*Iotasperma sessilifolium*	Erect herb. Fl. pink.	Cracking clay, black loam. Edges of waterholes, plains.	74.9	Jul. to Sept.			X			
Low	P3	*Maireana prosthecochaeta*	Open, densely-leaved shrub, 0.3-0.6 m high.	Laterite. Hills, salty places.	42.7	June to Sept.?		X	X			

Likelihood of Occurrence	Status	Taxon	Description	Habitat	Distance from Survey Area (km)	Flowering Time	AVH	TPFL	WAHerb	Ecoscape	Nature	Onshore Environm
Low	P3	*Sida sp. Barlee Range (S. van Leeuwen 1642)*	Spreading shrub, to 0.5 m high. Fl. Yellow.	Skeletal red soils pockets. Steep slope.	50.3	Aug.			X			
Low	P3	*Stylidium weeliwolli*	Annual, herb, 0.1-0.25 m high, throat appendages 4, rod-shaped. Fl. pink & red.	Gritty sand soil, sandy clay. Edge of watercourses.	67.1	Aug to Sep.			X			
Low	P3	*Swainsona thompsoniana*	Erect, herb. Stems terete, not spiny, glabrous.	Flat crabhole plain.	8.9	Apr. Jun. & Aug.	X		X			
Low	P3	*Tecticornia medusa*	Shrub 0.4 m. Bright green utricles.	Edge of large salt lake.	71.6	July & Nov.			X			
Low	P3	*Themeda sp. Hamersley Station (M.E. Trudgen 11431)*	Tussock grass.	Flat terrain, low in landscape. Red loamy soil with some alluvial sand material and stones.	32.2	Unknown						
Low	P3	*Triodia sp. Mt Ella (M.E. Trudgen 12739)*	Perennial, grass-like or herb, 0.4 m high.	Gullies. Hill slopes. Drainage lines.	23.0	Jan. to Apr.?			X			
Low	P3	*Xerochrysum boreale*	Erect perennial, branched herb to 50 cm high. Stems glandular-hirtellus.	Stony surface. Red brown clay loam.	52.8	Unknown			X			
Low	P4	*Acacia bromilowiana*	Tree or shrub, to 12 m high, bark dark grey, fibrous; phyllodes more or less glaucous & slightly pruinose; inflorescence in spikes. Fl. yellow/pink, Jul to Aug.	High in landscape. Edge of cliff. Rocky ironstone scree. Skeletal soil.	48.3	July - Aug. yellow/pink	X					
Low	P4	*Eremophila magnifica subsp. magnifica*	Shrub, 0.5-1.5 m high. Fl. blue, Aug to Nov.	Skeletal soils over ironstone. Rocky screes.	13.0	Aug.-Nov.	X		X		X	
Low	P4	*Eremophila youngii subsp. lepidota*	Eremophila youngii is an erect, highly-branched, shrub which grows to a height of between 1 and 4 m.	Stony red sandy loam. Flats, plains. Floodplains, sometimes semi-saline. Clay flats.	20.3	Unknown.	X		X	X	X	
Low	P4	*Goodenia berringbinensis*	Ascending annual, herb, 0.1-0.3 m high. Fl. yellow,	Red sandy loam. Along watercourses.	20.3	Oct.			X		X	
Low	P4	*Lepidium catapycnon*	Open, woody perennial, herb or shrub, 0.2-0.3 m high, stems zigzag. Fl. white, Oct.	Skeletal soils. Hillsides.	15.9	Oct.-Jan.	X	X	X		X	
Low	P4	*Ptilotus trichocephalus*	Prostrate, spreading perennial, herb. Fl. white,	Sandy soils. Colluvial plains.	67.1	Sep.			X			

Appendix E: Flora Site by Species Matrix

Family	Taxon	Opp coll	R001	R002	R003	R004	R005	R006	R007
Aizoaceae	*Trianthema triquetrum*	X	-	-	-	-	-	-	-
Amaranthaceae	*Gomphrena affinis* subsp. *pilbarensis*	X	-	-	-	-	-	-	-
	Ptilotus exaltatus	X	X	-	-	-	-	-	-
	Ptilotus helipteroides	X	-	-	-	-	-	-	-
	Ptilotus obovatus	X	-	-	X	-	X	-	-
Asteraceae	*Pterocaulon sphacelatum*	X	-	-	-	-	-	-	-
Boraginaceae	*Trichodesma zeylanicum*	X	-	-	-	-	-	-	-
Caryophyllaceae	*Polycarpaea corymbosa*	X	-	-	-	-	-	-	-
Chenopodiaceae	*Enchylaena tomentosa*	X	-	-	-	-	-	-	-
	Maireana ?tomentosa	X	-	-	-	-	-	-	-
	Maireana planifolia	X	-	-	-	-	-	-	-
	Maireana triptera	X	X	-	-	-	-	-	-
	Rhagodia eremaea	X	-	-	-	-	-	-	-
	Sclerolaena lanicuspis	X	-	-	-	-	-	-	-
	Maireana georgei	X	-	-	-	-	-	-	-
Cleomaceae	*Arivela viscosa*	X	-	-	-	-	-	-	-
Convolvulaceae	*Duperreya commixta*	X	-	-	-	-	-	-	-
	Evolvulus alsinoides var. *villosicalyx*	X	-	-	-	-	-	-	-
	Ipomoea calobra	-	-	X	-	-	-	-	-
Cucurbitaceae	*Cucumis variabilis*	X	-	-	-	-	-	-	-
Cyperaceae	*Fimbristylis* sp?	X	-	-	-	-	-	-	-
Euphorbiaceae	*Euphorbia biconvexa*	X	-	-	-	-	-	-	-
Fabaceae	*Acacia ?macraneura*	-	X	X	X	X	X	X	X
	Acacia citrinoviridis	X	-	-	-	-	-	-	-
	Acacia paraneura	-	-	-	X	-	-	-	-
	Acacia rhodophloia	X	-	-	-	-	-	-	-
	Acacia synchronicia	-	X	X	-	-	-	-	-
	Acacia tetragonophylla	X	-	-	-	-	-	-	X
	Senna artemisioides subsp. *helmsii*	X	-	-	-	-	-	-	-
	Senna artemisioides subsp. *oligophylla*	X	-	-	-	-	-	-	-
	Senna glutinosa subsp. *×luerssenii*	-	X	X	-	X	X	X	X
	Senna notabilis	X	-	-	-	-	-	-	-
	Senna stricta	X	-	-	-	-	-	-	-
	Acacia pruinocarpa	X	-	-	-	-	-	-	-
	Acacia sclerosperma	X	-	-	-	-	-	-	-
	Indigofera monophylla	-	-	-	X	-	-	-	-
	Neptunia dimorphantha	X	-	-	-	-	-	-	-
	Senna sp. Meekatharra (E. Bailey 1-26)	-	X	X	-	X	-	X	-
	Tephrosia sp. Newman (A.A. Mitchell PRP 29)	X	-	-	-	-	-	-	-
Goodeniaceae	*Goodenia microptera*	-	-	-	-	-	-	X	-
	Goodenia muelleriana	X	-	-	-	-	-	-	-
	Scaevola spinescens	X	-	-	-	-	-	-	-

Family	Taxon	Opp coll	R001	R002	R003	R004	R005	R006	R007
Loranthaceae	*Amyema fitzgeraldii*	-	-	-	-	X	-	-	-
Malvaceae	*Hibiscus burtonii*	X	-	-	-	-	-	-	-
	Hibiscus coatesii	X	-	-	-	-	-	-	-
	Sida fibulifera	X	-	-	-	-	-	-	-
	Abutilon lepidum	X	-	-	-	-	-	-	-
	Abutilon otocarpum	-	-	-	X	-	-	-	-
	Corchorus tridens	-	-	-	X	-	-	-	-
	**Malvastrum americanum*	X	-	-	-	-	-	-	-
Myrtaceae	*Corymbia aspera*	X	-	-	-	-	-	-	-
Nyctaginaceae	*Boerhavia coccinea*	X	-	-	-	-	-	-	-
Poaceae	*Aristida contorta*	X	-	-	-	-	X	-	-
	Aristida latifolia	X2	-	-	-	X	X	-	X
	**Cenchrus ciliaris*	X	X	X	-	X	X	X	X
	**Cenchrus setiger*	X	-	-	-	-	-	-	-
	Chrysopogon fallax	X	-	-	-	-	-	-	-
	**Cynodon dactylon*	X	-	-	-	-	-	-	-
	Dactyloctenium radulans	X	-	-	-	-	-	-	-
	Digitaria brownii	X	-	-	-	-	-	-	-
	Enneapogon caerulescens	X	-	-	-	-	-	-	-
	Enneapogon polyphyllus	X	-	-	X	-	-	-	-
	Enteropogon ramosus	X	-	-	-	-	-	-	-
	Eragrostis ?xerophila	-	-	X	-	-	-	-	-
	Eriachne mucronata	X	-	-	X	-	-	-	-
	Eriachne pulchella subsp. *pulchella*	-	-	-	-	-	-	X	-
	Iseilema vaginiflorum	X	-	-	-	-	-	-	-
	Paraneurachne muelleri	X	-	-	-	-	-	-	-
	Paspalidium clementii	-	-	-	X	-	-	-	-
	**Setaria verticillata*	X	-	-	-	-	-	-	-
	Sporobolus australasicus	X	-	-	-	-	-	-	-
	Tragus australianus	X	-	-	-	-	-	-	-
	Themeda triandra	X	-	-	-	-	-	-	-
	Triodia pungens	X	-	-	-	-	-	-	-
Portulacaceae	*Portulaca filifolia*	X	-	-	-	-	-	-	-
	Portulaca oleracea	-	-	X	-	-	-	-	-
Proteaceae	*Grevillea berryana*	X	-	-	-	-	-	-	-
	Hakea lorea subsp. *lorea*	X	-	-	-	-	-	-	-
	Hakea preissii	X	-	-	-	-	-	-	-
Santalaceae	*Exocarpos aphyllus*	X	-	-	-	-	-	-	-
Scrophulariaceae	*Eremophila cuneifolia*	-	X	X	-	-	-	X	-
	Eremophila latrobei subsp. *filiformis*	-	-	-	-	-	X	-	-
	Eremophila ?platycalyx	X	-	-	X	-	X	-	-
Solanaceae	*Solanum lasiophyllum*	X	-	-	-	-	-	-	-

Appendix F: Fauna Species Desktop

Scientific Name	Common Name	Conservation Status			Database Result			Literature Review	Current Survey
		EPBC Act	BC Act	DBCA	DBCA	NatureMap	PMST	Woodman (2016)	
MAMMALS									
DASYURIDAE									
Tachyglossus aculeatus	Short-beaked Echidna					x		x	
Dasycercus blythi	Brush-tailed Mulgara			P4	x	x		x	
Dasykaluta rosamondae	Little Red Kaluta					x			
Dasyurus hallucatus	Northern Quoll	EN	EN				x		
Ningaui timealeyi	Pilbara Ningaui					x			
Pseudantechinus woolleyae	Woolley's Pseudantechinus					x			
Pseudantechinus roryi	Rory's Pseudantechinus					x			
Sminthopsis longicaudata	Long-tailed Dunnart			P4	x				
THYLACOMYIDAE									
Macrotis lagotis	Greater Bilby	VU	VU		x	x	x		
MACROPODIDA									
Macropus robustus	Euro					x			
Macropus rufus	Red Kangaroo					x		x	
Petrogale lateralis subsp. lateralis	Black-flanked Rock-wallaby				x	x			
Petrogale rothschildi	Rothschild's Rock-wallaby					x			
MURIDAE									
Notomys alexis	Spinifex Hopping-mouse					x			
Pseudomys chapmani	Western Pebble-mound Mouse			P4	x	x			
Pseudomys desertor	Desert Mouse					x			
Pseudomys hermannsburgensis	Sandy Inland Mouse					x			
MEGADERMATIDAE									
Macroderma gigas	Ghost Bat	VU	VU		x	x	x		
HIPPOSIDERIDAE									
Chaerephon jobensis	Greater Northern Freetail-bat					x			
VESPERTILIONIDAE									
Chalinolobus gouldii	Gould's Wattled Bat					x			
Nyctophilus geoffroyi	Lesser Long-eared Bat					x			
Scotorepens balstoni	Inland Broad-nosed Bat					x			
Scotorepens greyii	Little Broad-nosed Bat					x			
RHINONYCTERIDAE									

Rhinonicteris aurantia	Pilbara leaf-nosed bat	VU	VU		x	x	x		
EMBALLONURIDAE									
Saccolaimus flaviventris	Yellow-bellied Sheath-tailed Bat					x			
INTRODUCED MAMMALS									
**Bos taurus*	European Cattle					x		x	x
**Camelus dromedarius*	Camel					x	x		
**Equus asinus*	Donkey					x	x		
**Felis catus*	Cat					x	x	x	
**Mus musculus*	House Mouse					x	x		
**Oryctolagus cuniculus*	Rabbit					x	x	x	
**Canis lupus familiaris*	Dog						x	x	
**Equus caballus*	Horse						x	x	
**Vulpes vulpes*	Red Fox						x		
BIRDS									
CASUARIIDAE									
Dromaius novaehollandiae	Emu					x		x	
PHASIANIDAE									
Coturnix pectoralis	Stubble Quail					x			
Coturnix ypsilophora	Brown Quail					x			
ANSERANATIDAE									
Anseranas semipalmata	Magpie Goose					x			
ANATIDAE									
Anas gracilis	Grey Teal					x			
Anas rhynchotis	Australasian Shoveler					x			
Anas superciliosa	Pacific Black Duck					x			
Aythya australis	Hardhead					x			
Biziura lobata	Musk Duck					x			
Chenonetta jubata	Australian Wood Duck					x			
Cygnus atratus	Black Swan					x		x	
Dendrocygna arcuata	Wandering Whistling Duck					x			
Dendrocygna eytoni	Plumed Whistling Duck					x			
Malacorhynchus membranaceus	Pink-eared Duck					x			
Stictonetta naevosa	Freckled Duck					x			
Tadorna tadornoides	Australian Shelduck					x			

PODARGIDAE									
Podargus strigoides	Tawny Frogmouth					x			
CAPRIMULGIDAE									
Eurostopodus argus	Spotted Nightjar					x			
AEGOTHELIDAE									
Aegotheles cristatus	Australian Owlet-nightjar					x			
ANHINGIDAE									
Anhinga novaehollandiae	Australasian Darter					x			
OTIDIDAE									
Ardeotis australis	Australian Bustard					x		x	
CUCULIDAE									
Centropus phasianinus	Pheasant Coucal					x			
Chrysococcyx basalis	Horsfield's Bronze Cuckoo					x			
Chrysococcyx osculans	Black-eared Cuckoo					x			
Cacomantis pallidus	Pallid Cuckoo					x			
COLUMBIDAE									
Geopelia cuneata	Diamond Dove					x		x	x
Geopelia humeralis	Bar-shouldered Dove					x			
Geopelia striata	Zebra Dove					x			
Geophaps plumifera	Spinifex Pigeon					x			
Ocyphaps lophotes	Crested Pigeon					x		x	x
Phaps chalcoptera	Common Bronzewing					x			
RALLIDAE									
Fulica atra	Eurasian Coot					x			
Gallirallus philippensis	Buff-banded Rail					x			
Porzana pusilla	Baillon's Crake					x			
Porzana tabuensis	Spotless Crake					x			
Porphyrio porphyrio	Purple Swamphen					x			
Tribonyx ventralis	Black-tailed Native-hen					x			
PODICIPEDIDAE									
Podiceps cristatus	Great Crested Grebe					x			
Poliocephalus poliocephalus	Hoary-headed Grebe					x			
Tachybaptus novaehollandiae	Australasian Grebe					x		x	
TURNICIDAE									

Turnix velox	Little Button-quail					x		x	
RECURVIROSTRIDAE									
Himantopus himantopus	Black-winged Stilt					x			
BURHINIDAE									
Burhinus grallarius	Bush Stone-curlew					x		x	
RECURVIROSTRIDAE									
Cladorhynchus leucocephalus	Banded Stilt					x			
CHARADRIIDAE									
Vanellus tricolor	Banded Lapwing					x			
Elseyornis melanops	Black-fronted Dotterel					x			
Vanellus tricolor	Banded Lapwing					x			
ROSTRATULIDAE									
Rostratula australis	Australian Painted Snipe	EN	IA				x		
MELIPHAGIDAE									
Acanthagenys rufogularis	Spiny-cheeked Honeyeater					x			
ACCIPITRIDAE									
Accipiter cirrocephalus	Collared Sparrowhawk					x			
Accipiter fasciatus	Brown Goshawk					x			
ACROCEPHALIDAE									
Acrocephalus australis	Australian Reed Warbler					x			
RECURVIROSTRIDAE									
Recurvirostra novaehollandiae	Red-necked Avocet					x			
Cladorhynchus leucocephalus	Banded Stilt					x			
CHARADRIIDAE									
Charadrius ruficapillus	Red-capped Plover					x			
Elseyornis melanops	Black-fronted Dotterel					x			
SCOLOPACIDAE									
Calidris acuminata	Sharp-tailed Sandpiper	MI	MI		x	x			
Calidris ferruginea	Curlew Sandpiper	MI	MI		x	x	x		
Calidris melanotos	Pectoral Sandpiper	MI	MI		x	x			
Calidris ruficollis	Red-necked Stint	MI	MI		x	x			
Calidris subminuta	Long-toed Stint	MI	MI		x	x			
Charadrius veredus	Oriental Plover	MI	MI		x				
CHARADRIIFORMES									

Actitis hypoleucos	Common Sandpiper	MI	MI		x	x			
Tringa glareola	Wood Sandpiper	MI	MI		x	x			
Tringa nebularia	Common Greenshank	MI	MI		x	x			
Tringa stagnatilis	Marsh Sandpiper	MI	MI		x	x			
Tringa totanus	Common Redshank	MI	MI		x	x			
GLAREOLIDAE									
Stiltia isabella	Australian Pratincole					x		x	
LARIDAE									
Gelochelidon nilotica	Gull-billed Tern	MI	MI		x	x			
Hydroprogne caspia	Caspian Tern	MI	MI		x	x			
Larus novaehollandiae	Silver Gull					x			
CICONIIDAE									
Ephippiorhynchus asiaticus	Black-necked Stork					x			
PHALACROCORACIDAE									
Phalacrocorax melanoleucos	Little pied cormorant					x			
Phalacrocorax carbo	Great Cormorant					x		x	
Phalacrocorax melanoleucos	Little Pied Cormorant					x			
Phalacrocorax sulcirostris	Little Black Cormorant					x		x	
Phalacrocorax varius	Pied Cormorant					x			
THRESKIORNITHIDAE									
Plegadis falcinellus	Glossy Ibis	MI	MI		x	x			
Threskiornis spinicollis	Straw-necked Ibis					x		x	
Platalea flavipes	Yellow-billed Spoonbill					x			
Platalea regia	Royal Spoonbill					x			
ARDEIDAE									
Ardea pacifica	White-necked Heron					x			
Nycticorax caledonicus	Rufous Night Heron					x			
Ardea ibis	Cattle Egret					x			
Ardea intermedia	Intermediate Egret					x			
Ardea modesta	Great egret					x			
Egretta garzetta	Little egret					x			
PELECANIDAE									
Pelecanus conspicillatus	Australian Pelican					x			
ACCIPITRIDAE									

Circus approximans	Swamp Harrier					x			
Circus assimilis	Spotted Harrier					x			
Haliaeetus leucogaster	White-bellied Sea-Eagle					x			
Haliastur sphenurus	Whistling Kite					x		x	
Hamirostra melanosternon	Black-breasted Buzzard					x		x	
Hieraaetus morphnoides	Little Eagle					x		x	
Milvus migrans	Black Kite					x			x
Elanus caeruleus	Black-shouldered Kite					x			
ictinia isura	Square-tailed kite					x			
Aquila audax	Wedge-tailed Eagle					x		x	
TYTONIDAE									
Tyto alba subsp. delicatula	Barn Owl					x			
STRIGIDAE									
Ninox connivens	Barking Owl					x			
Tyto alba subsp. delicatula	Barn Owl					x			
ALCEDINIDAE									
Dacelo leachii	Blue-winged Kookaburra					x			
Todiramphus pyrrhopygius	Red-backed Kingfisher					x		x	
Todiramphus sanctus	Sacred Kingfisher					x		x	
MEROPIDAE									
Merops ornatus	Rainbow Bee-eater					x		x	
FALCONIDAE									
Falco berigora	Brown Falcon					x		x	
FALCO CENCHROIDES	Australian Kestrel					x		x	
Falco hypoleucos	Grey Falcon	VU	VU				x		
Falco longipennis	Australian Hobby			OS		x			
Falco peregrinus	Peregrine Falcon			OS	x	x			
Cacatuidae									
Cacatua roseicapilla	Galah					x		x	
Cacatua sanguinea	Little Corella					x		x	
Melopsittacus undulatus	Budgerigar					x		x	
Nymphicus hollandicus	Cockatiel					x		x	
Platycercus zonarius	Port Lincoln Parrot					x			
PSITTACIDAE									

Neophema bourkii	Bourke's Parrot					x			
Pezoporus occidentalis	Night Parrot	EN	EN				x		
Platycercus zonarius	Australian Ringneck					x			x
Polytelis alexandrae	Princess Parrot	VU	VU	P4			x		
PTILONORHYNCHIDAE									
Ptilonorhynchus maculatus subsp. guttatus	Western Bowerbird					x			
MALURIDAE									
Amytornis striatus	Striated Grasswren					x			
Malurus lamberti	Variegated Fairy-wren					x		x	x
Malurus leucopterus	White-winged Fairy-wren					x		x	
Malurus splendens	Splendid Fairy-wren					x			
Stipiturus ruficeps	Rufous-crowned Emu-wren					x			
MELIPHAGIDAE									
Epthianura aurifrons	Orange Chat					x			
Epthianura tricolor	Crimson Chat					x			
Gavicalis virescens	Singing Honeyeater					x		x	x
Melithreptus gularis	Black-chinned Honeyeater					x			
Manorina flavigula	Yellow-throated Miner					x			x
Lacustroica whitei	Grey Honeyeater					x			
Lichmera indistincta	Brown Honeyeater					x			
Ptilotula keartlandi	Grey-headed Honeyeater					x			
Purnella albifrons	White-fronted Honeyeater					x			
Pyrrholaemus brunneus	Redthroat					x			
Certhionyx variegatus	Pied Honeyeater					x			
PARDALOTIDAE									
Pardalotus rubricatus	Red-browed Pardalote					x		x	
Pardalotus striatus	Striated Pardalote					x			
ACANTHIZIDAE									
Acanthiza apicalis	Broad-tailed Thornbill					x			
Acanthiza chrysorrhoa	Yellow-rumped Thornbill					x			
Acanthiza robustirostris	Slaty-backed Thornbill					x			
Acanthiza uropygialis	Chestnut-rumped Thornbill					x			
Aphelocephala leucopsis	Southern Whiteface					x			
Gerygone fusca	Western Gerygone					x			

Smicrornis brevirostris	Weebill					x		x	
POMATOSTOMIDAE									
Pomatostomus superciliosus	White-browed Babbler					x			
Pomatostomus temporalis	Grey-crowned Babbler					x			
PSOPHODIDAE									
Psophodes occidentalis	Western Wedgebill					x			
ARTAMIDAE									
Artamus cinereus	Black-faced Woodswallow					x			
Artamus cyanopterus	Dusky Woodswallow					x			
Artamus minor	Little Woodswallow					x			
Artamus personatus	Masked Woodswallow					x			
Artamus superciliosus	White-browed Woodswallow					x			
PACHYCEPHALIDAE									
Colluricincla harmonica	Grey Shrike-thrush					x			
Pachycephala rufiventris	Rufous Whistler					x			
MONARCHIDAE									
Grallina cyanoleuca	Magpie-lark					x			x
RHIPIDURIDAE									
Rhipidura albiscapa	Grey Fantail					x			
Rhipidura leucophrys	Willie Wagtail					x			
CRACTICIDAE									
Coracina maxima	Ground Cuckoo-shrike					x			
Corvus bennetti	Little Crow					x			
Corvus orru	Torresian Crow					x			
Cracticus nigrogularis	Pied Butcherbird					x			
Cracticus tibicen	Australian Magpie					x			
Cracticus torquatus	Grey Butcherbird					x			
Lalage tricolor	White-winged Triller					x			
CAMPEPHAGIDAE									
Coracina novaehollandiae	Black-faced Cuckoo-shrike					x		x	
OREOICIDAE									
Oreoica gutturalis	Crested Bellbird					x			
PETROICIDAE									
Melanodryas cucullata	Hooded Robin					x			

Petroica goodenovii	Red-capped Robin					x			
LOCUSTELLIDAE									
Eremiornis carteri	Spinifexbird					x			
Megalurus gramineus	Little Grassbird					x			
Megalurus gramineus	Little Grassbird					x			
Mirafra javanica	Horsfield's Bush Lark					x			
HIRUNDINIDAE									
Cheramoeca leucosterna	White-backed Swallow					x			
Petrochelidon ariel	Fairy Martin					x			
Petrochelidon nigricans	Tree Martin					x			
Hirundo neoxena	Welcome Swallow					x			
DICAEIDAE									
Dicaeum hirundinaceum	Mistletoebird					x			
ESTRILDIDAE									
Taeniopygia guttata	Zebra Finch					x			x
Emblema pictum	Painted Finch					x			
Neochmia ruficauda	Star Finch					x			
MOTACILLIDAE									
Anthus australis	Australian Pipit					x			
REPTILES									
CHELIDAE									
Chelodina steindachneri	Flat-shelled Turtle					x			
CARPHODACTYLIDAE									
Nephrurus wheeleri subsp. cinctus						x			
DIPLODACTYLIDAE						x			
Diplodactylus conspicillatus	Fat-tailed Gecko								
Diplodactylus savagei	Southern Pilbara Beak-faced Gecko					x			
Lucasium stenodactylum						x			
Lucasium wombeyi						x			
Rhynchoedura ornata	Western Beaked Gecko					x			
Strophurus elderi						x			
Strophurus jeanae						x			
Strophurus wellingtonae						x			
Oedura marmorata	Marbled Velvet Gecko					x			

GEKKONIDAE									
Gehyra pilbara						x			
Gehyra punctata						x			
Gehyra variegata						x			
Heteronotia binoei	Bynoe's Gecko					x			
Heteronotia planiceps						x			
Heteronotia spelea	Desert Cave Gecko					x			
PYGOPODIDAE									
Delma butleri						x			
Delma elegans						x			
Delma haroldi						x			
Delma nasuta						x			
Delma pax						x			
Delma tincta						x			
Lialis burtonis						x			
Pygopus nigriceps						x			
AGAMIDAE									
Amphibolurus longirostris	Long-nosed Dragon					x			
Ctenophorus caudicinctus	Ring-tailed Dragon					x			
Ctenophorus isolepis	Crested Dragon, Military Dragon					x		x	
Ctenophorus maculatus	Spotted Military Dragon					x			
Ctenophorus nuchalis	Central Netted Dragon					x		x	
Ctenophorus reticulatus	Western Netted Dragon					x		x	
Diporiphora amphiboluroides	Mulga Dragon					x			
Diporiphora valens	Southern Pilbara Tree Dragon					x			
Pogona minor	Dwarf Bearded Dragon					x			
Tympanocryptis cephalus	Pebble Dragon					x			
SCINCIDAE									
Carlia munda	Shaded-litter Rainbow Skink					x			
Carlia triacantha	Desert Rainbow Skink					x			
Cryptoblepharus buchananii						x			
Cryptoblepharus ustulatus						x			
Ctenotus ariadnae						x			
Ctenotus duricola						x			

Ctenotus grandis						x			
Ctenotus helenae						x			
Ctenotus leonhardii						x			
Ctenotus pantherinus	Leopard Ctenotus					x			
Ctenotus rubicundus						x			
Ctenotus rutilans						x			
Ctenotus saxatilis	Rock Ctenotus					x			
Ctenotus schomburgkii						x			
Ctenotus uber	Spotted Ctenotus					x			
Cyclodomorphus melanops	Slender Blue-tongue					x		x	
Egernia cygnitos	Western Pilbara Spiny-tailed Skink					x			
Egernia depressa	Southern Pygmy Spiny-tailed Skink					x			
Egernia formosa						x			
Eremiascincus richardsonii	Broad-banded Sand Swimmer					x			
Lerista bipes						x			
Lerista flammicauda						x			
Lerista macropisthopus subsp. remota	unpatterned robust slider					x			
Lerista muelleri						x			
Lerista neander						x			
Lerista zietzi						x			
Menetia greyii						x			
Menetia surda subsp. surda						x			
Morethia ruficauda						x			
Tiliqua multifasciata	Central Blue-tongue					x			
VARANIDAE									
Varanus acanthurus	Spiny-tailed Monitor					x			
Varanus brevicauda	Short-tailed Pygmy Monitor					x			
Varanus bushi	Pilbara Mulga Monitor					x			
Varanus caudolineatus						x			
Varanus eremius	Pygmy Desert Monitor					x		x	
Varanus giganteus	Perentie					x		x	
Varanus gouldii	Sand Monitor					x		x	
Varanus panoptes	Yellow-spotted Monitor					x		x	
Varanus pilbarensis	Pilbara Rock Monitor					x			

Varanus tristis	Racehorse Monitor					x			
Vermicella snelli									
TYPHLOPIDAE									
Anilios ganei	Gane's blind snake			P1	x	x			
Liasis olivaceus subsp. barroni	Pilbara Olive Python	VU	VU			x	x		
Antaresia perthensis	Pygmy Python					x			
Antaresia stimsoni	Stimson's Python					x			
Aspidites melanocephalus	Black-headed Python					x			
ELAPIDAE									
Acanthophis wellsi	Pilbara Death Adder					x			
Furina ornata	Moon Snake					x			
Brachyurophis approximans	North-western Shovel-nosed Snake					x			
Demansia psammophis	Yellow-faced Whipsnake					x			
Demansia rufescens	Rufous Whipsnake					x			
Parasuta monachus						x			
Pseudechis australis	Mulga Snake					x			
Pseudonaja mengdeni	Western Brown Snake					x			
Pseudonaja modesta	Ringed Brown Snake					x			
Pseudonaja nuchalis	Gwardar, Northern Brown Snake					x			
Suta fasciata	Rosen's Snake					x			
Suta punctata	Spotted Snake					x			
AMPHIBIAN									
PELODRYADIDAE									
Cyclorana maini	Sheep Frog					x			
Cyclorana platycephala	Water-holding Frog					x			
Litoria rubella	Little Red Tree Frog					x			
Limnodynastidae									
Neobatrachus kunapalari	Kunapalari Frog					x			
Notaden nichollsi	Desert Spadefoot					x			
Platyplectrum spenceri	Centralian Burrowing Frog					x			
MYOBATRACHIDAE									
Pseudophryne douglasi	Gorge Toadlet					x			
Uperoleia russelli	Northwest Toadlet					x			
Uperoleia saxatilis	Pilbara Toadlet					x			

Appendix G: Migratory Water Birds

Species	Conservation Status			Nature Map	DBCA	PMST	Preferred Habitats	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA					
Migratory Shorebirds								
Common Sandpiper (*Actitis hypoleucos*)	MI	MI		•	•	•	Coastal habitats include wetlands, estuaries, mudflats, rocky inlets, reefs, and sandy beaches. Inland habitats include wetlands, floodplains and grassland areas, ephemeral water sources (Reference EPBC Act Policy Statement 3.21).	**Very Low:** No suitable habitat occurs in the Survey Area.
Sharp-tailed Sandpiper (*Calidris acuminata*)	MI	MI		•	•	•		
Curlew Sandpiper (*Calidris ferruginea*)	CR	CR		•	•	•		
Pectoral Sandpiper (*Calidris melanotos*)	MI	MI		•	•	•		
Red-necked Stint (*Calidris ruficollis*)	MI	MI		•	•			
Long-toed Stint (*Calidris subminuta*)	MI	MI		•	•			
Oriental Plover (*Charadrius veredus*)	MI	MI			•	•		
Wood Sandpiper (*Tringa glareola*)	MI	MI		•	•			
Common Greenshank (*Tringa nebularia*)	MI	MI		•	•			
Marsh Sandpiper (*Tringa stagnatilis*)	MI	MI		•	•			
Common Redshank (*Tringa totanus*)	MI	MI		•	•			

Species	Conservation Status			Nature Map	DBCA	PMST	Preferred Habitats	Likelihood of Occurrence
	EPBC Act	BC Act	DBCA					
Other Migratory Water Birds								
Gull-billed Tern (*Gelochiledon nilotica*)	MI	MI		•	•		Primarily on tidal flats but also occurs inland on large ephemeral lakes and wetlands (Menkhorst *et al.*, 2019).	**Very Low:** No suitable habitat occurs in the Survey Area.
Caspian Tern (*Hydroprogne caspia*)	MI	MI		•	•		Coastal waters. Inland occurs in large rivers, lakes of varying salinity, reservoirs and temporary wetlands (Menkhorst *et al.*, 2019).	**Very Low:** No suitable habitat occurs in the Survey Area.
Glossy Ibis (*Plegadis falcinellus*)	MI	MI		•	•		Lakes, rivers, lagoons, flood-plains, swamps, reservoirs and sewage ponds. Forages in fringing freshwater marshes (Australian Government & Department of Agriculture Water and the Environment, 2021).	**Very Low:** No suitable habitat occurs in the Survey Area.
Grey Wagtail (*Motacilla cinerea*)	MI	MI				•	Fast-flowing watercourses, lakes ploughed fields and creeks (Pizzey and Knight, 2012).	**Very Low:** Rare visitor to Australia, no nearby records. Potential habitat is listed as present in the area by the Protected Matter Search Tool (PMST). No regional observations have been recorded.
Yellow Wagtail (*Motacilla flava*)	MI	MI				•	Damp and wet habitats with low vegetation including meadows, marshes and waterside pastures (Birdlife International, 2020).	**Very Low:** Rare visitor to Australia, no nearby records. Potential habitat is listed as present in the area by the Protected Matter Search Tool (PMST). No regional observations have been recorded.

APPENDIX D

Bushfire Prone Planning Assessment

Bushfire management plan/Statement addressing the Bushfire Protection Criteria coversheet

Site address:

Site visit: Yes ☐ No ☐

Date of site visit (if applicable): Day Month Year

Report author or reviewer:

WA BPAD accreditation level (please circle):

Not accredited ☐ Level 1 BAL assessor ☐ Level 2 practitioner ☐ Level 3 practitioner ☐

If accredited please provide the following.

BPAD accreditation number: Accreditation expiry: Month Year

Bushfire management plan version number:

Bushfire management plan date: Day Month Year

Client/business name:

	Yes	No
Has the BAL been calculated by a method other than method 1 as outlined in AS3959 (tick no if AS3959 method 1 has been used to calculate the BAL)?		
Have any of the bushfire protection criteria elements been addressed through the use of a performance principle (tick no if only acceptable solutions have been used to address all of the bushfire protection criteria elements)?		

Is the proposal any of the following (see SPP 3.7 for definitions)?	Yes	No
Unavoidable development (in BAL-40 or BAL-FZ)		
Strategic planning proposal (including rezoning applications)		
High risk land-use		
Vulnerable land-use		

None of the above ☐

Note: Only if one (or more) of the above answers in the tables is yes should the decision maker (e.g. local government or the WAPC) refer the proposal to DFES for comment.

Why has it been given one of the above listed classifications (E.g. Considered vulnerable land-use as the development is for accommodation of the elderly, etc.)?

The information provided within this bushfire management plan to the best of my knowledge is true and correct:

Signature of report author or reviewer

Date

Bushfire Management Plan

Lot 571 Great Northern Highway, Newman

Shire of East Pilbara

Planning Stage:	Strategic Proposal - Local Development Plan (lot layout known)
Planning Development Type:	Subdivision

Job Number:	200775
Assessment Date:	30 April 2021
Report Date:	14 May 2021

BPP Group Pty Ltd t/a Bushfire Prone Planning
ACN: 39 166 551 784 | ABN: 39 166 551 784

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Review/Authorise:	Kathy Nastov (BPAD Level 3 - No. 27794)	

VERSION HISTORY		
Version	**Version Details**	**Date**
1.0	Original Document Issue	18 May 2021
-		

BMP (Subdivision) Template v8.4

DISTRIBUTION				
Destination	**Version**	**No. Copies**	**Hard Copy**	**Electronic Copy**
Person/Business: Andrew Mack/Talis Consultants Email:	1.0		☐	☒
Person/Business: Email:			☐	☐

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LIST OF FIGURES

EXECUTIVE SUMMARY

This Bushfire Management plan is to accompany a re-zoning application for Lot 571 Great Northern Highway, Newman located at the Newman Airport. The proposal intends to rezone the subject site from "Rural" to "Special-use", and create 15 industrial lots. The lot layout adopted for this Plan is indicative only. The final leasehold lots will be created at the discretion of the Shire of East Pilbara.

Where the proposed development is staged each stage must comply with the requirements of the Guidelines for Planning in Bushfire Prone Areas and this Bushfire Management Plan. This may require the creation of roads or management of land or installation of water supply outside that particular stage to achieve compliance.

The assessments and bushfire protection measures detailed the BMP, assume that environmental approval will be achieved or clearing permit exemptions will apply.

It is advised that the proponent seek further advice from an Environmental Consultant or the WA Department of Biodiversity Conservation and Attractions for further information on the condition and species contained within the proposed development area and the requirement for referral of the proposal.

The proposed development site currently has a moderate to extreme bushfire hazard level. However, an area is able to be established within each lot where buildings can be constructed to a BAL rating of BAL-29 or lower.

It is expected that once the industrial lots are developed, they will be cleared, or mostly cleared, of native vegetation to allow for construction of buildings, Asset Protection Zones, storage, lay down and parking areas.

It should be noted that, as it is unlikely that all proposed lots will be developed at the same time, vegetation on the balance or vacant lot(s) may adversely affect the indicative BAL ratings of buildings on lots being developed. This should be assessed prior to the sale of the lots and the required vegetation on the balance or vacant lot managed and maintained until developed, or the indicative BAL ratings for the affected lots amended.

Future buildings on all proposed lots will be able to achieve a BAL rating of BAL-29 or lower. Restrictions to size and location of future buildings on lots may apply with respect to:

1. Required separation distances from existing vegetation within the Great Northern Highway road reserve.

2. Required separation distances from existing vegetation within undeveloped neighbouring lots in the development.

3. Remnant vegetation within the proposed easement and road reserve.

The main access/egress route from the development will be from Road 1 via Dewar Avenue to Great Northern Highway. Proposed Road 1 will be a cul-de-sac of approximately 1.2kms in length, which is greater than the minimum of 200 metres as stated in the Guidelines for Planning in Bushfire Prone Areas. However, an Emergency Access Way is planned to join the southern end of Road 1 with the Great Northern Highway, providing a secondary access/egress route.

Where a building site is greater than 50 metres from a public road, the driveway to that building must comply with the construction technical requirements established by the Guidelines.

The proposed lots will comply with the requirements of the local government annual firebreak notice issued under s33 of the Bush Fires Act 1954. Firebreaks to be installed prior to subdivision clearance.

A reticulated water supply will be made available to the subject site and hydrants will be installed in locations as required by the relevant authority.

1 PROPOSAL DETAILS

1.1 Description and Associated Plans and Maps

Proponent:	Talis Consultants
Bushfire Prone Planning Commissioned to Produce the Bushfire Management Plan (BMP) By:	Talis Consultants
For Submission To:	Shire of East Pilbara
Purpose of the BMP:	To accompany a re-zoning application and associated subdivision application
'Development' Site Total Area:	Approximately 37 hectares
No. of Proposed Lots:	15 proposed lots
Description of the Proposed Development/Use:	
This Bushfire Management plan is to accompany a re-zoning application for Lot 571 Great Northern Highway, Newman located at the Newman Airport. The proposal intends to rezone the subject site from "Rural" to "Special-use", and create 15 industrial lots. The lot layout adopted for this Plan is indicative only. The final leasehold lots will be created at the discretion of the Shire of East Pilbara.	

Figure 1.1

Proposed Industrial Estate Site Plan

Lot 571 on Plan 71045
Great Northern Highway
NEWMAN
SHIRE OF EAST PILBARA

DEWAR AV
RULAND CCT
GREAT NORTHERN HWY
Easement
Road 1
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

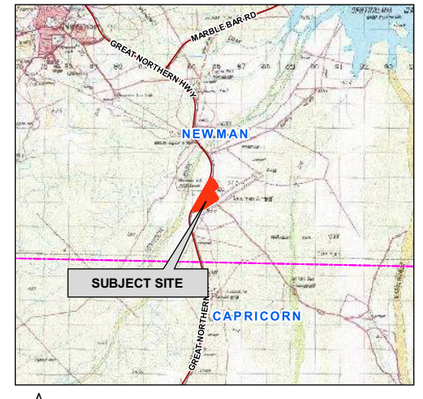
------ LEGEND ------

- Proposed Lots (Indicative)
- Road Pavement
- Emergency Access Way (Proposed)
- Subject Site
- Cadastre

0 50 100 150 200 250 300

Metres

------ LOCALITY ------



N

AERIAL IMAGERY: Landgate/SLIP

BUSHFIRE PRONE PLANNING

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Ian Macleod 07-05-2021
SCALE (A3): 1 : 5000

Figure 1.2

Proposed Industrial Estate Spatial Context Map

Lot 571 on Plan 71045
Great Northern Highway
NEWMAN
SHIRE OF EAST PILBARA

Parnpajinya Community
NEWMAN VFRS
Newman Hospital
GILES AV
DANIELS DR
NEWMAN DR
KALGAN DR
FORREST AV
GUN CLUB RD
WELSH DR
YATES RD
Paddy Well
Eastern Ridge
Homestead Creek
Homestead Creek
Homestead Creek
Ophthalmia Dam
Fortescue River
Fortescue River
Warrawanda Creek
Newman Water Reserve
MARBLE BAR RD
Whaleback Creek
Fortescue River
MARBLE BAR RD
Diggina Well
Ginginanra Pool
NEWMAN
SHIRE OF EAST PILBARA
Warrawanda Creek
Newman Aerodrome
Fortescue River
Western Creek
No. 18 Bore
Round Hill
Capricorn Roadhouse
Catalina Well
CAPRICORN
SHIRE OF MEEKATHARRA
Western Creek
Warrawanda Creek

------ LEGEND ------

- DFES Stations
- Subject Site
- Local Government Area
- Cadastre

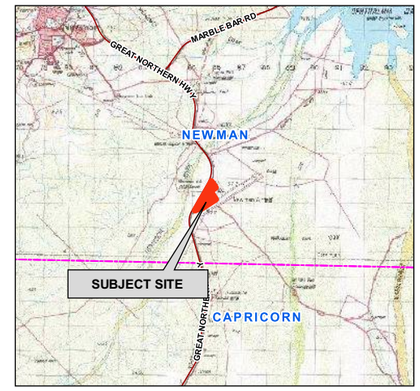
Reserves_UCL

- Reserve
- Unallocated Crown Land

0 1,000 2,000 3,000 4,000

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

N

BUSHFIRE PRONE PLANNING

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Ian Macleod 07-05-2021
SCALE (A3): 1 : 60000

Figure 1.2

Proposed Industrial Estate Spatial Context Map

Lot 571 on Plan 71045
Great Northern Highway
NEWMAN
SHIRE OF EAST PILBARA

NEWMAN VFRS
MINDARRA DR
GILES DR
NEWMAN DR
KALGAN DR
DANIELS DR
MARBLE BAR RD
WELSH DR
GUN CLUB RD
MCBRIDE DR
YATES RD
MARBLE BAR RD
Fortescue River
Warrawanda Creek
NEWMAN
SHIRE OF EAST PILBARA
DEWAR AV
Fortescue River
Fortescue River
Western Creek
Fortescue River
GREAT NORTHERN HWY
CAPRICORN
Warrawanda Creek

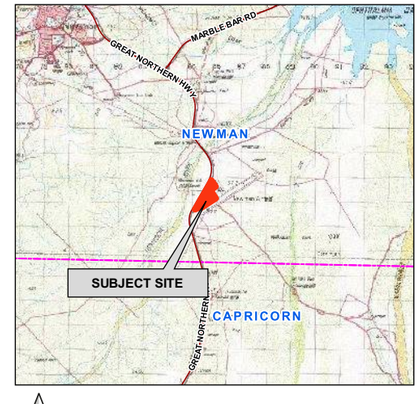
------ LEGEND ------

- DFES Stations
- Bush Fire Prone Areas 2019
- Subject Site
- Local Government Area
- Cadastre

0 500 1,000 1,500 2,000 2,500 3,000

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Ian Macleod 07-05-2021
SCALE (A3): 1 : 50000

BUSHFIRE PRONE PLANNING

1.2 Existing Documentation Relevant to the Construction of this Plan

This section acknowledges any known reports or plans that have been prepared for previous planning stages, that refer to the subject area and that may or will impact upon the assessment of bushfire risk and/or the implementation of bushfire protection measures and will be referenced in this Bushfire Management Plan.

Table 2.1: Existing relevant documentation.

RELEVANT EXISTING DOCUMENTS		
Existing Document	Copy Provided by Client	Title
Structure Plan	No	
Environmental Report	No	
Landscaping (Revegetation) Plan	No	
Bushfire Risk Assessments	No	

2 ENVIRONMENTAL CONSIDERATIONS

2.1 Native Vegetation – Restrictions to Modification and/or Clearing

Many bushfire prone areas also have high biodiversity values. SPP 3.7 policy objective 5.4 recognises the need to consider bushfire risk management measures alongside environmental, biodiversity and conservation values (Guidelines s2.3).

There is a requirement to identify the need for onsite modification and/or clearing of native vegetation and whether this might trigger potential environmental impact/referral requirements under State and Federal environmental legislation. Confirmation that any proposed native vegetation modification and/or clearing is acceptable, should be received from the relevant agencies by the proponent and provided to the bushfire consultant for inclusion in the Bushfire Management Plan if it will influence the required bushfire planning assessments and outcomes. The following table details any potential environmental restrictions of which the author of this report is aware.

Table 2.2: Native vegetation and potential environmental considerations and restrictions.

NATIVE VEGETATION MODIFICATION / CLEARING - POTENTIAL ENVIRONMENTAL RESTRICTIONS IDENTIFIED				
Environmental Considerations / Features	Potential Mapping Data Source (SLIP / Local Planning)	Relevant to Proposed Development	Data Applied	Action Required
Onsite clearing of native vegetation is required.		Yes		
Environmental impact/referral requirements under State and Federal environmental legislation may be triggered.		Possible		
National Park / Nature Reserve	DBCA-011	No- Confirmed by Bushfire Consultant	Relevant Database Reviewed by Bushfire Consultant	None
Conservation Covenant	DPIRD-023	Not Known	Data Not Readily Available to Bushfire Consultant	Proponent to Seek Advice
Bush Forever Site	DPLH-019	No- Confirmed by Bushfire Consultant	Relevant Database Reviewed by Bushfire Consultant	None
RAMSAR Wetland	DBCA-010	No- Confirmed by Bushfire Consultant	Relevant Database Reviewed by Bushfire Consultant	None
Geomorphic and Other Wetland	DBCA-011-019, 040, 043, 044	Not Known	Data Not Readily Available to Bushfire Consultant	Proponent to Seek Advice
Threatened and Priority Ecological Communities (TECs or PECs)	DBCA-038	Yes- Confirmed by Bushfire Consultant	Relevant Database Reviewed by Bushfire Consultant	Proponent to Seek Advice
Threatened and Priority Flora including Declared Rare Flora (DRFs)	DBCA-036	No- Confirmed by Bushfire Consultant	Relevant Database Reviewed by Bushfire Consultant	None

Land Identified as significant through a Local Biodiversity Strategy	LG - Intramaps	Not Known	Data Not Readily Available to Bushfire Consultant	Proponent to Seek Advice

Statement of how the identified environmental feature(s) is dealt with in this Bushfire Management Plan (and the location of relevant information):

The assessments and bushfire protection measures detailed the BMP, assume that environmental approval will be achieved or clearing permit exemptions will apply.

It is advised that the proponent seek further advice from an Environmental Consultant or the WA Department of Biodiversity Conservation and Attractions for further information on the condition and species contained within the proposed development area and the requirement for referral of the proposal.

Development Design Considerations

Establishing development in bushfire prone areas can adversely affect the retention of native vegetation through clearing associated with the creation of lots and/or asset protection zones. Where loss of vegetation is not acceptable or causes conflict with landscape or environmental objectives, it will be necessary to consider available design options to minimise the removal of native vegetation.

Table 2.3: Development design.

MINIMISE THE REMOVAL OF NATIVE VEGETATION	
Design Option	Assessment / Action
Reduction of lot yield	N/A
Cluster development	N/A
Construct building to a standard corresponding to a higher BAL as per BCA (AS 3959:2018 and/or NASH Standard)	N/A
Modify the development location	N/A
It is expected that once the industrial lots are developed, they will be cleared of native vegetation to allow for construction of buildings, Asset Protection Zones, storage, lay down and parking areas.	
IMPACT ON ADJOINING LAND	
Is this planning proposal able to implement the required bushfire protection measures within the boundaries of the land being developed so as not to impact on the bushfire and environmental management of neighbouring reserves, properties or conservation covenants?	Yes
BAL-29 Asset Protection Zones are able to be established within each lot, but this will be dependent upon the size and location of future buildings on the lots.	

2.2 Retained Vegetation / Re-vegetation / Landscape Plans (including POS)

Riparian zones, wetland/foreshore buffers, road verges and public open space may have plans to re-vegetate or retain vegetation as part of the proposed development. Vegetation corridors may be created between offsite and onsite vegetation and provide a route for fire to enter a development area.

All retained/planned vegetation and its management will be considered in the development of this Bushfire Management Plan.

Is re-vegetation of riparian zones and/or wetland or foreshore buffers and/or public open space a part of this Proposal?	No
N/A	
Is the requirement for ongoing maintenance of existing vegetation in riparian zones and/or wetland or foreshore buffers and/or public open space a part of this Proposal?	No
N/A	
Has a landscape plan been developed for the proposed development?	No
N/A	

3 POTENTIAL BUSHFIRE IMPACT ASSESSMENT

3.1 Assessment Input

3.1.1 Fire Danger Index (FDI) Applied

AS 3959:2018 Table 2.1 specifies the fire danger index values to apply for different regions. The values used in the model calculations are for the Forest Fire Danger Index (FFDI) and for which equivalent representative values of the Grassland Fire Danger Index (GFDI) are applied as per Appendix B. The values can be modified if appropriately justified.

Table 3.1: Applied FDI Value

FDI VALUE			
Vegetation Areas	As per AS 3959:2018 Table 2.1	As per DFES for the Location	Value Applied
1-5	80	N/A	80

3.1.2 Vegetation Classification and Effective Slope

Classification: Bushfire prone vegetation identification and classification has been conducted in accordance with AS 3959:2018 s2.2.3 and the Visual Guide for Bushfire Risk Assessment in WA (DoP February 2016).

When more than one vegetation type is present, each type is identified separately, and the applied classification considers the potential bushfire intensity and behaviour from the vegetation types present and ensures the worst case scenario is accounted for – this may not be from the predominant vegetation type.

The vegetation structure has been assessed as it will be in its mature state (rather than what might be observed on the day). Areas of modified vegetation are assessed as they will be in their natural unmodified state (unless maintained in a permanently low threat, minimal fuel condition, satisfying AS 3959:2018 s2.2.3.2(f) and asset protection zone standards). Vegetation destroyed or damaged by a bushfire or other natural disaster has been assessed on its revegetated mature state.

Effective Slope: Refers to the ground slope under each area of classified vegetation and is described in the direction relative to the view from the building or proposed development site. Effective slope is not the same as 'average slope', rather it is the slope which most significantly influences fire behaviour. This slope has a direct and significant influence on a bushfire's rate of spread and intensity.

Where there is a significant change in effective slope under an area of classified vegetation, that will cause a change in fire behaviour, separate vegetation areas will be identified to enable the correct assessment.

When the effective slope, under a given area of bushfire prone vegetation, will be different relative to multiple proposed development sites, then the effective slopes corresponding to the different locations, are separately identified.

Table 3.2: Vegetation classification and effective slope.

ALL VEGETATION WITHIN 150 METRES OF THE PROPOSED DEVELOPMENT				
Vegetation Area	Identified Vegetation Types [1] or Description if 'Excluded'	Applied Vegetation Classification [1]	Effective Slope (degrees)[2] (AS 3959:2018 Method 1)	
			Assessed	Applied Range
1	Low open shrubland G-19	Class G Grassland	0	upslope or flat
2	Open scrub D-14	Class D Scrub	0	upslope or flat
3	Tussock grassland G-22 Open tussock G-23	Class G Grassland	0	upslope or flat
4	Open heath C-11	Class C Shrubland	0	upslope or flat
5	Closed scrub D-13	Class D Scrub	0	upslope or flat
Representative photos of each vegetation area, descriptions and classification justification, are presented on the following pages. The areas of classified vegetation are defined, and the photo locations identified on Figure 3.1, the vegetation and topography map.				
Note[1]: Described and classified as per AS 3959:2018 Table 2.3 and Figures 2.3 and 2.4 (A)-(H) Note[2]: Effective slope measured as per AS 3959:2018 Section 2.2.5 and Appendix B Part B4				

Additional Supporting Information

In all instances the precautionary principle has been adopted to assess vegetation areas.

VEGETATION AREA 1	
AS 3959:2018 Vegetation Classification Applied:	Class G Grassland
Vegetation Types Present:	Low open shrubland G-19
Description/Justification:	Shrubs to 1 meter tall, 15% foliage cover, occasional scrub, little to no understorey.

Photo ID: 1a

Photo ID: 1b

Photo ID: 1c

Photo ID: 1d

Photo ID: 1e

Photo ID: 1f

VEGETATION AREA 1	
AS 3959:2018 Vegetation Classification Applied:	Class G Grassland
Vegetation Types Present:	Low open shrubland G-19
Description/Justification:	**Species: Tree/Shrub Height: % Foliage Cover: Dominant Layers: Sub-Dominant Layers: Understorey:** Justify further as necessary e.g. expected fire behaviour**:**

Photo ID: 1g

VEGETATION AREA 2	
AS 3959:2018 Vegetation Classification Applied:	Class D Scrub
Vegetation Types Present:	Open scrub D-14
Description/Justification:	Scrub 4 to 6 metres tall, less than 30% foliage cover, shrubs, occasional small tree, grass understorey in places.

Photo ID: 2a

Photo ID: 2b

VEGETATION AREA 2	
AS 3959:2018 Vegetation Classification Applied:	Class D Scrub
Vegetation Types Present:	Open scrub D-14
Description/Justification:	Scrub 4 to 6 metres tall, less than 30% foliage cover, shrubs, occasional small tree, grass understorey in places.

Photo ID: 2c

Photo ID: 2d

Photo ID: 2e

Photo ID: 2f

Photo ID: 2g

Photo ID: 2h

VEGETATION AREA 2	
AS 3959:2018 Vegetation Classification Applied:	Class D Scrub
Vegetation Types Present:	Open scrub D-14
Description/Justification:	Scrub 4 to 6 metres tall, less than 30% foliage cover, shrubs, occasional small tree, grass understorey in places.

Photo ID: 2i

Photo ID: 2j

Photo ID: 2k

Photo ID: 2l

<table>
<tr><th colspan="3">VEGETATION AREA 3</th></tr>
<tr><td colspan="2">AS 3959:2018 Vegetation Classification Applied:</td><td>Class G Grassland</td></tr>
<tr><td>Vegetation Types Present:</td><td>Tussock grassland G-22</td><td>Open tussock G-23</td></tr>
<tr><td>Description/Justification:</td><td colspan="2">Open grassland areas, some areas cleared with grassy regrowth.</td></tr>
<tr><td colspan="3">  </td></tr>
<tr><td colspan="3">Photo ID: 3a</td></tr>
<tr><td colspan="3">  </td></tr>
<tr><td colspan="3">Photo ID: 3b</td></tr>
<tr><td colspan="3">  </td></tr>
<tr><td colspan="3">Photo ID: 3c</td></tr>
<tr><td colspan="3">  </td></tr>
<tr><td colspan="3">Photo ID: 3d</td></tr>
</table>

VEGETATION AREA 4	
AS 3959:2018 Vegetation Classification Applied:	Class C Shrubland
Vegetation Types Present:	Open heath C-11
Description/Justification:	Shrubs to 1 metre tall, less than 30% foliage cover, occasional scrub, grassy understorey, some open areas with minimal understorey.

Photo ID: 4a

Photo ID: 4b

Photo ID: 4c

Photo ID: 4d

Photo ID: e

VEGETATION AREA 5	
AS 3959:2018 Vegetation Classification Applied:	Class D Scrub
Vegetation Types Present:	Closed scrub D-13
Description/Justification:	Scrub to 5 metres tall, greater than 30% foliage cover, shrubs, grass understorey in places.

Photo ID: 5a

Photo ID: 5b

Photo ID: 5c

Vegetation Area	Vegetation Class	Vegetation Type	Effective Slope
1	G	Grassland	0
2	D	Scrub	0
3	G	Grassland	0
4	C	Shrubland	0
5	D	Scrub	0
6	Ex	Exempt	

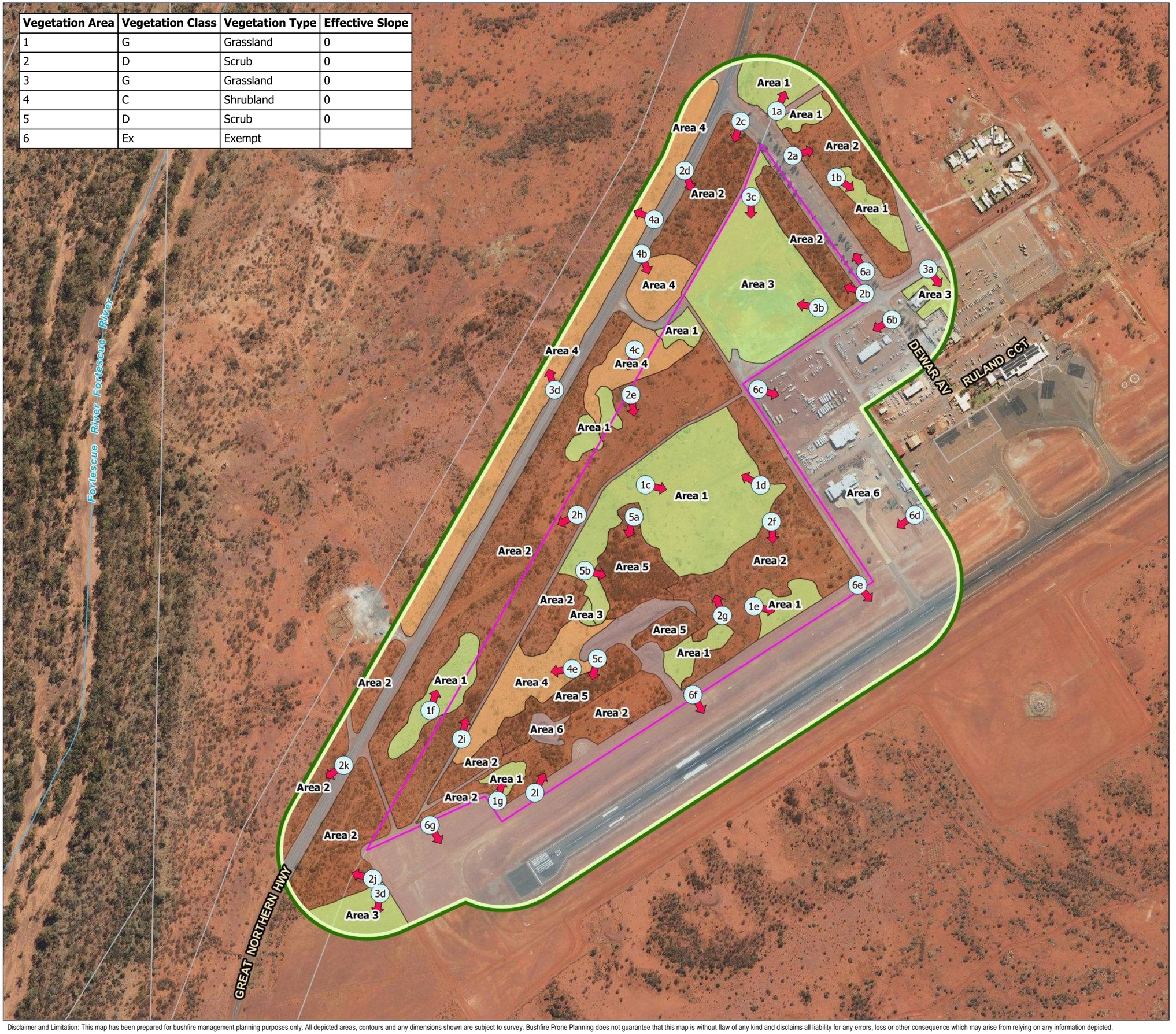


Figure 3.1

Existing Topography & Classified Vegetation

Lot 571 on Plan 71045
Great Northern Highway
NEWMAN
SHIRE OF EAST PILBARA

------ LEGEND ------

- Photos
- Subject Site
- Cadastre

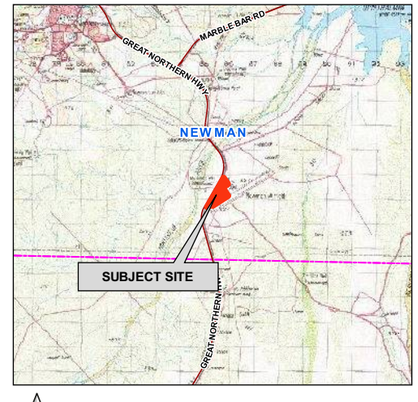
Classified Vegetation

- Class C - Shrubland
- Class D - Scrub
- Class G - Grassland
- Exclusion 2.2.3.2

0 50 100 150 200 250 300 350

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Ian Macleod 07-05-2021
SCALE (A3): 1 : 6000

BUSHFIRE PRONE PLANNING

3.1.3 Vegetation Separation Distance

The vegetation separation distance is the horizontal distance measured from the relevant parts of an existing building or a future building's planned location (within a lot), to the determined edge of an area of classified vegetation.

This separation distance applied to determining a Bushfire Attack Level (BAL) can be either:

- The *measured distance* – for which the location of the building relative to the edge of classified vegetation must be known. This will result in single determined BAL that will apply to a building. (The measured distance is a required calculation input); or
- A *calculated minimum and maximum distance (range)* that will correspond to each individual BAL. The calculated distances provide an indicative (or achievable) BAL for which the determined BAL will be dependent on the known location of the building relative to the edge of classified vegetation.

  The calculated range of distances corresponding to each BAL can be presented in different formats (tables or a BAL contour map), dependent on the form of information that is most appropriate for the proposed development/use. These distance ranges corresponding to BAL(s) will be presented in Section 3.2: 'Assessment Output".

For the proposed development/use, the applicable vegetation separation distances will be presented within the Bushfire Management Plan in this location:	In Section 3.2 'Assessment Output' as a table containing the calculated ranges of distance corresponding to each BAL and illustrated as a BAL Contour Map.

3.2 Assessment Output

3.2.1 Bushfire Hazard Level (BHL) Assessment

UNDERSTANDING THE RESULTS OF THE BUSHFIRE HAZARD LEVEL IMPACT ASSESSMENT

"A Bushfire Hazard Level assessment provides a 'broad-brush' means of determining the potential intensity of a bushfire for a particular area. The Bushfire Hazard Level assessment assists in informing the suitability of land contained within strategic planning proposals for future subdivision and development.

The Bushfire Hazard Level assessment categorises land within a designated bushfire prone area as having a low, moderate or extreme bushfire hazard level. Different hazard levels may be assigned to different parts of individual lots.

Bushfire Hazard Level assessments allow for early strategic consideration of bushfire risk which can then be used to inform the more detailed stages that follow, ensuring all issues are considered, identified and properly addressed at the earliest possible time ('Guidelines' s4.1)".

For a summary of the assessment methodology refer to Appendix 2 of the "Guidelines for Planning in Bushfire Prone Areas". BHL assessments are required to accompany all strategic planning proposals unless the future lot layout of the Proposal is known in which case a BAL Contour Map is more appropriate (SPP 3.7 s6.3).

For this proposal a Bushfire Hazard Level Map and BAL Contour Map is presented as an indicative lot layout is available.

3.2.2 Bushfire Hazard Level Assessment Summary

The results of the Bushfire Hazard Level assessment detailing the vegetation type, class and the hazard levels assigned, are presented in Tables 3.3 & 3.4, and visually in Figure 3.2 as a Bushfire Hazard Level Map.

Table 3.3: Vegetation classifications and assessed Bushfire Hazard Levels.

ALL VEGETATION WITHIN 150 METRES OF THE PROPOSED DEVELOPMENT				
Vegetation Area	Identified Vegetation Types [1] or Description if 'Excluded'	Applied Vegetation Classification [1]	Effective Slope (degrees)[2] Assessed	Assessed Bushfire Hazard level
1	Low open shrubland G-19	Class G Grassland	0	Moderate
2	Open scrub D-14	Class D Scrub	0	Extreme
3	Tussock grassland G-22 Open tussock G-23	Class G Grassland	0	Moderate
4	Open heath C-11	Class C Shrubland	0	Moderate
5	Closed scrub D-13	Class D Scrub	0	Extreme
Representative photos of each vegetation area, descriptions and classification justification, are presented on the following pages. The areas of classified vegetation are defined, and the photo locations identified on Figure 3.1, the vegetation and topography map.				
Note[1]: Described and classified as per AS 3959:2018 Table 2.3 and Figures 2.3 and 2.4 (A)-(H) Note[2]: Effective slope measured as per AS 3959:2018 Section 2.2.5 and Appendix B Part B4				

Figure 3.2

Proposed Industrial Estate Bushfire Hazard Level Map

Lot 571 on Plan 71045
Great Northern Highway
NEWMAN
SHIRE OF EAST PILBARA

Fortescue River

GREAT NORTHERN HWY

DEWAR AV

RULAND CCT

Easement

Road 1

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

------ LEGEND ------

- Proposed Lots (Indicative)
- Subject Site
- Cadastre

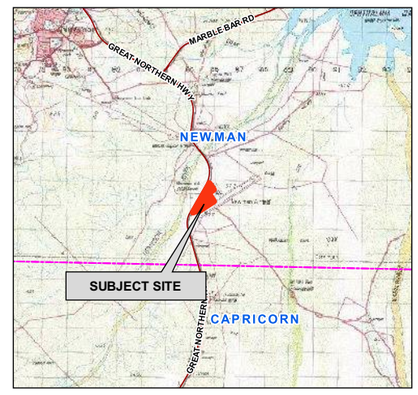
Bushfire Hazard Level

- Extreme
- Moderate
- Low

0 50 100 150 200 250 300 350

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

N

BUSHFIRE PRONE PLANNING

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Ian Macleod 10-05-2021
SCALE (A3): 1 : 6000

Table 3.4: Bushfire Hazard Level Assessment

BUSHFIRE HAZARD LEVEL ASSESSMENT FOR PROPOSED DEVELOPMENT	
Data Used (methodology as per the 'Guidelines' Appendix 2):	Physical site inspection + aerial map data.
Assessed Area	Bushfire Hazard Level
Land inside the external boundary of the subject site:	Moderate + Extreme
Land within 150 metres of external boundary of the subject site:	Low + Moderate + Extreme
Note[1] Assessment inputs applied are presented in Section 3.1.	

The proposed development site has areas of Moderate and Extreme bushfire hazard level. However, management of onsite vegetation will achieve areas having a BAL rating of BAL-29 or lower for each proposed lot.

3.2.3 Bushfire Attack Level Results - BAL Contour Map Format

UNDERSTANDING THE RESULTS OF THE BUSHFIRE ATTACK LEVEL IMPACT ASSESSMENT

Bushfire Attack Levels (BALs) – Their Application in the Building Environment is Different to the Planning Environment

In the building environment, a ***determined BAL*** is required for the proposed construction at the building application stage. This is to inform approval considerations and establish the bushfire construction standards that are to apply. An indicative BAL is not acceptable for a building application.

In the planning environment, through the application of SPP 3.7 and associated Guidelines, the deemed to satisfy requirement for a proposed 'development site' or sites (defined by the LPS Amendment Regulations 2015 as "that part of a lot on which a building that is the subject of development stands or is to be constructed"), is that a BAL-29 or lower rating can be achieved once all works associated with the proposal are completed. For planning approval purposes, an ***indicative BAL*** can provide the required information.

Determined Bushfire Attack Level

A determined BAL is to apply to an existing building or the 'development site' on which the building is to be constructed and not to a lot or building envelope. Its purpose is to state the potential radiant heat flux to which the building will be exposed, thereby determining the construction standard to be applied.

A determined BAL cannot be given for a future building whose design and position on the lot are unknown or the vegetation separation distance has not been established. It is not until these variables have been fixed that a determined BAL can be stated, and a BAL Certificate can be issued.

The one exception is when a building ***of any dimension*** can be ***positioned anywhere*** on a proposed lot (within R-Code building setbacks) or within a defined building envelope, and always remain subject to the same BAL, regardless of the retention of any existing classified vegetation either onsite or offsite.

Indicative Bushfire Attack Level

If a BAL is not able to achieve 'determined' status it will be an indicative BAL. It indicates the BAL that can be achieved by the proposed development/use. However, it is conditional upon an assessment variable(s) being confirmed at a later stage (e.g. the building location is established/changed, or vegetation is modified/removed to establish the vegetation separation distance).

A BAL certificate cannot be issued for an indicative BAL – unless that BAL cannot vary (refer to 'Determined BAL' above).

In table form, a single or a range of indicative BAL(s) may be presented. If a single indicative BAL is stated for a defined area (i.e. the lot or building envelope), this will be the highest indicative BAL impacting the defined area.

In BAL contour map form, the illustrated BAL contours visually identify areas of land for which if any part of an existing or proposed building is located on that land and within the BAL contours, then the highest BAL affecting that building (or part of the land on which the building will be constructed), will be the indicative BAL that is to apply.

The BAL can only become a determined BAL once the actual location of that building on the land is known and/or the required minimum vegetation separation distance corresponding to the relevant BAL contour is established (refer to Table 3.5).

INTERPRETATION OF THE BUSHFIRE ATTACK LEVEL (BAL) CONTOUR MAP

The contour map will present different coloured contour intervals extending from the areas of classified bushfire prone vegetation. These represent the different bushfire attack levels that will exist at varying distances away from the classified vegetation in the event of a bushfire in that vegetation.

The areas of classified vegetation to be considered in developing the BAL contours, are those that will remain as the intended end state of the subject development once earthworks, clearing and/or landscaping and re-vegetation have been completed (or each stage completed).

Each bushfire attack level corresponds to a set range of radiant heat flux that is generated by a bushfire. That range is defined by the AS 3959:2018 BAL determination methodology.

The width of each shaded BAL contour is a diagrammatic representation of the separation distances from the classified vegetation that correspond to each BAL for each separately identified area of classified vegetation. They have been calculated by the application of the unique site variables including vegetation types and structure, ground slope and applied fire weather.

(Refer to Section 3.2 'Understanding the Results of the Bushfire Impact Assessment' for the explanation of how BAL(s) for buildings will be assessed from the BAL Contour Map).

Construction of the BAL Contours

VEGETATION AREAS APPLIED TO THE DEVELOPMENT OF THE BAL CONTOUR MAP

Vegetation areas outside the development site are applied and vegetation areas within the development site are excluded in the creation of the BAL Contours. This approach is applied to indicate the achievable bushfire attack levels for the proposal once the site is fully developed. The assumption is that all lots will be cleared of classifiable vegetation once developed.

It should be noted that, as it is unlikely that all proposed lots will be developed at the same time, existing vegetation on neighbouring lots may affect BAL ratings and available building locations for future buildings on lots being developed.

VEGETATION SEPARATION DISTANCES APPLIED

The distances that have been applied to illustrating the width of each BAL contour shown in Figure 3.3 are stated in Table 3.5. These correspond to each Bushfire Attack Level and are specific to the proposed development site.

Table 3.5: Vegetation separation distances applied to construct the BAL contours.

BAL CONTOUR MAP – APPLIED VEGETATION SEPARATION DISTANCES								
Derived from the Application of Method 1 BAL Determination Methodology (AS 3959:2018 Section 2, Table 2.5)[1]								
Vegetation Area	Vegetation Classification	Effective Slope (degree range)	BAL and Corresponding Separation Distance (m)					
			BAL-FZ	BAL-40	BAL-29	BAL-19	BAL12.5	BAL-LOW
1	Class G Grassland	upslope or flat	<6	6-<8	8-<12	12-<17	17-<50	>50
2	Class D Scrub	upslope or flat	<10	10-<13	13-<19	19-<27	27-<100	>100
3	Class G Grassland	upslope or flat	<6	6-<8	8-<12	12-<17	17-<50	>50
4	Class C Shrubland	upslope or flat	<7	7-<9	9-<13	13-<19	19-<100	>100
5	Class D Scrub	upslope or flat	<10	10-<13	13-<19	19-<27	27-<100	>100
Note[1] All the assessment inputs applied are presented in Section 3.1.								

Vegetation Area	Vegetation Class	Vegetation Type	Effective Slope
1	G	Grassland	0
2	D	Scrub	0
3	G	Grassland	0
4	C	Shrubland	0
5	D	Scrub	0

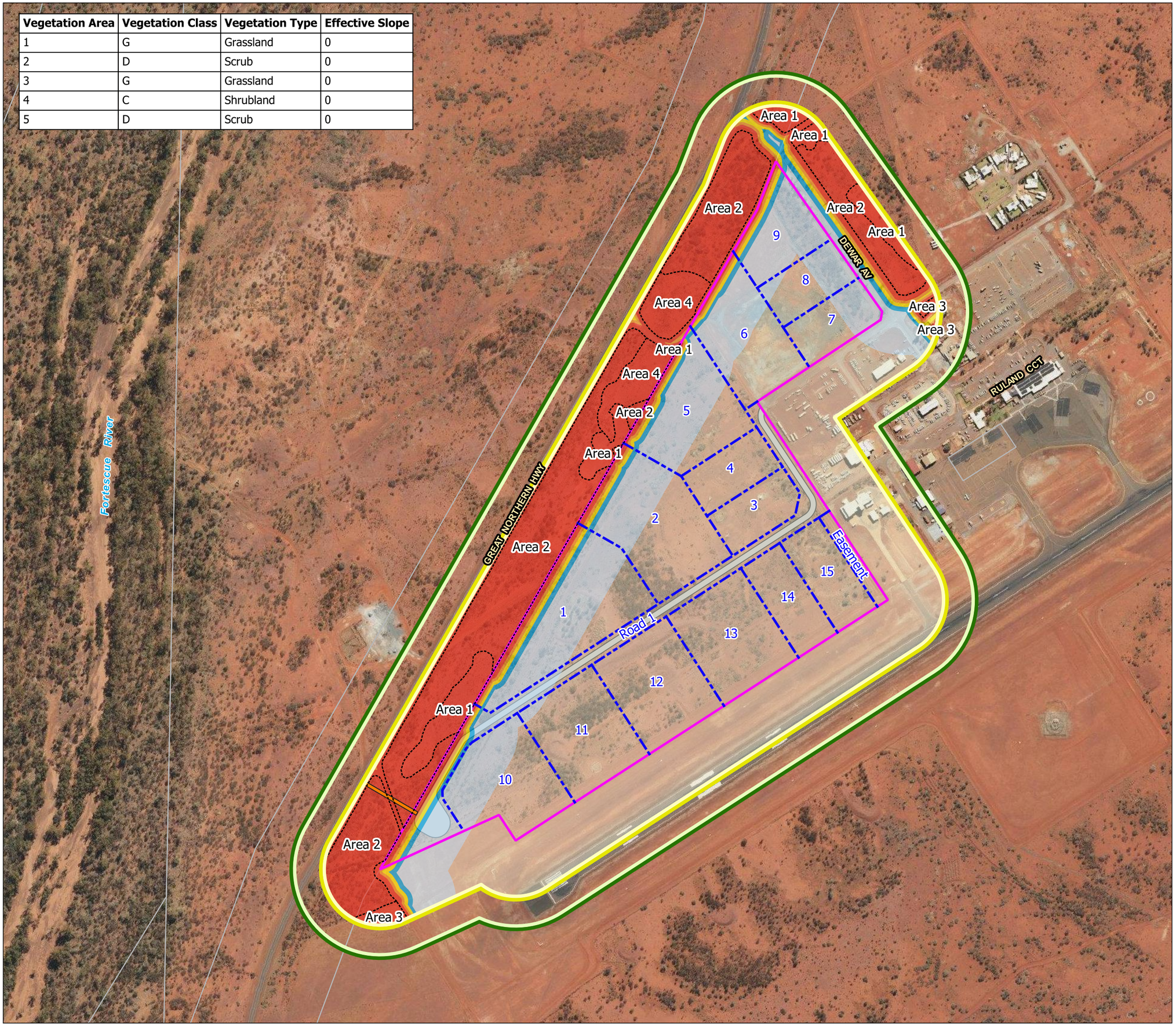


Figure 3.3

Proposed Industrial Estate BAL Contour Map

Lot 571 on Plan 71045
Great Northern Highway
NEWMAN
SHIRE OF EAST PILBARA

------ LEGEND ------

- Proposed Lots (Indicative)
- Road Pavement (Proposed)
- Emergency Access Way (Proposed)
- Subject Site
- 100m BAL Buffer
- 150m_Assessment_Area
- Cadastre
- Vegetation Outline

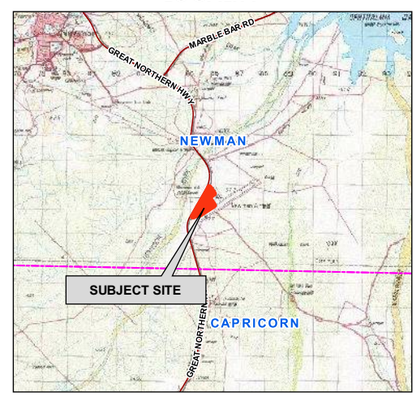
BAL Contours

- BAL-FZ
- BAL-40
- BAL-29
- BAL-19
- BAL-12.5
- BAL-LOW

0 50 100 150 200 250 300 350

Metres

------ LOCALITY ------



AERIAL IMAGERY: Landgate/SLIP

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Merctaor Units: Metre
Map by: Ian Macleod 10-05-2021
SCALE (A3): 1 : 6000

3.2.4 Bushfire Attack Level Results - Derived from The BAL Contour Map

The assumption in creating the BAL Contour Map is that, once the site is fully developed, all lots will be cleared of classifiable vegetation.

Table 3.6: Indicative and determined BAL(s) for future building works on proposed lots.

BUSHFIRE ATTACK LEVEL FOR FUTURE BUILDING WORKS ON PROPOSED LOTS		
BAL Determination Methodology Applied[1]	Method 1 as per AS 3959:2018 s2.2.6 and Table 2.5.	
Lot No.	Indicative BAL (Highest BAL rating that affects the lot)	Is BAL-29 or Lower Achievable on the Lot (planning requirement).
1	BAL-FZ	Yes
2	BAL-FZ	Yes
3	BAL-LOW	Yes
4	BAL-LOW	Yes
5	BAL-FZ	Yes
6	BAL-FZ	Yes
7	BAL-12.5	Yes
8	BAL-12.5	Yes
9	BAL-FZ	Yes
10	BAL-19	Yes
11	BAL-12.5	Yes
12	BAL-LOW	Yes
13	BAL-LOW	Yes
14	BAL-LOW	Yes
15	BAL-LOW	Yes
Note[1] Assessment inputs applied are presented in Section 3.1. If applicable.		

Future buildings on all proposed lots will be able to achieve a BAL rating of BAL-29 or lower. Restrictions to size and location of future buildings on lots may apply with respect to:

1. Required separation distances from existing vegetation within the Great Northern Highway road reserve.
2. Required separation distances from existing vegetation within undeveloped neighbouring lots in the development.
3. Remnant vegetation within the proposed easement and road reserve.

4 IDENTIFICATION OF BUSHFIRE HAZARD ISSUES

In response to the Bushfire Management Plan requirements established by Appendix 5 of the Guidelines for Planning in Bushfire Prone Areas (WAPC 2017 v1.3), the following statements are made to assist in the understanding of whether the proposal is likely to be able to comply with the bushfire protection criteria now or in subsequent planning stages.

Spatial Context - Broader Landscape Considerations	
Wider road network and access constraints	The proposed development is located alongside the Great Northern Highway at Newman Airport which provides access north to Newman at a distance of approximately 8 kilometres, or south to Meekatharra at a distance of approximately 415 kilometres. Access onto the Great Northern Highway is via Dew3ar Avenue, the main access road to the airport, and a proposed emergency access way at the western end of the proposed site.
Proximity of settlements and emergency services	Newman is the closest settlement, located 8 kilometres to the north-west of the development. The Newman Volunteer Fire and Rescue Service is located in Newman and approximately 10 kilometres from the development.
Bushfire prone vegetation types and extent (including conserved vegetation)	Classifiable vegetation within and external to the site varies from areas of closed scrub to areas of open grassland and low open shrubland, having a moderate to extreme bushfire hazard level. The site abuts the runway and existing developments at the Newman Airport. These areas are generally managed to a low bushfire threat state.
Topography and fire behaviour interactions.	The topography in and around the site is flat and will not influence the rate of spread of a bushfire.
Potential for extreme fire behaviour and pyro convective events.	Unlikely, due to topography and vegetation types.
Environmental Considerations	
Constraints to implementing required and/or additional bushfire protection measures	The environment considerations have not identified any issues constraining bushfire hazard protection measures.
Provision of Access Within the Subject Site	
Potential constraints	Will require agreement from Main Roads Western Australia for the installation of the Emergency Access Way.
Potential Bushfire Impacts	
Flame and radiant heat and ability to establish an APZ	The proposed lot sizes will allow a BAL-29 dimensioned APZ to be established within each lot. This will prevent flame contact from the classified vegetation. Application of the BAL-29 bushfire construction standard will mitigate the risks from radiant heat impact to what is considered an acceptable level.
Embers/firebrands, smoke and fire-driven wind	These will be the major impacts to the subject site after development of the lots. The appropriate protection measures of building construction and strict management of the APZ will mitigate the risk to what is considered an acceptable level.
Issues to be Considered at Subsequent Planning Stages (additional assessments/documents)	
Specific land uses to be addressed	High Risk or Vulnerable land uses must comply with the requirements of the Guidelines for Planning in Bushfire Prone Areas.
Additional assessments	Once lot layout in finalised, each lot is to be assessed with respect to SPP 3.7 and the Guidelines for Planning in Bushfire Prone Areas. Prior to approval, future buildings on the proposed lots will require a BAL Assessment.
Additional documents	N/A

5 ASSESSMENT AGAINST THE BUSHFIRE PROTECTION CRITERIA ESTABLISHED BY THE GUIDELINES

For a subdivision application to be considered compliant with SPP 3.7, it must satisfy (achieve) the intent of each of the four elements of the bushfire protection criteria. These criteria are established by the *Guidelines for Planning in Bushfire Prone Areas WAPC 2017 v1.3*). Compliance can be achieved by either:

- Meeting all applicable acceptable solutions corresponding to each element (i.e. the minimum bushfire protection measures that are deemed to satisfy planning requirements); or
- Where an acceptable solution cannot be met, by developing a performance solution that satisfies the established requirements.

5.1 Local Government Variations to Apply

Local governments may add to or modify the acceptable solutions of the Bushfire Protection Criteria (BPC) and/or apply technical requirements that vary from those specified in the Guidelines for Planning in Bushfire Prone Areas (WAPC). In such instances, this Proposal will be assessed against these variations and/or any specific local government technical requirements for emergency access and water. Refer to Appendices 2 and 3 for relevant technical requirements.

Will local or regional variations (endorsed by WAPC / DFES) to the applicable acceptable solutions established by the *Guidelines* or the *Position Statement: Tourism land uses in bushfire prone areas WAPC October 2019,* apply to this Proposal?	N/A

5.2 Summary of Assessment Against the Bushfire Protection Criteria

SUMMARISED OUTCOME OF THE ASSESSMENT AGAINST THE BUSHFIRE PROTECTION CRITERIA					
Element of the Bushfire Protection Criteria	Basis for the Proposal Achieving Full Compliance with SPP 3.7			The Proposal Cannot Achieve Full Compliance with SPP 3.7	
	Acceptable Solutions Met	Achieves the Intent of the Element			
	All applicable solutions are fully met	All applicable solutions are not fully met. A merit based assessment and/or a bushfire performance comparison of the proposals residual risk with that of the residual risk of the acceptable solution is conducted (refer Note 4)	A performance principle-based solution is applied	Bushfire planning development type that may not require full compliance is applied	An improvement in bushfire performance compared to the existing development is detailed (refer Note 4)
1. Location	✓			N/A	
2. Siting and Design of Development	✓				
3. Vehicular Access	✓				
4. Water	✓				

Note: The development proposal has been assessed:

1. Against the requirements established in Appendix 4 of the *Guidelines for Planning in Bushfire Prone Areas, WAPC 2017 v1.3 (Guidelines)*. The Guidelines are found at https://www.planning.wa.gov.au/8194.aspx; and
2. Applying the interpretation guidance provided in *Position Statement: Planning in bushfire prone areas – Demonstrating Element 1: Location and Element 2: Siting and design (WAPC Nov 2019)*.
3. Applying any endorsed variations to the Guideline's acceptable solutions and associated technical requirements that have been established by the local government. If known and applicable these have been stated in Section 5.1 with the detail included as an appendix if required by the local government.
4. When non-compliant with SPP 3.7 and when appropriate, by utilising additional compliance pathways that include the application of merit based assessment and comparative bushfire performance. The validity of this approach is derived from relevant decisions made by the responsible authorities (refer Appendix 2).

5.3 Assessment Detail

Element 1: Location	
Intent: To ensure that strategic planning proposals, subdivision and development applications are located in areas with the least possible risk of bushfire to facilitate the protection of people, property and infrastructure.	
Compliance: How the proposed development achieves the intent of Element 1:	By fully meeting all applicable acceptable solutions established by the bushfire protection criteria (Guidelines v1.3 WAPC 2017)

ASSESSMENT (COMPLIANCE) STATEMENTS

For each applicable acceptable solution, the following statements present the results of the assessment of the proposed development against the requirements established by the *Guidelines (WAPC 2017 v1.3)* and apply the interpretation guidance established by the *Position Statement: Planning in bushfire prone areas – Demonstrating Element 1: Location and Element 2: Siting and design (WAPC Nov 2019)*.

Acceptable Solution: A1.1: Development Location

ASSESSMENT AGAINST THE REQUIREMENTS ESTABLISHED BY THE GUIDELINES

The proposed subdivision will provide an area of land within each lot that can be considered suitable for development as BAL-40 or BAL-FZ construction standards will not be required to be applied. This meets the requirements established by Acceptable Solution A1.1 and its associated explanatory note.

Future building location and size may be restricted by existing vegetation within the abutting Great Northern Highway road reserve (Lots 1, 2, 5, 6 and 9), and by existing or remnant vegetation on undeveloped or partly developed neighbouring lots, road reserve or easement within the subject site.

ASSESSMENT AGAINST THE REQUIREMENTS ESTABLISHED BY THE POSITION STATEMENT

The position statement establishes that:

- The source of risk (the hazard) to be considered in Element 1 is the "level of bushfire exposure" from the type and extent of bushfire prone vegetation and the topography of the land on which it exists; and
- "Consideration should be given to the site context" which includes the land both "within and adjoining the subject site". The "hazards remaining within the site should not be considered in isolation of the hazards adjoining the site, as the potential impact of a bushfire will be dependent on the wider risk context."

The position statement also recognises:

- That the proposed development site and its surrounding land may be part of an area "identified for development or intensification of land use prior to the release of SPP 3.7"; consequently
- Consideration by decision-makers "should also be given to improving bushfire management of the site and surrounding area, thereby reducing the vulnerability of people property and infrastructure to bushfire"; and
- The application of mitigation measures to lessen the risk to the broader area would include improvements to the local road network (including emergency access ways), improvements/additions to firefighting water supply and increasing separation distance from the hazard.

The Hazard Within the Subject Site

The subject site is vegetated with Scrub, Shrubland and Grassland type vegetation with occasional non-vegetated areas. The topography is flat and with not affect the intensity and rate of spread of a bushfire.

Element 1: Location

The ability to establish a BAL-29 dimensioned APZ, as a minimum, within each proposed lot's boundaries removes the threat of greater levels of radiant heat or flame contact upon a future building.

The primary bushfire threat from bushfire prone vegetation remaining within the proposed lot will be embers. This threat will be mitigated by the application of appropriate building design, bushfire construction standards and the ongoing maintenance of the APZ to ensure the buildings will not be impacted by consequential fire within combustible materials used, stored or accumulated within the APZ.

The Hazard Adjoining the Subject Site

The Newman Airport abuts the southern and a portion of the eastern boundaries of the proposed development. This area is managed to a low bushfire threat state and the main bushfire threat from this direction would be ember attack.

Land adjoining to the west, north and east consists of Scrub, Shrubland and Grassland type vegetation. The topography of the neighbouring land is generally flat but slopes down to the Fortescue River further west. The potential exists for intense bushfire behaviour to occur within these areas of bushfire prone vegetation. The potential bushfire impact on persons and property within the proposed lots will be to increase the level of ember attack in the event of a bushfire.

This ember threat will be mitigated by the application of appropriate building design, bushfire construction standards and the ongoing maintenance of a minimum BAL-29 dimensioned APZ, to ensure the buildings will not be impacted by consequential fire within combustible materials used, stored or accumulated inside the APZ.

Element 2: Siting and Design of Development

Intent: To ensure that the siting and design of development (note: not building/construction design) minimises the level of bushfire impact.

Compliance: How the proposed development achieves the intent of Element 2:	By fully meeting all applicable acceptable solutions established by the bushfire protection criteria (Guidelines v1.3 WAPC 2017)

ASSESSMENT (COMPLIANCE) STATEMENTS

For each applicable acceptable solution, the following statements present the results of the assessment of the proposed development/use against the requirements established by the *Guidelines (WAPC 2017 v1.3)* and apply the interpretation guidance established by the *Position Statement: Planning in bushfire prone areas – Demonstrating Element 1: Location and Element 2: Siting and design (WAPC Nov 2019)*.

Acceptable Solution: A2.1: Asset Protection Zone

THE APZ - DEVELOPMENT SITING AND DESIGN PLANNING REQUIREMENTS

The necessary outcome of bushfire planning for development siting and design, is to ensure that a building can be located within the developable portion of any lot (i.e. outside those parts of the lot that form the required R-Code building setbacks, or any other excluded area), and be subject to potential radiant heat from a bushfire not exceeding 29 kW/m^2 (i.e. a maximum BAL of BAL-29).

This will be achieved when the size of the "low fuel area immediately surrounding a building", the asset protection zone (APZ), is large enough. This requires a certain separation distance to exist between the building and areas of classified vegetation. These are the BAL-29 APZ dimensions and they will vary dependent on site specific parameters.

The APZ should be contained solely within the boundaries of each lot, except in instances where the neighbouring lot(s) or adjacent public land will be managed in a low-fuel state on an ongoing basis, in perpetuity.

Where possible, planning for siting and design should incorporate elements that include non-vegetated areas (e.g. roads/parking/drainage) and/or formally managed areas of vegetation (public open space/recreation areas/ services installed in a common section of land), as either part of the required APZ dimensions or to additionally increase separation distances to provide greater protection. These elements create robust and easier managed asset protection zones.

THE ASSESSMENT

Future buildings on the lot(s) of the proposed subdivision can be surrounded by an APZ that will ensure the potential radiant heat impact of a bushfire does not exceed 29 kW/m^2 (BAL-29). The required APZ specifications of width, location and management can be achieved.

APZ Width: The required APZ dimensions to ensure buildings are subject to a maximum BAL of BAL-29 (measured from any external wall or supporting post or column to the edge of the classified vegetation), has been determined in Section 3.2 of this BMP and are:

BAL-29 APZ Dimensions		
Applicable to Following Lot(s): Lots 1 to 15	Building to Vegetation Area 1	Minimum 8 metres
	Building to Vegetation Area 2	Minimum 13 metres
	Building to Vegetation Area 3	Minimum 8 metres
	Building to Vegetation Area 4	Minimum 9 metres
	Building to Vegetation Area 5	Minimum 13 metres

APZ Location: Asset protection zones of the widths stated above can be contained solely within the boundaries of each lot. Onsite vegetation will be required to be modified/removed, the authority for which may need to be received from the local government.

Element 2: Siting and Design of Development

Where the BAL-29 APZ will exist both within and outside the proposed lots. The portions of the required size APZ that exist outside each proposed lot will consist of:

- Roads
- Footpaths
- Parking bays
- Portions of adjacent lots with no existing vegetation or low bushfire threat landscaping, which are to be managed in perpetuity
- Road verge with a commitment from the local government to manage.

APZ Management: Retained vegetation will be managed in accordance with the technical requirements established by the Schedule 1: 'Standards for Asset Protection Zones (Guidelines). The APZ specifications are also detailed in Appendix 1 and the Shire of East Pilbara may have additional requirements established by their Fire Break Notice.

THE APZ – REQUIRED DIMENSIONS TO SATISFY FUTURE BUILDING (AND ONGOING MANAGEMENT)

It is important for the landowner to be aware that the APZ dimensions that will be required to be physically established and maintained on each lot surrounding relevant future buildings, may be different to those stated above for the BAL-29 APZ - which is the minimum dimension a planning proposal needs to show can be established to comply with SPP 3.7.

The actual APZ dimensions to be physically established and maintained, will be based on which of the following establishes the larger APZ dimension:

- The dimensions corresponding to the determined BAL of a building (refer to Section 3.2 for explanation of the 'planning' versus 'building' requirements and 'indicative' versus 'determined' BAL); or
- The APZ dimensions established by the local government's Firebreak Notice.

If the dimensions of the APZ that are to be established are known at this time, they will be stated below.

For the proposed development, there is potential to reduce construction BAL's for future buildings below BAL-29 dependent upon the size and location of buildings on the lot and allowable clearing requirements.

The required separation distances to achieve lower BAL ratings are stated in the Tables below:

The Required Vegetation Separation Distances to Achieve a BAL-19 APZ		
Applicable to Buildings on the Following Lot(s): Lots 1 to 15	Building to Vegetation Area 1	Minimum 12 metres
	Building to Vegetation Area 2	Minimum 19 metres
	Building to Vegetation Area 3	Minimum 12 metres
	Building to Vegetation Area 4	Minimum 13 metres
	Building to Vegetation Area 5	Minimum 19 metres

The Required Vegetation Separation Distances to Achieve a BAL-12.5 APZ		
Applicable to Buildings on the Following Lot(s): Lots 1 to 15	Building to Vegetation Area 1	Minimum 17 metres
	Building to Vegetation Area 2	Minimum 27 metres
	Building to Vegetation Area 3	Minimum 17 metres
	Building to Vegetation Area 4	Minimum 19 metres
	Building to Vegetation Area 5	Minimum 27 metres

Element 2: Siting and Design of Development

The Required Vegetation Separation Distances to Achieve a BAL-LOW APZ		
Applicable to Buildings on the Following Lot(s): Lots 1 to 15	Building to Vegetation Area 1	Minimum 50 metres
	Building to Vegetation Area 2	Minimum 100 metres
	Building to Vegetation Area 3	Minimum 50 metres
	Building to Vegetation Area 4	Minimum 100 metres
	Building to Vegetation Area 5	Minimum 100 metres

Consideration/Implementation of Staged Development/Vacant Lots

Where the proposed development is staged each stage must comply with the requirements of the Guidelines for Planning in Bushfire Prone Areas and this Bushfire Management Plan. This may require the creation of roads or management of land or installation of water supply lines outside that particular stage to achieve compliance.

Vegetation on the balance or vacant lot(s) may adversely affect the indicative BAL ratings of buildings on lots being developed. This should be assessed prior to the sale of the lots and the required vegetation on the balance or vacant lot managed and maintained until developed, or the indicative BAL ratings for the affected lots amended.

Element 3: Vehicular Access

Intent: To ensure that the vehicular access serving a subdivision/development is available and safe during a bushfire event.

Compliance: How the proposed development achieves the intent of Element 3:	By fully meeting all applicable acceptable solutions established by the bushfire protection criteria (Guidelines v1.3 WAPC 2017)

ASSESSMENT (COMPLIANCE) STATEMENTS

For each applicable acceptable solution, the following statements present the results of the assessment of the proposed development/use against the requirements established by the *Guidelines (WAPC 2017 v1.3)*.

Acceptable Solution: A3.1: Two Access Routes

The main access/egress route from the development will be from Road 1 via Dewar Avenue to Great Northern Highway. A secondary access/egress route is proposed to be made available via an Emergency Access Way from the southern end of Road 1 onto Great Northern Highway.

Acceptable Solution: A3.2: Public Road

Proposed Road 1 will comply with the construction technical requirements established by the Guidelines. These requirements are set out in Appendix 2.

Acceptable Solution: A3.3: Cul-de-sacs (including a dead-end road)

Proposed Road 1 will be a cul-de-sac of approximately 1.2kms in length, which is greater than the minimum of 200 metres as stated in the Guidelines for Planning in Bushfire Prone Areas. However, an Emergency Access Way is planned to join the southern end of Road 1 with the Great Northern Highway, providing a secondary access/egress route.
The construction technical requirements established by the Guidelines will be complied with. These requirements are set out in Appendix 2.

Acceptable Solution: A3.4: Battle-axe

N/A. There are no battle-axe lots planned for this development.

Acceptable Solution: A3.5: Private Driveways

Where a building site is greater than 50 metres from a public road, the driveway to that building must comply with the construction technical requirements established by the Guidelines. These requirements are set out in Appendix 2.

Acceptable Solution: A3.6: Emergency Access Way

An Emergency Access Way is proposed to link the southern end of Road 1 with the Great Northern Highway.
The construction technical requirements established by the Guidelines will be complied with. These requirements are set out in Appendix 2.

Acceptable Solution: A3.7: Fire Service Access Routes

N/A. There are no Fire Service Access Routes planned for this development.

Acceptable Solution: A3.8: Firebreak Width

The proposed lots will comply with the requirements of the local government annual firebreak notice issued under s33 of the Bush Fires Act 1954. Firebreaks to be installed prior to subdivision clearance.

Element 4: Water	
Intent: To ensure water is available to the subdivision, development or land use to enable people, property and infrastructure to be defended from bushfire.	
Compliance: How the proposed development achieves the intent of Element 4:	By fully meeting all applicable acceptable solutions established by the bushfire protection criteria (Guidelines v1.3 WAPC 2017)
ASSESSMENT (COMPLIANCE) STATEMENTS For each applicable acceptable solution, the following statements present the results of the assessment of the proposed development/use against the requirements established by the *Guidelines (WAPC 2017 v1.3)*.	
Acceptable Solution: A4.1: Reticulated Areas	
A reticulated water supply will be made available to the subject site and hydrants will be installed in locations as required by the relevant authority.	
Acceptable Solution: A4.2: Non-Reticulated Areas	
N/A	
Acceptable Solution: A4.3: Non-Reticulated Areas – Individual Lots	
N/A	

6 RESPONSIBILITIES FOR IMPLEMENTATION AND MANAGEMENT OF THE BUSHFIRE PROTECTION MEASURES

Table 6.1: BMP Implementation responsibilities prior to the issue of titles.

Developer (Landowner) – Implementation Responsibilities		
No.	Implementation Actions	Subdivision Clearance
Note: Planning approval may be conditioned with the requirements: 1. To place certain notifications on the certificates of title and the deposited plan, regarding the existence of this bushfire management plan and the obligations it creates; and 2. To provide certification of the implementation of certain bushfire protection measures established by this bushfire management plan.		
1	Condition (as per Code F1 of Model Subdivision Schedule, WAPC April 2020): Information is to be provided to demonstrate that the measures contained in Section 6; Tables 6.1 and 6.2 of this Bushfire Management Plan (version and date referenced in the condition), have been implemented during subdivisional works. This information should include a completed 'Certification by Bushfire Consultant' from the bushfire management plan. (Local Government) Or Information is to be provided to demonstrate that the measures contained in this bushfire management plan that address the following: (a) (b) (c) Have been implemented during subdivisional works. This information should include a notice of 'Certification by Bushfire Consultant'.	☐
2	Condition (as per Code F2 of Model Subdivision Schedule, WAPC April 2020): A notification, pursuant to Section 165 of the *Planning and Development Act 2005*, is to be placed on the certificate(s) of title of the proposed lot(s) with a Bushfire Attack Level (BAL) rating of 12.5 or above, advising of the existence of a hazard or other factor. Notice of this notification is to be included on the diagram or plan of survey (deposited plan). The notification is to state as follows: *"This land is within a bushfire prone area as designated by an Order made by the Fire and Emergency Services Commissioner and is/may be subject to a Bushfire Management Plan. Additional planning and building requirements may apply to development on this land."* (Western Australian Planning Commission).	☐
3	Construct the public roads and cul-de-sacs to the standards stated in the BMP.	☐
4	Construct the emergency access ways and associated signs and gates to the standards stated in the BMP.	☐
5	Install the reticulated water supply (hydrants) to the standards stated in the BMP.	☐

Table 6.2: BMP Implementation responsibilities prior to lot sale, occupancy or building.

Landowner (Developer) - Prior to Sale of Lot(s), Building or Occupancy	
No.	Implementation Actions
1	Prior to sale and post planning approval, the entity responsible for having the BMP prepared should ensure that anyone listed as having responsibility under the Plan has endorsed it and is provided with a copy for their information and informed that it contains their responsibilities. This includes the landowners/proponents (including future landowners where the Plan was prepared as part of a subdivision approval), local government and any other authorities or referral agencies ('Guidelines' s4.6.3).
2	Prior to sale of the subject lots, each individual lot is to be compliant with the Shire of East Pilbara Firebreak Notice issued under s33 of the Bushfires Act 1954. This may include specifications for asset protection zones that differ from the Guideline's APZ Standards, with the intent to better satisfy local conditions. When these are more stringent than those created by the Guidelines, or less stringent and endorsed by the WAPC and DFES, they must be complied with. Refer to Appendix 1.
3	Prior to any building work, inform the builder of the existence of this Bushfire Management Plan and the responsibilities it contains, regarding the required construction standards. This will be: • The standard corresponding to the determined BAL, as per the bushfire provisions of the Building Code of Australia (BCA); and/or • A higher standard because the BMP establishes that the construction standard is to correspond to a higher BAL as an additional bushfire protection measure.
4	Prior to occupancy, install the private driveways to the standards stated in the BMP.

Table 6.3: Ongoing management responsibilities for the Landowner/Occupier.

Landowner/Occupier - Ongoing	
No.	Ongoing Management Actions
1	Maintain the Asset Protection Zone (APZ) surrounding future buildings to the largest dimension as determined by either: • The dimensions corresponding to the determined BAL of a building (refer to Section 3.2 for explanation of the 'planning' versus 'building' requirements and 'indicative' versus 'determined' BAL); or • The dimensions corresponding to the local government's Firebreak Notice. Maintain the APZ to the above dimensions and to the standards established by the Guidelines (refer to Appendix 1) or as varied by the local government through their Firebreak Notice (refer to the following responsibility).
2	Comply with the Shire of East Pilbara Firebreak Notice issued under s33 of the Bush Fires Act 1954. This may include specifications for asset protection zones that differ from the Guideline's APZ Standards, with the intent to better satisfy local conditions. When these are more stringent than those created by the Guidelines, or less stringent and endorsed by the WAPC and DFES, they must be complied with. Refer to Appendix 1.
3	Maintain vehicular access routes within the lot to the required surface condition and clearances as stated in the BMP.
4	Ensure that any builders (of future structures on the lot) are aware of the existence of this Bushfire Management Plan and the responsibilities it contains regarding the application of construction standards corresponding to a determined BAL.
5	Ensure all future buildings the landowner has responsibility for, are designed and constructed in full compliance with: 1. the requirements of the WA Building Act 2011 and the bushfire provisions of the Building Code of Australia (BCA); and 2. with any identified additional requirements established by this BMP or the local government.

Table 6.4: Ongoing management responsibilities for the Local Government.

Local Government - Ongoing	
No.	Ongoing Management Actions
1	Monitor landowner compliance with the Bushfire Management Plan and the annual Firebreak Notice.

A1.1 Requirements Established by the Guidelines – Standards for Asset Protection Zones

(Source: Guidelines for Planning in Bushfire Prone Areas - WAPC 2017 v1.3 Appendix 4, Element 2, Schedule 1 and Explanatory Note E2.1)

DEFINING THE ASSET PROTECTION ZONE (APZ)

Description: An APZ is an area surrounding a building that is managed to reduce the bushfire hazard to an acceptable level (by reducing fuel loads). The width of the required APZ varies with slope and vegetation and varies corresponding to the BAL rating determined for a building (lower BAL = greater dimensioned APZ).

For planning applications, the minimum sized acceptable APZ is that which is of sufficient size to ensure the potential radiant heat impact of a fire does not exceed 29kW/m² (BAL-29). It will be site specific.

For subdivision planning, design elements and excluded/low threat vegetation adjacent to the lot(s) can be utilised to achieve the required vegetation separation distances and therefore reduce the required dimensions of the APZ within the lot(s).

Defendable Space: The APZ includes a defendable space which is an area adjoining the asset within which firefighting operations can be undertaken to defend the structure. Vegetation within the defendable space should be kept at an absolute minimum and the area should be free from combustible items and obstructions. The width of the defendable space is dependent on the space, which is available on the property, but as a minimum should be 3 metres.

Establishment: The APZ should be contained solely within the boundaries of the lot on which the building is situated, except in instances where the neighbouring lot or lots will be managed in a low-fuel state on an ongoing basis, in perpetuity.

The APZ may include public roads, waterways, footpaths, buildings, rocky outcrops, golf courses, maintained parkland as well as cultivated gardens in an urban context, but does not include grassland or vegetation on a neighbouring rural lot, farmland, wetland reserves and unmanaged public reserves.

[Note: Regardless of whether an Asset Protection Zone exists in accordance with the acceptable solutions and is appropriately maintained, fire fighters are not obliged to protect an asset if they think the separation distance between the dwelling and vegetation that can be involved in a bushfire, is unsafe.]

Schedule 1: Standards for APZ

Fences: within the APZ are constructed from non-combustible materials (e.g. iron, brick, limestone, metal post and wire). It is recommended that solid or slatted non-combustible perimeter fences are used.

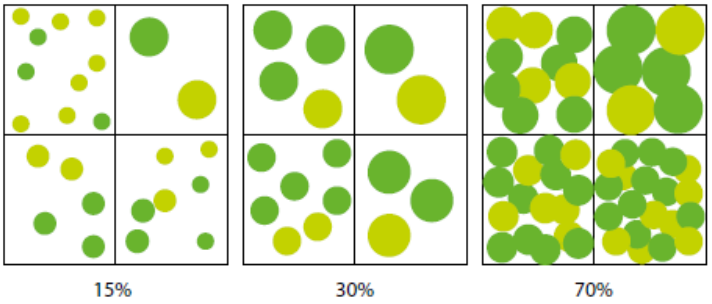
Objects: within 10 metres of a building, combustible objects must not be located close to the vulnerable parts of the building i.e. windows and doors.

Fine Fuel Load: combustible dead vegetation matter less than 6 mm in thickness reduced to and maintained at an average of two tonnes per hectare (example below).

Example: Fine fuel load of 2 t/ha
(Image source: Shire of Augusta Margaret River's Firebreak and Fuel Reduction Hazard Notice)

Trees (> 5 metres in height): trunks at maturity should be a minimum distance of 6 metres from all elevations of the building, branches at maturity should not touch or overhang the building, lower branches should be removed to a height of 2 metres above the ground and or surface vegetation, canopy cover should be less than 15% with tree canopies at maturity well spread to at least 5 metres apart as to not form a continuous canopy. Diagram below represents tree canopy cover at maturity.

Tree canopy cover – ranging from 15 to 70 per cent at maturity



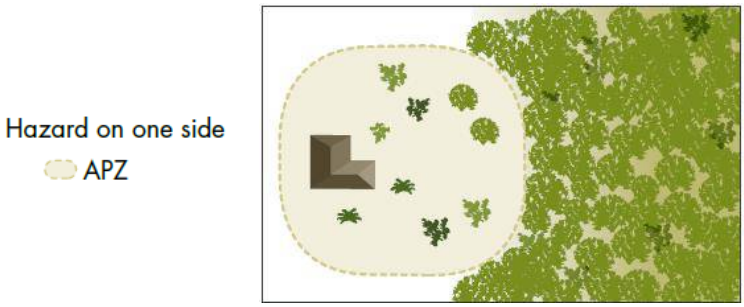
(Source: Guidelines for Planning in Bushfire Prone Areas 2017, Appendix 4)

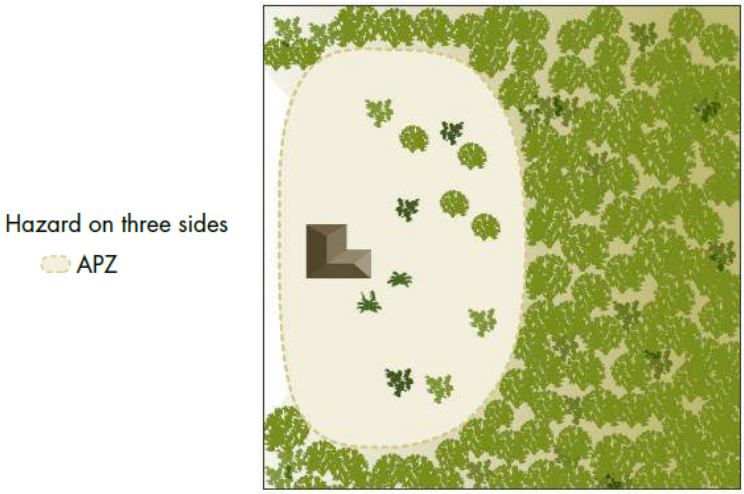
Shrubs (0.5 metres to 5 metres in height): should not be located under trees or within 3 metres of buildings, should not be planted in clumps greater than 5m2 in area, clumps of shrubs should be separated from each other and any exposed window or door by at least 10 metres. Shrubs greater than 5 metres in height are to be treated as trees.

Ground covers (<0.5 metres in height): can be planted under trees but must be properly maintained to remove dead plant material and any parts within 2 metres of a structure, but 3 metres from windows or doors if greater than 100 mm in height. Ground covers greater than 0.5 metres in height are to be treated as shrubs.

Grass: should be managed to maintain a height of 100 mm or less.

The following example diagrams illustrate how the required dimensions of the APZ will be determined by the type and location of the vegetation.





A1.2 Requirements Established by the Local Government – the Firebreak Notice

The local government's current Firebreak Notice is available on their website, at their offices and is distributed as ratepayer's information. It must be complied with.

These requirements are established by the local government's Firebreak Notice created under s33 of the Bushfires Act 1954 and issued annually (potentially with revisions). The Firebreak Notice may include additional components directed at managing fuel loads, accessibility and general property management with respect to limiting potential bushfire impact.

If Asset Protection Zone (APZ) specifications are defined in the Firebreak Notice, these may differ from the Standards established by the Guideline's, with the intent to better satisfy local conditions. When these are more stringent than those created by the Guidelines, or less stringent and endorsed by the WAPC and DFES, they must be complied with.

The APZ dimensions to be physically established and maintained, will be based on which of the following establishes the larger APZ dimension:

- The dimensions corresponding to the determined BAL of a building (refer to Section 3.2 explanation of the 'planning' versus 'building' requirements and 'indicative' versus 'determined' BAL(s)); or
- The APZ dimensions established by the local government's Firebreak Notice.

A1.3 Requirements Recommended by DFES – Property Protection Checklists

Further guidance regarding ongoing/lasting property protection (from potential bushfire impact) is presented in the publication 'DFES – Fire Chat – Your Bushfire Protection Toolkit'. It is available from the Department of Fire and Emergency Services (DFES) website.

A1.4 Requirements Established by AS 3959:2018 – 'Minimal Fuel Condition'

This information is provided for reference purposes. This knowledge will assist the landowner to comply with Management Requirement No. 3 set out in the Guidance Panel at the start of this Appendix. It identifies what is required for an area of land to be excluded from classification as a potential bushfire threat.

"Australian Standard - AS 3959:2018 Section 2.2.3.2: Exclusions - Low threat vegetation and non-vegetated areas:

The Bushfire Attack Level shall be classified BAL-LOW where the vegetation is one or a combination of the following:

a) Vegetation of any type that is more than 100m from the site.

b) Single areas of vegetation less than 1ha in area and not within 100m of other areas of vegetation being classified vegetation.

c) Multiple area of vegetation less than 0.25ha in area and not within 20m of the site or each other or other areas of vegetation being classified vegetation.

d) Strips of vegetation less than 20m in width (measured perpendicular to the elevation exposed to the strip of vegetation) regardless of length and not within 20m of the site or each other, or other areas of vegetation being classified vegetation.

e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops.

f) *Vegetation regarded as low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a* ***minimal fuel condition,*** *(means insufficient fuel available to significantly increase the severity of a bushfire attack – for example, recognisable as short cropped grass to a nominal height of 100mm), mangroves and other saline wetlands, maintained lawns, golf courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and windbreaks (single row of trees)."*

APPENDIX 2: TECHNICAL REQUIREMENTS FOR VEHICULAR ACCESS

Each local government may have their own standard technical requirements for emergency vehicular access, and they may vary from those stated in the Guidelines.

When required, these are stated in Section 5.1 of this bushfire management plan.

Requirements Established by the Guidelines – The Acceptable Solutions

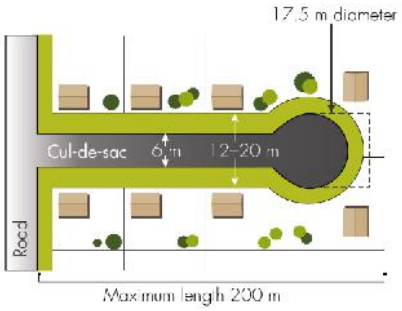
(Source: Guidelines for Planning in Bushfire Prone Areas WAPC 2017 v1.3, Appendix 4)

VEHICULAR ACCESS TECHNICAL REQUIREMENTS - PART 1

Acceptable Solution 3.3: Cul-de-sacs (including a dead-end road)

Their use in bushfire prone areas should be avoided. Where no alternative exists then the following requirements are to be achieved:

- Maximum length is 200m. If public emergency access is provided between cul-de-sac heads (as a right of way or public access easement in gross), the maximum length can be increased to 600m provided no more than 8 lots are serviced and the emergency access way is less than 600m in length;
- Turnaround area requirements, including a minimum 17.5m diameter head to allow type 3.4 fire appliances to turn around safely;
- The cul-de-sac connects to a public road that allows for travel in two directions; and
- Meet the additional design requirements set out in Part 2 of this appendix.



Acceptable Solution 3.5: Private Driveways

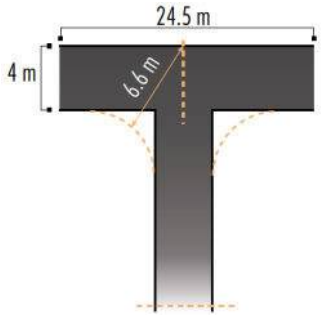
The following requirements are to be achieved:

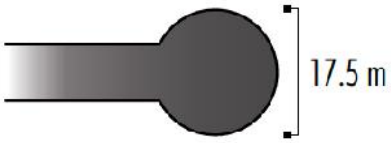
- The design requirements set out in Part 2 of this appendix; and

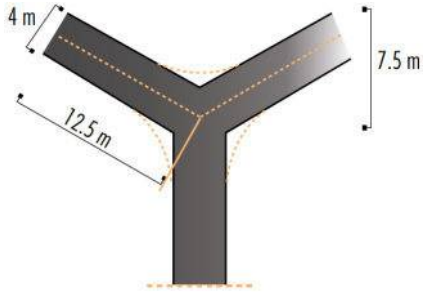
Where the house site is more than 50 metres from a public road:

- Passing bays every 200 metres with a minimum length of 20 metres and a minimum width of two metres (ie combined width of the passing bay and constructed private driveway to be a minimum six metres);
- Turn-around areas every 500 metres and within 50 metres of a house, designed to accommodate type 3.4 fire appliances to turn around safely (ie kerb to kerb 17.5 metres);
- Any bridges or culverts are able to support a minimum weight capacity of 15 tonnes; and
- All weather surface (i.e. compacted gravel, limestone or sealed).

VEHICULAR ACCESS TECHNICAL REQUIREMENTS - PART 1



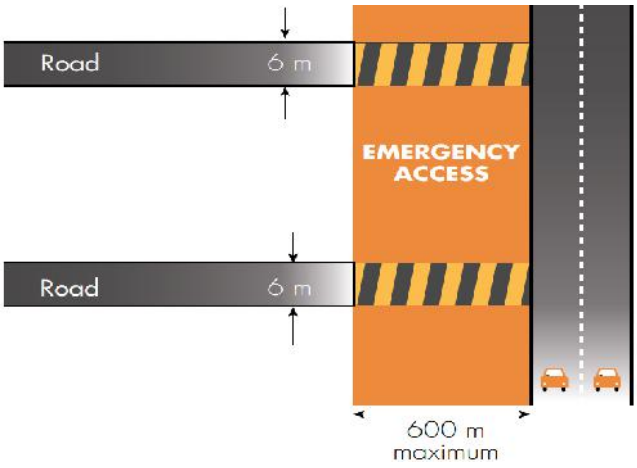




Acceptable Solution 3.6: Emergency Access Way

An access way that does not provide through access to a public road is to be avoided bushfire prone areas. Where no alternative exists, an emergency access way is to be provided as an alternative link to a public road during emergencies. The following requirements are to be achieved:

- No further than 600 metres from a public road;
- Must be signposted including where they ajoin public roads;
- Provided as a right of way or public access easement in gross;
- Where gates are used they must not be locked and they must be a minimum width of 3.6 metres with design and construction approved by local government (refer to the example in this appendix); and
- Meet the additional design requirements set out in Part 2 of this appendix.



Acceptable Solution 3.8: Firebreak Width

Lots greater than 0.5 hectares must have an internal perimeter firebreak of a minimum width of three meters or to the level as prescribed in the local firebreak notice issued by the local government.

VEHICULAR ACCESS TECHNICAL REQUIREMENTS - PART 2					
Technical Component	Vehicular Access Types				
	Public Roads	Cul-de-sacs	Private Driveways	Emergency Access Ways	Fire Service Access Routes
Minimum trafficable surface (m)	6*	6	4	6*	6*
Horizontal clearance (m)	6	6	6	6	6
Vertical clearance (m)	4.5	4.5	4.5	4.5	4.5
Maximum grade <50 metres	1 in 10	1 in 10	1 in 10	1 in 10	1 in 10
Minimum weight capacity (t)	15	15	15	15	15
Maximum cross-fall	1 in 33	1 in 33	1 in 33	1 in 33	1 in 33
Curves minimum inner radius (m)	8.5	8.5	8.5	8.5	8.5
* A six metre trafficable surface does not necessarily mean paving width. It could, for example, include four metres of paving and one metre of constructed road shoulders. In special circumstances, where 8 lots or less are being serviced, a public road with a minimum trafficable surface of four metres for a maximum distance of ninety metres may be provided subject to the approval of both the local government and DFES.					

Reticulated Areas

[Source: Guidelines for Planning in Bushfire Prone Areas WAPC 2017 v1.3, Appendix 4, Element 4]

The Water Corporation's 'No 63 Water Reticulation Standard' is deemed to be the baseline criteria for developments and should be applied unless local water supply authority's conditions apply.

The requirement is to supply a reticulated water supply and fire hydrants, in accordance with the technical requirements of the relevant water supply authority and DFES.

Key specifications in the most recent version/revision of the design standard include:

- ***Residential Standard*** – hydrants are to be located so that the maximum distance between the hydrants shall be no more than 200 metres.
- ***Commercial Standard*** – hydrants are to be located with a maximum of 100 metre spacing in Industrial and Commercial areas.
- ***Rural Residential Standard*** – where minimum site areas per dwelling is 10,000 m^2 (1ha), hydrants are to be located with a maximum 400m spacing. If the area is further subdivided to land parcels less than 1ha, then the residential standard (200m) is to be applied.

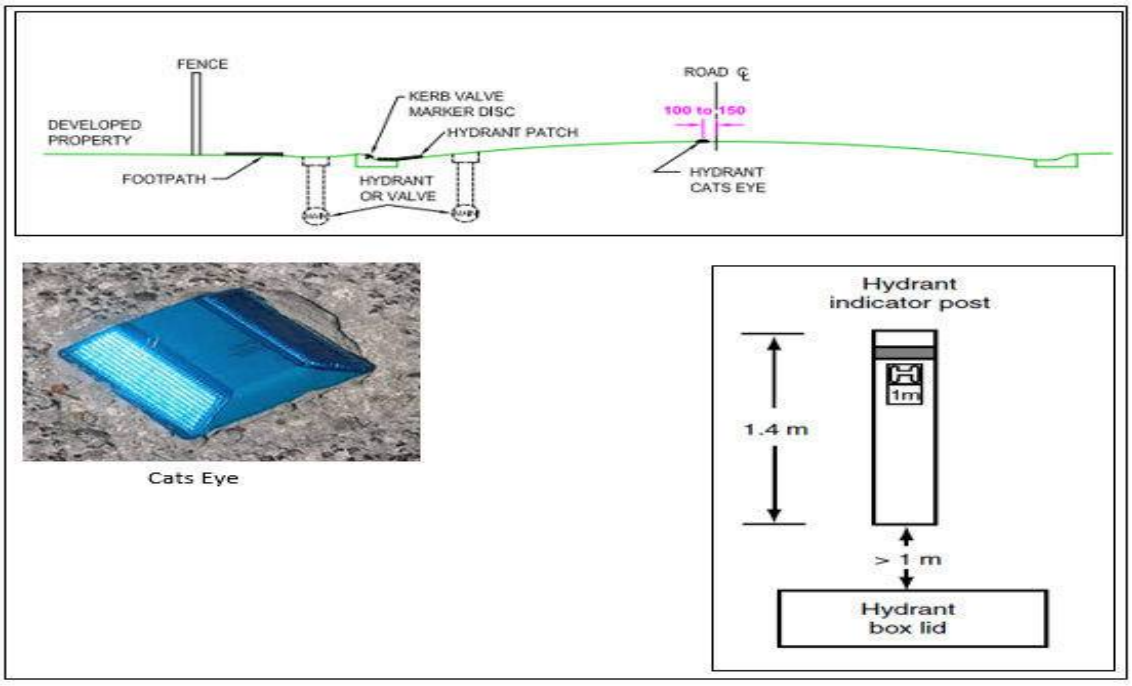


Figure A4.1: Hydrant Location and Identification Specifications

Assets | Engineering | Environment | Noise | Spatial | Waste

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APPENDIX C

Servicing Report

Servicing Report

Newman Airport General Industrial Area

Prepared for Shire of East Pilbara

28 June 2021

Project Number: TC20042

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Approval for Release		
Name	**Position**	**File Reference**
Paul Gauci	Senior Civil Engineer	TC20042_Servicing Report_3.0
Signature		

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Appendices

1 Introduction

Talis Consultants Pty Ltd (Talis) has been commissioned by the Shire of East Pilbara (the Shire) to prepare a Servicing Report for the proposed development of industrial lots at Newman Airport (the Site). The location of the proposed General Industrial Area (GIA) is shown on Diagram 1-1.

Newman Airport is managed by the Shire in terms of a Land Management Order issued by State Lands, as the Airport is sited upon Crown Land. The Site is currently zoned "Rural" under Shire of East Pilbara Local Planning Scheme No.4. The Shire is now required to rezone the land to "Special-use" zone to provide for industrial land development at the Site.

The Shire requires this Servicing Report to support its Scheme Amendment Report. This Servicing Report includes details on geotechnical characteristics of the Site; earthworks; clearing requirements; sewer; solid waste management; water supply; power supply; gas supply; telecommunications; roads; drainage; and flooding.

This Servicing Report has been completed as a desktop study, prior to the commencement of any engineering design.

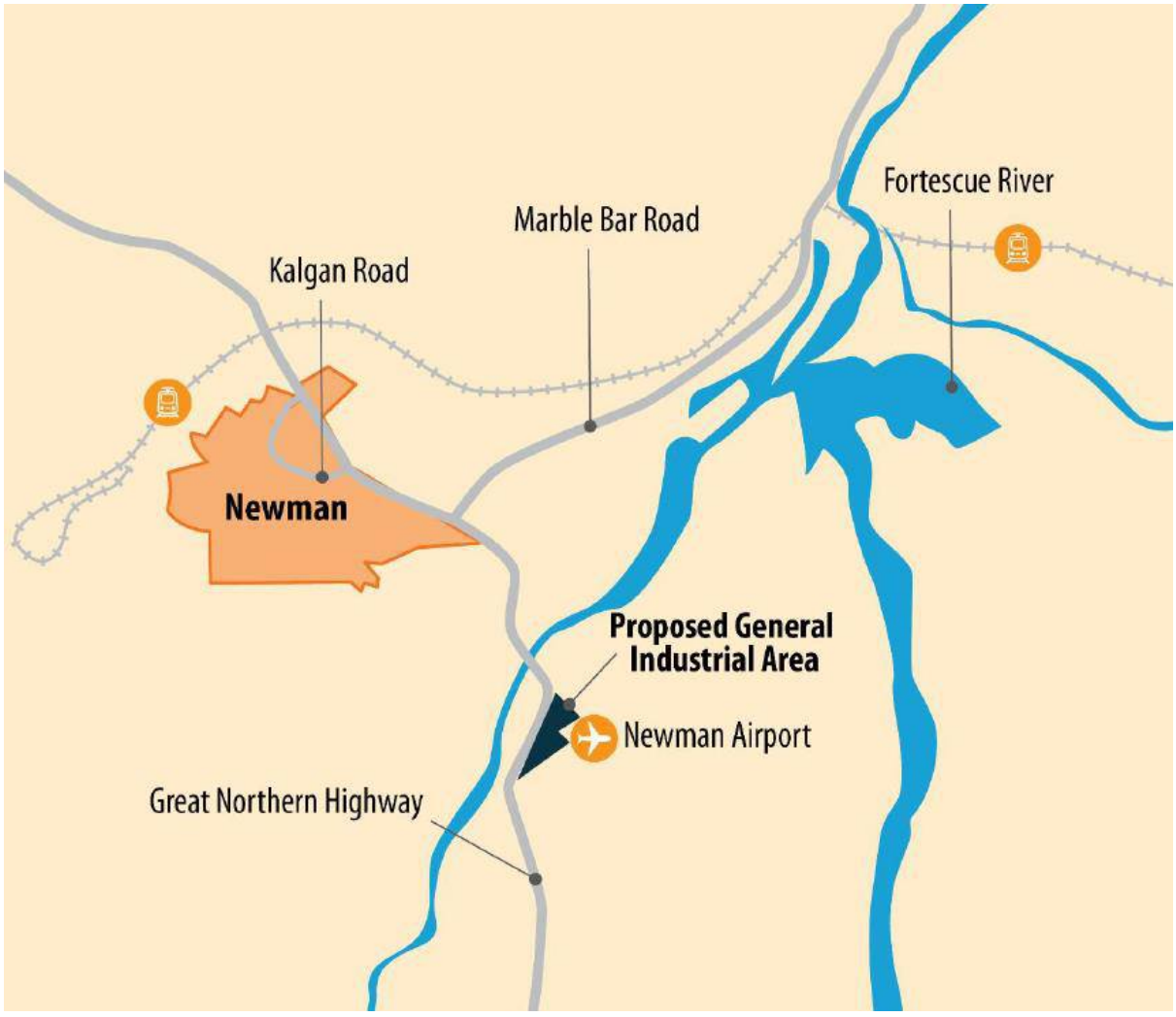


Diagram 1-1: Locality Plan (JJ Ryan Consulting Pty Ltd, 2020)

2 Background

The proposed GIA is being developed upon 36.87 hectares of vacant land adjacent the existing Newman Airport, as depicted in Diagram 2-1 below. The GIA will be released in two stages: Stage A of 9.48 hectares; and Stage B of 27.39 hectares. In the current design the two stages will combine for a total of 11 leasehold lots with land sizes ranging between 2.24 hectares and 3.74 hectares. However, the Shire is currently undertaking a review of the proposed lot layout.

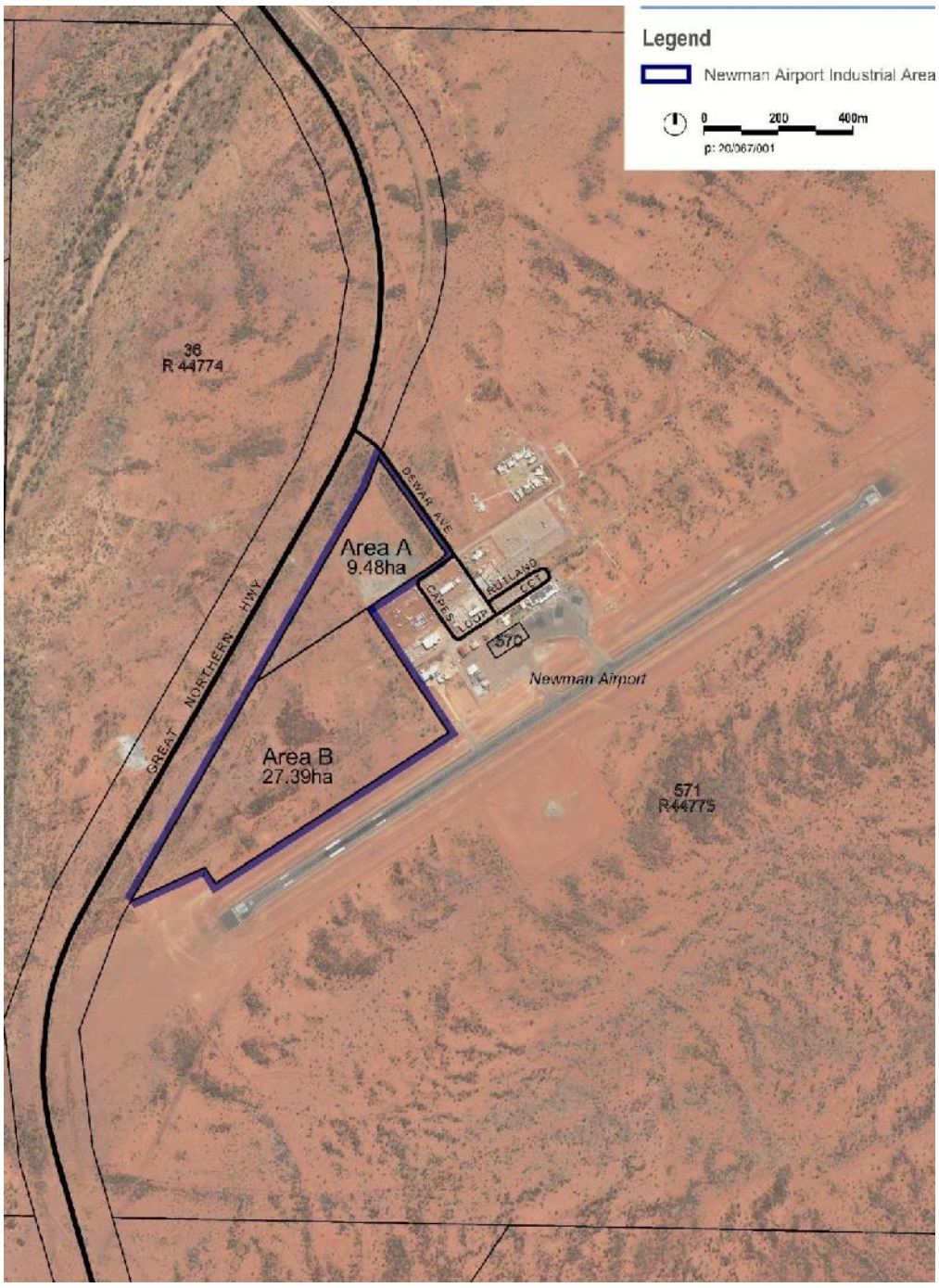


Diagram 2-1: General Industrial Area

3 Existing Infrastructure & Proposed Requirements

3.1 Geotechnical

The investigation identified that both development areas were underlain by loam soils, with loam soils being clayey silty sands. This horizon was noted from surface, to a maximum proven depth of 2.5 m below ground level (bgl). This horizon was underlain by a duricrust, which is a hard mineral layer caused by chemical precipitation, which usually occur near the surface. The depth this horizon was encountered varied, from 0.6 m bgl, to 2.0 m bgl. This horizon was difficult to excavate with a 14 tonne at points, with the penetration thickness varying from 0.1 m to a maximum penetration of 2.5 m.

In-situ dynamic cone penetrometer (DCP) testing highlighted the underlying soils were firm to hard in strength.

Further detail on the geotechnical properties in provided in the Geotechnical Investigations Report.

No ground water study or contaminated sites investigation has been undertaken as part of this Servicing Report.

3.2 Earthworks and Clearing

3.2.1 Earthworks

The Site for the proposed GIA is relatively flat. The south-west of the Site is at approximately 525mAHD and falls to 523.5mAHD at the north-east of the Site, over a distance of 1.4 kilometres. There are a couple of small mounds which will have to be removed to enable development, but overall there will be minimal earthworks across the Site.

3.2.2 Clearing

Under Section 51C of the WA *Environmental Protection Act 1986* (EP Act), clearing of native vegetation is an offence unless it is undertaken under the authority of a clearing permit, or the clearing is undertaken subject to an exemption. If a Native Vegetation Clearing Permit (NVCP) is required, the application will need to be supported with appropriate site-specific data regarding the vegetation required to be cleared. Furthermore, other approvals to take rare or endangered flora species will also be required if present onsite.

From a Federal Government perspective, the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires that any action that will have or has the potential to have a significant impact on a Matter of National Environmental Significance (MNES) should be referred to the Department of Agriculture, Water and the Environment (DAWE) for consideration. Where a MNES is present onsite and the action is determined to have a significant impact, it will be considered as a Controlled Action and either refused or conditionally approved.

A site-specific biological survey will be required to support both of these processes.

3.2.3 Erosion and Sediment Control

The Design Engineer should consider any possible requirements for erosion and sediment control in their design.

3.3 Grey Water

Details of the existing grey water infrastructure has been obtained from the Shire. Currently both the old and the new facility at the airport are serviced by septic tanks and leech drains. These are not performing well, anecdotally this is due to lack of maintenance (rather than due to soil permeability). The approach currently proposed by the Shire is for the proposed GIA leasehold lots to all have their own on-site septic tanks and leech drains. Given the remoteness of the Site, the relatively large industrial lots proposed (2.24ha to 3.74ha) and the lack of information on the proposed site usage, this is considered to be the most appropriate approach.

3.4 Solid Waste Management

The nearest waste management facility to the proposed GIA is the Newman Landfill and Septage Pond. Newman Landfill is a Class 2 facility and is located on Yates Road in Newman. The landfill can accept the waste streams as stipulated on its licence (L7059/1997/12), which includes aqueous based wastes; solvent based wastes; waste mineral oils; waste from grease traps; sewage waste from reticulated sewerage systems; septage wastes; asbestos; ceramic based fibres; clinical waste; and used tyres.

Anticipated waste types and servicing requirements for the GIA are presented in Table 3-1 below. Design and development must include adequate space to accommodate sufficient room for storage of waste within each Lot.

Identification of waste types during design and development will allow for the appropriate waste collection services to be accommodated and provide opportunities to reduce or phase out use of hazardous or unnecessary materials from operations at the Site.

Table 3-1: Anticipated Industrial Waste Types

Waste Type	Materials	Disposal	Servicing Requirements
Construction and demolition waste	Concrete, brick, rubble, asphalt, metals (ferrous and non-ferrous), timber, wallboard, glass, plastics, asbestos, soil, and other building materials and products	Reuse/recycling General landfill	Reused on or offsite. Specialist commercial contractors for removal and processing
General Waste	General commercial waste including plastic bags, plastic film, polystyrene, non-recyclable packaging, mixed waste including food scraps, broken ceramics and glass and shredded paper (bagged)	General landfill	Source separation of materials for specialist recycling Waste collection contractor for disposal to landfill
Recyclables	Cardboard and paper, aluminium cans, plastic bottles, plastic tubs and containers, glass jars and bottles, steel cans	Recycling	Waste collection contractor to transport at waste transfer station for processing
E-Waste	TVs, computers, mobile phones, printer cartridges and kitchen appliances	Specialty e-waste recycling and disposal	Specialist waste contractor for collection and dismantling for reprocessing, donation to community/charity
Hazardous	Aerosols, alkali, arsenic based products, asbestos batteries - household, dry cell, clinical or related waste, cyanides, engine coolants and glycols, EPIRBs or PLBs, explosives, ammunition or fire arms, fire	Specialty disposal including hazardous landfill and incineration (clinical)	Specialist waste contractor for disposal at appropriately classified waste facility

Waste Type	Materials	Disposal	Servicing Requirements
	extinguishers, flammable liquids (hydrocarbons and fuels), flammable solids, flares, fluorescent tubes, CFL and light fittings, gas cylinders, cleaners, heavy metal compounds, inorganic oxidising agents, low level radioactive substances (smoke detectors), mercury (elemental), organic peroxides, paint, PCB materials, pharmaceuticals sharps, tyres, used motor oil		

3.5 Water Supply

Information on the potable water supply has been provided by both the Shire of East Pilbara and its consultants Permeate Partners.

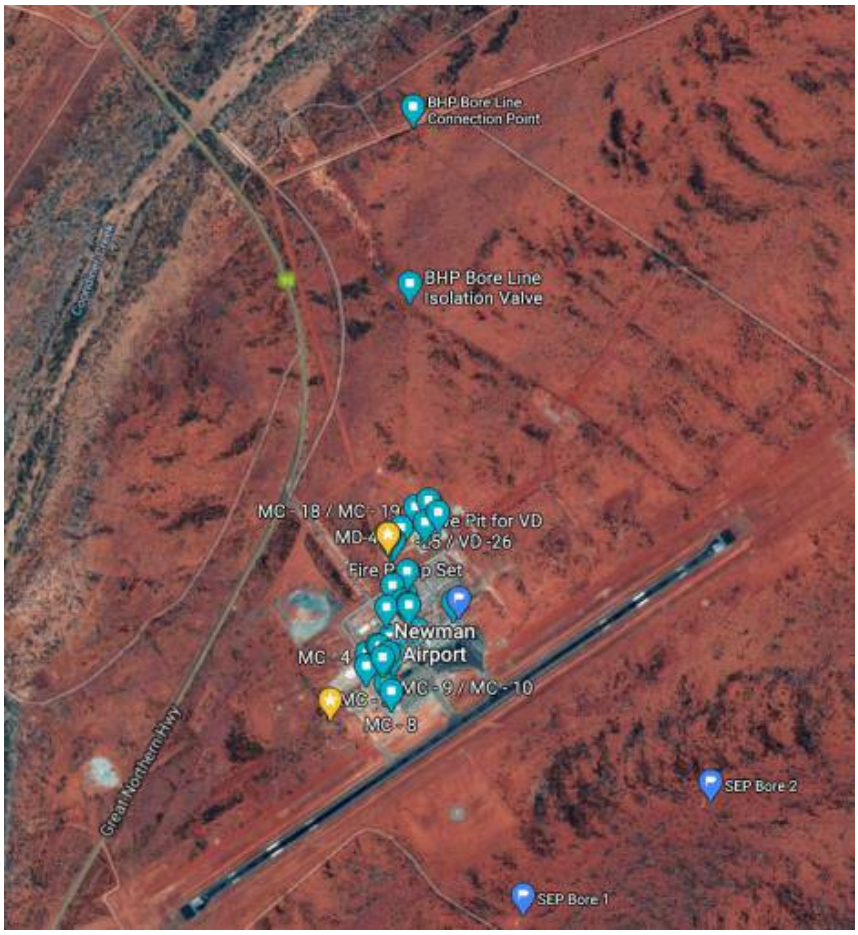


Diagram 3 -1: Existing Potable Water Infrastructure

The current water supply to Newman Airport is via a raw water feed line provided off the BHP supply immediately to the north of the airport. Whilst there is ample water supply off this main, the water quality is quite poor, and the supply can be intermittent and unreliable.

The raw water is treated by reverse osmosis (RO) at the existing water treatment plant located adjacent to, and immediately north of the existing airport terminal. The water is then chlorinated and

stored in a 70kL storage tank. The Newman Airport is then reticulated with potable water aided by distribution pumps located at the 70kL storage tank.

The RO water treatment plant is composed of 4 RO plants being RO1, RO2, RO3 and RO4. Information provided suggests that RO1 and RO2 have been decommissioned, and RO3 is proposed to be decommissioned soon. The remaining RO4 plant is a dual train 2 x 45kL/day system which could supply up to a maximum of 90kL/d. This RO treatment plant is controlled remotely.

The Shire has recently drilled two new bores to the south east of the runway. The water quality is much improved on that being provided from the BHP raw water feed and provides a reliable source which is under the control of the Shire.

The Shire of East Pilbara has provided the system curves suggesting that the max capacity of each new bore with the current pumps and proposed DN125 PE 100 main is in the order of 5 l/s. Whilst the ultimate water demand of the GIA development has not yet been determined, there is an expectation by the Shire of East Pilbara that the supply quantity is adequate for both the current Newman Airport demand and the proposed GIA expansion. To provide the 90kL/d to achieve the capacity of the RO4 water treatment plant, based on the system curves the bore pumps would need to pump approximately 5 hrs/day working alternatively. Based on this there is ample supply from the two bores to service both the existing Newman Airport facilities, and the 11 industrial lots at the proposed GIA development.

The Shire of East Pilbara currently propose to link the two new bores into the current water treatment system as the main supply/feed water, whilst maintaining the connection to the BHP feed line as an emergency backup.

Water usage graphs for the Newman Airport provided by Permeate Partners shows average daily usage in the order of 30kL/day. This does not include irrigation water which uses untreated bore water and is on a separate irrigation main system.

The RO4 plant is a dual train 2 x 45kL/day system which could supply up to a maximum of 90kL/d. Water usage graphs have been obtained from Permeate Partners. The water usage graphs indicate that the current maximum daily draw is in the order of 30kL/d, suggesting that there is existing capacity in the order of up to 60kL/day supply that could be provided to the proposed GIA development from the existing RO4 water treatment plant.

A concept potable water supply design has been undertaken by Serling Consulting as part of this services review.

The concept potable water supply includes the following components: -

- Connection of the two new bores by feeder pipe to the RO water treatment plant site, as per the Porter Engineering concept design;
- There is an isolation valve on the BHP raw water feeder pipe – close the valve and keep the existing feeder pipe connected to the feed water at the RO4 plant as a backup on the system;
- Install new DN150 PE100 reticulation pipe system to service the proposed 11 GIA lease hold industrial lots and connect to the existing 70kL tank and reticulation pump system.
- This DN150 PE100 reticulation pipe would have hydrants along the main, and each industrial lot would have a dedicated fire service off the main in addition to the potable supply required to satisfy the industrial operations for each of the lots.

Should the current system not satisfy the ultimate water demand required to service the proposed 11 industrial lots in the GIA, then duplication may be required of the following components: -

- Duplication of the of the RO4 plant immediately adjacent to the existing RO4 plant for efficiencies/ maintenance / flexibility of system;
- Duplicate the existing 70kL tank as necessary to provide a minimum of 1 day potable water supply; and
- Duplicate or upgrade the reticulation pump system as necessary.

The existing RO water treatment system has the capacity of 90kL/d, whilst the current potable water daily demand draw is in the order of 30kL/d. That means that there is a spare capacity (approximately 60kL/d) in the existing potable system to service at least the initial stage of the GIA.

Detailed design would need to arrive at the total system capacity required for the proposed 11 GIA industrial lots. Should additional capacity be required then upgrades as necessary could be staged as necessary to smooth out the capital expenditure requirements.

Refer to Serling Consultants Potable Water and Grey Water Infrastructure Servicing Report for further information.

Refer to Drawing C-104 for proposed concept water network.

3.5.1 Fire Reticulation and Hydrants

Hydrants will be installed as a matter of course on the reticulation main proposed for the 11 GIA lots. Each of the lots would also have a fire service off the reticulation main.

3.5.2 Irrigation

The irrigation at the existing Newman Airport is separate to the potable water system and is serviced off the BHP raw water main/bores. Any extension into the GIA area should be connected to the existing irrigation system.

3.6 Power Supply

New electrical services infrastructure is required to support the GIA lots and the following has been considered by ETC in preparing this report:

- Power distribution infrastructure;
- Telecommunications infrastructure;
- Road lighting.

The full ETC Electrical Infrastructure Servicing Report is attached as APPENDIX D.

3.6.1 Scope of Work

The scope of this report is to address the following:

- Anticipated power requirements;
- Major electrical services infrastructure locations and routes including quantities and locations of electrical plant;
- Description of the proposed methodology for power and communications reticulation;
- Description of the proposed road lighting strategy;

- Opinion of Probable Cost (OPC).

The intent of this report is to outline and summarise the above enabling the Shire of East Pilbara (the Shire) to plan and guide the next phases of the project.

3.6.2 Staging and Programme

The development is understood to be split into Stage 1 and Stage 2 as shown on the plans.

The timing for each stage is currently unknown.

3.6.3 Qualifications and Limitations

This report is to be read in conjunction with the qualifications and limitations made below, which includes assumptions made and limitations on our assessment.

- Lots are assumed to not be greenfield lots, and are leasehold lots located on Airport crown land.
- Power density has been calculated based on 50kVA/ha based on light industrial land use
- The current HV/LV network design proposal is based on limited discussion with BHP and is subject to change depending on BHP preferences and outcomes of a BHP network study.
- Proposed HV/LV network design is based on typical Horizon Power type public distribution system. We have not considered implications of BHP requiring installation to BHP specification.
- The relocation of the following items associated with airside services currently clashing with the proposed land development, and power and telecom infrastructure associated with these items, is assumed will be relocated as part of a separate project, and has not been considered in this report: Non-Directional Beacon (NDB) navigational aid; Runway lighting cabling; Windsock.
- This report has been prepared based on a desktop study only utilising the site records and documentation provided to ETC which may not correctly reflect the current status, location, type or physical condition of a particular service or installation. A thorough site study/investigation should be commissioned to validate all site information used in preparing this report.

3.6.4 References

The following primary references were used in preparing this report:

- Newman Airport Master Plan v0.1 (JJ Ryan Consulting, 2020)
- Newman Airport - Report on the provision of electrical power to Air Services Fire Station from the existing electrical infrastructure (Wood & Grieve Engineers, 2018)
- Newman Airport Electrical Services Plan Detail Survey 100618-AS-001-A (MNG, 2018)

3.6.5 Abbreviations

The following abbreviations have been used.

A, V, W	Amps, Volts, Watts
ADMD	After Diversity Maximum Demand
BESS	Battery Energy Storage System

CASA	Civil Aviation Safety Authority
ETC	Engineering Technology Consultants
LED	Light Emitting Diode
LV	Low Voltage, 50V to 1000V
HV	High Voltage, 1kV to 66kV
kV	Kilovolt, 1000 volts
kVA	Kilovolt-amperes, 1000 volt-amperes
kW	Kilowatt, 1000 watts
kWh	Kilowatt-hour, 1000 watt-hours
OHL	Overhead Power Line
OLS	Obstruction Limit Surface
PD	Power Density
PV	Photovoltaic
WAER	Western Australia Electrical Requirements

3.6.6 Power Distribution

3.6.6.1 *Existing Supply*

BHP, the electricity supply authority for the Newman townsite, provides Newman Airport with electricity via an existing 11kV overhead line that terminates at a BHP owned substation located centrally within the airport. The substation comprises of 2+1 11kV switchgear and 11/0.415kV 500kVA transformer to provide the airport with a low voltage 415V metered connection point.

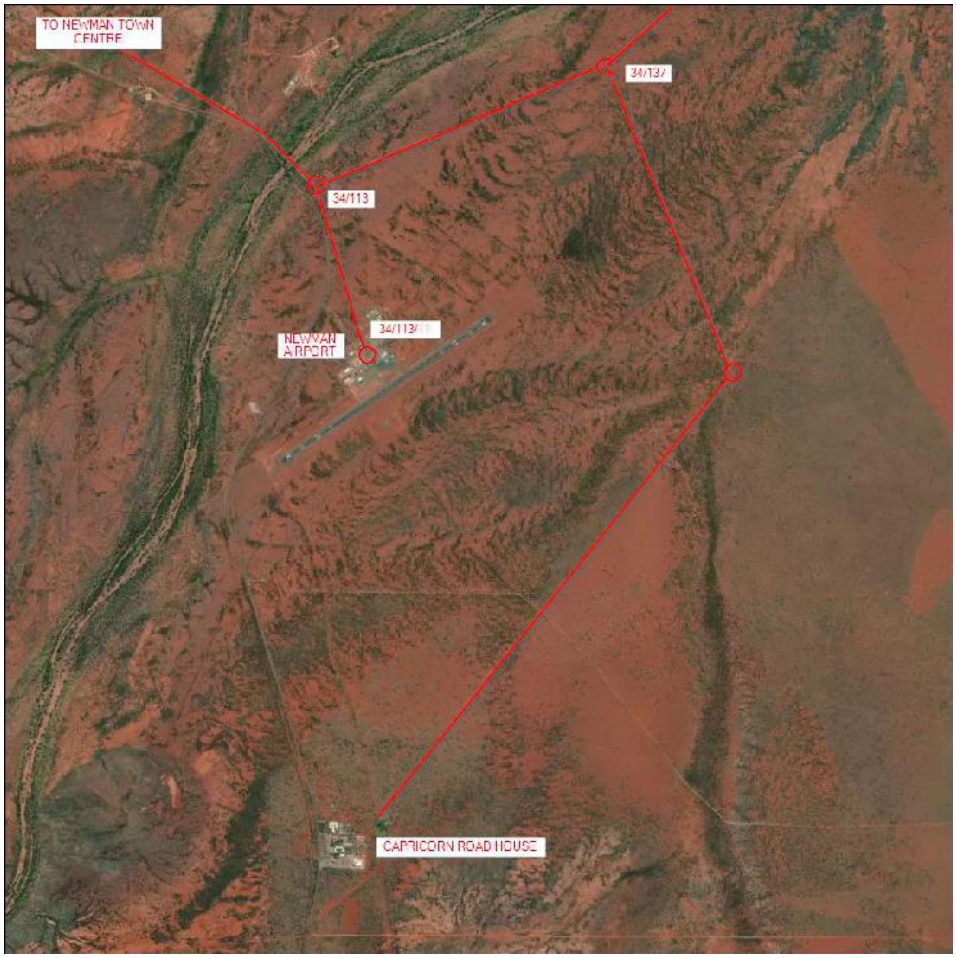


Diagram 3-2: BHP Network

3.6.6.2 *Development Power Requirements*

Methodology

The forecast power requirement is estimated by applying a power density to the developable land area to determine an After Diversity Maximum Demand (ADMD) allocation to each lot. The determination of an appropriate power density is discussed further herein.

The lots, areas and staging considered is based on the following information received:

- E20-115 A01 Rev D 18/08/20

Results

The ADMD determined for each lot is provided below:

Table 3-2: Power Demand

Lot	Land Use	Stage	Area (ha)	PD (kVA/ha)	ADMD (KVA)
1	Light Industrial	1	3.67	50	183.5
2	Light Industrial	1	2.95	50	147.5
3	Light Industrial	1	2.46	50	123

Lot	Land Use	Stage	Area (ha)	PD (kVA/ha)	ADMD (KVA)
4	Light Industrial	1	2.86	50	143
5	Light Industrial	1	2.8	50	140
6	Light Industrial	2	2.24	50	112
7	Light Industrial	2	2.24	50	112
8	Light Industrial	2	2.24	50	112
9	Light Industrial	2	3.15	50	157.5
10	Light Industrial	2	3.74	50	187
11	Light Industrial	2	3.71	50	185.5
Sub-Total		1	14.74		737
Sub-Total		2	17.32		866
Total			**32.06**		**1603**

Prospective tenants should be made aware of the power allocation to prospective lots. Should the Shire currently be in discussion with possible major/anchor tenants, their power requirements should be discussed and agreed and preferably incorporated in the infrastructure design in advance.

Power Density

There is no accurate method for determining power requirements for future development and so power demand requirements for land development are normally forecast by the application of an estimated power density to the development area to be created. The power density considered ranges considerably depending on the proposed land use and has a significant impact on electrical infrastructure requirements.

Normally, for subdivisions in Perth and regional centres, a minimum power density of 200kVA per hectare is applied as a requirement of Western Power and Horizon Power for new lot creation. A prospective developer is aware of the limitations of the power servicing to their purchased lot and understands that should their development require more power than is provisioned, they will be responsible for paying for upgrades to electrical infrastructure to meet an increased power requirement. This is relevant to most commercial subdivisions however light industrial land use, which is understood to be the case for this project, normally comprises of large open spaces, warehouses, laydown yards etc. and so a reduced design power density value is appropriate to avoid over capitalising on oversized electrical infrastructure. For this project in particular, the power density applied will have substantial impact to BHP's existing 11kV OHL.

ETC has previously completed work on various LandCorp (now DevelopmentWA) light industrial estates in Karratha (Gap Ridge, KARSI, Madigan Road), for which a design power density of 50kVA per hectare was determined and agreed with Horizon Power and LandCorp accounting for the type of land use.

On this basis a design power density of 50kVA per hectare is proposed for the Newman Airport industrial area. This requires further discussion and agreement with the relevant stakeholders however this value has been used for the purposes of this high level servicing report.

3.6.6.3 *Electrical Network Upgrade Concept Design*

Lot Supply Arrangement

As the proposed development lots are not green titled free hold lots subdivided from the Airport lot, and are leasehold lots located on Airport land, it is not permissible under the WA Electrical Requirements (WAER) to supply the proposed lots directly from BHP's network. This will require the new leasehold lots to be supplied from the Airport's privately owned electrical network and therefore the Airport's existing electrical supply will be required to be upgraded to suit.

Existing airport electrical network and capacity

The entire airport is currently served via an existing 500kVA rated transformer. The existing site maximum power demand based on BHP power monitoring between 29 October 2020 and 9 November 2020 is 243kVA however an additional 20% loading is considered for the summer period and so the maximum demand is taken to be 291kVA. The estimated power requirement for Stage 1 and Stage 2 of this project is 737kVA and 866kVA respectively, for a total of 1603kVA which represents a fivefold increase in the Airport's existing power requirement and far exceeds the installed capacity of the network infrastructure.

From discussions with BHP, it is understood the 11kV OHL is at, or very near to, capacity and cannot support any significant extra load without upgrade. The 11kV OHL is shared with a number of other sites/customers. It is envisaged that a significant upgrade will be necessary to BHP's network at the Shire's expense.

BHP currently provides the Airport an LV point of connection at BHP's substation central to the site from which the airport operates an LV network. Due to the distances involved in the development, an LV network will not be sufficient and a new high voltage network will be required.

BHP Network Modification

From initial discussions with BHP, the implications of the increased demand on the BHP network will be subject to a power study that BHP will be required to commission however it is understood that the existing 11kV OHL that enters the site will require replacement. BHP have requested that any such study should include the Airport's ultimate future power requirements and so an Airport electrical masterplan should be commissioned by the Shire to further inform the study.

Any modification to the BHP network would propose to establish a new HV point of supply on the boundary of the airport site so as to not encumber future development land.

The above proposal will require the existing BHP 11/0.415kV substation currently located centrally to the airport site to be disconnected and the existing 11kV OHL currently running through the Airport to be removed by BHP. Subject to agreement between BHP and the Shire, it is proposed that the ownership of the existing substation be transferred to the Shire for re-use in serving the existing airport facilities unchanged. A condition assessment should be completed to ensure the existing substation is in good working order. Alternatively, the substation can be replaced and all existing LV connections re-established.

New Airport Industrial Area HV/LV Network

A new HV network operating at 11kV is proposed to be constructed as the most practicable option to service the new development lots. Upgrade of the existing LV network to supply the development is unlikely to be feasibile due to the magnitude of the increased power demand, the cabling distances required and the cost of LV infrastructure to the lots. A HV network will be more cost effective and a

better overall solution. An advantage of having the airport connected and metered at HV is that a HV tariff will become available (assuming tariffs available are similar to those available on Western Power/Horizon Power networks) which will provide power consumption (kWh) charges at a reduced rate compared to LV tariffs.

A HV network solution will require the Shire to own and operate a high voltage network which will be an operation and maintenance burden on the Shire. It is possible that BHP will agree to maintain and operate this new HV network on the behalf of the Shire, however BHP will have conditions that will be required to be met. From initial discussion, such conditions may include a requirement for the installation to meet BHP specification and for an easement to be placed over the network alignment. Further discussions are required with BHP to understand this further.

A study of the reduced consumption charges against the increased maintenance/operation expenditure will likely reveal an overall saving and therefore a means to recover cost of the initial capital expenditure over time, however this is heavily dependent on the Shire's current tariff arrangement and the availability of a HV tariff from BHP.

The following works to establish a new airport HV network are proposed:

- BHP OHL network modifications as discussed above.
- New HV point of supply at the boundary, comprising of:
    - BHP ground mount HV switchgear and metering unit that will provide HV connection point and demarcation between BHP and Airport networks.
    - Airport ground mount HV switchgear that will be the start of the Airport's network and will provide overcurrent and fault protection for the network.
- New underground radial HV supplies as follows:
    - One 11kV feeder cable to the existing airport substation
    - One 11kV feeder cable to the new industrial land area
    - Feeder cabling shall be underground, direct buried, armoured and termite protected
    - Provision for future HV ring for additional supply security if required (HV switchgear provisions only)
- Three (3) new 11/0.415kV kiosk substations, comprising of ring main unit, transformer and LV switchboard to supply multiple lots. Kiosk substation transformers shall typically be 1MVA oil filled type complete with oil bund self-contained within the base of a weatherproof kiosk enclosure to avoid need for concrete oil bunding. Minimum spare capacity of 80% has been considered to the infrastructure.
- LV supplies and connections to each lot from the substation LV switchboard are subject to further discussion and agreement with the Shire as there are various options available. For the purposes of this report, a method similar to a Horizon Power/Western Power solution is proposed which comprises of LV connection pillars at each lot, similar to Horizon Power/Western Power standard uni pillars (green domes) as a cost effective and tried and tested solution. Site conditions may warrant an alternative solution (e.g. free standing switchboard) however this is to be reviewed and considered in detailed design. LV cabling is proposed to be installed in underground conduit to facilitate future replacement however direct buried cable could also be considered.
- All HV, LV, roadway lighting and communications services are proposed to be installed in standard alignment within road reserve to Utility Provider Code of Practice guidelines.

Refer to Drawing C-102 for proposed concept power network.

3.6.6.4 *Alternative Power Options*

Alternative power options have not been considered in this study, however the following could be considered to reduce the airport's ultimate power loading on the BHP network, justify a reduced power supply requirement and therefore reduce capital expenditure in upgrading the network and reduce ongoing demand and consumption charges.

- Large scale solar PV installation(s) could be installed to offset power draw from the grid, possibly paired with a battery energy storage system (BESS). A BESS may not be worthwhile with the expectation that peak demand would occur at the same time that peak PV power is generated however BHP may require such a system regardless for 'solar smoothing'.
- Use of the airport's existing diesel backup generators to 'load lop' peak demand. This would however require some substantial investment in necessary control and protection systems.

3.7 Telecommunications Infrastructures

3.7.1 Overview

The telecommunications servicing is proposed to consist of underground fibre ready conduits and access pits that provide a cable pathway between existing telecommunications presence on site to the development lots. This will enable third party telecommunications providers such as Telstra to install their cabling and provide services connections to prospective tenants on application or request by said tenants to their chosen third party provider.

It is not proposed to extend the Airport or the Shire private telecommunications infrastructure to the development lots as it is not expected the Airport or the Shire will require network presence there.

Due to the above, no requirement to install any cabling or networking equipment as part of these works is envisaged as they will be installed by third party providers and so only cable access (conduit and pit infrastructure) is required.

3.7.2 Conduit and Pit Infrastructure

Conduit and pit infrastructure is proposed to be provided to Telstra's technical requirements, as it is understood that Telstra already have a presence on site and are the provider most likely to be provide services to tenants. Note that Telstra's requirements will be equal to or more onerous than other provider's requirements.

The conduit and pit infrastructure is proposed to comprise of the following:

- 2x100mm underground conduits to form a 'trunk', terminating at cable pits outside lots;
- 50mm underground conduit stub from pits to lots.

All conduit infrastructure shall be 'fibre ready' to G.645 Fibre Ready Pit and Pipe Specification for Real Estate Development Projects and other regulatory standards including AS/CA S009, AS/CA S008 and AS/NZ 3084.

Further discussions will be required with the Shire and Telstra (or other provider) regarding ownership and responsibility of the pit and pipe network however one of the following is envisaged:

- The Shire will retain ownership and maintenance responsibility of the pit and pipe and the Shire will provide licence and access rights to a telecommunications provider (e.g. Telstra) to utilise the pit and pipe for their services; or
- Pipe and pit infrastructure will be gifted to an interested service provider (e.g. Telstra) whom will then be responsible for maintenance.

The outcomes of the above may dictate installation requirements and pit selection, including requirements for pit lids to be embossed to provider requirements. NBNCo should be contacted in future design phases to understand their availability to service the site.

Refer to Drawing C-103 for proposed concept telecommunications network.

3.7.3 Existing Network Interface

The new pipe and pit network is proposed to be installed to a location which will allow an interface to existing telecommunications provider network infrastructure.

From our desktop review, it is understood there is an existing Telstra tower and fibre distribution enclosure located on the site (adjacent Airport Manager's residence) and the new conduit infrastructure is proposed to terminate there.

This will be required to be verified and confirmed in detailed design.

3.8 Roadway Lighting

3.8.1 Overview

A new road is being created to service the new lots. The new road is an extension of an existing internal airport road and it is noted that this existing road is not currently provided with lighting. The only road lighting that appears to be present on site is at the existing Dewar Avenue entry/intersection with Great Northern Highway to illuminate the intersection (referred to as 'flag lighting'). Carpark lighting also exists with what we understand is solar powered lighting.

There is no mandatory requirement to illuminate the new roads - this is a decision to be made by the Shire however for the purpose of this report ETC has considered new lighting for safety reasons and an order of magnitude cost is provided for consideration and review by the Shire to enable an informed decision.

3.8.2 Design Criteria

The basis of design used for the road lighting is the Australian Standard AS/NZS 1158.3.1:2020 which provides recommendations for local/minor road lighting. V-Category type lighting to AS/NZS 1158.1.1:2005 is an alternative however in our opinion is not warranted given the expected low traffic volume, low pedestrian activity and increased lighting infrastructure required.

The following criteria considered is summarised below:

- Lighting technical parameters to achieve AS/NZS 1158.3.1:2020 Sub-category PR4 which provides a similar level of lighting to a local road in a suburban area.
- 10 to 12.5m light poles with 3m outreach to maximise pole spacing
- The following lighting options are considered:

  - Option A: Solar powered LED lighting without connection to the 240V electrical network (i.e. stand-alone), similar to the existing carpark lighting.
  - Option B: Traditional 240V network powered LED lighting.

- The airport's obstruction limit surfaces (OLS) has been reviewed and it is determined that the OLS at the closet road exceeds 15m and so poles up to 12.5m tall are not an issue.
- The new roads are located within the Airport's 0cd lighting intensity restriction zone to CASA requirements. This requires that new lighting has no upward lighting component and all lighting is directed downwards. This is typically not an issue for LED type luminaires which have full-cutoff optics (i.e. all light is directed downwards).

3.8.3 Lighting Selection

Two options were explored for the lighting selection. A solar powered option as per initial request from the Shire (Option A) and a grid connected 240V option (Option B).

3.8.3.1 *Option A – Solar Lighting*

The existing solar powered lighting installed to the airport carpark was manufactured by "ECOFx" in 2016, however following investigation it appears that this company is no longer in business.

ETC researched several similar alternative suppliers and have considered a solar powered lighting solution from Green Frog Systems whom ETC have experience with for a number of Perth based projects. We understand also they are a preferred supplier to City of Karratha (their products are installed in the town centre) as well as a number of other installations in regional Western Australia and so appear to have demonstrated experience in remote and harsh installations.

ETC has considered the GFS-200 or GFS-400 product which are very similar to the ECOFx product already installed. Some of these options can be considered equivalent in performance to traditional grid connected lighting solution, however the costs per pole are significantly higher due to the solar panel and battery requirements. These additional costs are offset somewhat by not requiring the extra 240V cable and conduit infrastructure associated with grid connected lighting, however on review in ETC's opinion the solar lighting option will not be a more cost effective option. Note that solar powered lighting also has additional reliability, longevity and maintenance considerations.

ETC has not assessed the overall energy savings from a solar solution which are also a consideration however a building mounted PV installation is considered a more efficient means to offset roadway lighting energy consumption.

3.8.3.2 *Option B – Grid Connected Lighting*

For this option we considered standard Western Power / Horizon Power type installation which is a 12.5m galvanized octagonal steel pole with 3m outreach and LED Philips RoadFlair or RoadGrace luminaire.

This option appears to provide better performance than Option A and is a most cost effective option, even when considering the additional cable and conduit infrastructure. This option has been considered for this report.

3.8.4 Lighting Design

Preliminary calculations were completed based on the Option B solution. The following pole spacings were determined for a 25m road reserve width as per the current development proposal.

Table 3-3: Light Pole Spacing Table

Configuration	Height	Outreach	Pole Spacing
RoadGrace 53W	12.5m	3m	-
RoadFlair 80W	12.5m	3m	95m
RoadFlar 160W	12.5m	3m	110m

On the basis of the above results, the 160W configuration is considered for the purposes of this report.

3.9 Roads and Transport

The proposed GIA lot layout has one main access road which runs through the middle of the proposed lots. This access road runs from Lot 09 and ends at Lot 03. However, it is unclear from the lot layout where this proposed road connects to existing road infrastructure, and how Lot 01 and Lot 02 will be accessed. It is acknowledged that the current lot layout is under review by the Shire, and the road layout may also be amended. It is recommended that the proposed access road be connected to the existing Dewar Avenue.

Access to the existing Newman Airport and to the proposed GIA is via Dewar Avenue off Great Northern Highway. Great Northern Highway is a Primary Distributer and is permitted for Restricted Access Vehicles (RAV) Category 10 without conditions. However, Dewar Avenue has is not categorised for any RAV vehicles and will need to be upgraded if any of the tenants require access for vehicles larger than a semi-trailer.

For the purposes of this stage of the study RAV 10 access (up to 36.5m long vehicles) has been assumed in the design of the GIA road and the connections to Great Northern Highway.

To achieve this, the intersection of Great Northern Highway and Dewar Avenue will have to be upgraded to allow correct turning movements from RAV vehicles. Dewar Avenue, and other public roads in the development, will have to be upgraded for RAV classification.

Refer to drawing C-106 for the proposed concept layout of roads and drainage.

3.10 Drainage

There is an existing open drain, and culverts, that runs along the southern and eastern boundaries of the proposed leasehold sites. The open drain services the Airport and conveys stormwater to the Airport's entrance on Dewar Avenue. From there, it travels north to discharge into the Fortescue River. It is unclear from the available survey information as to the exact extents of this open drain and its catchment size. The Design Engineering shoulder consider the overarching stormwater system of the Airport in the design of the GIA.

The existing swale and culverts fall within the land denoted for the proposed development of industrial lots and road infrastructure. Therefore, the existing open drain and culverts will have to be

realigned. When the open drain and culverts are realigned, they could be resized to allow for increased flows from the proposed development GIA.

Based on the results of the investigations and laboratory testing it is unlikely that on-site soakage systems would be appropriate for this development.

The following stormwater management tools were recommended in the *Newman Airport Master Plan* (JJ Ryan 2020) to be implemented at the Site:

- Biofilters, tree pits and/or vegetated swales in car parks and internal roads;
- Pervious paving for footpaths; and
- Roof runoff managed by above or below ground tank to capture roof runoff for reuse, or with a below ground infiltration system.

Based on the geotechnical investigation it is unlikely that pervious paving will be an effective stormwater management device give the site's low permeability rates.

It is recommended that each developed lot, at the very least, uses attenuation ponds to control the stormwater runoff on its lot to reduce the peak flows through the drainage system.

3.11 Flooding

A summary of the 100-year Average Recurrence Interval (ARI) maximum flood levels at several key locations is provided in Table 3-4. A detailed flood model and risk assessment should be undertaken prior to any development in the area to confirm whether development would be subject to flooding in a 100-year ARI storm event (JJ Ryan, 2020).

It is unclear from the JJ Ryan report as to where the key locations relate. However, it is noted that the Site is between 523.5mAHD and 525.0mAHD, which in some instances is below the levels documented in Table 3-4. The flood study should be reviewed and further flood modelling should be undertaken if required.

Table 3-4: 100-year ARI Flood Levels at Key Locations (JJ Ryan, 2020)

Key Location	100-year ARI Flood Level (mAHD)
1	526.1
2	526.2
3	523.7
4	523.3
5	522.3

4 Opinion of Probable Cost

The OPC has been prepared by Canning & Associates Cost Consulting Quantity Surveying Consultancy Services (CACC QS).

The Opinion of Probable Cost (OPC) has been broken down to provide an estimated cost for each Stage 1 & 2 for infrastructure development for 11 lots.

CACC QS has used their market knowledge and applied industry standard rates applicable to the scope of works for infrastructure development in the North Western of Western Australia to enable it to produce a detailed OPC Estimate which aligns with the documentation provided.

A summary of the OPC, to an accuracy of ±30%, is provided in Table 4-1 below. All costs are reported exclusive of Goods and Services Tax. The full cost report is attached in APPENDIX C.

Table 4-1: Summary of OPC (+/- 30 Cost Accuracy)

Description Headings	Stage 1	Stage 2	Total
Contractor Overheads / Preliminaries	$1,803,085	$2,439,468	$4,242,554
Earthworks	$1,642,128	$1,839,873	$3,482,000
Roadworks	$1,841,438	$1,781,063	$3,622,500
Drainage	$216,750	$293,250	$510,000
Finishing Works	$140,250	$189,750	$330,000
Electrical	$1,802,836	$854,695	$2,657,532
Potable Water / Irrigation	$438,283	$592,971	$1,031,254
Margin	$472,306	$639,003	$1,111,309
Sub-Total Construction Costs	**$8,357,076**	**$8,630,072**	**$16,987,148**
Design	$866,345	$1,172,113	$2,038,458
Provisional	$301,750	$408,250	$710,000
Risk & Contingency	$796,825	$1,078,057	$1,874,883
Total	**$10,321,995**	**$11,288,493**	**$21,610,489**

5 Conclusion

Talis has been commissioned by the Shire to prepare a Servicing Report for the proposed development of industrial lots at Newman Airport. The Site is currently zoned "Rural" under Shire of East Pilbara Local Planning Scheme No.4, and the Shire is now required to rezone the land to "Special-use" to support the industrial land development at the Site.

This Servicing Report supports the Scheme Amendment Report currently being undertaken by the Shire. This Servicing Report includes details on geotechnical characteristics of the site; earthworks; clearing requirements; sewer; solid waste management; water supply; power supply; telecommunications; roads; drainage; and flooding.

This Servicing Report has been completed as a desktop study, prior to the commencement of any engineering design. Further investigation will be required in the engineering design stages to confirm the usage requirements of the proposed lots.

APPENDIX A

Newman Airport General Industrial Area

Local Development Plan

Implementation

- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]

Built Form Design and Quality

- [redacted]
  - [redacted]
  - [redacted]
  - [redacted]
- [redacted]

Building Setbacks

- [redacted]
- [redacted]
- [redacted]

Parking and Access

- [redacted]
- [redacted]
- [redacted]
- [redacted]

Landscaping Standards

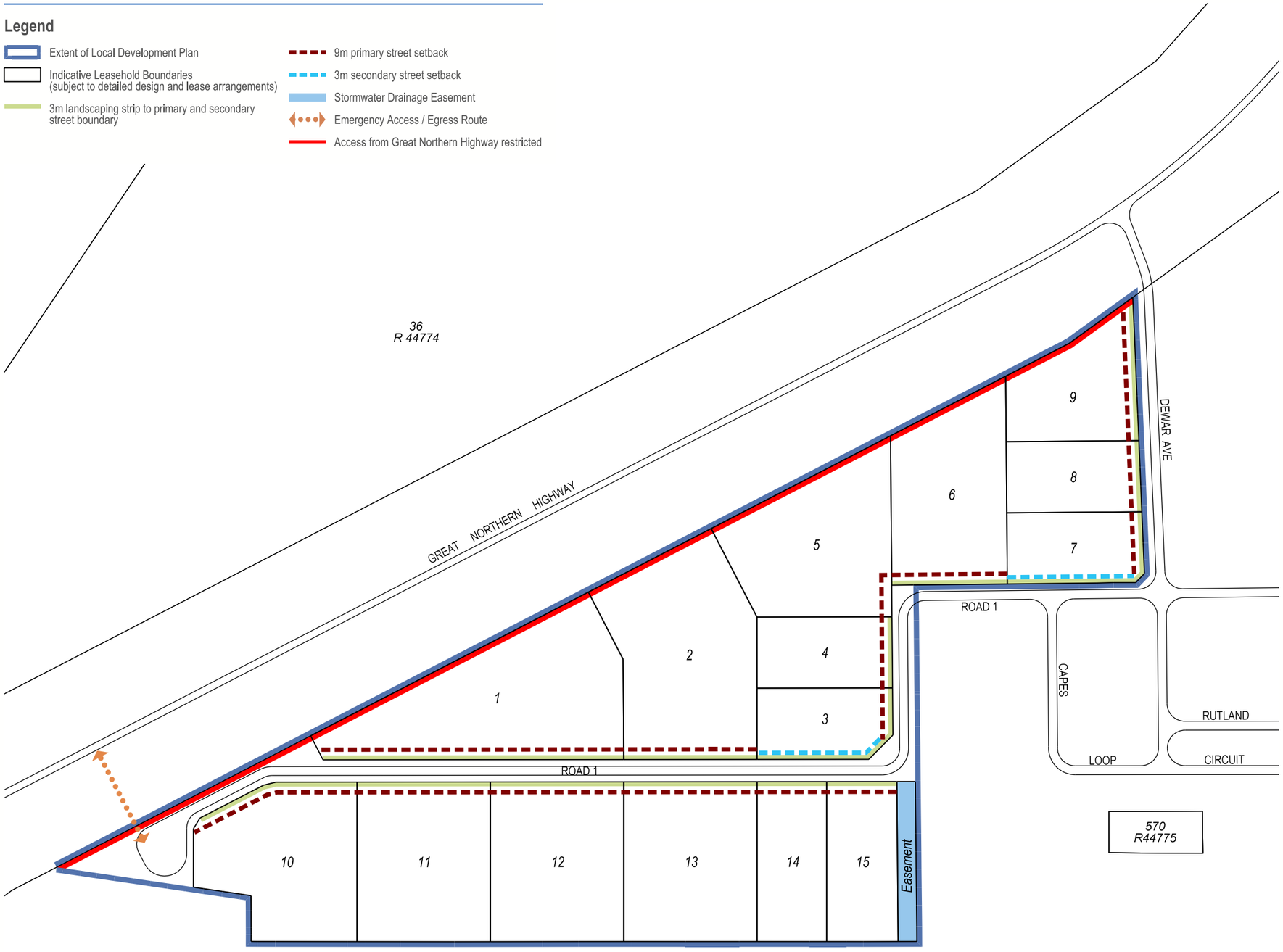
- [redacted]
- [redacted]
- [redacted]

Boundary Fencing

- [redacted]
- [redacted]
- [redacted]
  - [redacted]
  - [redacted]
- [redacted]

Legend

- Extent of Local Development Plan
- Indicative Leasehold Boundaries (subject to detailed design and lease arrangements)
- 3m landscaping strip to primary and secondary street boundary
- 9m primary street setback
- 3m secondary street setback
- Stormwater Drainage Easement
- Emergency Access / Egress Route
- Access from Great Northern Highway restricted



Endorsement Table

The Local Development Plan has been approved in accordance with clause 52 of Deemed Provisions of the Planning and Development (Local Planning Schemes) Regulations 2015.

Authorised Officer: _____

Date: _____

Newman Airport
571
R44775

Shire of East Pilbara NEWMAN AIRPORT

Local Development Plan

NEWMAN AIRPORT INDUSTRIAL AREA

A Shire of East Pilbara Project

DRAFT

scale: 1:5000@A3 | 1:2500@A1

0 50 100m

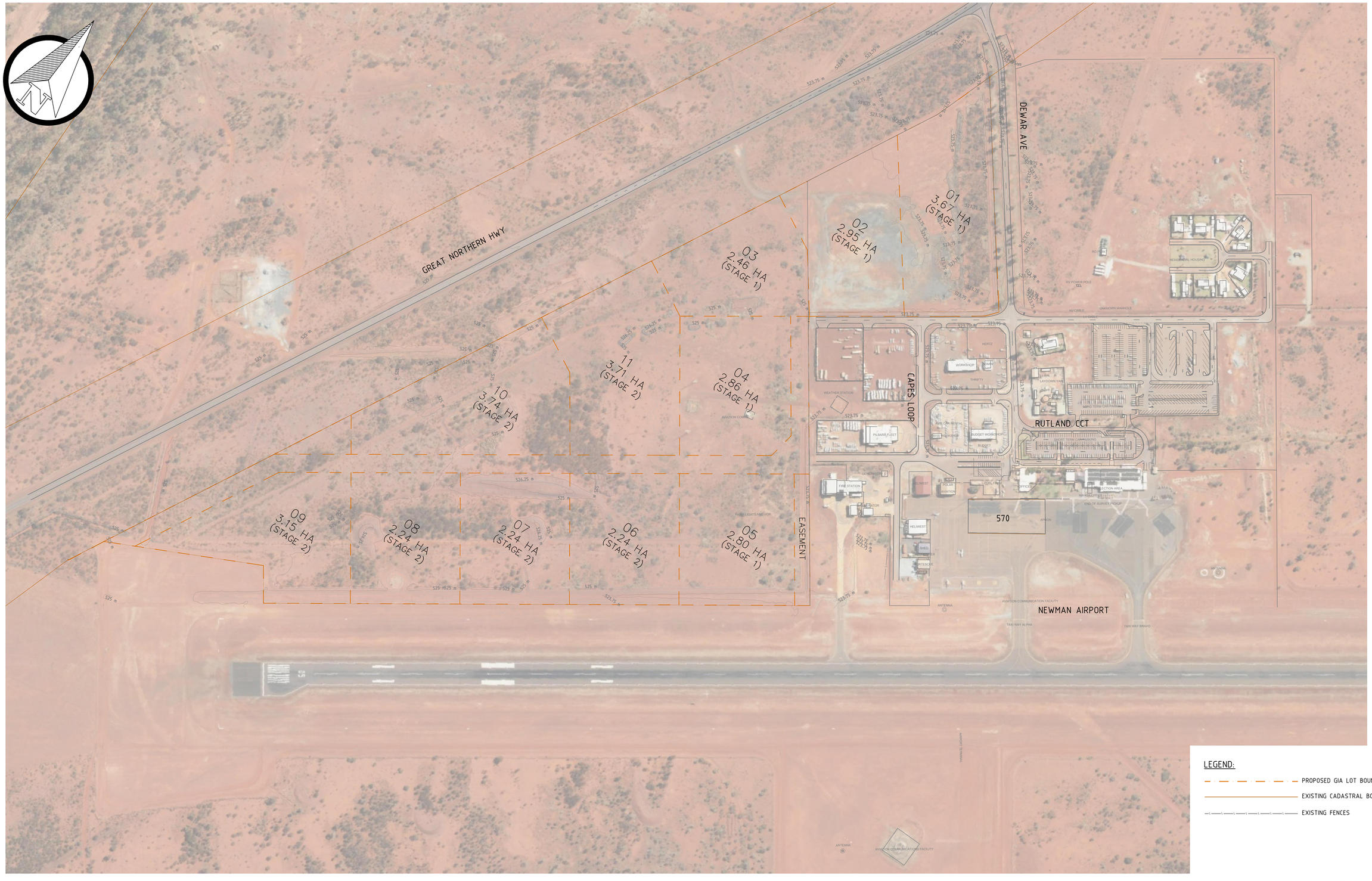
plan: 20/067/007

date: 12 Apr 2021

Taylor Burrell Barnett Town Planning & Design
Level 7, 160 St Georges Terrace, Perth WA 6000
e: admin@tbbplanning.com.au
p: (08) 9226 4276

Taylor Burrell Barnett

APPENDIX B
Concept Services Layout



LEGEND:

- PROPOSED GIA LOT BOUNDARY
- EXISTING CADASTRAL BOUNDARY
- EXISTING FENCES

100m 0m 100m 200m

1:2500 @ A1

VERTICAL DATUM: AUSTRALIAN HEIGHT DATUM
HORIZONTAL DATUM: MGA 94 ZONE 50

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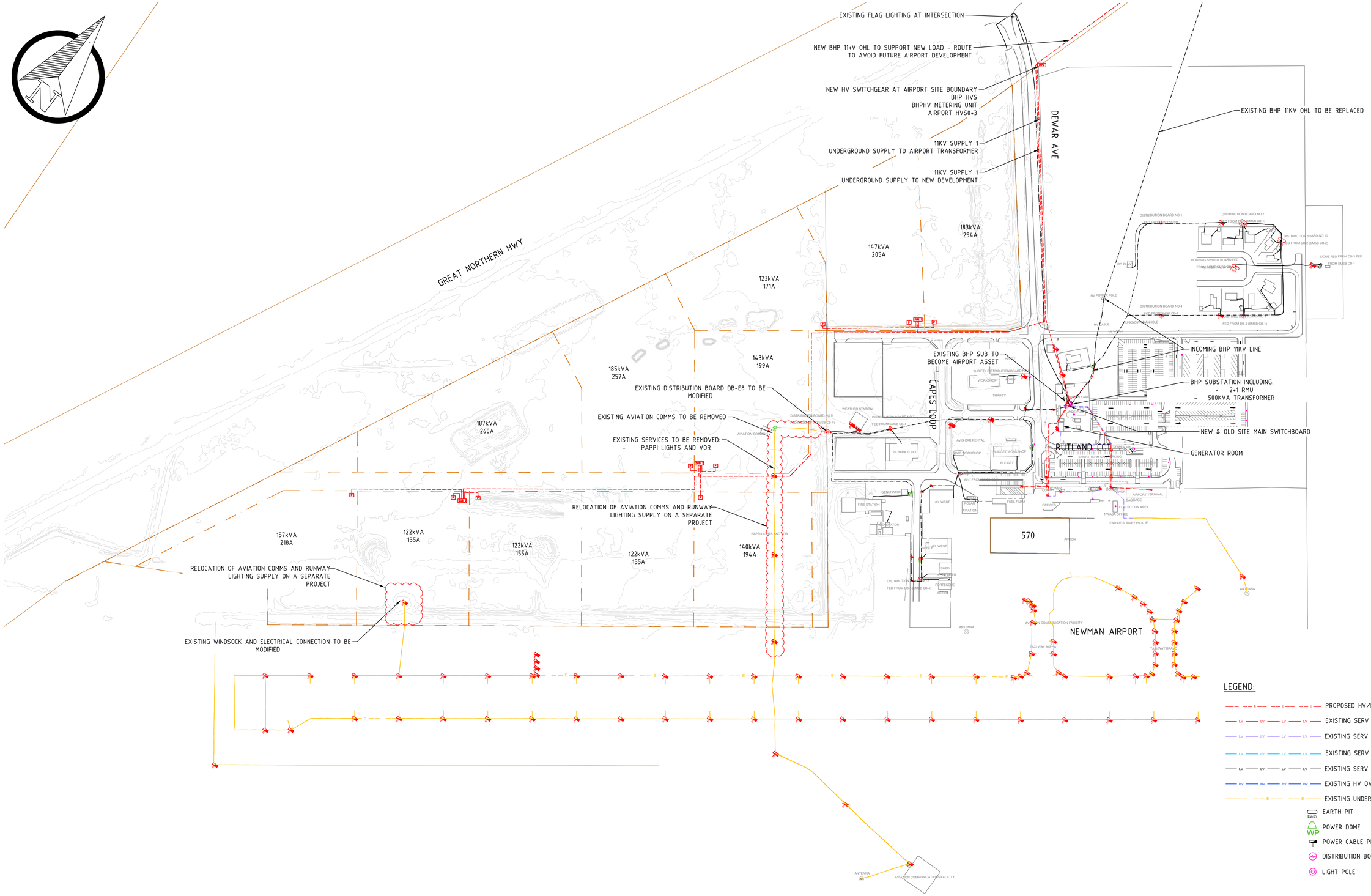
No.	Date	By	Chk	Amendment / Issue	App.
A	15.02.2021	YJ	AB	PRELIMINARY ISSUE	

Project: NEWMAN AIRPORT GENERAL INDUSTRIAL AREA

Title: EXISTING SITE AND TOPOGRAPHY LAYOUT

Scale: 1:2500 @ A1		Date: 15.02.2021	
Drawn: YJ	Checked: AB	Approved:	
Job No: TC20042	Drg. No: C-101	Rev: A	

Filename: TC20042-NEWMAN AIRPORT_SET.DWG



VERTICAL DATUM: AUSTRALIAN HEIGHT DATUM
HORIZONTAL DATUM: MGA 94 ZONE 50

LEGEND:

- PROPOSED HV/LV NETWORK
- EXISTING SERV ESSENTIAL LV FEEDER CABLE
- EXISTING SERV ESSENTIAL LV SUB-MAIN CABLE
- EXISTING SERV NON ESSENTIAL LV FEEDER CABLE
- EXISTING SERV NON ESSENTIAL LV SUB-MAIN CABLE
- EXISTING HV OVERHEAD FEEDER
- EXISTING UNDERGROUND POWER
- EARTH PIT
- POWER DOME
- POWER CABLE PIT
- DISTRIBUTION BOARD
- LIGHT POLE

100m 0m 100m 200m

1:2500 @ A1

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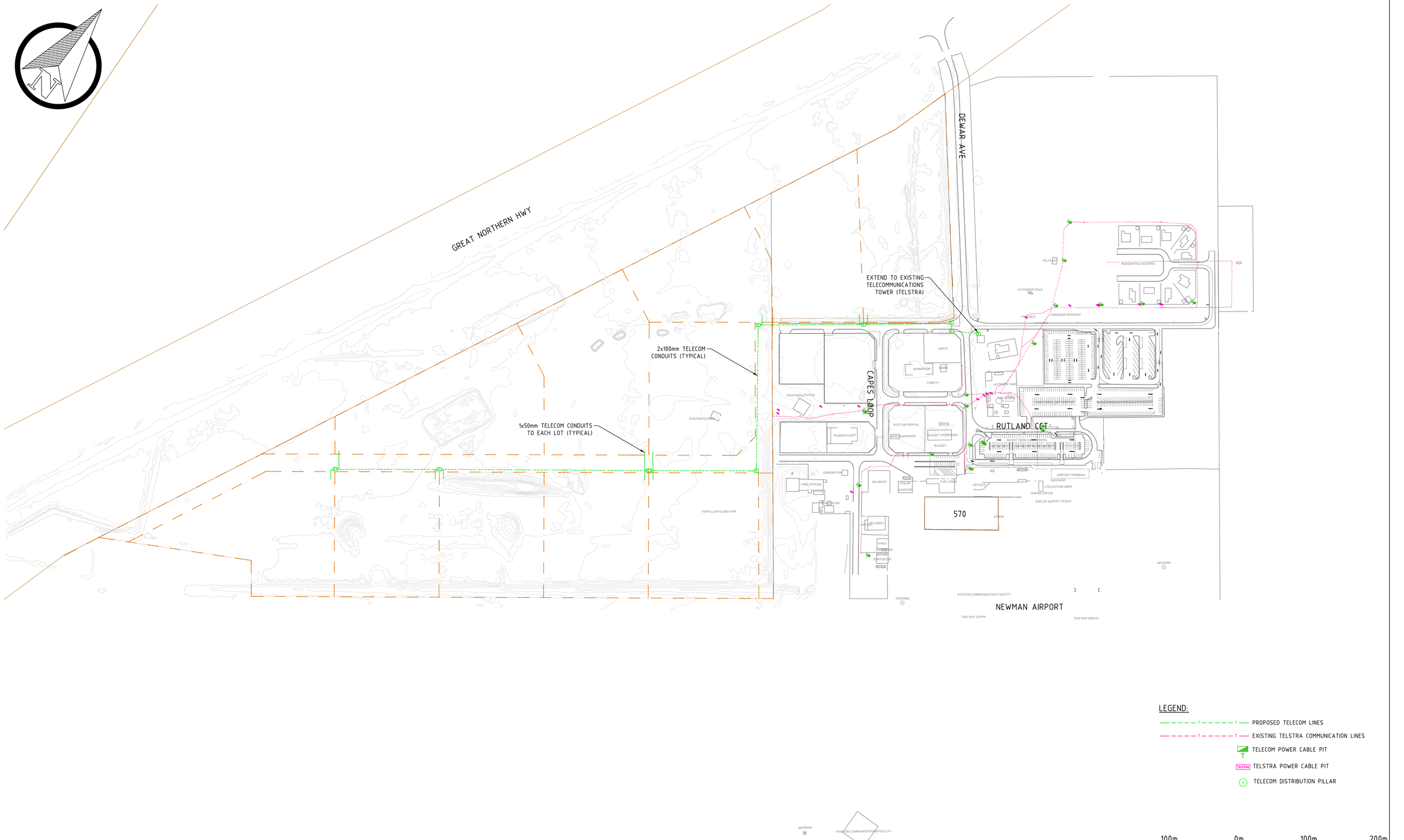
No.	Date	Drn	Chk	Amendment / Issue	App.
B	22.02.2021	AB	PG	LINE MODIFICATIONS ADDED	
A	15.02.2021	YJ	AB	PRELIMINARY ISSUE	

Project: NEWMAN AIRPORT GENERAL INDUSTRIAL AREA

Title: EXISTING & PROPOSED POWER SERVICES LAYOUT

Scale: 1:2500 @ A1 | Date: 15.02.2021
Drawn: YJ | Checked: AB | Approved:
Job No: TC20042 | Drg. No: C-102 | Rev: B
Filename: TC20042-NEWMAN AIRPORT_SET.DWG



LEGEND:

- PROPOSED TELECOM LINES
- EXISTING TELSTRA COMMUNICATION LINES
- TELECOM POWER CABLE PIT
- TELSTRA POWER CABLE PIT
- TELECOM DISTRIBUTION PILLAR

100m 0m 100m 200m

1:2500 @ A1

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HORIZONTAL DATUM: MGA 94 ZONE 50

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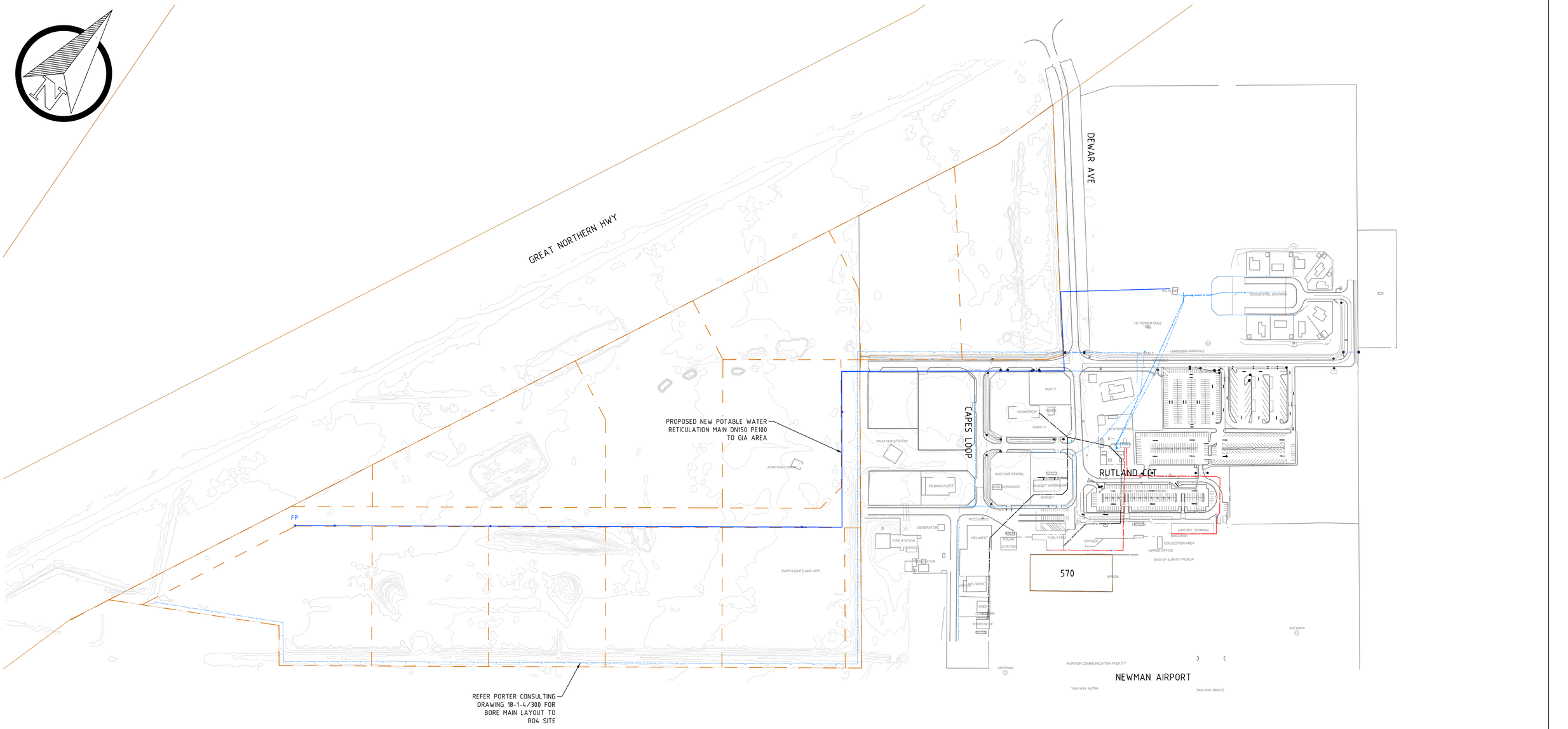
No.	Date	Dft	Ch	Amendment / Issue	App.
A	15.02.2021	YJ	AB	PRELIMINARY ISSUE	

Project: NEWMAN AIRPORT GENERAL INDUSTRIAL AREA

Title: EXISTING & PROPOSED COMMUNICATION SERVICES LAYOUT

Scale: 1:2500 @ A1	Date: 15.02.2021	
Drawn: YJ	Checked: AB	Approved:
Job No: TC20042	Drg. No: C-103	Rev: A

Filename: TC20042-NEWMAN AIRPORT_SET.DWG



PROPOSED WATER LEGEND:

- DN150 PE100 WATER MAIN (1.5m ALIGNMENT)
- FP — FLUSHING POINT / 150mm HYDRANT

LEGEND:

- EXISTING WATER PIPES
- EXISTING DRAIN PIPES
- EXISTING SEWER LINES
- EXISTING FIRE WATER PIPES
- EXISTING POTABLE WATER PIPES

100m 0m 100m 200m

1:2500 @ A1

VERTICAL DATUM: AUSTRALIAN HEIGHT DATUM
HORIZONTAL DATUM: MGA 94 ZONE 50

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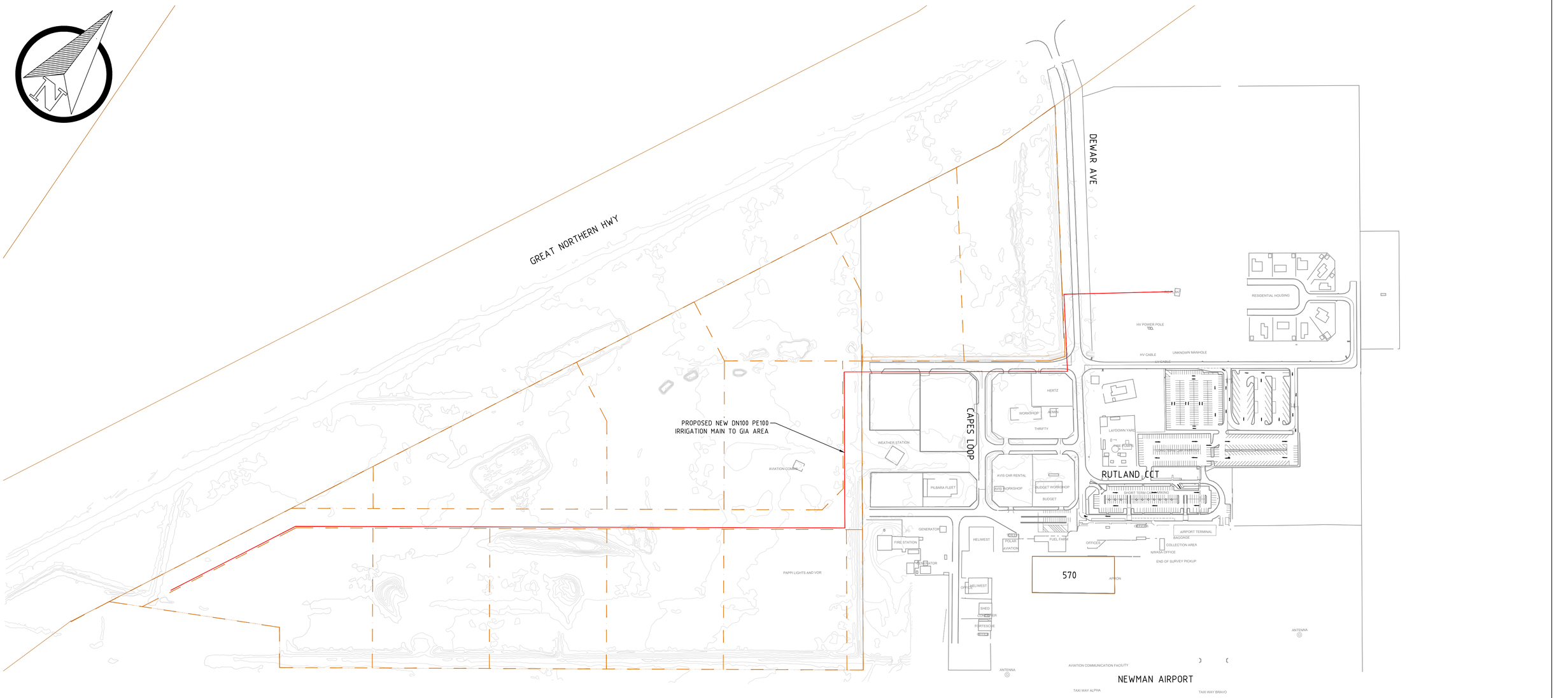
No.	Date	Dn	Ch	Amendment / Issue	App.
B	22.02.21	AB	PG	PROPOSED WATER LINES ADDED	
A	15.02.2021	YJ	AB	PRELIMINARY ISSUE	

Project: NEWMAN AIRPORT GENERAL INDUSTRIAL AREA

Title: EXISTING & PROPOSED WATER SERVICES LAYOUT

Scale: 1:2500 @ A1 | Date: 15.02.2021
Drawn: YJ | Checked: AB | Approved:
Job No: TC20042 | Drg. No: C-104 | Rev: B
Filename: TC20042-NEWMAN AIRPORT_SET.DWG



PROPOSED WATER LEGEND:

DN100 PE100 IRRIGATION MAIN (2.0m ALIGNMENT)

100m 0m 100m 200m

1:2500 @ A1

VERTICAL DATUM: AUSTRALIAN HEIGHT DATUM
HORIZONTAL DATUM: MGA 94 ZONE 50

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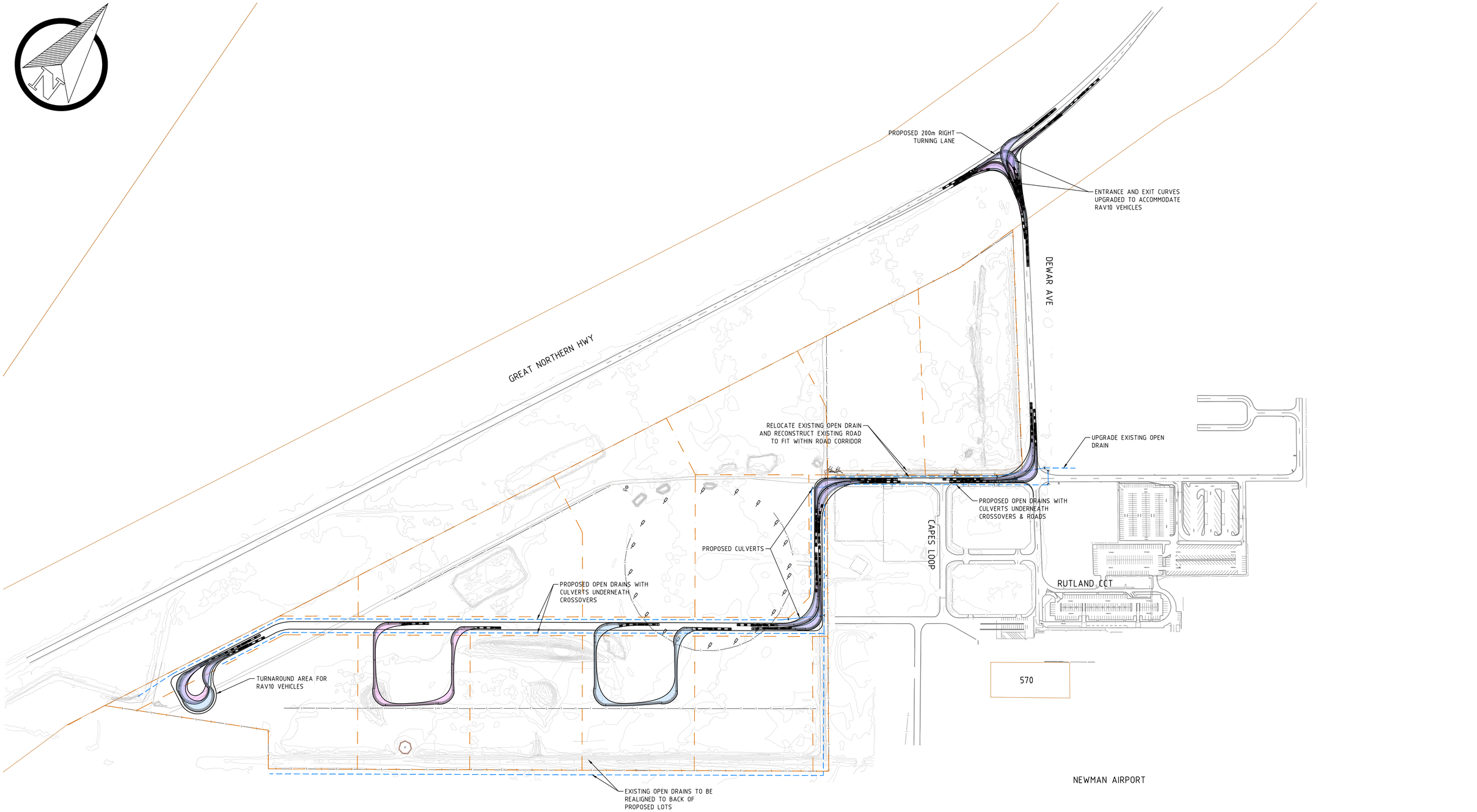
No.	Date	Dft	Ctd	Amendment / Issue	App.
A	15.02.2021	YJ	AB	PRELIMINARY ISSUE	

Project: NEWMAN AIRPORT GENERAL INDUSTRIAL AREA

Title: EXISTING & PROPOSED IRRIGATION LAYOUT

Scale: 1:2500 @ A1 | Date: 15.02.2021
Drawn: YJ | Checked: AB | Approved:
Job No: TC20042 | Drg. No: C-105 | Rev: A
Filename: TC20042-NEWMAN AIRPORT_SET.DWG



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100m 0m 100m 200m

1:2500 @ A1

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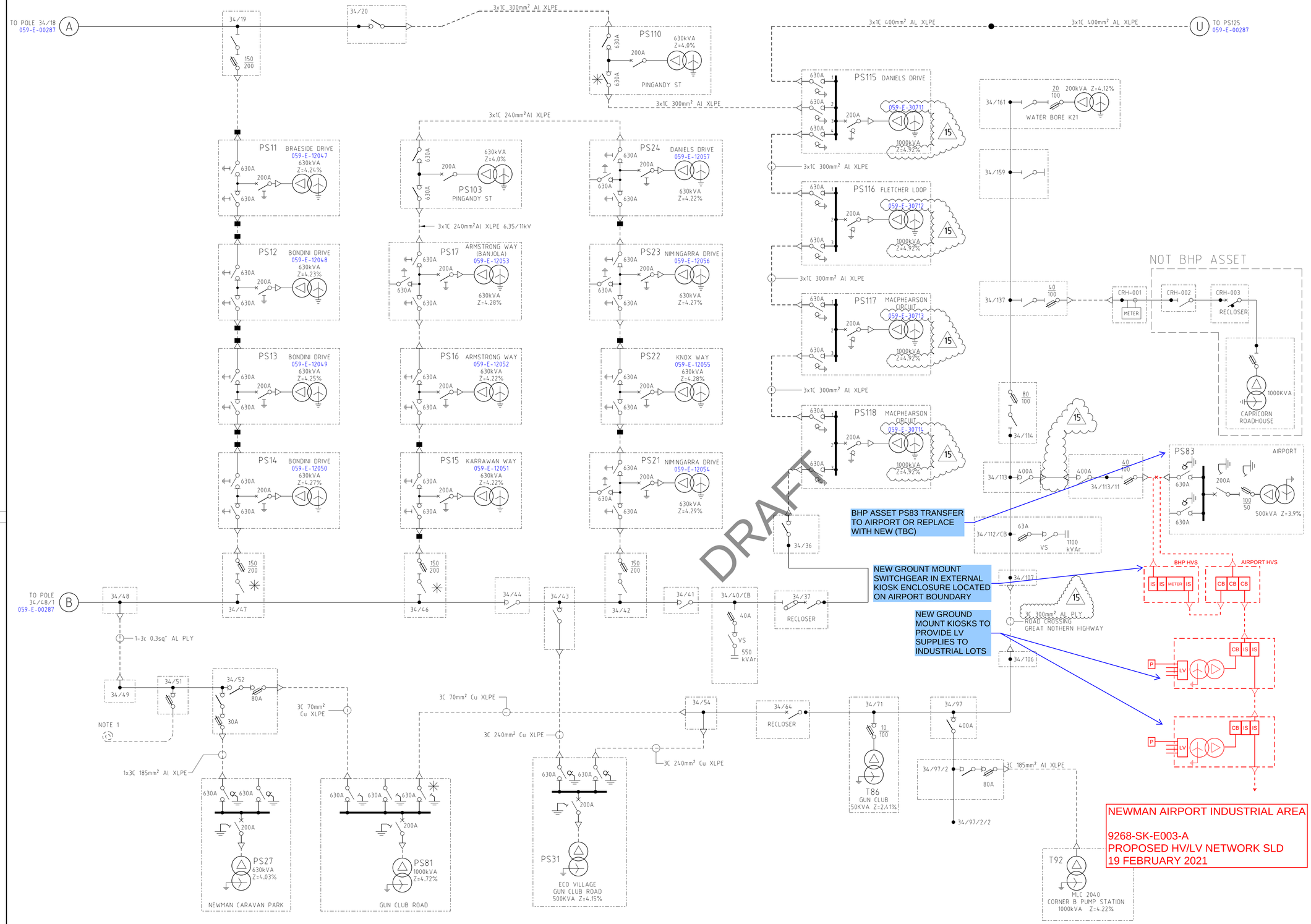
No.	Date	Drn	Chk	Amendment / Issue	App.
A	15.02.2021	YJ	AB	PRELIMINARY ISSUE	

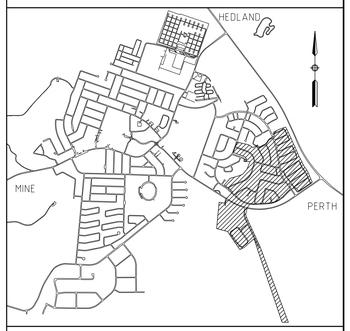
Project: NEWMAN AIRPORT GENERAL INDUSTRIAL AREA

Title: EXISTING & PROPOSED ROADS AND DRAINAGE LAYOUT

Scale: 1:2500 @ A1 | Date: 15.02.2021
Drawn: YJ | Checked: AB | Approved:
Job No: TC20042 | Drg. No: C-106 | Rev: A
Filename: TC20042-NEWMAN AIRPORT_SET.DWG



KEY PLAN



LEGEND

- 11/0.433KV 3Φ TRANSFORMER
- 11KV 3 POLE SWITCH FUSE NOT LOAD BREAKING
- 11KV 3 POLE SWITCH FUSE - LOAD BREAKING
- 11KV DROP-OUT FUSE
- 400A 11KV ISOLATOR - NOT LOAD BREAKING
- 400A 11KV ISOLATOR - 200A LOAD BREAKING
- VS VACUUM SWITCH ISOLATOR - LOAD BREAKING
- CIRCUIT BREAKER
- HV LINK
- FUSE
- LIGHTNING ARRESTOR
- NORMALLY OPEN
- 11KV OVERHEAD LINE
- 11KV UNDERGROUND CABLE
- UNDERGROUND CABLE JOINT
- 32/38/18 POLE NUMBER
- CAPACITOR BANK
- TRANSITION FROM 3C 185mm² Al PAPER/LEAD BELTED SECTOR CABLE TO 12.7/22kV 1 C 185mm² Al BUNDLED XLPE/NY/PVC 10 METRE EXTENSIONS

POLE NUMBER → XXX / XX / NXX / NXX

VOLTAGE
0 = 433V
1 = 3.3KV
2 = 6.6KV
3 = 11KV
4 = 66KV
5 = 132KV
1st FEEDER NUMBER
2nd FEEDER NUMBER
Nth POLE ON MAIN LINE
FOR MUTI-TEE-OFF OFF SAME POLE
Nth POLE ON 1st SPUR LINE
FOR MUTI-TEE-OFF OFF SAME POLE
Nth POLE ON 2nd TEE-OFF, OFF SPUR LINE

OVERHEAD CONDUCTORS

L	LEMON	--	30/7/3.00
B	BANANA	--	6/1/3.75
C	CHERRY	--	6/4.75 7/1.50
M	MINK	--	6/1/3.66
P	PHOSPHORUS	--	37/3.75 AAAC/1120

NOTES

1. OLD CABLE AT POLE 34151 TO PS27 DISCONNECTED, CAPPED AND ABANDONED.

NEWMAN TOWNSHIP DISTRIBUTION SYSTEM DRAWING INDEX	059-E-30402
CONTRACT NUMBER OR PURCHASE ORDER NUMBER	
REFERENCE DOCUMENTS	**DOC NO**

NO	DATE	REVISION (Revision Approvals by Designer/Contractor confirms designs are in accordance with BHPIO SEP-57 procedures)	DES BY	DRN BY	CHK BY	DES/ HSEC	BHPIO	DATE
11	03.12.15	AS BUILT - SMALL CORRECTIONS TO POLE DOF'S CROSS REFERENCE LETTER REVISED DUE TO DUPLICATION	N-A	WJM	TF	JB	AB	28.01.16
10	07.04.15	AS BUILT - NOP MOVED TO PS81 RMU PS27 FEEDER CHANGED FROM SWITCH FUSE TO ABS	N-A	WJM	KS	MJ	ODeC	22.04.15
9	31.10.14	PS115 THROUGH PS118 ADDED - AS BUILT	WJM	WJM	ER	KMcC	KMcC	22.01.15
8	10.08.14	UPDATED - AS BUILT	PB	PB	MDG	MDG	MDG	12.06.14
15	12.01.21	AS-BUILT - AS PER NE03075	BHP	SGL	MD	TF	WT	22.11.17
14	16.11.17	AS BUILT - AS PER FIELD VERIFICATION	AR	RVR	JB	JB	AB	24.08.16
13	27.06.16	DRAWING REVISED AS NOTED	NA	WJM	TF	JB	AB	
12	16.03.16	AS BUILT - CAPRICORN ROADHOUSE SUPPLY REVISED FUSES REMOVED FROM POLE 34.43	DES BY	DRN BY	CHK BY	DES/ HSEC	BHPIO	DATE

BHPIO TO COMPLETE

DRAWING STATUS REVIEW	SIGNED	DATE	REV
PRELIMINARY ONLY			
QUOTATION ONLY			
CONSTRUCTION MAY PROCEED / AS BUILT			15
CONSTRUCTION MAY PROCEED EXCEPT AS NOTED			
REVISE AND RESUBMIT			

BHPIO/REVIEWER TO COMPLETE

COMPANY
NAME
SIGNED
DATE

THIS DRAWING HAS BEEN REVIEWED FOR GENERAL COMPLIANCE AS PER SEP-57

DESIGNER/CONTRACTOR TO COMPLETE

COMPANY BHPIO
DESIGNED BY
DRAWN BY M.EVANS
CHECKED BY
DESIGN & HSEC APPROVED BY
DATE APPROVED

BHP — CHECKED ASSURED Complete, Correct and Compliant Standard 2.2

INTERNAL 12 Jan 21

BHP

BHP Billiton Iron Ore Pty Ltd ABN 46 008 700 981

TOWNSHIP - NEWMAN
POWER - 11kV DISTRIBUTION
EAST NEWMAN SUBDIVISION
SINGLE LINE DIAGRAM SHT 2

SCALE NTS | A1 | DRG. NO. 059 - E - 00377 /15

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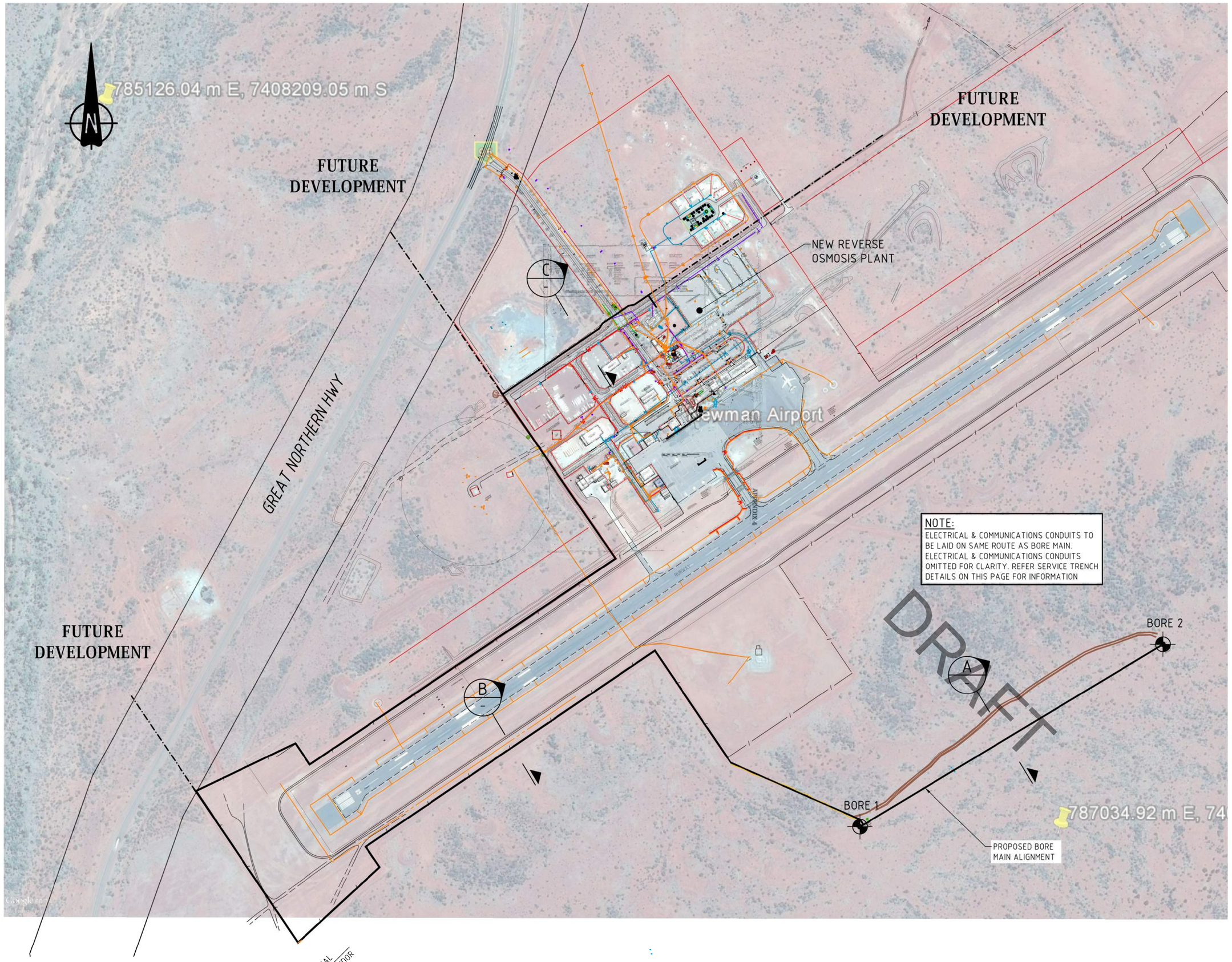
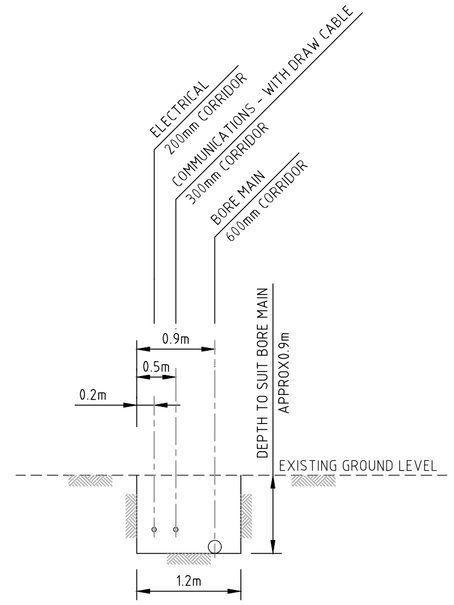
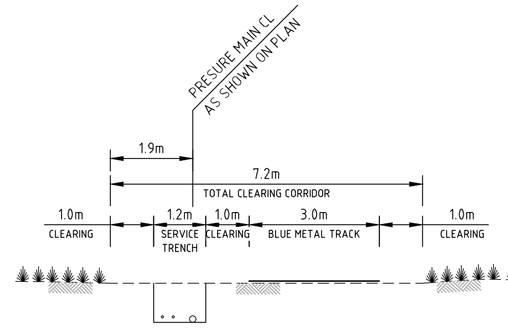




TYPICAL SERVICES TRENCH

SECTION A
1:50



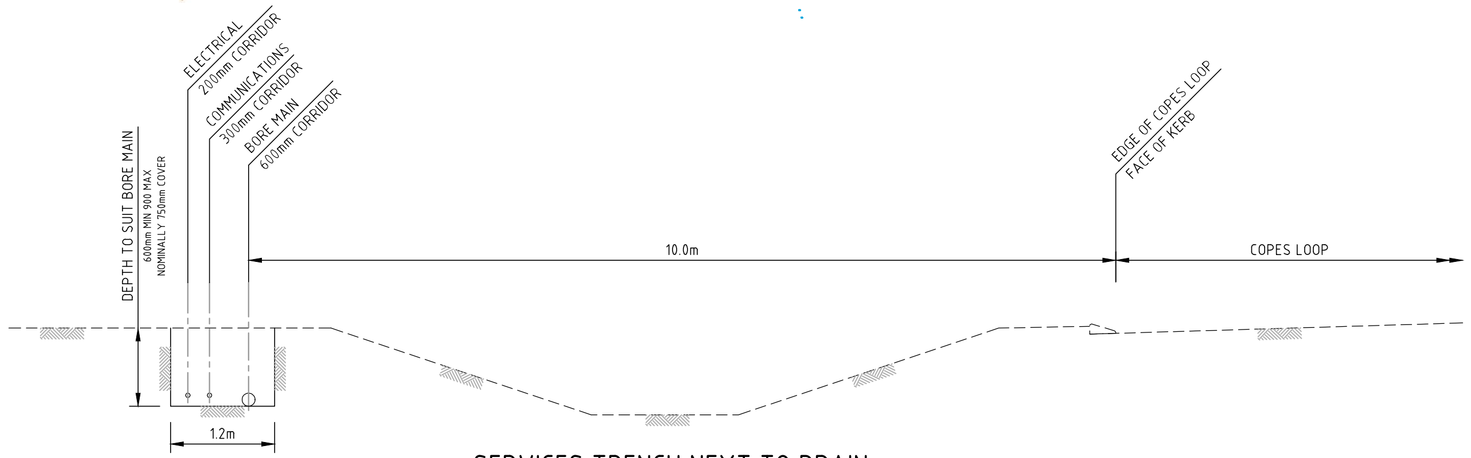
SECTION B
1:100

GENERAL NOTES

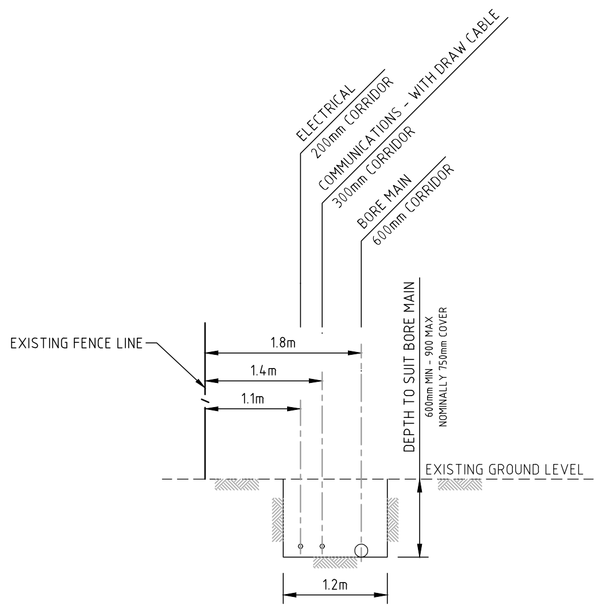
1. ALL WORKS SHALL BE CONSTRUCTED IN ACCORDANCE WITH WATER CORPORATION MANUALS AND STANDARDS.
2. **SERVICES, SUCH AS SEWER, WATER, GAS, TELEPHONE, ELECTRICITY, AND DRAINAGE MAY BE ENCOUNTERED DURING CONSTRUCTION OF THE WORKS. SERVICES INFORMATION SHOWN ON DRAWINGS IS INDICATIVE ONLY AND MAY NOT BE COMPLETE. BEFORE EXCAVATION COMMENCES THE LOCATION OF ALL SUCH SERVICES SHALL BE OBTAINED FROM THE RELEVANT AUTHORITIES.**
3. **CO-ORDINATE THE LOCATION OF ALL EXISTING AND PROPOSED SERVICES PRIOR TO COMMENCEMENT OF WORK. ANY CONFLICTS ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY.**
4. UNLESS OTHERWISE SHOWN ALL DIMENSIONS ARE IN METRES.
5. ALL PIPES SHALL BE INSTALLED TO WITHIN 4.0m OF EXISTING MAIN. LEVEL AND ALIGNMENT OF NEW WORKS SHALL MATCH EXISTING. CONNECTION TO EXISTING BY WATER CORPORATION.
6. UNLESS OTHERWISE DIRECTED BY THE ENGINEER, COVER REQUIREMENTS SHALL COMPLY WITH THE WATER CORPORATION STANDARDS.
7. MINIMUM CLEARANCE TO GAS = 300mm, MINIMUM CLEARANCE TO OTHER SERVICES = 150mm.
8. ALL WORKS SHALL BE IN DRY GROUND. GROUND WATER SHALL NOT BE PERMITTED TO ENTER PIPES.
9. UNLESS OTHERWISE SHOWN ON THIS DRAWING OR VARIED BY THE ENGINEER ALL PIPES AND FITTINGS SHALL BE LAID ON AN ALIGNMENT OF 2.1m FROM THE CENTRE OF THE PIPE TO THE ROAD RESERVE BOUNDARY.
10. FLUSHING POINTS SHALL BE INSTALLED ON ALL MAINS AT CONNECTION POINTS TO EXISTING MAINS OR WHERE SPECIFIED.
11. CONTRACTOR SHALL INSTALL FLUSHING POINTS AT ALL DEAD ENDS.
12. UNLESS DIMENSIONED OTHERWISE, MAINS SHALL EXTEND AT LEAST 8m ALONG THE FRONT OF LAST LOT SERVED.
13. ALL VALVES SHALL BE OPPOSITE BOUNDARY PEGS UNLESS DIMENSIONED OTHERWISE, ALL HYDRANTS SHALL BE POSITIONED IN THE MIDDLE OF LOTS OR OPPOSITE BOUNDARY PEGS AS SHOWN.
14. SERVICE CROSSINGS SHALL BE LOCATED AT RIGHT ANGLES TO BOUNDARY AND INSTALLED IN ACCORDANCE WITH THE REQUIREMENTS OF THE WATER CORPORATION.
15. THE CONTRACTOR SHALL ALLOW FOR ALL AS CONSTRUCTED INFORMATION (INCLUDING SURVEY) TO BE PLOTTED IN ACCORDANCE WITH THE WATER CORPORATIONS CURRENT PRACTICE AND DELIVERED TO THE ENGINEER FOR SIGNING AND PRESENTATION TO THE WATER CORPORATION.
16. IT IS DEEMED THAT THE AS CONSTRUCTED DOCUMENTS FORM PART OF THE WORKS. PRACTICAL COMPLETION CAN NOT BE AWARDED IF ACCEPTABLE AS CONSTRUCTED DOCUMENTS HAVE NOT BEEN PROVIDED TO THE ENGINEER.

NOTE:
ALL BURIED PIPES TO BE INSTALLED WITH UNDERGROUND DETECTABLE LOCATOR TAPE NOMINALLY 150mm-300mm ABOVE THE RESPECTIVE PIPE BUT NO DEEPER THAN 600mm BELOW THE FINISHED SURFACE. (ORANGE TAPE FOR ELECTRICAL, WHITE TAPE FOR COMMS, LILAC / PURPLE FOR THE BORE WATER PIPE. TAPE WIRE TO BE JOINED, CRIMPED & INSTALLED TO MANUFACTURES REQUIREMENTS.

NOTE:
PIPEWORK & FITTINGS TO BE PN20 RATED



SERVICES TRENCH NEXT TO DRAIN
SECTION D
1:50



TYPICAL SERVICES TRENCH - NEXT TO FENCE
SECTION C
1:50

DIAL BEFORE YOU DIG www.1100.com.au

1:2000 0m 40 80 120m

PROJECT:
NEWMAN AIRPORT WATER MAIN NEWMAN

No	DATE	REVISION	BY

Porter Consulting Engineers
Level 2 Kishorn Court
58 Kishorn Road
Mt Pleasant 6153 WA
PO Box 1036
Canning Bridge 6153 WA
Tel (08) 9315 9955
Fax (08) 9315 9959
Email office@porterceng.com.au
www.porterceng.com.au
TVSMO Pty Ltd ACN 070 097 148 as trustee for the Consulting Engineering Unit Trust trading as Porter Consulting Engineers ABN 78 636 396 385

CLIENT:
Shire of EAST Pilbara
AUSTRALIA'S LARGEST SHIRE

DRAWING:
BORE MAIN LAYOUT
FOR APPROVAL

SCALE	1:2000
DATE	JAN '18
DESIGN	DPE
DRAWN	DPE
CHECK	
DRAWING No.	18-1-4/300
REV No.	A
ORIGINAL DRAWING SIZE	A1
FILE NAME	S:\ACTIVE PROJECTS\18-01-004\ACAD\180104-300.dwg
APP'D	

APPENDIX C
Cost Report

Canning & Associates Cost Consulting
Quantity Surveyors

www.canningcc.com.au

Project: Newman Airport Industrial Area

RFQ: Cost Planning Consultancy Services

Prepared For: Talis Consultants

Attention: Allan Mason

1 TABLE OF CONTENTS

2 CONFIDENTIALITY & DOCUMENT CONTROL

2.1 Confidentiality Clause

The information contained in this document is submitted with the express understanding that it will be held in strict confidence and will not be disclosed, duplicated, or used, in whole or in part, for any purpose other than evaluation of this document, without prior written consent of Canning & Associates Cost Consulting Pty Ltd.

This document contains proprietary and confidential information and is classified as "Commercial in Confidence" by Canning & Associates Cost Consulting Pty Ltd.

2.2 Document Control

Version	Date	Reviewer	Authorised	Status
V.0	25/02/2021	PC	PC	For Review

2.3 Distribution of Copies

Version	Date	Copy No's	Electronic	Issued To
V.0	25/02/2021	1	Yes	Talis Consultants – Allan Mason & Paul Gauci

3 EXECUTIVE SUMMARY

Canning & Associates Cost Consulting (QS) (herein referred to as "CACC QS") has been engaged by Talis Consultants to prepare an Order of Probably Costs (herein referred to as "OPC") for the Newman Airport Industrial Area.

The OPC has been broken down into the following categories for each Stage 1 & 2 for infrastructure development for 11 lots:

- Contractor Overheads / Preliminaries
- Earthworks - Civil
- Roadworks - Civil
- Drainage
- Finishing Works
- Electrical Works
- Potable Water / Irrigation
- Margin
- Design
- Provisional Sums
- Risk & Contingency

CACC QS has used their market knowledge and applied industry standard rates applicable to the scope of works for infrastructure development in the North West of Western Australia to enable it to produce a detailed OPC Estimate which aligns with the documentation provided.

4 ORDER OF PROBABLY COSTS (+/-30% Cost Accuracy)

CACC QS provides OPC Estimate for construction costs based on documentation provided in table 2 below. Summary of OPC is displayed in Table 1 below.

Please refer to the attached OPC Cost Plan in Appendix 15 for further information and the scope of works included.

All costs are reported exclusive of Goods and Services Tax.

Table 1

Summary of OPC (+/- 30 Cost Accuracy)				
Description Headings		**Stage 1`**	**Stage 2**	**Total**
1	Contractors Overheads / Preliminaries	1,803,085	2,439,468	4,242,554
2	Earthworks	1,642,128	1,839,873	3,482,000
3	Roadworks	1,841,438	1,781,063	3,622,500
4	Drainage	216,750	293,250	510,000
5	Finishing Works	140,250	189,750	330,000

Summary of OPC (+/- 30 Cost Accuracy)				
Description Headings		Stage 1`	Stage 2	Total
6	Electrical	1,802,836	854,695	2,657,532
7	Potable Water / Irrigation	438,283	592,971	1,031,254
8	Margin	472,306	639,003	1,111,309
	Sub-Total Construction Costs	8,357,076	8,630,072	16,987,148
9	Design	866,345	1,172,113	2,038,458
10	Provisional	301,750	408,250	710,000
11	Risk & Contingency	796,825	1,078,057	1,874,883
	Totals	**10,321,995**	**11,288,493**	**21,610,489**

5 SCOPE OF WORKS

We note the OPC Estimate is based on take-offs from the drawings in Table 2 below and industry rates applicable to the North West region of Western Australia and is therefore indicative only of the possible Order of Probably Costs. All components of the Order of Probably Cost Estimate will require confirmation once further documentation is available.

The following documentation formed the basis for the Order of Probably Cost Estimate:

Table 2

Ref	Discipline	Document Number	Date	Revision
1	General	TC20042-Newman Airport_Set-C-101	15/02/2021	A
2	General	TC20042-Newman Airport_Set-C-102	15/02/2021	A
3	General	TC20042-Newman Airport_Set-C-103	15/02/2021	A
4	General	TC20042-Newman Airport_Set-C-104	15/02/2021	A
5	General	TC20042-Newman Airport_Set-C-105	15/02/2021	A
6	General	TC20042-Newman Airport_Set-C-106	15/02/2021	A
7	General	Bore Main Layout	Jan 2018	A
8	Electrical	9268-SK-E003-A PROPOSED HV/LV NETWORK SLD	19/02/2021	A

5.1 Architectural

Not applicable

5.2 Structural Engineering

Not applicable

5.3 Civil Engineering

As denoted in Table 2 above.

5.4 Services (Mechanical / Electrical / Hydraulic / Fire / Security / Communications)

As denoted in Table 2 above.

5.5 Environmental Sustainable Design (ESD)

Not applicable

5.6 Other design services not listed

Not applicable

6 RISK & CONTINGENCY

The OPC Estimate includes the following contingencies:

- Construction risk - 5% of Overall Costs
- Design risk - 1% of Overall Costs
- Cost Plan Contingency - 3.5% of Overall Costs

7 COST ESCALATION

The OPC Estimate is based on costs current as of February 2021. An allowance has been made for cost escalation. The current Building Cost Index[1] for February 2021 is 179.50 and the forecast Building Cost Index for August 2022 is 187.0.

Calculation is ((187.0 / 179.5)-1) x Total Construction Cost + Design

[1] Published by Australian Institute of Quantity Surveyors

8 OTHER DEVELOPMENT COSTS

The following other development cost allowances have been excluded in the OFC Estimate:

- Authority and Headwork Fees
- Development Approval
- Lease agreements with potential proponents

9 COST ASSUMPTION / INCLUSIONS

- Programme is based on Stage 1 & 2 completed concurrently over a 12-month period
- Traffic Management
- Temporary fence hire incl shade cloth
- Underground service locations
- Material soil testing
- Survey
- Design costs include client-side PM services
- Irrigation main connection point in the vicinity of RO4 treatment plant
- Construction shall be undertaken in the drier months of the year to mitigate the need for dewatering

10 EXCLUSIONS / ASSUMPTIONS

- Client overheads
- Construction side-tracks on the land
- Verge construction
- Relocation of aviation comms and runway lighting supply is understood to be a separate project
- Removal or disposal for acid sulphate soils, PFAS, asbestos and/or any other contaminated soils that may be present on site
- New BHP Boundary HV Switchgear
- BHP headworks charges for new equipment and OH line and supply excluded
- BHP network study
- BHP network upgrade
- Replacement of existing BHP 500kVA substation
- Water / electrical yearly rates
- Alternative power options such as solar PV installation or diesel generators
- Head works associated with water
- Upgrade of existing 2no bores. Preliminary reports suggestion adequate capacity to cater for new development
- Implications associated with Geotechnical report. (No geotechnical report published at time of Order of Possible Costs report)
- Upgrades to existing septic tanks or leach drains at Newman Airport

- Fire Hydrants
- Dewatering
- Rock excavation
- Each lot to have their own retention pond system (Constructed by proponent)
- Extension of the irrigation system to service the GIA industrial lots
- Biofilters, tree pits and/or vegetated swales in car parks and internal roads
- Pervious paving for footpaths
- Roof runoff managed by above or below ground tank to capture roof runoff for reuse, or with a below ground infiltration system
- Temporary cross overs
- Local road connections
- Industrial connections
- Pedestrian walkways & connections
- Median strips in the middle of the road
- Traffic signals (electronic)
- Existing distribution board DB-E8 to be modified as per 9268-SK-E001-A
- Existing aviation comms to be removed as per 9268-SK-E001-A
- Existing services to be removed (Pappi lights and VOR) as per 9268-SK-E001-A
- Existing windsock & electrical connection to be modified
- Upgrades to existing bore holes or any duplication of the existing 70kL storage tank, distribution pumps or any upgrade of the existing RO4 water treatment plant
- Non-Directional Beacon (NDB) navigational aid; Runway lighting cabling; Windsock
- Condition assessment of existing BHP 11/0415kV substation
- Relocation of existing underground services
- Goods and Services Tax

11 MAIN RISK AREAS

The main risk areas associated with cost are:

- Alignment of OPC with project budget
- Scope creep
- Exclusions (as noted above)

12 PUPRPOSE OF THIS DOCUMENT

Please note, this design cost estimate is for project purposes and is not intended, and should not be used in any format, as a tender document. The item descriptions and quantities are not intended for the use by others. Should a tender document be required, then the appropriate document is a Bill of Quantities.

13 LIMITATIONS

The conclusions presented herein are based on the information made available to us during the current design phase and may be subject to change should the information upon which they are based is determined to be false, inaccurate, or incomplete.

The purpose and contents of this document are intended solely for the recipient. If you are not the intended recipient, you are hereby notified that you must not disseminate, copy, or take any action in reliance on it.

14 DISCLAIMER

No warranty, undertaking or guarantee whether expressed or implied, is made with respect to the costs reported or the conclusion drawn within this report. To the fullest extent permitted at law, CACC QS, its officers, employees and agents assumes no responsibility and will not be liable to any third party for, or in relation to any losses, damages or expenses (including any indirect, consequential or punitive losses or damages or any amounts for loss of profit, loss of revenue, loss of opportunity to earn profit, loss of production, loss of contract, increased operational costs, loss of business opportunity, site depreciation costs, business interruption or economic loss) of any kind whatsoever, suffered and incurred by a third party.

15 APPENDICES

15.1 2315_Feasibility OPC Cost Plan Newman Airport Industrial Area v.0

Summary of Cost Plan (+/- 30 Cost Accuracy)				
Description Headings		**Stage 1`**	**Stage 2**	**Total**
1	Contractors Overheads / Preliminaries	1,803,085	2,439,468	4,242,554
2	Earthworks	1,857,730	2,131,570	3,482,000
3	Roadworks	1,841,438	1,781,063	3,622,500
4	Drainage	216,750	293,250	510,000
5	Finishing Works	140,250	189,750	330,000
6	Electrical	1,802,836	854,695	2,657,532
7	Potable Water / Irrigation	420,898	569,451	990,349
8	Margin	471,089	637,356	1,108,445
	Sub-Total Construction Costs	8,554,077	8,896,603	16,943,380
9	Design	864,112	1,169,093	2,033,206
10	Provisional Sums	301,750	408,250	710,000
11	Risk & Contingency	794,846	1,075,380	1,870,226
	Totals	**10,514,785**	**11,549,326**	**21,556,811**

Newman Airport Industrial Area			
Cost Plan Rev.0 Dated 25th February 2021			
Assumed Program (weeks)			**51.00**
Assumed Program (Months)			**12.00**
Assumed Program (Days)			**360.00**
Calculated CV			21,556,811

								10,514,785		11,549,326	
Item	**Description**	**Stg 1**	**Stg 2**	**Total Qty 1&2**	**Unit**	**Rate**	**Amount**	**Stg 1 Amount**	**% of CV Stg 1**	**Stg 2 Amount**	**% of CV Stg 2**
1.00	**Contractor Overheads / Preliminaries**						**4,242,554**	**1,803,085**	**17%**	**2,439,468**	**21%**
1.01	**Non Recurring Overheads**										
1.02	Establish yard/site compound	0.43	0.58	1.00	PS	75,000	75,000	31,875		43,125	
1.03	IT establishment	0.43	0.58	1.00	PS	50,000	50,000	21,250		28,750	
1.04	Services (phone/telecom/power/water) establishment	0.43	0.58	1.00	item	25,000	25,000	10,625		14,375	
1.05	Demobilise & Clean up	0.43	0.58	1.00	item	30,000	30,000	12,750		17,250	
1.06	**Recurring Overheads**										
1.07	Staff salaries	5.10	6.90	12.00	months	153,225	1,838,697	781,446		1,057,251	
1.08	Site light vehicles	153.00	207.00	360.00	days	450	162,000	68,850		93,150	
1.09	Staff travel & accommodation (say 50% of the time)	76.50	103.50	180.00	days	875	157,500	66,938		90,563	
1.10	Site offices 2no x 12x3m	153.00	207.00	360.00	days	140	50,400	21,420		28,980	
1.11	Ablutions block 6x3m incl 4m + urinal / 2F pans incl concrete tie downs & temp	153.00	207.00	360.00	days	60	21,600	9,180		12,420	
1.12	Potable water tank 4.5KL incl concrete tie downs & temp connections	153.00	207.00	360.00	days	50	18,000	7,650		10,350	
1.13	Sewerage holding tank incl concrete tie downs & temp connections	153.00	207.00	360.00	days	50	18,000	7,650		10,350	
1.14	Entrance steps	153.00	207.00	360.00	days	15	5,400	2,295		3,105	
1.15	Surveying (2no surveyors + equipment)	153.00	207.00	360.00	days	2,200	792,000	336,600		455,400	
1.16	Training & Audits	0.43	0.58	1.00	PS	50,000	50,000	21,250		28,750	
1.17	Insurances & Fees	-	-					-		-	
1.18	Contract Works Insurance (0.112%)	0.00	0.00	0.112%	Item	13,500,000	15,120	6,426		8,694	
1.19	Public Liability Insurance (0.200%	0.00	0.00	0.200%	Item	13,500,000	27,000	11,475		15,525	
1.20	Professional Indemnity Insurance (0.05%)	0.00	0.00	0.050%	Item	13,500,000	6,750	2,869		3,881	
1.21	Bank Guarantees (5% for contract duration)	0.43	0.58	1.00	Item	188,377	188,377	80,060		108,317	
1.22	Bank Guarantees (2.5% for Defects Liability Period)	0.43	0.58	1.00	Item	128,890	128,890	54,778		74,111	
1.23	Application Fee	0.43	0.58	1.00	Item	500	500	213		288	
1.24	Small tools & equipment	153.00	207.00	360.00	days	50	18,000	7,650		10,350	
1.25	Non productive labour (5no x workers x 1 day per month)	5.10	6.90	12.00	months	5,000	60,000	25,500		34,500	
1.26	Establish access roads	0.43	0.58	1.00	item	50,000	50,000	21,250		28,750	
1.27	Property condition assessments	6.38	8.63	15.00	days	2,000	30,000	12,750		17,250	
1.28	Construction side tracks	0.43	0.58	1.00	item	-	Excluded	-		-	
1.29	Service location (including NDD)	0.43	0.58	1.00	item	-	Included	-		-	
1.30	Provision of construction water	16.15	21.85	38.00	weeks	3,500	133,000	56,525		76,475	

Item	Description	Stg 1	Stg 2	Total Qty 1&2	Unit	Rate	Amount	Stg 1 Amount	% of CV Stg 1	Stg 2 Amount	% of CV Stg 2
1.31	Traffic management (50% of the time)	57.38	77.63	135.00	days	2,000	270,000	114,750		155,250	
1.32	Project Notice Board	0.43	0.58	1.00	Item	1,320	1,320	561		759	
1.33	Permits	0.43	0.58	1.00	item	20,000	20,000	8,500		11,500	
2.00	**Earthworks - Civil**						**3,482,000**	**1,857,730**	**18%**	**2,131,570**	**18%**
2.01	Stabilise	143,735.00	194,465.00	338,200.00	Item	2	507,300	215,603		291,698	
2.02	Plant mobilisation & demobilisation	0.43	0.58	1.00	each	100,000	100,000	42,500		57,500	
2.03	Tree Removal	190,100.00	148,100.00	338,200.00	m2	2	676,400	380,200		296,200	
2.04	Clear, Grub and Strip Topsoil incl roots & existing rubbish on site	190,100.00	148,100.00	338,200.00	m2	1.5	507,300	285,150		222,150	
2.05	Cut material disposal fee off site say 150mm deep	21,560.25	29,169.75	50,730.00	m3	20	1,014,600	431,205		583,395	
2.06	Fill construction incl compaction testing - say 100mm deep	14,373.50	19,446.50	33,820.00	m3	35	1,183,700	503,073		680,628	
2.07	Verge construction				lm	-	Excluded				
3.00	**Roadworks - Civil**						**3,622,500**	**1,841,438**	**18%**	**1,781,063**	**15%**
3.01	**New Road Construction**										
3.02	Mobilisation / Demobilisation of plant & equipment	0.43	0.58	1.00	PS	50,000	50,000	21,250		28,750	
3.03	Sub grade Compaction and Preparation (Provisional Quantity)	6,162.50	8,337.50	14,500.00	m2	7.5	108,750	46,219		62,531	
3.04	300mm crushed lime (Provisional Quantity)	6,162.50	8,337.50	14,500.00	m2	20	290,000	123,250		166,750	
3.05	200mm crushed rock base course (Provisional Quantity)	6,162.50	8,337.50	14,500.00	m2	25	362,500	154,063		208,438	
3.06	40mm Dense Graded Asphalt (Provisional Quantity)	6,162.50	8,337.50	14,500.00	m2	45	652,500	277,313		375,188	
3.07	Two coat system incl tack coat (Provisional Quantity)	6,162.50	8,337.50	14,500.00	m2	8	108,750	46,219		62,531	
3.08	NATA compaction testing (Provisional Sum)	0.43	0.58	1.00	PS	150,000	150,000	63,750		86,250	
3.09	Provision of road marking (Provisional Sum)	0.43	0.58	1.00	PS	75,000	75,000	31,875		43,125	
3.10	Provision of signage (Provisional Sum) - non electric	0.43	0.58	1.00	PS	50,000	50,000	21,250		28,750	
3.11	Form lot entries	4.68	6.33	11.00	No	15,000	165,000	70,125		94,875	
3.12	Temporary Crossovers	0.43	0.58	1.00	each		Excluded	-		-	
3.13	Local road connections	0.43	0.58	1.00	item		Excluded	-		-	
3.14	Industrial connections	0.43	0.58	1.00	item		Excluded	-		-	
3.15	Semi-mountable kerbing	1,253.75	1,696.25	2,950.00	m	50	147,500	62,688		84,813	
3.16	Pedestrian walkways & connections	0.43	0.58	1.00	item		Excluded	-		-	
3.17	**Great Northern Highway**							-		-	
3.18	Mobilisation / Demobilisation of plant & equipment	1.00		1.00	PS		Included	-		-	
3.19	Sub grade Compaction and Preparation (Provisional Quantity)	5,000.00		5,000.00	m2	7.5	37,500	37,500		-	
3.20	300mm crushed lime (Provisional Quantity)	5,000.00		5,000.00	m2	20	100,000	100,000		-	
3.21	200mm crushed rock base course (Provisional Quantity)	5,000.00		5,000.00	m2	25	125,000	125,000		-	
3.22	40mm Dense Graded Asphalt (Provisional Quantity)	5,000.00		5,000.00	m2	45	225,000	225,000		-	
3.23	Two coat system incl tack coat (Provisional Quantity)	5,000.00		5,000.00	m2	8	37,500	37,500		-	
3.24	NATA compaction testing (Provisional Sum)	1.00		1.00	Item		Included	-		-	
3.25	Provision of road marking (Provisional Sum)	1.00		1.00	Item		Included	-		-	
3.26	Provision of signage (Provisional Sum) - non electric	1.00		1.00	Item		Included	-		-	
3.27	**Upgrade of existing roads**							-		-	
3.28	Mobilisation / Demobilisation of plant & equipment	0.43	0.58	1.00	PS		Included	-		-	

Item	Description	Stg 1	Stg 2	Total Qty 1&2	Unit	Rate	Amount	Stg 1 Amount	% of CV Stg 1	Stg 2 Amount	% of CV Stg 2
3.29	Provision of removing existing road	3,187.50	4,312.50	7,500.00	m2	20	150,000	63,750		86,250	
3.30	Sub grade Compaction and Preparation (Provisional Quantity)	3,187.50	4,312.50	7,500.00	m2	7.5	56,250	23,906		32,344	
3.31	300mm crushed lime (Provisional Quantity)	3,187.50	4,312.50	7,500.00	m2	20	150,000	63,750		86,250	
3.32	200mm crushed rock base course (Provisional Quantity)	3,187.50	4,312.50	7,500.00	m2	25	187,500	79,688		107,813	
3.33	40mm Dense Graded Asphalt (Provisional Quantity)	3,187.50	4,312.50	7,500.00	m2	45	337,500	143,438		194,063	
3.34	Two coat system incl tack coat (Provisional Quantity)	3,187.50	4,312.50	7,500.00	m2	8	56,250	23,906		32,344	
3.35	NATA compaction testing (Provisional Sum)	0.43	0.58	1.00	Item		Included	-		-	
3.36	Provision of road marking (Provisional Sum)	0.43	0.58	1.00	Item		Included	-		-	
3.37	Provision of signage (Provisional Sum) - non electric	0.43	0.58	1.00	Item		Included	-		-	
4.00	**Drainage**						**510,000**	**216,750**	**2%**	**293,250**	**3%**
4.01	Provision to form open V-drains	1,487.50	2,012.50	3,500.00	m	100	350,000	148,750		201,250	
4.02	Provision for culverts underneath crossovers	1.70	2.30	4.00	No	25,000	100,000	42,500		57,500	
4.03	Provision for rock pitching	0.43	0.58	1.00	PS	60,000	60,000	25,500		34,500	
5.00	**Finishing Works**						**330,000**	**140,250**	**1%**	**189,750**	**2%**
5.01	Landscaping works (including maintenance during DLP)	0.43	0.58	1.00	PS	200,000	200,000	85,000		115,000	
5.02	Road & other signage (Included in Roadworks section)	0.43	0.58	1.00	PS		Included	-		-	
5.03	Linemarking (Included in Roadworks section)	0.43	0.58	1.00	PS		Included	-		-	
5.04	W beam Guardfence	0.43	0.58	1.00	PS		-	-		-	
5.05	1800mm high chainlink fencing incl concrete footings at every 3m	850.00	1,150.00	2,000.00	m	65	130,000	55,250		74,750	
5.06	Traffic Signals			Excluded	Intersections		Excluded	Excluded		Excluded	
6.00	**Electrical Works**						**2,657,532**	**1,802,836**	**17%**	**854,695**	**7%**
	Power Distribution										
	Existing distribution board DB-E8 to be modified as per 9268-SK-E001-A			Excluded			Excluded	Excluded		Excluded	
	Existing aviation comms to be removed as per 9268-SK-E001-A			Excluded			Excluded	Excluded		Excluded	
	Existing services to be removed (Pappi lights and VOR) as per 9268-SK-E001-A			Excluded			Excluded	Excluded		Excluded	
	Existing windsock & electrical connection to be modified			Excluded			Excluded	Excluded		Excluded	
	New BHP Boundary HV Switchgear	1.00	-	Excluded			Excluded	Excluded		Excluded	
	New Airport 11kV HV switchgear	1.00	-	1.00	No	132,000	132,000	132,000		-	
	New 11kV feeder cable from boundary RMU to reconnect existing airport substation, 3C 120sqmm Cu XLPE/SCR/PVC/Ny/SWA/PV	508.00	-	508.00	m	330	167,640	167,640		-	
	New 11kV feeder cable from boundary RMU to new industrial area substations, 3C 120sqmm Cu XLPE/SCR/PVC/Ny/SWA/PVC	1,184.00	407.00	1,591.00	m	330	525,030	390,720		134,310	
	Cable joints	2.00	1.00	3.00	No	4,125	12,375	8,250		4,125	
	Local 22/0.415kV substation kiosks, complete with nominal 1MVA transformer, HV switchgear, LV kiosk	2.00	1.00	3.00	No	231,000	693,000	462,000		231,000	
	LV Pillars	5.00	5.00	10.00	No	4,950	49,500	24,750		24,750	

Item	Description	Stg 1	Stg 2	Total Qty 1&2	Unit	Rate	Amount	Stg 1 Amount	% of CV Stg 1	Stg 2 Amount	% of CV Stg 2
	LV cabling from substation to LV pillars, 3x1C 240sqmm Cu XLPE/PVC/NY/PVC	198.00	220.00	418.00	m	198	82,764	39,204		43,560	
	100mm dia electrical conduits for LV feeder + 1 spare 100mm conduit	396.00	440.00	836.00	m	33	27,588	13,068		14,520	
	Turning pits, clean fill sand pits or similar with mechanical protection	4.00	4.00	8.00	No	825	6,600	3,300		3,300	
	Trenching incl bedding sand & backfilling (*Not exceeding 1.5m deep*)	2,286.00	1,067.00	3,353.00	m	85	285,005	194,310		90,695	
	Replacement of existing BHP 500kVA substation			Excluded			Excluded	Excluded		Excluded	
	Communications			-			-	-		-	
	1x100mm dia communications conduit, excl. trenching	795.00	514.00	1,309.00	m	21	28,078	17,053		11,025	
	1x50mm dia communications conduit, excl. trenching	60.00	80.00	140.00	m	21	3,003	1,287		1,716	
	Cable pit (Aco Type 99 Concrete Polymer)	7.00	2.00	9.00	No	3,000	27,000	21,000		6,000	
	Trenching incl backfilling (*Not exceeding 1.5m deep*)	795.00	514.00	1,309.00	m	85	111,265	67,575		43,690	
	Lighting			-			-	-		-	
	Light poles - Single 3m outreach steel standard 12.5m, direct bury incl concrete footings & HD bolts	9.00	8.00	17.00	No	7,500	127,500	67,500		60,000	
	Light fittings - Philips RoadFlair	9.00	8.00	17.00	No	1,500	25,500	13,500		12,000	
	Cable - 2C&E 16sqmm PVC - S&I	1,001.00	880.00	1,881.00	m	25	46,555	24,775		21,780	
	Conduit - 50mm dia HD orange c/w tape - S&I	1,001.00	880.00	1,881.00	m	20	37,244	19,820		17,424	
	Trenching incl backfilling (*Not exceeding 1.5m deep*)	1,001.00	880.00	1,881.00	m	85	159,885	85,085		74,800	
	Tie-ins to 11 lots, terminate & make safe for future use	5.00	6.00	11.00	No	10,000	110,000	50,000		60,000	
				-							
7	**Potable Water / Irrigation**						**990,349**	**420,898**	**4%**	**569,451**	**5%**
	Siteworks										
	Water Reticulation										
	Supply, lay, joint and test pipes and all fittings and services not separately scheduled, excavation, backfill, bedding laying, joining and thrust blocks										
	200mm UPVC	301.75	408.25	710.00	m	74	52,718	22,405		30,313	
	Hydrants complete including tees, risers, boxes and markers										
	200mm UPVC	2.13	2.88	5.00	No	2,475	12,375	5,259		7,116	
	Valves complete including tees, risers, boxes and markers										
	200mm UPVC	0.85	1.15	2.00	No	4,125	8,250	3,506		4,744	
	Deadend with flushing point					-	-	-		-	
	200mm dia P-12	0.43	0.58	1.00	No	1,403	1,403	596		806	
	Cast iron fittings with thrust block										
	Tee 200 x 200 x 200	0.43	0.58	1.00	No	792	792	337		455	
	Bend 200 x 90°	1.28	1.73	3.00	No	726	2,178	926		1,252	
	Supply and install marker posts	5.10	6.90	12.00	No	99	1,188	505		683	

Item	Description	Stg 1	Stg 2	Total Qty 1&2	Unit	Rate	Amount	Stg 1 Amount	% of CV Stg 1	Stg 2 Amount	% of CV Stg 2
	Installation of prelaid lot water service including tapping bands, pipework and valve(s) for Short double service off										
	200mm dia UPVC	2.13	2.88	5.00	No	825	4,125	1,753		2,372	
	Connection to existing mains	0.43	0.58	1.00	Item	4,950	4,950	2,104		2,846	
	Testing and as con	0.43	0.58	1.00	Item	7,425	7,425	3,156		4,269	
	tap protectors	2.13	2.88	5.00	No	140	701	298		403	
	GHS Meters	2.13	2.88	5.00	No	3,300	16,500	7,013		9,488	
	Allow to bore under road	25.50	34.50	60.00	m	850	51,000	21,675		29,325	
						-		-		-	
	Bore Pressure Mains					-		-		-	
	Supply and install DN125 P100 pressure main	1,878.50	2,541.50	4,420.00	m	58	255,255	108,483		146,772	
	Air valves	4.68	6.33	11.00	No	3,300	36,300	15,428		20,873	
	Scour valve	4.68	6.33	11.00	No	3,300	36,300	15,428		20,873	
	Bends	4.68	6.33	11.00	No	743	8,168	3,471		4,696	
	Boring under obstacles/ drains etc	42.50	57.50	100.00	m	850	85,000	36,125		48,875	
	As constructed drawings	0.43	0.58	1.00	Item	8,250	8,250	3,506		4,744	
	Conduits and cables	1,878.50	2,541.50	4,420.00	m	41	182,325	77,488		104,837	
	Extra over for excavation of joint use service trench - including sand bedding, removal of rubble and sand backfill										
	a) 1.8m wide trench for power, telephone, gas			Included			Included			Included	
	b) Sand bedding and backfill			Included			Included			Included	
	Restoration along alignment	1,878.50	2,541.50	4,420.00	m	33	145,860	61,991		83,870	
	Testing and as con	0.43	0.58	1.00	Item	20,000	20,000	8,500		11,500	
	Miscellaneous Items										
	Irrigation main DN100 PE100	301.75	408.25	710.00	m	41	29,288	12,447		16,840	
	BCITF Levy (Included above)			Included		-	Included			Included	
	Allowance for QA and testing	0.43	0.58	1.00	Item	20,000	20,000	8,500		11,500	
8	**Margin**						**1,108,445**	**471,089**	**4%**	**637,356**	**6%**
	Margin @ x% on all Costs	0.03	0.04	0.07	%	15,834,934	1,108,445	471,089		637,356	
	Sub-Total Construction Costs						16,943,380	8,554,077		8,896,603	
9	**Design**						**2,033,206**	**864,112**	**8%**	**1,169,093**	**10%**
	All Consultants inc QS (10% of CV)	0.05	0.07	12%	item	16,943,380	2,033,206	864,112		1,169,093	
10	**Provisional Sums**						**710,000**	**301,750**	**3%**	**408,250**	**4%**
	Rise and Fall (BCI as of Feb 2021 is 179.5 and Forecast start date for Development August 2022 BCI is 187.0)	0.43	0.58	1.00	item	710,000	710,000	301,750		408,250	
11	**Risk & Contingency**						**1,870,226**	**794,846**	**8%**	**1,075,380**	**9%**

Item	Description	Stg 1	Stg 2	Total Qty 1&2	Unit	Rate	Amount	Stg 1 Amount	% of CV Stg 1	Stg 2 Amount	% of CV Stg 2
	Construction risk - 5% of OCs	0.02	0.03	5.0%	%	19,686,585	984,329	418,340		565,989	
	Design risk - 1% of OCs	0.00	0.01	1.0%	%	19,686,585	196,866	83,668		113,198	
	Cost Plan Contingency - 3.5% of OCs	0.01	0.02	3.5%	%	19,686,585	689,030	292,838		396,193	

APPENDIX D

Electrical Infrastructure Servicing Report

NEWMAN AIRPORT INDUSTRIAL AREA

ELECTRICAL INFRASTRUCTURE SERVICING REPORT

Prepared By:	**D. Phelps**
Client:	**Talis Consultants**
Doc Ref:	**9268DP-PR-119889**
Revision:	**B – For Review**
Date:	**22/02/2021**
Reviewed/Approved:	**K. McRae**

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REVISION REGISTER

Revision	Date	Clause No.	Revision Details	Originator	Reviewed	Approved
A	19/02/21		For Review	DP	KM	KM
B	22/02/21		For Review	DP	KM	KM

TABLE OF CONTENTS

1 GENERAL

1.1 Introduction

Engineering Technology Consultants / ETC were engaged by Talis Consultants on behalf of the Shire of East Pilbara to undertake a high level electrical infrastructure servicing report for the Newman Airport Industrial Area project.

The Newman Airport Industrial Area (the Project) comprises of the development of 36 hectares of largely vacant land on the Newman Airport Reserve to create a number of new lots for lease to industrial tenants. New electrical services infrastructure is required to support these lots and the following has been considered by ETC in preparing this report:

- Power distribution infrastructure;
- Telecommunications infrastructure;
- Road lighting.

1.2 Scope of Work

The scope of this report is to address the following:

- Anticipated power requirements;
- Major electrical services infrastructure locations and routes including quantities and locations of electrical plant;
- Description of the proposed methodology for power and communications reticulation;
- Description of the proposed road lighting strategy;
- Opinion of Probable Cost (OPC).

The intent of this report is to outline and summarise the above enabling the Shire of East Pilbara (the Shire) to plan and guide the next phases of the project.

1.3 Staging and Programme

The development is understood to be split into Stage 1 and Stage 2 as shown on the plans.

The timing for each stage is currently unknown.

1.4 Qualifications and Limitations

This report is to be read in conjunction with the qualifications and limitations made below, which includes assumptions made and limitations on our assessment.

Table 1 – Qualifications and Limitations

1	Lots are assumed to not be greenfield lots, and are leasehold lots located on Airport crown land.
2	Power density has been calculated based on 50kVA/ha based on light industrial land use
3	The current HV/LV network design proposal is based on limited discussion with BHP and is subject to change depending on BHP preferences and outcomes of a BHP network study.
3	Proposed HV/LV network design is based on typical Horizon Power type public distribution system. We have not considered implications of BHP requiring installation to BHP specification.
4	The relocation of the following items associated with airside services currently clashing with the proposed land development, and power and telecom infrastructure associated with these items, is assumed will be relocated as part of a separate project, and has not been considered in this report: Non-Directional Beacon (NDB) navigational aid; Runway lighting cabling; Windsock.

5	This report has been prepared based on a desktop study only utilising the site records and documentation provided to ETC which may not correctly reflect the current status, location, type or physical condition of a particular service or installation. A thorough site study/investigation should be commissioned to validate all site information used in preparing this report.

1.5 References

The following primary references were used in preparing this report:

Newman Airport Master Plan v0.1 (JJ Ryan Consulting, 2020)

Newman Airport - Report on the provision of electrical power to Air Services Fire Station from the existing electrical infrastructure (Wood & Grieve Engineers, 2018)

Newman Airport Electrical Services Plan Detail Survey 100618-AS-001-A (MNG, 2018)

1.6 Abbreviations

The following abbreviations have been used.

A, V, W	Amps, Volts, Watts
ADMD	After Diversity Maximum Demand
BESS	Battery Energy Storage System
CASA	Civil Aviation Safety Authority
ETC	Engineering Technology Consultants
LED	Light Emitting Diode
LV	Low Voltage, 50V to 1000V
HV	High Voltage, 1kV to 66kV
kV	Kilovolt, 1000 volts
kVA	Kilovolt-amperes, 1000 volt-amperes
kW	Kilowatt, 1000 watts
kWh	Kilowatt-hour, 1000 watt-hours
OHL	Overhead Power Line
OLS	Obstruction Limit Surface
PD	Power Density
PV	Photovoltaic
WAER	Western Australia Electrical Requirements

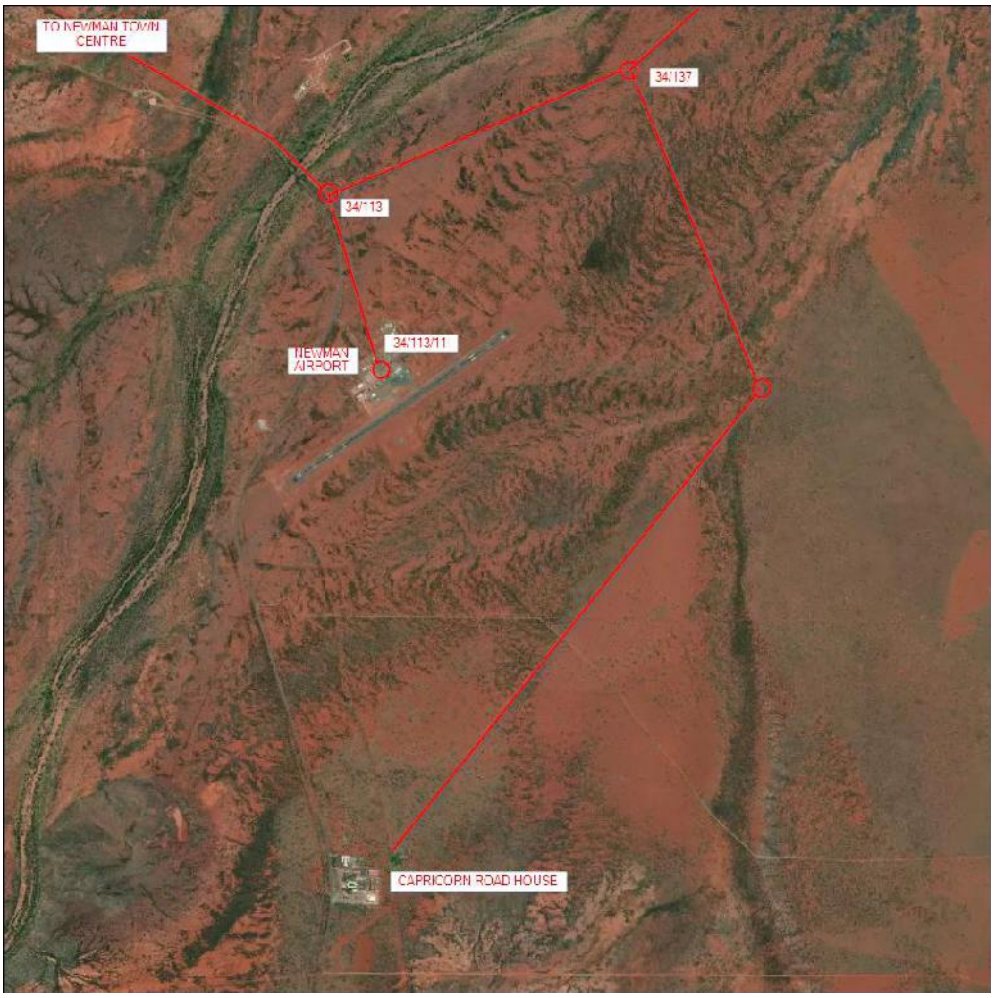
2 POWER DISTRIBUTION

2.1 Existing Supply

BHP, the electricity supply authority for the Newman townsite, provides Newman Airport with electricity via an existing 11kV overhead line that terminates at a BHP owned substation located centrally within the airport. The substation comprises of 2+1 11kV

switchgear and 11/0.415kV 500kVA transformer to provide the airport with a low voltage 415V metered connection point.

Figure 1 - BHP Network



2.2 Development Power Requirements

2.2.1 Methodology

The forecast power requirement is estimated by applying a power density to the developable land area to determine an After Diversity Maximum Demand (ADMD) allocation to each lot. The determination of an appropriate power density is discussed further herein.

The lots, areas and staging considered is based on the following information received:

- E20-115 A01 Rev D 18/08/20

2.2.2 Results

The ADMD determined for each lot is provided below:

Table 2 – Power Demand

Lot	Land Use	Stage	Area (ha)	PD (kVA/ha)	ADMD (KVA)
1	Light Industrial	1	3.67	50	183.5

2	Light Industrial	1	2.95	50	147.5
3	Light Industrial	1	2.46	50	123
4	Light Industrial	1	2.86	50	143
5	Light Industrial	1	2.8	50	140
6	Light Industrial	2	2.24	50	112
7	Light Industrial	2	2.24	50	112
8	Light Industrial	2	2.24	50	112
9	Light Industrial	2	3.15	50	157.5
10	Light Industrial	2	3.74	50	187
11	Light Industrial	2	3.71	50	185.5
	Sub-Total	1	14.74		737
	Sub-Total	2	17.32		866
	Total		**32.06**		**1603**

Prospective tenants should be made aware of the power allocation to prospective lots. Should the Shire currently be in discussion with possible major/anchor tenants, their power requirements should be discussed and agreed and preferably incorporated in the infrastructure design in advance.

2.2.3 Power Density

There is no accurate method for determining power requirements for future development and so power demand requirements for land development are normally forecast by the application of an estimated power density to the development area to be created. The power density considered ranges considerably depending on the proposed land use and has a significant impact on electrical infrastructure requirements.

Normally, for subdivisions in Perth and regional centres, a minimum power density of 200kVA per hectare is applied as a requirement of Western Power and Horizon Power for new lot creation. A prospective developer is aware of the limitations of the power servicing to their purchased lot and understands that should their development require more power than is provisioned, they will be responsible for paying for upgrades to electrical infrastructure to meet an increased power requirement. This is relevant to most commercial subdivisions however light industrial land use, which is understood to be the case for this project, normally comprises of large open spaces, warehouses, laydown yards etc. and so a reduced design power density value is appropriate to avoid over capitalising on oversized electrical infrastructure. For this project in particular, the power density applied will have substantial impact to BHP's existing 11kV OHL.

ETC has previously completed work on various LandCorp (now DevelopmentWA) light industrial estates in Karratha (Gap Ridge, KARSI, Madigan Road), for which a design power density of 50kVA per hectare was determined and agreed with Horizon Power and LandCorp accounting for the type of land use.

On this basis a design power density of 50kVA per hectare is proposed for the Newman Airport industrial area. This requires further discussion and agreement with the relevant

stakeholders however this value has been used for the purposes of this high level servicing report.

2.3 Electrical Network Upgrade Concept Design

2.3.1 Lot Supply Arrangement

As the proposed development lots are not green titled free hold lots subdivided from the Airport lot, and are leasehold lots located on Airport land, it is not permissible under the WA Electrical Requirements (WAER) to supply the proposed lots directly from BHP's network. This will require the new leasehold lots to be supplied from the Airport's privately owned electrical network and therefore the Airport's existing electrical supply will be required to be upgraded to suit.

2.3.2 Existing airport electrical network and capacity

The entire airport is currently served via an existing 500kVA rated transformer. The existing site maximum power demand based on BHP power monitoring between 29 October 2020 and 9 November 2020 is 243kVA however an additional 20% loading is considered for the summer period and so the maximum demand is taken to be 291kVA. The estimated power requirement for Stage 1 and Stage 2 of this project is 737kVA and 866kVA respectively, for a total of 1603kVA which represents a fivefold increase in the Airport's existing power requirement and far exceeds the installed capacity of the network infrastructure.

From discussions with BHP, it is understood the 11kV OHL is at, or very near to, capacity and cannot support any significant extra load without upgrade. The 11kV OHL is shared with a number of other sites/customers. It is envisaged that a significant upgrade will be necessary to BHP's network at the Shire's expense.

BHP currently provides the Airport an LV point of connection at BHP's substation central to the site from which the airport operates an LV network. Due to the distances involved in the development, an LV network will not be sufficient and a new high voltage network will be required.

2.3.3 BHP Network Modification

From initial discussions with BHP, the implications of the increased demand on the BHP network will be subject to a power study that BHP will be required to commission however it is understood that the existing 11kV OHL that enters the site will require replacement. BHP have requested that any such study should include the Airport's ultimate future power requirements and so an Airport electrical masterplan should be commissioned by the Shire to further inform the study.

Any modification to the BHP network would propose to establish a new HV point of supply on the boundary of the airport site so as to not encumber future development land.

The above proposal will require the existing BHP 11/0.415kV substation currently located centrally to the airport site to be disconnected and the existing 11kV OHL currently running through the Airport to be removed by BHP. Subject to agreement between BHP and the Shire, it is proposed that the ownership of the existing substation be transferred to the Shire for re-use in serving the existing airport facilities unchanged. A condition assessment should be completed to ensure the existing substation is in good working order. Alternatively, the substation can be replaced and all existing LV connections re-established.

2.3.4 New Airport Industrial Area HV/LV Network

A new HV network operating at 11kV is proposed to be constructed as the most practicable option to service the new development lots. Upgrade of the existing LV network to supply the development is unlikely to be feasibile due to the magnitude of the increased power

demand, the cabling distances required and the cost of LV infrastructure to the lots. A HV network will be more cost effective and a better overall solution. An advantage of having the airport connected and metered at HV is that a HV tariff will become available (assuming tariffs available are similar to those available on Western Power/Horizon Power networks) which will provide power consumption (kWh) charges at a reduced rate compared to LV tariffs.

A HV network solution will require the Shire to own and operate a high voltage network which will be an operation and maintenance burden on the Shire. It is possible that BHP will agree to maintain and operate this new HV network on the behalf of the Shire, however BHP will have conditions that will be required to be met. From initial discussion, such conditions may include a requirement for the installation to meet BHP specification and for an easement to be placed over the network alignment. Further discussions are required with BHP to understand this further.

A study of the reduced consumption charges against the increased maintenance/operation expenditure will likely reveal an overall saving and therefore a means to recover cost of the initial capital expenditure over time, however this is heavily dependent on the Shire's current tariff arrangement and the availability of a HV tariff from BHP.

The following works to establish a new airport HV network are proposed:

- BHP OHL network modifications as discussed above.
- New HV point of supply at the boundary, comprising of:
  - BHP ground mount HV switchgear and metering unit that will provide HV connection point and demarcation between BHP and Airport networks.
  - Airport ground mount HV switchgear that will be the start of the Airport's network and will provide overcurrent and fault protection for the network
- New underground radial HV supplies as follows:
  - One 11kV feeder cable to the existing airport substation
  - One 11kV feeder cable to the new industrial land area
  - Feeder cabling shall be underground, direct buried, armoured and termite protected
  - Provision for future HV ring for additional supply security if required (HV switchgear provisions only)
- Three (3) new 11/0.415kV kiosk substations, comprising of ring main unit, transformer and LV switchboard to supply multiple lots. Kiosk substation transformers shall typically be 1MVA oil filled type complete with oil bund self-contained within the base of a weatherproof kiosk enclosure to avoid need for concrete oil bunding. Minimum spare capacity of 80% has been considered to the infrastructure.
- LV supplies and connections to each lot from the substation LV switchboard are subject to further discussion and agreement with the Shire as there are various options available. For the purposes of this report, a method similar to a Horizon Power/Western Power solution is proposed which comprises of LV connection pillars at each lot, similar to Horizon Power/Western Power standard uni pillars (green domes) as a cost effective and tried and tested solution. Site conditions may warrant an alternative solution (e.g. free standing switchboard) however this is to be reviewed and considered in detailed design. LV cabling is proposed to be installed in underground conduit to facilitate future replacement however direct buried cable could also be considered.
- All HV, LV, roadway lighting and communications services are proposed to be installed in standard alignment within road reserve to Utility Provider Code of Practice guidelines.

Refer to the following concept design sketches provided in Appendix C.

- SK-E002 HV LV Concept Plan
- SK-E003 HV SLD

2.4 Alternative Power Options

Alternative power options have not been considered in this study, however the following could be considered to reduce the airport's ultimate power loading on the BHP network, justify a reduced power supply requirement and therefore reduce capital expenditure in upgrading the network and reduce ongoing demand and consumption charges.

- Large scale solar PV installation(s) could be installed to offset power draw from the grid, possibly paired with a battery energy storage system (BESS). A BESS may not be worthwhile with the expectation that peak demand would occur at the same time that peak PV power is generated however BHP may require such a system regardless for 'solar smoothing'.
- Use of the airport's existing diesel backup generators to 'load lop' peak demand. This would however require some substantial investment in necessary control and protection systems.

3 TELECOMMUNICATIONS INFRASTRUCTURE

3.1 Overview

The telecommunications servicing is proposed to consist of underground fibre ready conduits and access pits that provide a cable pathway between existing telecommunications presence on site to the development lots. This will enable third party telecommunications providers such as Telstra to install their cabling and provide services connections to prospective tenants on application or request by said tenants to their chosen third party provider.

It is not proposed to extend the Airport or the Shire private telecommunications infrastructure to the development lots as it is not expected the Airport or the Shire will require network presence there.

Due to the above, no requirement to install any cabling or networking equipment as part of these works is envisaged as they will be installed by third party providers and so only cable access (conduit and pit infrastructure) is required.

3.2 Conduit and Pit Infrastructure

Conduit and pit infrastructure is proposed to be provided to Telstra's technical requirements, as it is understood that Telstra already have a presence on site and are the provider most likely to be provide services to tenants. Note that Telstra's requirements will be equal to or more onerous than other provider's requirements.

The conduit and pit infrastructure is proposed to comprise of the following:

- 2x100mm underground conduits to form a 'trunk', terminating at cable pits outside lots;
- 50mm underground conduit stub from pits to lots.

All conduit infrastructure shall be 'fibre ready' to *G.645 Fibre Ready Pit and Pipe Specification for Real Estate Development Projects* and other regulatory standards including AS/CA S009, AS/CA S008 and AS/NZ 3084.

Further discussions will be required with the Shire and Telstra (or other provider) regarding ownership and responsibility of the pit and pipe network however one of the following is envisaged:

- The Shire will retain ownership and maintenance responsibility of the pit and pipe and the Shire will provide licence and access rights to a telecommunications provider (e.g. Telstra) to utilise the pit and pipe for their services; or
- Pipe and pit infrastructure will be gifted to an interested service provider (e.g. Telstra) whom will then be responsible for maintenance.

The outcomes of the above may dictate installation requirements and pit selection, including requirements for pit lids to be embossed to provider requirements. NBNCo should be contacted in future design phases to understand their availability to service the site.

Refer to the following concept design sketch:

- SK-E004 Telecom Concept

3.3 Existing Network Interface

The new pipe and pit network is proposed to be installed to a location which will allow an interface to existing telecommunications provider network infrastructure.

From our desktop review, it is understood there is an existing Telstra tower and fibre distribution enclosure located on the site (adjacent Airport Manager's residence) and the new conduit infrastructure is proposed to terminate there.

This will be required to be verified and confirmed in detailed design.

4 ROADWAY LIGHTING

4.1 Overview

A new road is being created to service the new lots. The new road is an extension of an existing internal airport road and it is noted that this existing road is not currently provided with lighting. The only road lighting that appears to be present on site is at the existing Dewar Avenue entry/intersection with Great Northern Highway to illuminate the intersection (referred to as 'flag lighting'). Carpark lighting also exists with what we understand is solar powered lighting.

There is no mandatory requirement to illuminate the new roads - this is a decision to be made by the Shire however for the purpose of this report ETC has considered new lighting for safety reasons and an order of magnitude cost is provided for consideration and review by the Shire to enable an informed decision.

4.2 Design Criteria

The basis of design used for the road lighting is the Australian Standard AS/NZS 1158.3.1:2020 which provides recommendations for local/minor road lighting. V-Category type lighting to AS/NZS 1158.1.1:2005 is an alternative however in our opinion is not warranted given the expected low traffic volume, low pedestrian activity and increased lighting infrastructure required.

The following criteria considered is summarised below:

- Lighting technical parameters to achieve AS/NZS 1158.3.1:2020 Sub-category PR4 which provides a similar level of lighting to a local road in a suburban area.
- 10 to 12.5m light poles with 3m outreach to maximise pole spacing
- The following lighting options are considered:

  - Option A: Solar powered LED lighting without connection to the 240V electrical network (i.e. stand-alone), similar to the existing carpark lighting.
  - Option B: Traditional 240V network powered LED lighting.
- The airport's obstruction limit surfaces (OLS) has been reviewed and it is determined that the OLS at the closet road exceeds 15m and so poles up to 12.5m tall are not an issue.
- The new roads are located within the Airport's 0cd lighting intensity restriction zone to CASA requirements. This requires that new lighting has no upward lighting component and all lighting is directed downwards. This is typically not an issue for LED type luminaires which have full-cutoff optics (i.e. all light is directed downwards).

4.3 Lighting Selection

Two options were explored for the lighting selection. A solar powered option as per initial request from the Shire (Option A) and a grid connected 240V option (Option B).

4.3.1 Option A – Solar Lighting

The existing solar powered lighting installed to the airport carpark was manufactured by "ECOFx" in 2016, however following investigation it appears that this company is no longer in business.

ETC researched several similar alternative suppliers and have considered a solar powered lighting solution from Green Frog Systems whom ETC have experience with for a number of Perth based projects. We understand also they are a preferred supplier to City of Karratha (their products are installed in the town centre) as well as a number of other installations in regional Western Australia and so appear to have demonstrated experience in remote and harsh installations.

ETC has considered the GFS-200 or GFS-400 product which are very similar to the ECOFx product already installed. Some of these options can be considered equivalent in performance to traditional grid connected lighting solution, however the costs per pole are significantly higher due to the solar panel and battery requirements. These additional costs are offset somewhat by not requiring the extra 240V cable and conduit infrastructure associated with grid connected lighting, however on review in ETC's opinion the solar lighting option will not be a more cost effective option. Note that solar powered lighting also has additional reliability, longevity and maintenance considerations.

ETC has not assessed the overall energy savings from a solar solution which are also a consideration however a building mounted PV installation is considered a more efficient means to offset roadway lighting energy consumption.

4.3.2 Option B – Grid Connected Lighting

For this option we considered standard Western Power / Horizon Power type installation which is a 12.5m galvanized octagonal steel pole with 3m outreach and LED Philips RoadFlair or RoadGrace luminaire.

This option appears to provide better performance than Option A and is a most cost effective option, even when considering the additional cable and conduit infrastructure. This option has been considered for this report.

4.4 Lighting Design

Preliminary calculations were completed based on the Option B solution. The following pole spacings were determined for a 25m road reserve width as per the current development proposal.

Table 3 – Light Pole Spacing Table

Configuration	Height	Outreach	Pole Spacing
RoadGrace 53W	12.5m	3m	-
RoadFlair 80W	12.5m	3m	95m
RoadFlar 160W	12.5m	3m	110m

On the basis of the above results, the 160W configuration is considered for the purposes of this report.

5 OPINION OF PROBABLE COST

An Opinion of Probable Cost (OPC) is provided in Appendix A. Noting the early stages of this project, the OPC should be considered an order of magnitude estimate only.

6 APPENDIX A – OPINION OF PROBABLE COST

REF		ITEM	QTY PER STAGE 1	QTY PER STAGE 2	TOTAL QTY	UNIT	RATE	AMOUNT	REMARKS
1		**ELECTRICAL SERVICES**							
1.1		**Power Distribution**							
>	1.1.1	*New BHP Boundary HV Switchgear*	1			ea		$ -	Excluded
>	1.1.2	*New Airport 11kV HV switchgear*	1		1	ea	80,000.00	$ 80,000.00	
>	1.1.3	*New 11kV feeder cable from boundary RMU to reconnect existing airport substation, 3C 120sqmm Cu XLPE/SCR/PVC/Ny/SWA/PVC*	508		508	m	200.00	$ 101,640.00	
>	1.1.4	*New 11kV feeder cable from boundary RMU to new industrial area substations, 3C 120sqmm Cu XLPE/SCR/PVC/Ny/SWA/PVC*	1,184	407	1,591	m	200.00	$ 318,120.00	
>	1.1.5	*Cable joints for items 1.2.1, 1.2.2*	2	1	3	ea	2,500.00	$ 6,750.00	
>	1.1.6	*Local 22/0.415kV substation kiosks, comlpete with nominal 1MVA transformer, HV switchgear, LV kiosk*	2	1	3	ea	140,000.00	$ 420,000.00	
>	1.1.7	*LV Pillars*	5	5	10	ea	3,000.00	$ 30,000.00	
	1.1.8	*LV cabling from substation to LV pillars, 3x1C 240sqmm Cu XLPE/PVC/NY/PVC*	198	220	418	m	120.00	$ 50,160.00	
>	1.1.9	*100mm dia electrical conduits for LV feeder + 1 spare 100mm conduits*	396	440	836	m	20.00	$ 16,720.00	Rate for single conduit
>	1.1.10	*Turning pits, clean fill sand pits or similar with mechanical protection*	4	4	8	ea	500.00	$ 4,200.00	
>	1.1.11	*Trenching*						$ -	Excluded, by civil
>	1.1.12	*Replacement of existing BHP 500kVA substation*						$ -	Not assessed, assumed to be gifted
1.2		**Communications**							
>	1.2.1	*1x100mm dia communications conduit, excl. trenching*	795	514	1,309	m	13.00	$ 17,017.00	Rate for single conduit
>	1.2.2	*1x50mm dia communications conduit, excl. trenching*	60	80	140	m	13.00	$ 1,820.00	Rate for single conduit
>	1.2.3	*Cable pit*	7	2	9	ea	1,200.00	$ 10,934.80	
>	1.2.4	*Trenching*							Excluded, by civil
1.3		**Lighting**							
>	1.4.1	*Light poles - Single 3m outreach steel standard 12.5m, direct bury*	9	8	17	ea	3,500.00	$ 59,850.00	
>	1.4.6	*Light fittings - Philips RoadFlair*	9	8	17	ea	1,500.00	$ 25,650.00	
>	1.4.8	*Cable - 2C&E 16sqmm PVC - S&I*	1,001	880	1,881	m	15.00	$ 28,215.00	
>	1.4.9	*Conduit - 50mm dia HD orange c/w tape - S&I*	1,001	880	1,881	m	12.00	$ 22,572.00	
>	1.4.10	*Trenching*							Excluded, by civil
1.4		**Other**							
>	1.5.1	*BHP network study*							Not assessed
>	1.5.2	*BHP network upgrade*							Not assessed

Stage 1	$ 844,085.90
Stage 2	$ 349,562.90
TOTAL (Excl. GST)	$1,193,648.80

NOTES AND QUALIFICATIONS

1. This OPC is based on a concept design only, is subject to change and so shall be considered an order of magnitude cost only.
2. GST excluded
3. Escalation excluded
4. Head Contractor's margin & supervision excluded
5. Reinstatement of all existing surfaces including paving, turf, gardens etc. excluded
6. Preliminaries including rubbish removal, cleaning, storage, site amenities etc. excluded
7. Traffic Management excluded
8. Dewatering excluded
9. Annual costs excluded
10. All rates are ex Perth. Regional loading has not been applied.
11. BHP headworks charges for new equipment and OH line and supply excluded
12. Contingency/uncertainty has not been applied.

7 APPENDIX B – BHP CORRESPONDENCE

Daniel Phelps

From: Ferreira, Tony <tony.ferreira@bhp.com>
Sent: Tuesday, 16 February 2021 10:57 AM
To: Daniel Phelps
Cc: Hunter, Gary; Fonseca, Aline
Subject: RE: Newman Airport - Industrial Land Development
Attachments: 059-E-00377_15.pdf; Airport LV.pdf; Airport LV CCT.pdf; APPENDIX C DESIGN AND QUOTATION APPLICATION FORM.pdf; PS83 Load Logging.xlsx

Hi Daniel,

With reference to the mail received regarding the upgraded supply to the Newman Airport, we hereby comment as follows:

The airport is currently on an LV connection supplied from padsub, PS83 (500kVA). The existing configuration is indicated on the attached drawings, 059-E-00377. The existing route of the overhead line is indicated on the attached drawing, "2021-02-03 Overview for BHP TF Review". Unfortunately I do not have any information pertaining to the internal LV distribution apart of the attached drawings, "Airport LV and Airport LV CCT".
With the proposed development, the entire electrical connection will have to be assessed and altered to comply with the current requirements and the BHP Technical Rules and Standards.

As previously mentioned, a load study will need to be done on the existing overhead line before any additional load is added. The existing overhead line is currently at its maximum loading and parameters. Any additional loads may result in either an new line being constructed or the existing line being altered to accommodate the increase in load. The estimate duration of the load study is approximately 8 weeks upon which an estimate budget figure would be available for the proposed changes to the HV overhead line.

With regards to the request load increase, the following:

1. ***Appropriate type of connection:***
    a. On reviewing the information provided and discussing the proposed development with the UNA Superintendent, the following options may be explored in making the connection available:
        i. The existing overhead line within the lot boundary is to be rerouted and an appropriate HV Connection established that incorporates the existing padsub, PS83.
        ii. BHP may operate and maintain the electrical distribution infrastructure network on condition that all electrical services are installed in accordance to the Utility Providers Code of Practice for Western Australia and installed with easement registered over the installed services.
2. ***Estimated Load Demand:***
    a. The estimated load demand of approximately 2MVA has been provided for Stages 1 and 2;
    b. For the existing load, an allowance of 500kVA will be made for PS83.;
    c. To my knowledge, the emergency services and control tower is on generator power. If this is the case, has provision been made to include these facilities into the mains supply? If so, has this load incorporated into the 2MVA load demand?
    d. With reference to the proposed development drawing provided "2021-02-03 Overview for BHP", there is still a vast amount of land that is still to be developed. In order to allow for these loads in the load study, are we able to be advised of the proposed estimated loads for the future. It would be beneficial to include these future loads now in order to avoid in having to redo both the load study and further line upgrades.
3. ***Additional Notes:***
    a. With regards to the additional notes from our discussion, please refer to my comments in RED below.

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i. BHP confirmed airport currently connected at LV via BHP padmount substation (size unknown). BHP OH 11kV lines that originate from the town centre supply the substation, and this OH line also supplies other customers.
As mentioned above, existing padsub, PS83 is 500kVA.
Attached is a copy of some load logging records done on PS83. We advise that there are some logging records done on 3/03/2016 to 17/03/2016 which has failed.

ii. ETC current estimate of required additional power is in the order of 1.5 – 2MVA for Stages 1 & 2.
As requested in item 2 above, does these loads include the emergency services and tower. Confirmation is also required with regards to the remainder of the land that may be developed.

iii. BHP noted they would need to carry out a power line study to assess the impact of the above, as initiated by a formal request from ourselves/Shire to do so. Such a study would take in the order of 8 – 12 weeks, and a cost in the order of $40k.
The costs for the load study will be covered by BHP/UNA. However, in order to initiate the load study and review of the requested increase in load demand, the attached copy of the Design and Quotation Application (DQA) is to be completed and returned to our office. There will be an nominal fee charged for the review of the application and portion of the load study to be done.

iv. BHP would like to understand the future plans of the airport and long term load implications, as they would want to consider this in their study also. They would rather upgrade the power line once as a long term solution.
Correct, as referred to in item 2 and ii above.

v. BHP can provide ETC on details of the connection into the airport, not they do not have details of the airport's private network.
Correct, refer to attached drawings.

vi. ETC/BHP suggested the airport may require a HV connection point (instead of LV currently) in which case the airport will need to establish their own private HV network. The extra capital expenditure to establish this is a consideration, but moreso is the ongoing maintenance and operational expenditure required (HV installations have more onerous maintenance requirements than LV).
As mentioned above, a HV connection may be established for revenue aspects with an separate agreement for the operating and maintenance of the internal distribution network. Should the option be for BHP/UNA to operate and maintain the infrastructure within the Newman Airport boundaries and to avoid any uncertainties and irregularities for the maintenance strategies, operating of equipment, fault finding, etc., it may be requested that the assets to be installed on the internal network be equal and or similar to the assets installed within the Newman Township distribution network.

vii. Note that given lack of information on the Airport's existing private network it is likely that we will end up on site in the coming weeks to review the existing network ourselves to obtain the information we need. It would be great to organise a meeting with yourself and the airport's representative to discuss the project. Would you be willing to attend such a meeting if organised?
The only information that can be provided on the internal distribution is the copy of the drawing attached, "Airport LV and Airport LV CCT" being the LV Main switchboard schematic. I'd also like to advise that due to the age of the installation and our records not being updated with regards to private networks, the attached drawing may need to be verified on site.
With regards to the meeting proposed, I'm in favour of such a meeting to be held. I'm normally in Newman on a Monday to Thursday basis.

We trust that the abovementioned and attached information is in order and acceptable. Should there be any further information or outstanding queries please do not hesitate to contact myself.

Kind Regards,

2

BHP

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From: Daniel Phelps <dphelps@etcpl.com.au>
Sent: Wednesday, 3 February 2021 9:12 PM
To: Ferreira, Tony <tony.ferreira@bhp.com>
Subject: FW: Newman Airport - Industrial lande development

Hi Tony,

Thanks for your time on the phone last week. As discussed, we're electrical engineering consultants part of a team engaged by the Shire of East Pilbara to complete a feasibility study for the proposed Newman Airport Industrial Area.

As requested, I've attached the proposed project area. It is effectively a light industrial subdivision project, but land is not being subdivided into new green title lots – they will be leasehold lots on airport land. As such, the preferred method of servicing the lots directly via BHP's network would not be allowable under the WA Electrical Rules and so we expect the lots will need to be served via the Airport's private network. I expect we'll need to establish a new HV network for the airport if the airport is currently connected at LV as per our discussion.

Stage 1 comprises about 15ha of new land, Stage 2 about 17ha. I am assuming a power density for this light industrial land in the order of 50kVA per hectare based on similar assessments we have done on light industrial land at Perth Airport. This gives a rough estimate of 0.74MVA + 0.86MVA for Stage 1 and 2 respectively, for a total of 1.6MVA additional load on the airport network.

I don't have details of the airport's existing network or demand. As discussed if you have any details you could share it would be appreciated.

If a new HV network is established, as you mentioned the airport is not going to have the expertise to operate the network themselves and they'll need to contract it out. Would BHP offer to operate on the Airport's behalf? We have explored similar arrangements with Western Power with private HV customers and thought BHP may do so also.

Finally, I believe you mentioned BHP previously commissioned a study for the airport a year or so back – possibly something to do with adding a caravan park site. The Airport mentioned this but they haven't been able to provide a copy of the report/study. Would you be able to share that?

Some further notes from our discussion FYI. If I've got anything wrong here please let me know,

- BHP confirmed airport currently connected at LV via BHP padmount substation (size unknown). BHP OH 11kV lines that originate from the town centre supply the substation, and this OH line also supplies other customers.
- ETC current estimate of required additional power is in the order of 1.5 – 2MVA for Stages 1 & 2.

3

- BHP noted they would need to carry out a power line study to assess the impact of the above, as initiated by a formal request from ourselves/Shire to do so. Such a study would take in the order of 8 – 12 weeks, and a cost in the order of $40k
- BHP would like to understand the future plans of the airport and long term load implications, as they would want to consider this in their study also. They would rather upgrade the power line once as a long term solution.
- BHP can provide ETC on details of the connection into the airport, not they do not have details of the airport's private network.
- ETC/BHP suggested the airport may require a HV connection point (instead of LV currently) in which case the airport will need to establish their own private HV network. The extra capital expenditure to establish this is a consideration, but moreso is the ongoing maintenance and operational expenditure required (HV installations have more onerous maintenance requirements than LV).

Note that given lack of information on the Airport's existing private network it is likely that we will end up on site in the coming weeks to review the existing network ourselves to obtian the information we need. It would be great to organise a meeting with yourself and the airport's representative to discuss the project. Would you be willing to attend such a meeting if organised?

Regards,

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8 APPENDIX C – CONCEPT SKETCHES

EXISTING FLAG LIGHTING AT INTERSECTION

NOTE: UNDERGROUND SERVICES DEPICTED ON THIS PLAN ARE
INDICATIVE ONLY AND NOT TO BE RELIED UPON.
PHYSICAL LOCATION OF UNDERGROUND SERVICES IS RECOMMENDED PRIOR TO ANY DETAILED DESIGN
OR CONSTRUCTION WORKS PROPOSED FOR THE SITE.

GREAT NORTHERN HWY

DEWAR AVE

LEGEND
- EARTH PIT
- TELSTRA PIT
- UNKNOWN PIT
- POWER DOME
- POWER CABLE PIT
- BUILDING
- FENCE
- BOTTOM OF KERB
- TOP OF KERB
- SUPPLY FEED IN
- MAIN SUPPLY FEED

01 3.67 HA (STAGE 1)
02 2.95 HA (STAGE 1)
03 2.46 HA (STAGE 1)
04 2.86 HA (STAGE 1)
05 2.80 HA (STAGE 1)
06 2.24 HA (STAGE 2)
07 2.24 HA (STAGE 2)
08 2.24 HA (STAGE 2)
09 3.15 HA (STAGE 2)
10 3.74 HA (STAGE 2)
11 3.71 HA (STAGE 2)

EASEMENT

RELOCATION OF AVIATION COMMS AND RUNWAY LIGHTING SUPPLY IS UNDERSTOOD TO BE A SEPARATE PROJECT

RELOCATION OF AVIATION COMMS AND RUNWAY LIGHTING SUPPLY IS UNDERSTOOD TO BE A SEPARATE PROJECT

EXISTING WINDSOCK AND ELECTRICAL CONNECTION TO BE MODIFIED

INCOMING BHP 11KV LINE

BHP SUBSTATION INCLUDING:
- 2+1 RMU
- 500KVA TRANSFORMER

NEW & OLD SITE MAIN SWITCHBOARD

GENERATOR ROOM

EXISTING DISTRIBUTION BOARD DB-E8 TO BE MODIFIED

EXISTING AVIATION COMMS TO BE REMOVED

EXISTING SERVICES TO BE REMOVED:
- PAPPI LIGHTS AND VOR

DISTRIBUTION BOARD NO 1
FED FROM DB-2 SMSB
DISTRIBUTION BOARD NO 2
FED FROM DB-3 (SMSB CB-1)
DISTRIBUTION BOARD NO 10
FED FROM DB-2 (SMSB CB-2)
DOME FED FROM DB-3 FED FROM SMSB CB-1
HOUSING SWITCH BOARD FED FROM DOME SMSB CB-5
RESIDENTIAL HOUSING
RO PLANT
HV POWER POLE
HV CABLE
LV CABLE
UNKNOWN MANHOLE
DISTRIBUTION BOARD NO 4
FED FROM SMSB CB-3
DISTRIBUTION BOARD NO 3
FED FROM DB-4 (SMSB CB-1)
HERTZ
THRIFTY DISTRIBUTION BOARD NO 9
WORKSHOP
ADMIN
THRIFTY
WEATHER STATION
DISTRIBUTION BOARD NO 7
FED FROM SMSB CB-4
AVIS CAR RENTAL
AVIS WORKSHOP
BUDGET WORKSHOP
BUDGET
PILBARA FLEET
DISTRIBUTION BOARD NO 11
FED FROM SMSB CB-4
GENERATOR
FIRE STATION
HELIWEST
POLAR AVIATION
FUEL FARM
COMMS
OFFICES
QANTAS
COURIER POWER
AIRPORT TERMINAL
BAGGAGE COLLECTION AREA
END OF SURVEY PICKUP
APRON
HELIWEST OFFICE
SHED CONTAINER
FORTESCUE OFFICE
DISTRIBUTION BOARD NO 6
FED FROM DB-5 (SMSB CB-4)
ANTENNA
AVIATION COMMUNICATION FACILITY
TAXI WAY ALPHA
TAXI WAY BRAVO
OLD MAIN YARD
FIRE PUMP
LONG TERM CAR PARKING
SHORT TERM CAR PARKING
POWER PIT
AVIATION COMMS
DISTRIBUTION BOARD NO 8
FED FROM DB-4
WIND SOCK
PAPPI LIGHTS
APPROXIMATE LOCATION OF CONDUIT

NEWMAN AIRPORT INDUSTRIAL AREA

9268-SK-E001-A
EXISTING SITE SERVICES OVERLAY
19 FEBRUARY 2021

SCALE 1:2500 (NTS IF PRINTED)

EXISTING BHP 11KV OHL TO BE REPLACED

NEW BHP 11kV OHL TO SUPPORT NEW LOAD, ROUTE TO AVOID FUTURE AIRPORT DEVELOPMENT

NEW HV SWITCHGEAR AT AIRPORT SITE BOUNDARY
- BHP HVS
- BHPHV METERING UNIT
- AIRPORT HVS 0+3

11KV SUPPLY 1
UNDERGROUND SUPPLY TO AIRPORT TRANSFORMER

11KV SUPPLY 2
UNDERGROUND SUPPLY TO NEW DEVELOPMENT

NORTH

GREAT NORTHERN HWY

EDWARD ROAD

392.71 m

462.56 m
835.97 m

NOTE: UNDERGROUND SERVICES DEPICTED ON THIS PLAN ARE
INDICATIVE ONLY AND NOT TO BE RELIED UPON.
PHYSICAL LOCATION OF UNDERGROUND SERVICES IS RECOMMENDED PRIOR TO ANY DETAILED DESIGN
OR CONSTRUCTION WORKS PROPOSED FOR THE SITE.

LEGEND
- EARTH PIT
- TELSTRA PIT
- UNKNOWN PIT
- POWER DOME
- POWER CABLE PIT
- BUILDING
- FENCE
- BOTTOM OF KERB
- TOP OF KERB
- SUPPLY FEED IN
- MAIN SUPPLY FEED

01 3.67 HA (STAGE 1) — 183kVA 254A
02 2.95 HA (STAGE 1) — 147kVA 205A
03 2.46 HA (STAGE 1) — 123kVA 171A
04 2.86 HA (STAGE 1) — 143kVA 199A
05 2.80 HA (STAGE 1) — 140kVA 194A
06 2.24 HA (STAGE 2) — 112kVA 155A
07 2.24 HA (STAGE 2) — 112kVA 155A
08 2.24 HA (STAGE 2) — 112kVA 155A
09 3.15 HA (STAGE 2) — 157kVA 218A
10 3.74 HA (STAGE 2) — 187kVA 260A
11 3.71 HA (STAGE 2) — 185kVA 257A

P SUB1 P
P SUB2 P
P SUB3 P

DISTRIBUTION BOARD NO 1 FED FROM DB-2 SMSB
DISTRIBUTION BOARD NO 2 FED FROM DB-1 (SMSB CB-1)
DISTRIBUTION BOARD NO 10 FED FROM DB-2 (SMSB CB-2)
DOME FED FROM DB-3 FED FROM SMSB CB-1
HOUSING SWITCH BOARD FED FROM DOME SMSB CB-2 RESIDENTIAL HOUSING
RO PLANT
HV POWER POLE
DISTRIBUTION BOARD NO 4 FED FROM SMSB CB-3
DISTRIBUTION BOARD NO 3 FED FROM DB-4 (SMSB CB-1)
HV CABLE
LV CABLE
UNKNOWN MANHOLE
HERTZ
THRIFTY DISTRIBUTION BOARD NO 9 FED FROM SMSB CB-4
WEATHER STATION
DISTRIBUTION BOARD NO 8 FED FROM SMSB CB-4
DISTRIBUTION BOARD NO 7 FED FROM SMSB CB-4
AVIATION COMMS
AVIS CAR RENTAL
AVIS WORKSHOP
BUDGET WORKSHOP
BUDGET
PILBARA FLEET
DISTRIBUTION BOARD NO 6 FED FROM SMSB CB-4
GENERATOR
FIRE STATION
HELIWEST
POLAR AVIATION
FUEL FARM
DISTRIBUTION BOARD NO 5 FED FROM DB-5 (SMSB CB-4)
OFFICE
SHED
CONTAINER
PORTACRANE
ANTENNA
PAPPI LIGHTS AND VOR
EASEMENT
SHORT TERM CAR PARKING
LONG TERM CAR PARKING
FIRE PUMP
POWER PIT
COMMS POWER
OFFICES
AIRPORT TERMINAL
BAGGAGE COLLECTION AREA
END OF SURVEY PICKUP
APRON
AVIATION COMMUNICATION FACILITY
TAXI WAY ALPHA
TAXI WAY BRAVO
MAIN YARD
WIND SOCK
PAPPI LIGHTS
APPROXIMATE LOCATION OF CONDUIT

EXISTING BHP SUB TO BECOME AIRPORT ASSET

INCOMING BHP 11KV LINE

BHP SUBSTATION INCLUDING:
- 2+1 RMU
- 500KVA TRANSFORMER

NEW & OLD SITE MAIN SWITCHBOARD

GENERATOR ROOM

EXISTING DISTRIBUTION BOARD DB-E8 TO BE MODIFIED

EXISTING AVIATION COMMS TO BE REMOVED

EXISTING SERVICES TO BE REMOVED:
- PAPPI LIGHTS AND VOR

EXISTING WINDSOCK AND ELECTRICAL CONNECTION TO BE MODIFIED

NEWMAN AIRPORT INDUSTRIAL AREA

9268-SK-E002-A
PROPOSED HV/LV NETWORK SKETCH
19 FEBRUARY 2021

SCALE 1:2500 (NTS IF PRINTED)

TO POLE 34/18 059-E-00287 (A)

34/19 — 150/200

34/20

3x1C 300mm² AL XLPE

PS110 630kVA Z=4.0% — 630A, 200A — PINGANDY ST

3x1C 300mm² AL XLPE

3x1C 400mm² AL XLPE

3x1C 400mm² AL XLPE (U) TO PS125 059-E-00287

3x1C 240mm² AL XLPE

PS11 BRAESIDE DRIVE 059-E-12047 630kVA Z=4.24%

PS12 BONDINI DRIVE 059-E-12048 630kVA Z=4.23%

PS13 BONDINI DRIVE 059-E-12049 630kVA Z=4.25%

PS14 BONDINI DRIVE 059-E-12050 630kVA Z=4.27%

PS103 630kVA Z=4.0% — 630A, 200A — PINGANDY ST

3x1C 240mm² AL XLPE 6.35/11kV

PS17 ARMSTRONG WAY (BANJOLA) 059-E-12053 630kVA Z=4.28%

PS16 ARMSTRONG WAY 059-E-12052 630kVA Z=4.22%

PS15 KARRAWAN WAY 059-E-12051 630kVA Z=4.22%

PS24 DANIELS DRIVE 059-E-12057 630kVA Z=4.22%

PS23 NIMINGARRA DRIVE 059-E-12056 630kVA Z=4.27%

PS22 KNOX WAY 059-E-12055 630kVA Z=4.28%

PS21 NIMINGARRA DRIVE 059-E-12054 630kVA Z=4.29%

PS115 DANIELS DRIVE 059-E-30711 1000kVA Z=4.92%

PS116 FLETCHER LOOP 059-E-30712 1000kVA Z=4.92%

PS117 MACPHEARSON CIRCUIT 059-E-30713 1000kVA Z=4.92%

PS118 MACPHEARSON CIRCUIT 059-E-30714 1000kVA Z=4.92%

34/161 — 20/100 200kVA Z=4.12% — WATER BORE K21

34/159

NOT BHP ASSET

34/137 — 40/100 — CRH-001 METER — CRH-002 — CRH-003 RECLOSER — 1000KVA CAPRICORN ROADHOUSE

34/114 — 80/100

34/113 — 400A — 34/113/11 — 40/100

PS83 AIRPORT — 630A, 200A — 100/50 500kVA Z=3.9%

BHP ASSET PS83 TRANSFER TO AIRPORT OR REPLACE WITH NEW (TBC)

34/36

34/112/CB — 63A — VS — 1100 kVAr

NEW GROUNT MOUNT SWITCHGEAR IN EXTERNAL KIOSK ENCLOSURE LOCATED ON AIRPORT BOUNDARY

NEW GROUND MOUNT KIOSKS TO PROVIDE LV SUPPLIES TO INDUSTRIAL LOTS

BHP HVS — IS IS METER IS

AIRPORT HVS — CB CB CB

34/107

3C 300mm² AL PLY ROAD CROSSING GREAT NOTHERN HIGHWAY

34/106

TO POLE 34/48/1 059-E-00287 (B)

34/48 — 1-3c 0.3sq" AL PLY

34/49 — 34/51 — 34/52 — 80A, 30A — NOTE 1

1x3C 185mm² AL XLPE

3C 70mm² Cu XLPE

3C 70mm² Cu XLPE

3C 240mm² Cu XLPE

3C 240mm² Cu XLPE

34/47 — 150/200

34/46 — 150/200

34/44

34/43

34/42 — 150/200

34/41

34/40/CB — 40A — VS — 550 kVAr

34/37 RECLOSER

34/54

34/64 RECLOSER

34/71 — 10/100 — T86 GUN CLUB 50KVA Z=2.41%

34/97 — 400A

34/97/2 — 80A — 3C 185mm² AL XLPE

34/97/2/2

T92 MLC 2040 CORNER B PUMP STATION 1000kVA Z=4.22%

PS27 630kVA Z=4.03% — NEWMAN CARAVAN PARK

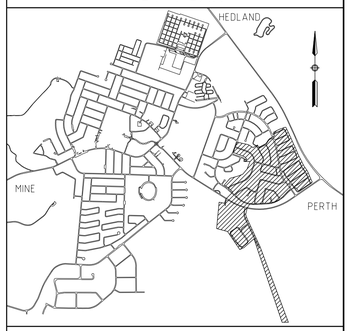
PS81 1000kVA Z=4.72% — GUN CLUB ROAD

PS31 — ECO VILLAGE GUN CLUB ROAD 500KVA Z=4.15%

NEWMAN AIRPORT INDUSTRIAL AREA

9268-SK-E003-A
PROPOSED HV/LV NETWORK SLD
19 FEBRUARY 2021

KEY PLAN



LEGEND

- 11/0.433KV 3Φ TRANSFORMER
- 11KV 3 POLE SWITCH FUSE NOT LOAD BREAKING
- 11KV 3 POLE SWITCH FUSE - LOAD BREAKING
- 11KV DROP-OUT FUSE
- 400A 11KV ISOLATOR - NOT LOAD BREAKING
- 400A 11KV ISOLATOR - 200A LOAD BREAKING
- VACUUM SWITCH ISOLATOR - LOAD BREAKING
- CIRCUIT BREAKER
- HV LINK
- FUSE
- LIGHTNING ARRESTOR
- NORMALLY OPEN
- 11KV OVERHEAD LINE
- 11KV UNDERGROUND CABLE
- UNDERGROUND CABLE JOINT
- 32/38/18 POLE NUMBER
- CAPACITOR BANK

TRANSITION FROM 3C 185mm² Al PAPER/LEAD BELTED SECTOR CABLE TO 12.7/22kV 1 C 185mm² Al BUNDLED XLPE/NY/PVC 10 METRE EXTENSIONS

POLE NUMBER → XXX / XX / NXX / NXX

VOLTAGE
0 = 433V
1 = 3.3KV
2 = 6.6KV
3 = 11KV
4 = 66KV
5 = 132KV

1st FEEDER NUMBER
2nd FEEDER NUMBER
Nth POLE ON MAIN LINE
FOR MUTI-TEE-OFF OFF SAME POLE
Nth POLE ON 1st SPUR LINE
FOR MUTI-TEE-OFF OFF SAME POLE
Nth POLE ON 2nd TEE-OFF, OFF SPUR LINE

OVERHEAD CONDUCTORS

L	LEMON	--	30/7/3.00
B	BANANA	--	6/1/3.75
C	CHERRY	--	6/4.75 7/1.50
M	MINK	--	6/1/3.66
P	PHOSPHORUS	--	37/3.75 AAAC/1120

NOTES

1. OLD CABLE AT POLE 34151 TO PS27 DISCONNECTED, CAPPED AND ABANDONED.

NEWMAN TOWNSHIP DISTRIBUTION SYSTEM DRAWING INDEX	059-E-30402
CONTRACT NUMBER OR PURCHASE ORDER NUMBER	
REFERENCE DOCUMENTS	**DOC NO**

NO	DATE	REVISION Revision Approvals by Designer/Contractor confirms designs are in accordance with BHPIO SEP-57 procedures	DES BY	DRN BY	CHK BY	DES/ HSEC	BHPIO	DATE
11	03.12.15	AS BUILT - SMALL CORRECTIONS TO POLE DOF'S CROSS REFERENCE LETTER REVISED DUE TO DUPLICATION	N-A	WJM	TF	JB	AB	28.06.16
10	07.04.15	AS BUILT - NOP MOVED TO PS81 RMU PS27 FEEDER CHANGED FROM SWITCH FUSE TO ABS	N-A	WJM	KS	MJ	DOuC	22.04.15
9	31.10.14	PS115 THROUGH PS118 ADDED - AS BUILT	WJM	WJM	ER	KMuC	KMuC	22.01.15
8	10.08.14	UPDATED - AS BUILT	PB	PB	MDG	MDG	MDG	12.04.14
15	12.01.21	AS-BUILT - AS PER NE03075						
14	16.11.17	AS BUILT - AS PER FIELD VERIFICATION	BHP	SGL	MD	TF	WT	22.11.17
13	27.06.16	DRAWING REVISED AS NOTED	AR	BVK	JB	JB	AB	24.08.16
12	16.03.16	AS BUILT - CAPRICORN ROADHOUSE SUPPLY REVISED FUSES REMOVED FROM POLE 34.43	NA	WJM	TF	JB	AB	

BHPIO TO COMPLETE

DRAWING STATUS REVIEW	SIGNED	DATE	REV
PRELIMINARY ONLY			
QUOTATION ONLY			
CONSTRUCTION MAY PROCEED / AS BUILT			15
CONSTRUCTION MAY PROCEED EXCEPT AS NOTED			
REVISE AND RESUBMIT			

BHPIO/REVIEWER TO COMPLETE

COMPANY
NAME
SIGNED
DATE

THIS DRAWING HAS BEEN REVIEWED FOR GENERAL COMPLIANCE AS PER SEP-57

DESIGNER/CONTRACTOR TO COMPLETE

COMPANY BHPIO
DESIGNED BY
DRAWN BY M.EVANS
CHECKED BY
DESIGN & HSEC APPROVED BY
DATE APPROVED

BHP CHECKED AGAINST: Corporate_Standard_v6.2, Standard_v6.2
INTERNAL 12 Jan 21

BHP

BHP Billiton Iron Ore Pty Ltd ABN 46 008 700 981

TOWNSHIP - NEWMAN
POWER - 11kV DISTRIBUTION
EAST NEWMAN SUBDIVISION
SINGLE LINE DIAGRAM SHT 2

SCALE NTS | A1 | DRG. NO. 059 - E - 00377 /15

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200

NOTE: UNDERGROUND SERVICES DEPICTED ON THIS PLAN ARE

INDICATIVE ONLY AND NOT TO BE RELIED UPON.

PHYSICAL LOCATION OF UNDERGROUND SERVICES IS RECOMMENDED PRIOR TO ANY DETAILED DESIGN

OR CONSTRUCTION WORKS PROPOSED FOR THE SITE.

LEGEND

- EARTH PIT
- TELSTRA PIT
- UNKNOWN PIT
- POWER DOME
- POWER CABLE PIT
- BUILDING
- FENCE
- BOTTOM OF KERB
- TOP OF KERB
- SUPPLY FEED IN
- MAIN SUPPLY FEED

EXTEND TO EXISTING TELECOMMUNICATIONS TOWER (TELSTRA)

2x100mm TELECOM CONDUITS (TYPICAL)

1x50mm TELECOM CONDUITS TO EACH LOT (TYPICAL)

INCOMING BHP 11KV LINE

BHP SUBSTATION INCLUDING:
- 2+1 RMU
- 500KVA TRANSFORMER

NEW & OLD SITE MAIN SWITCHBOARD

GENERATOR ROOM

EXISTING DISTRIBUTION BOARD DB-E8 TO BE MODIFIED

EXISTING AVIATION COMMS TO BE REMOVED

EXISTING SERVICES TO BE REMOVED:
- PAPPI LIGHTS AND VOR

EXISTING WINDSOCK AND ELECTRICAL CONNECTION TO BE MODIFIED

NEWMAN AIRPORT INDUSTRIAL AREA

9268-SK-E004-A
TELECOM CONCEPT
19 FEBRUARY 2021

SCALE 1:2500 (NTS IF PRINTED)

Assets | Engineering | Environment | Noise | Spatial | Waste

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APPENDIX D

Stormwater Management Plan

Stormwater Management Plan

Newman Airport General Industrial Area

Prepared for Shire of East Pilbara

10 February 2021

Project Number: TC20042

DOCUMENT CONTROL

Version	Description	Date	Author	Reviewer	Approver
0a	Internal Review	29/01/2021	PG	CL	AM
1a	First Release	10/02/2021	PG	AM	AM
1b	Second Release	10/02/2021	PG	AM	AM
1c	Third Release	15/03/2021	PG	AM	AM

Approval for Release

Name	Position	File Reference
Allan Mason	Engineering Section Leader	TC20042 - Stormwater Management Plan.1c
Signature		

Table of Contents

Tables

Appendices

1 Introduction

Talis Consultants Pty Ltd (Talis) was engaged by the Shire of East Pilbara (the Shire) to prepare a Stormwater Management Plan (SWMP) for the proposed development of leasehold industrial lots at Newman Airport (the Site). The location of the proposed General Industrial Area (GIA) is shown on Diagram 1-1.

Newman Airport is managed by the Shire in terms of a Land Management Order issued by State Lands, as the Airport is sited upon Crown Land. The Site is currently zoned "Rural" under Shire of East Pilbara Local Planning Scheme No.4. The Shire is now required to rezone the land to "Special-use" zone to provide for industrial land development at the site.

The Shire requires this SWMP to support its Scheme Amendment Report. This SWMP has been prepared in accordance with *Department of Water – Stormwater Management Manual* (Department of Water and Swan River Trust, 2007).

This SWMP should be further developed in consultation with the project working group and relevant stakeholders. This SWMP should be viewed as a live document that is actively consulted, reviewed and revised.

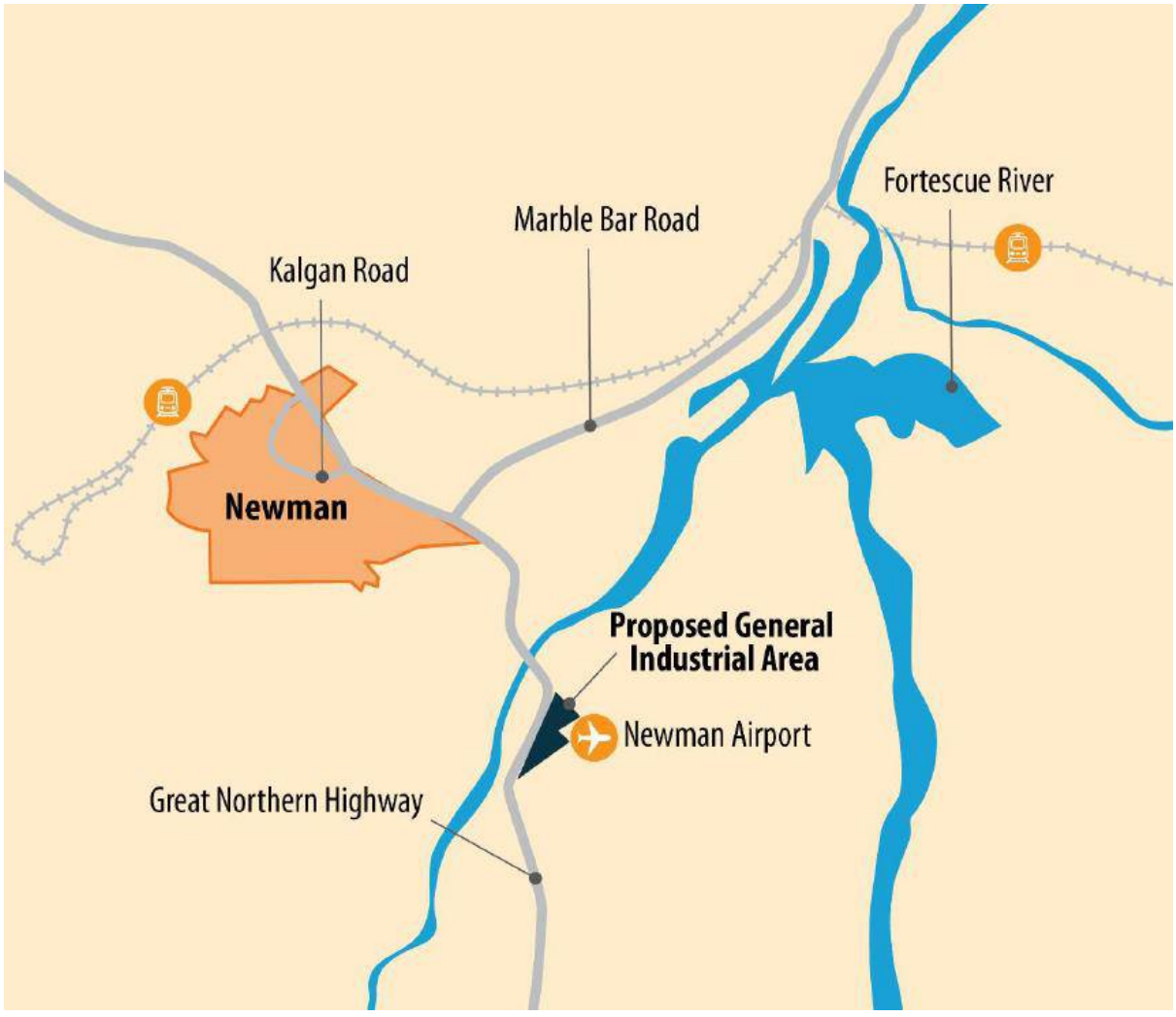

Diagram 1-1: Locality Plan (JJ Ryan, 2020)

2 Study Area Characteristics

2.1 Catchment Context

The boundary in this SWMP is defined by the proposed industrial lots being developed at Newman Airport. The catchment boundary is presented in the *Hames Sharley Industrial Development Airport Reserve drawing* (Hames Sharley, 2020), attached in APPENDIX A.

The Site is within the catchment of the Fortescue River. This River starts at an elevation of 602m and drops around 599m over its 1030km length, discharging into the Indian Ocean. It is an ephemeral river, flowing after rainfall from summer cyclones and autumn thunderstorms. The alluvial aquifer is recharged from direct infiltration through the riverbed during these periods of flow. The catchment of the Fortescue River is shown in Diagram 2-1 below.

The Site itself has a relatively flat terrain and drains directly toward the Fortescue River via overland flow and open channels.

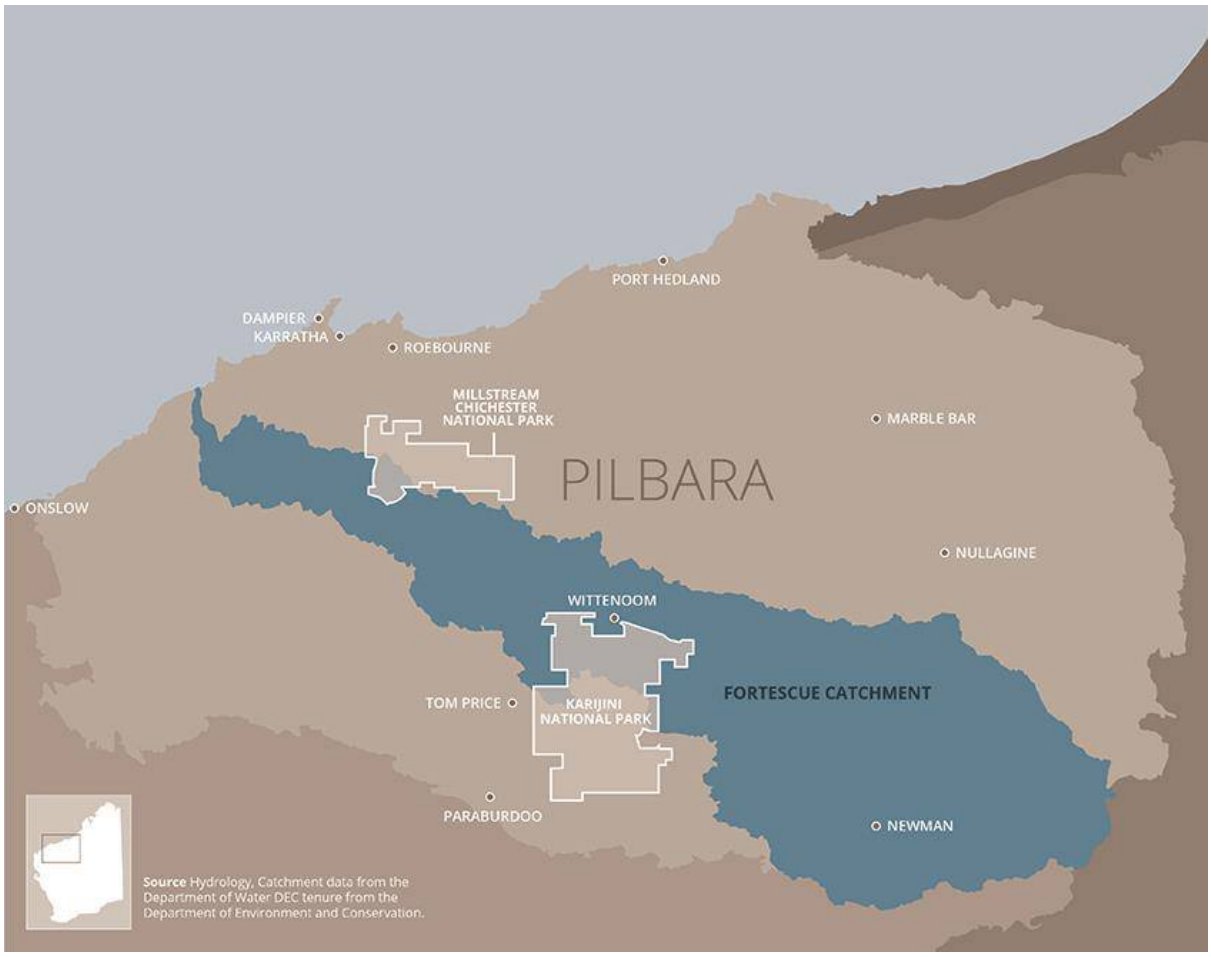

Diagram 2-1: Fortescue Catchment

2.2 Climate

The climate statistics for Newman Airport (Site number: 007176) is presented in Table 2-1 below. The table shows the mean maximum temperature; mean minimum temperature; and mean rainfall, for each month of the year. The warmest and coolest months are December and June, respectively. The months with the most and least rainfall are February and September, respectively.

Table 2-1: Climate Statistics for Newman Airport (Bureau of Meteorology, 2021)

Month	Mean Maximum Temperature (°C)	Mean Minimum Temperature (°C)	Mean Rainfall (mm)
January	39.0	25.1	69.8
February	37.4	24.1	70.2
March	35.6	22.2	41.7
April	32.2	17.8	21.3
May	27.1	11.8	18.4
June	23.1	7.5	15.9
July	23.2	6.5	14.4
August	26.2	8.0	6.4
September	30.6	12.3	3.6
October	35.3	17.9	5.9
November	37.6	21.2	12.4
December	39.2	24.1	35.3

The Annual Exceedance Probability (AEP) for a variety of different storm durations is presented in Table 2-2, showing millimetres of rainfall.

Table 2-2: Annual Exceedance Probability (AEP) (mm) (Bureau of Meteorology, 2021)

Duration	63.2%	50%	20%	10%	5%	2%	1%
2 min	2.50	2.92	4.23	5.11	5.96	7.13	8.04
5 min	5.31	6.23	9.13	11.1	13.0	15.6	17.6
10 min	8.63	10.1	14.9	18.2	21.4	25.5	28.7
15 min	10.9	12.8	18.8	22.9	26.9	32.1	36.1
30 min	15.1	17.7	25.9	31.5	36.9	44.1	49.5
1 hour	19.5	22.9	33.5	40.8	47.9	57.4	64.8
6 hours	34.4	40.7	62.1	78.1	94.9	119	138
12 hours	42.5	50.7	79.4	101	125	159	186
24 hours	51.3	61.8	98.6	127	159	200	235
48 hours	59.5	72.0	115	149	185	229	265

2.3 Surface Water Hydrology

A summary of the 100-year Average Recurrence Interval (ARI) maximum flood levels at several key locations is provided in Table 2-3. It is unclear from the JJ Ryan report as to where the key locations relate. However, it is noted that the Site is between 523.5mAHD and 525.0mAHD, which in some instances is below the levels documented in Table 2-3. A detailed flood model and risk assessment should be undertaken prior to any development in the area to confirm whether development would be subject to flooding in a 100-year ARI storm event (JJ Ryan, 2020).

It is unclear from the JJ Ryan report as to where the key locations relate. However, it is noted that the Site is between 523.5mAHD and 525.0mAHD, which in some instances is below the levels documented in Table 2-3.

Table 2-3: 100-year ARI Flood Levels at Key Locations (JJ Ryan, 2020)

Key Location	100-year ARI Flood Level (mAHD)
1	526.1
2	526.2
3	523.7
4	523.3
5	522.3

2.4 Geology

The *Newman Airport Master Plan* (JJ Ryan, 2020) has undertaken an assessment of the surrounding geology. A summary is provided below.

The land surrounding Newman is geologically rich and contains the minerals responsible for the significant mining activity in the area. The typical soils in and surrounding Newman are red earthy sands and red siliceous sands with ironstone gravels found locally. There are also occasional outcrops of sandstone, and conglomerate rise above the desert plain.

The Study Area is located in the Augustus sub-region of the Gascoyne Interim Biogeographic Regionalisation of Australia (IBRA) region. The Augustus IBRA sub-region consists of rugged low Proterozoic sedimentary and granite ranges divided by broad flat valleys. The Airport is located on alluvium and colluvium (Qw) which are red-brown sandy and clayey soils. The Gascoyne River System provides the main drainage in the sub-region and is the headwaters of the Ashburton and Fortescue Rivers.

2.5 Land Use Activities

2.5.1 Zoning

The Site is currently zoned “Rural” under Shire of East Pilbara Local Planning Scheme No.4. The Shire has proposed the Site to be developed for industrial purposes and therefore it is necessary to amend the zone to “Special Use” to provide for industrial land development at the Site.

2.5.2 Major Infrastructure

The Site is accessed via Great Northern Highway, which is under the jurisdiction of Main Roads Western Australia (MRWA). Access from Newman will be over a bridge (No. 1200) across the Fortescue River.

The Site is adjacent the Newman Airport. Newman Airport is owned and operated by the Shire of East Pilbara and links Newman and its surrounding communities to Perth, Karratha and Port Hedland. The Airport provides approximately 50 Regular Public Transport (RPT) flights per week between Newman and Perth, and serves as the preferred alternate airport to all the privately owned and operated jet airports within the catchment.

3 Stormwater Management Practices and Processes

3.1 Existing Stormwater Management Practices and Processes

The land is currently undeveloped and has no formal stormwater management infrastructure or strategy. Stormwater at the Site is currently directed toward the Fortescue River via overland sheet flow and open channels.

There is an existing open drain, and culverts, that runs along the southern and eastern boundaries of the proposed leasehold sites. The open drain services the Airport and conveys stormwater east, towards the Airport's entrance on Dewar Avenue. From there, it travels north to discharge into the Fortescue River. The location of the existing stormwater infrastructure is shown below in Diagram 3-1.

The existing swale and culverts fall within the land denoted for the proposed development of industrial lots and road infrastructure. Therefore, the existing open drain and culverts will have to be realigned. When the open drain and culverts are realigned, they could be resized to allow for increased flows from the proposed development GIA.

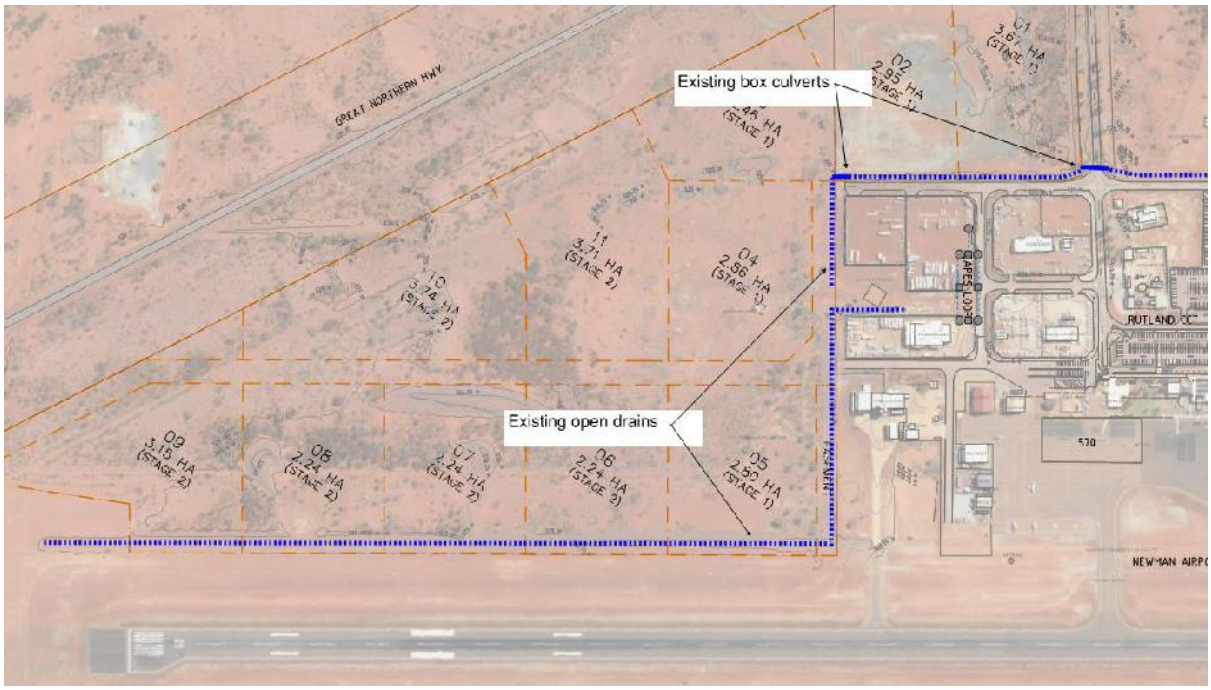

Diagram 3-1: Existing Stormwater Infrastructure

3.2 Stormwater Management after Proposed Development

It is the intention that the development of the Site will be in accordance with the Western Australian Stormwater Management Objectives and Western Australian Stormwater Management Principles, as per the Department of Water Stormwater Management Manual for Western Australia (Department of Water and Swan River Trust, 2007).

Per the Objectives and Principles, the stormwater at the Site will be managed with an aim to prevent pollution at the source; maximise infiltration to reduce stormwater runoff, recharge groundwater and minimise change to the natural water balance.

The *Newman Airport Master Plan* (JJ Ryan, 2020), where feasible, has stipulated the following stormwater management tools to be implemented at the Site:

- Biofilters, tree pits and/or vegetated swales in car parks and internal roads;
- Pervious paving for footpaths; and
- Roof runoff managed by above or below ground tank to capture roof runoff for reuse, or with a below ground infiltration system.

It is unclear if pervious paving or infiltration systems, as suggested in the Newman Airport Master Plan, will be suitable within the GIA development. The area will likely have pindan sands which typically have low infiltration rates. This should be reviewed following the results of a geotechnical investigation.

Water Sensitive Urban Design (WSUD) in Newman should ideally avoid designs which involve standing water. This could potentially attract mosquitos and increase the risk of mosquito transmitted diseases (Shire of East Pilbara, n.d.). Standing water can also attract birds and other fauna which is undesirable at an Airport.

Each individual industrial lot should attenuate the peak flows on-site to control the total stormwater runoff from the development. This will also reduce the need for significant stormwater infrastructure upgrades. It is recommended that the Proponent of each lot attenuates the peak flows to allow for a maximum allowable discharge of pre-development flows for a 1% Annual Exceedance Probability (AEP) event.

4 Ecological, Social/Cultural and Economic Values

Typical economic, ecological and social/cultural values of the local and receiving environments are outlined in Table 4-1. The Shire is encouraged to undertake community consultation to ensure that these values align with that of the community. It is desirable that the values are based on qualitative and anecdotal information.

Table 4-1: Ecological, Social/Cultural and Economic Values

Value Category	Specific Value Types	Description
Economic	Property / Infrastructure	• The stormwater system will contribute to the protection of the proposed development and existing infrastructure from flooding. • The installation of stormwater infrastructure may reduce the size and value of leasehold sites.
	Water Costs	• Reuse of stormwater on-site is encouraged in the development (JJ Ryan, 2020). There may be an economic benefit associated with using stormwater as a water source for reuse.
Ecological	Water Bodies	• Maintain the existing habitat for the flora and fauna detailed in Section **Error! Reference source not found.**.
Social / Cultural	Public Health	• The stormwater system will contribute to the minimisation of risk to public health and safety from flooding. • Positive free flowing stormwater drainage will prevent ponding and possible attraction of mosquitoes.

5 Threats

Threats have been determined and presented in Table 5-1. A threat is considered to be an activity or land use with potential to damage the local or receiving environment's social/cultural, ecological or economic values, via impacts to stormwater quantity or quality.

Table 5-1: Stormwater Threats

Threat	Cause	Key Impacts
Industrial land use runoff	Atmospheric deposition and build-up from traffic; poor waste management; accidental spills; and illegal discharges.	Increased flow, sediment, nutrients, litter, oxygen depleting material, hydrocarbons, pathogens, trace metals, pesticides, surfactants, heavy metals, trace metals and solvents.
Road and carpark runoff	Atmospheric and vehicular deposition and accumulation; litter; and chemicals from traffic accidents.	Increased flow, sediment, litter, heavy metals, trace metals, hydrocarbons and chemicals.
Surface runoff flow modification	Changes to runoff characteristics due to constructed impervious surfaces and collection and disposal of stormwater.	Altered water regimes in natural water bodies; formation of acid sulphate soils; flooding of buildings, roads and paths.
Inadequate maintenance of stormwater devices (e.g. drains, sumps, gross pollutant traps and side entry pits)	Accumulation, then release of pollutants out of unmaintained or poorly maintained stormwater devices; blockages of devices from uncleared sediment, litter, etc.; water pooling due to blockages from uncleared litter, sediment, etc.	Increased sediments, heavy metals, trace metals, nutrients, oxygen depleting substances, toxins and hydrocarbons; flooding of buildings, roads and paths; increased mosquito numbers.
Septic leakage	Groundwater infiltration and surface overflow from sewage systems.	Increased oxygen depleting material, pathogens and nutrients.

6 Management Objectives

The stormwater management objectives define the outcomes sought in the management of stormwater to maintain and protect existing values. This SWMP focuses on defining the outcomes sought, rather than strategies to be employed, in order to facilitate flexibility and encourage innovation in the management of stormwater.

The vision for this catchment is that the proposed development of industrial lots will not have a nett negative impact on the catchment or downstream.

The objectives of the catchment and proposed industrial development are:

- Prioritise the fitting of stormwater management devices to meet the guidelines in Chapters 6 and 9 of the *Department of Water – Stormwater Management Manual*. Management devices should be selected by the Designer, and could generally include:
  - Detention basins on individual lots which attenuate peak flows;
  - Open drains;
  - Culverts;
  - Floodways;
  - Reserves and open spaces which can be utilised as basins;
  - Biofilters, tree pits and/or vegetated swales; and
  - Below ground tanks to capture runoff for reuse.
- Protect all built infrastructure from flooding and waterlogging in the 100-year ARI event;
- Maintain the pre-development stormwater runoff discharging into the Fortescue River;
- Maintain the pre-development hydrologic regime;
- Encourage stormwater reuse within the catchment;
- Prevent mosquito problems in the catchment through good-practice stormwater management; and
- Ensure stormwater structural controls meet public health and safety standards.

7 Priority Management Issues

An assessment of the priority management issues was undertaken using the procedure outlined in *Appendix A of Department of Water – Stormwater Management Manual* (Department of Water and Swan River Trust, 2007). The assessment applies a qualitative rating (i.e. 1 = low, 2 = Moderate, 3 = High and 4 = Very High) for each value and each threat. A sensitivity score from 1 to 4 is also assigned depending on the influence of the threat on the specific value. Values that are highly sensitive to a given threat are assigned higher sensitivity scores. Using this approach, the risk magnitude for each combination of value and threat is calculated as the product of the value, threat and sensitivity. Risk cells have been shaded in accordance with magnitude, with darker cells representing higher overall risks. Scores greater than or equal to 24 have been considered as higher overall risk.

Table 7-1: Priority Management Issues

				Stormwater Threats									
				Industrial land use runoff		Road and carpark runoff		Surface runoff flow modification		Inadequate maintenance of stormwater devices		Septic leakages	
				3		2		2		2		1	
Receiving Values	Economic	Property / Infrastructure	**4**		2		2		2		1		1
				24		16		16		8		4	
		Water Costs	**2**		1		1		1		3		1
				6		4		4		12		2	
	Ecological	Water Bodies	**4**		4		4		4		1		3
				48		32		32		8		12	
	Social/Cultural	Public Health	**4**		2		2		2		2		2
				24		16		16		16		8	

8 Management Actions

Management actions have been prepared to address the priority management issues identified in Section 7. The management actions are listed in Table 8-1.

Table 8-1: Management Actions

Management Action	Description
Funding	Establish a budget and dedicated source of funding to implement the management plan actions. The budget for drainage is $510,000 ex GST (Canning & Associates Cost Consultants, 2021)
Realign the existing open drain and culverts which are currently servicing the Airport	Undertake stormwater design and replace the existing open drain and culverts with stormwater infrastructure to service the Airport and GIA.
Undertake water quantity and quality modelling and additional ecological studies	Determine water quantity and quality conditions before and after the proposed development to determine the impact of the proposed development.
Establish water quality and quantity targets	Determine targets for the proposed development area.
Each lot to install stormwater infrastructure which attenuates peak flows	Ensure that each industrial lot has stormwater infrastructure which attenuates peak flows in the overall system during significant rainfall events. This infrastructure should be installed by the Proponents of each individual lots, and can include above ground, or below ground, detention basins.
Develop and implement a water quality monitoring program	Including a sampling and analysis plan to identify pollution sources, establish baseline water quality data and establish water quality targets.
Minimise effective imperviousness within the development	Minimising effective imperviousness significantly improves the quality of stormwater that discharges to receiving environments and will help retain the pre-development hydrologic regime. Reduction of effective imperviousness can be achieved by: • The retention of pervious surfaces; • Retaining small rainfall events at-source through the installation of infiltration systems or re-using stormwater on-site; and • Continued use of overland flow and open drains across vegetated surfaces.
Stormwater re-use	Investigate opportunities for potential stormwater re-use in the development. Opportunities will be dependent upon the infrastructure which is built at each Lot. The Proponent of each Lot should be responsible for these initiatives.

Management Action	Description
Develop and use an infrastructure management program	Develop an use an infrastructure management program which ensure the appropriate maintenance of stormwater infrastructure.

9 Implementation Plan

It is recommended that the Shire develops an Implementation Plan to document how the SWMP will be implemented within the proposed development. It is expected that the Implementation Plan will need to be developed in coordination with the project control group, as it will likely require involvement and commitment from several stakeholders.

A basis for the Implementation Plan has been provided in Table 9-1 on the following page. This plan should be considered indicative only and subject to further development and ongoing review by the Shire.

Table 9-1: Implementation Plan

Threat	Value	Management Action	Responsibility	Timeline	KPIs
• Industrial land runoff • Surface runoff flow modifications	• Property / Infrastructure • Water costs • Water bodies • Public health	• Minimise effective imperviousness within the development • Stormwater reuse • Realign the existing open drain and culverts which are currently servicing the Airport • Each lot to install stormwater infrastructure which attenuates peak flows	Developer	From time of development	• Effective imperviousness within the development meets Shire requirements. • Stormwater reuse within the development meets Shire requirements. • Open drain and culvert is realigned • Each lot has stormwater infrastructure which attenuates peak flows.
• Road and carpark runoff • Septic leakage	• Water bodies • Public health	• Undertake water quantity and quality modelling and additional ecological studies. • Establish water quality and quantity targets. • Develop and implement a water quality monitoring program.	Shire	2021 and ongoing	• Water quantity and quality modelling undertaken. • Water quality and quantity targets established. • A water quality monitoring program is developed and implemented.
• Inadequate maintenance of stormwater devices	• Property/Infrastructure • Water costs • Water bodies • Public health	• Develop and use an infrastructure management program	Shire / Leaseholders	From time of development	• Infrastructure management program developed and implemented.

10 Performance Monitoring and Review

This SWMP should be viewed as a live document that is actively consulted, reviewed and revised. An Implementation Plan should be prepared by the Shire and the actions of that plan should be reviewed annually. The timing of the annual review should allow for review outcomes to be incorporated within budget planning cycles. This whole SWMP should be reviewed in entirety once the detailed engineering design of the proposed lots has commenced.

The following should be monitored through the review process:

- If actions have been implemented;
- Changes in stormwater management practices;
- Reductions in stormwater threats;
- Changes in stormwater quality;
- Changes in the quality/health of receiving water bodies; and
- Changing or new priorities.

11 Conclusions and Recommendations

Talis was engaged by the Shire to prepare a Stormwater Management Plan (SWMP) for the proposed development of industrial lots at Newman Airport. The SWMP will supports its Scheme Amendment Report and has been prepared in accordance with *Department of Water – Stormwater Management Manual* (Department of Water and Swan River Trust, 2007).

The boundary of the SWMP is defined by the proposed industrial lots being developed at Newman Airport. The Site itself has a relatively flat terrain and drains directly towards the Fortescue River.

The land is currently undeveloped and has no formal stormwater management infrastructure or strategy. Stormwater at the Site is currently directed toward the Fortescue River via overland sheet flow and some open drains. It is recommended that the lots be developed with an aim to retain the pre-development discharges, prevent pollution at the source, maximise infiltration, recharge groundwater; and minimise the change to the natural water balance. The *Newman Airport Master Plan* (JJ Ryan, 2020) has stipulated the following stormwater management tools to be implemented at the Site:

- Biofilters, tree pits and/or vegetated swales in car parks and internal roads;
- Pervious paving for footpaths; and
- Roof runoff managed by above or below ground tank to capture roof runoff for reuse, or with a below ground infiltration system.

Typical ecological, social/cultural and economic values have been outlined for this site. The Shire is encouraged to undertake community consultation to ensure that these values align with that of the community.

Activities or land uses with potential to damage the local or receiving environment's values, via impacts to stormwater quantity or quality have been determined and listed as threats to the values.

A qualitative rating was given to each value and each threat. A sensitivity score was also assigned depending on the influence of the threat on the specific value. Using this approach, the risk magnitude for each combination of values and threats were calculated. This determined that the highest risk was the threat of industrial land use runoff; road and carpark runoff; and surface runoff flow modification runoff, have on the downstream water bodies.

Management actions to address these risk were determined and detailed as:

- Funding;
- Realign the existing open drain and culverts which are currently servicing the Airport;
- Undertake water quality and quantity modelling and additional ecological studies;
- Establish water quality and quantity targets;
- Develop and implement a water quality monitoring program;
- Minimise effective imperviousness within the development;
- Each lot to install stormwater infrastructure which attenuates peak flows;
- Stormwater re-use; and
- Develop and use an infrastructure management program.

This SWMP focuses on defining the outcomes sought, rather that strategies to be employed, in order to facilitate flexibility and encourage innovation in the management of stormwater. The vision for this catchment is that the proposed development of industrial lots will not have a nett negative impact on the catchment. This SWMP has outlined the following objectives for the development:

- Prioritise the fitting of stormwater management devices to meet the guidelines in Chapters 6 and 9 of the *Department of Water – Stormwater Management Manual*;
- Protect buildings from flooding and waterlogging in the 100-year ARI event;
- Maintain the pre-development stormwater runoff discharging into the Fortescue River;
- Maintain the pre-development hydrologic regime;
- Encourage stormwater reuse within the catchment;
- Prevent mosquito problems in the catchment through good-practice stormwater management; and
- Ensure stormwater structural controls meet public health and safety standards.

This SWMP should be viewed as a live document that is actively consulted, reviewed and revised. Implementation of the actions should be reviewed annually. This SWMP should be reviewed in its entirety once the detailed engineering design for the lots has commenced.

12 References

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APPENDIX A
Catchment Boundary

Assets | Engineering | Environment | Noise | Spatial | Waste

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APPENDIX E

Newman General Industrial Area – Business Case


pracsys.

Document Control				
Document Version	**Description**	**Prepared By**	**Approved By**	**Date Approved**
v 1.0	Draft Business Case	Brayden Keizer	Dawson Demassiet-Huning	06/10/2020

Disclaimer

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CONTENTS

1 EXECUTIVE SUMMARY

This business case establishes the need for the rezoning of land to allow for industrial activities adjacent to the Newman Airport. The rezoned land will be named the Newman General Industrial Area (NGIA) and will address an identified shortage of industrial land supply in Newman. The economic impacts and benefits associated with the delivery of the NGIA have been identified and quantified where possible, establishing a rationale for de-constraining the land at the subject site to satisfy latent demand.

The economic impacts and benefits discussed in this business case refer principally to the demand-based stage of the NGIA project; that is, impacts and benefits attributable to the partial development of the full subject site at a scale commensurate with the extent of latent demand identified through consultation with prospective operators.[1] The impact and benefits attributable to the development of the full NGIA have also been quantified at a high level in **Section 5.5, Full Development Impacts** and **Section 6.2, Full Development Quantified Benefits**. These are considered potential long-term benefits as there does not appear to be sufficient demand to achieve full development of the NGIA in the short term. The industrial land referenced in this document includes a broad range of high-value land uses, principally referring to mining-servicing activities within the General Industrial land use category.

1.1 Benefits Case for the Newman General Industrial Area

The case for rezoning land at Newman Airport for development of the NGIA is strong, based on both a need for industrial land in the region and the economic benefits the project is likely to produce. Need is reflected by a shortage of industrial land supply in Newman that has led to latent demand for industrial land, identified through consultation with industrial operators in the region

While satisfying the need for industrial land provides a compelling case on its own, numerous benefits of facilitating the development of the NGIA have also been identified, including:

- Increased Productivity
- Industry Capacity Building
- Inward Investment Attraction
- Professional Pathways Development and Human Capital Uplift
- Increased Economic Diversity and Sustainability
- Increased Viability of Community Infrastructure and Recreational Facilities

These benefits have been quantified where possible and compared to project costs through a Cost-Benefit Analysis. Non-quantifiable benefits attributable to the project have been discussed qualitatively. Quantified benefits are summarised in **Section 1.3, Summary of Benefits**, and detailed in **Section 6, Benefits.**

[1] Latent demand refers to the unmet demand from private industry for industrial land

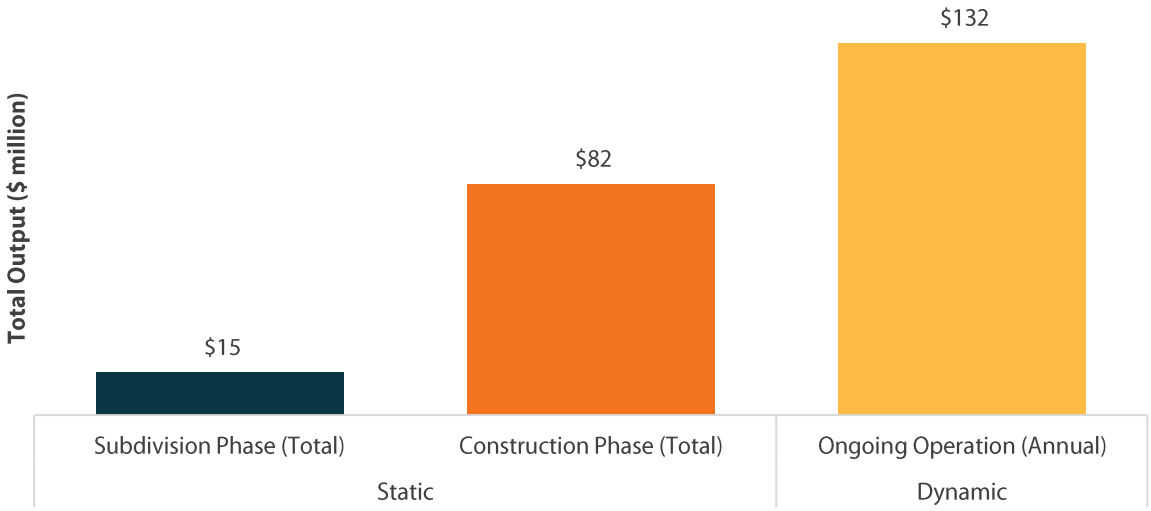
1.2 Summary of Economic Impact

The economic impact of the development of the demand-based stage of the NGIA has been quantified using Input-Output modelling, based on the yield of industrial land derived from the stated requirements of consulted businesses. The analysis quantifies two components of the demand-based stage of the NGIA:

- The static employment and output impacts of the subdivision and construction phases
- The dynamic impact of the ongoing operation phase

The subdivision and construction of the demand-based stage of the NGIA has been estimated to stimulate $98 million of total output in the East Pilbara economy. The ongoing operations of the NGIA's demand-based stage will generate $132 million of output per annum (Figure 1).

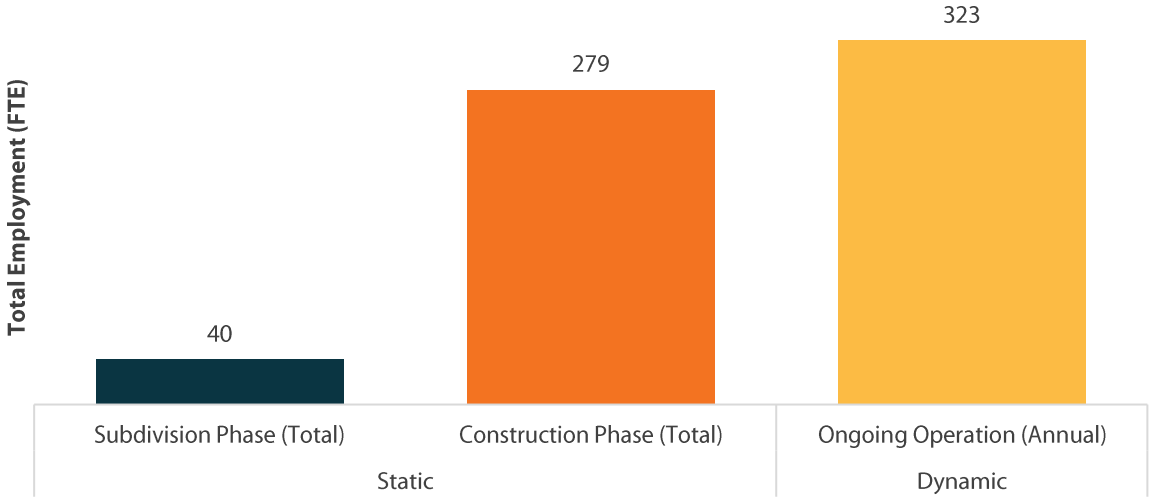
Figure 1. Total Output Attributable to Demand-Based Stage of NGIA Development



Source: Shire of East Pilbara 2020, Pracsys 2020

There will be approximately 320 one-off full-time equivalent (FTE) employment opportunities generated in the wider economy throughout the subdivision and construction of the demand-based stage (Figure 2). The demand-based stage of the NGIA's ongoing operations will generate 323 FTE jobs on an annual basis.

Figure 2. Total Employment Generated by Demand-Based Stage of NGIA Development



Note: This graph illustrates the number of FTE employment opportunities. For both the Subdivision and Construction Phases, these are the total FTE jobs created as a once-off impact over the relevant period (i.e. two-year construction phase). The Operation Phase represents the total number of FTE employment opportunities supported dynamically over each year in the long-term.

Source: Shire of East Pilbara 2020, Pracsys 2020

These demonstrated project impacts, together with the identified benefits and established need, provide a strong case for the rezoning of land to Industrial to facilitate the development of the NGIA.

1.3 Summary of Benefits

The potential economic and social benefits of the NGIA were assessed through impact pathways development, describing the process by which value is created through the Project. The identified impacts were then monetised using the 'benefit transfer' method, drawing values from high-quality studies and applying them to the context in question. Due to the nature of the benefits associated with the project, only certain benefits can be successfully expressed in monetary value; therefore, the total benefits of the project are expected to be higher than those quantified herein. The benefits have been estimated based on the demand identified through consultation; should there be further proponents that chose to locate at the NGIA, the scale of benefits attributable to the Project will increase proportionally with the scale of development and activity at the NGIA.

Figure 3. Summary of Project Benefits

Benefit		Present Value
	Additional Retail Expenditure	**$49.9 million**
	Additional Tourism Expenditure	**$15.2 million**
	Additional Health Services Expenditure	**$6.9 million**
	Additional Education Services Expenditure	**$3.9 million**
	Additional Expenditure in All Other Sectors	**$31.4 million**
	Industrial Rate Revenue	**$0.6 million**
	Productivity Benefits	*Qualitative*
	Industry Capacity Building	*Qualitative*
	Inward Investment Attraction	*Qualitative*
	Professional Pathways Development and Human Capital Uplift	*Qualitative*
Total Benefits		***$108 million***

Source: Pracsys 2020

1.4 Value for Money

A Cost-Benefit Analysis has assessed the value for money of the project from a community perspective. This was achieved by comparing the potential government investment required with quantified project benefits. Total quantified benefits amount to an estimated $108 million in present value terms over the twenty-year evaluation period (see Section 6 for the full breakdown of these benefits). Total present value costs amount to approximately $5 million, reflecting the estimated expense attributable to site subdivision (creation of lots, roads and landscaping) and ongoing maintenance. These are the financial liabilities that may potentially fall under the responsibility of Government.

The project's Net Present Value (NPV) is estimated at $103 million over the twenty-year evaluation period, with a Benefit-Cost Ratio (BCR) of 20.28 (Figure 4). This reflects that every dollar invested in the project is estimated to generate approximately $20.28 of benefits.

Figure 4. Summary of Project Value for Money

Total Present Value Benefits	$107,800,000
Total Present Value Costs	-$5,300,000
Net Present Value (NPV)	**$102,500,000**
Benefit Cost Ratio (BCR)	**20.28**

Source: Pracsys 2020

A high project BCR and NPV is reflective of the 'shovel-readiness' of the proponents, who require industrial land to undertake their business activities. The results evidence that the NGIA project is an excellent opportunity for Government to deliver significant economic benefits to Newman, the East Pilbara region and Western Australia.

The result of this Cost-Benefit Analysis reflects the likely lower bound return on investment for the full project when the Net Present Value is considered. As the NGIA develops beyond the demand-phase component, the net benefit will grow, as the ratio of benefits to costs is positive and constant. This indicates that de-constraining land for development of the NGIA represents a high-value return on government investment in both the short and long-term.

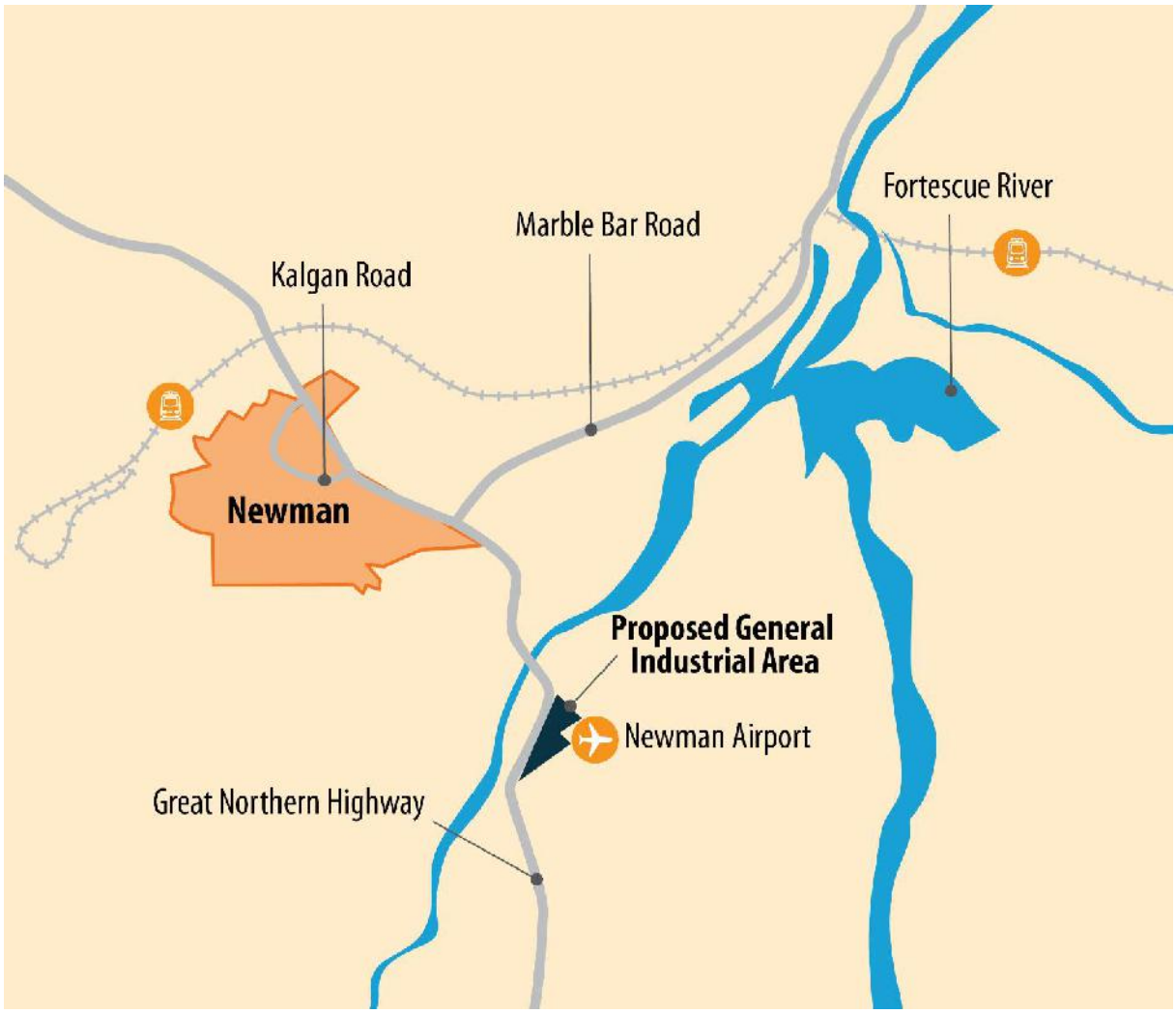
2 INTRODUCTION

2.1 Context

This business case establishes the need for rezoning industrial land adjacent to the Newman Airport to address an identified shortage of industrial land supply in Newman. The economic impacts and benefits associated with the delivery of the Newman General Industrial Area (NGIA) have been identified and quantified where possible, establishing a rationale for de-constraining the land at the subject site to satisfy latent demand.

The Shire of East Pilbara is proposing to rezone 36.9 hectares of land adjacent to the Newman Airport to allow for general Industrial land uses. The NGIA subject site is located adjacent to the Newman Airport on the south-eastern side of Great Northern Highway, offering prime access and proximity to key road and air transportation infrastructure (Figure 5).

Figure 5. Proposed General Industrial Area at Newman Airport



Source: Shire of East Pilbara 2020, Pracsys 2020

2.2 Industrial Activity in the Shire of East Pilbara

Industrial Floorspace

The existing scale and concentration of industrial activity in the Shire of East Pilbara has been quantified through analysis of ABS data. Department of Planning, Land Use and Heritage (DPLH) *Land Use and Employment Survey* floorspace per employee benchmarks have been applied to employment industry data to estimate the current industrial floorspace profile of the Shire of East Pilbara (Figure 6).

Figure 6. Estimated Industrial Floorspace Quantum by PLUC in the Shire of East Pilbara

Planning and Land Use Category (PLUC)	Floorspace (m^2)
Primary/Rural	1,258,430
Service Industry – Construction, Maintenance & Repairs	129,404
Storage/Distribution	90,706
Manufacturing/Processing/Fabrication	23,634
Utilities/Communications	12,690

Source: ABS 2016, LUES 2015-17, Pracsys 2020

The majority of the Shire's industrial activities are classified as Primary/Rural floorspace under the DPLH's Planning and Land Use Category (PLUC) codes. This PLUC captures the numerous mining activities undertaken in the Shire.

Within the Primary/Rural industrial floorspace category, Metal Ore Mining is the pre-eminent industry, employing 9,457 people. Based on floorspace benchmarking, this industry occupies approximately 115 hectares of net employment floorspace across the Shire. The floorspace quantum and the number of workers for all major[2] Primary/Rural industries is illustrated below (Figure 7).

Figure 7. Floorspace and Employment for Primary/Rural Industrial Land Use Category

Industry	Floorspace (m^2)	Workers
Metal Ore Mining	1,153,754	9,457
Other Mining Support Services	59,902	491
Mining, nfd[3]	18,422	151
Exploration	11,590	95
Coal Mining	9,638	79

Source: ABS 2016, LUES 2015-17, Pracsys 2020

[2] 'Major industries' have been defined as those industrial activities employing more than fifty workers in the Shire.
[3] Not further defined, used in ABS census when a respondent's ABS ANZSIC industry category does not fit into more detailed industry categories

Construction and Maintenance & Repairs are the most represented sub-categories within the Service Industry industrial floorspace category. Significant mining-servicing activities within this category include Heavy and Civil Engineering Construction and Machinery and Equipment Repair and Maintenance. The floorspace quantum and the number of workers for all major Service Industry activities is illustrated below (Figure 8).

Figure 8. Floorspace and Employment for Service Industry Industrial Land Use Category

Industry	Floorspace (m^2)	Workers
Heavy and Civil Engineering Construction	25,258	146
Machinery and Equipment Repair and Maintenance	19,376	112
Building Installation Services	17,992	104
Other Construction Services	17,300	100
Land Development and Site Preparation Services	14,878	86

Source: ABS 2016, LUES 2015-17, Pracsys 2020

The Shire's Storage/Distribution land use category contains an estimated 49,000m^2 of productive floorspace, comprised of the Specialised Industrial Machinery and Equipment Wholesaling and Road Freight Transport industries (Figure 9).

Figure 9. Floorspace and Employment for Storage/Distribution Industrial Land Use Category

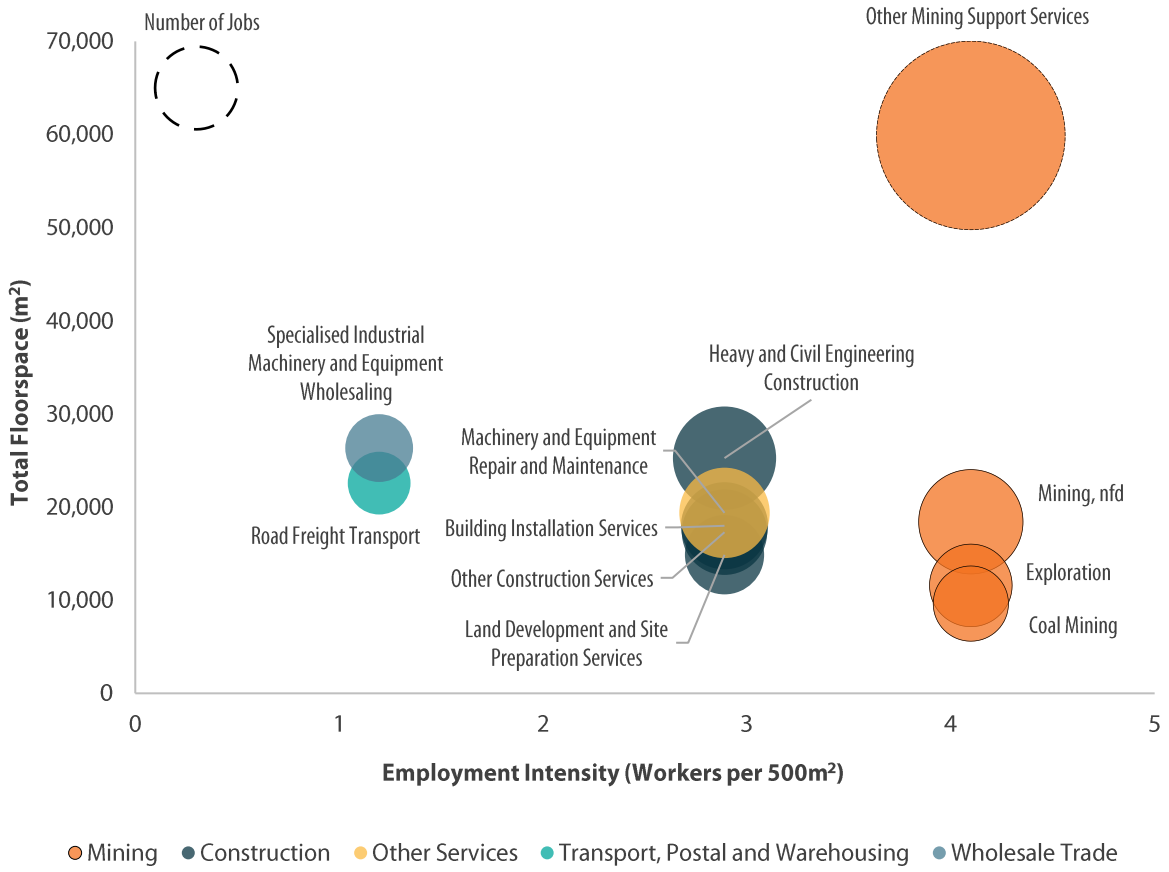
Industry	Floorspace (m^2)	Workers
Specialised Industrial Machinery and Equipment Wholesaling	26,334	63
Road Freight Transport	22,572	54

Source: ABS 2016, LUES 2015-17, Pracsys 2020

The employment intensity and quantum for each of the Shire's key industrial activities are illustrated below (Figure 10).[4] This analysis indicates that Other Mining Support Services is a major industrial employer in the region, with a high quantum of floorspace and a high employment intensity.

[4] Metal Ore Mining has been excluded from this chart, as its employment and floorspace magnitude far exceeds other industries in the Shire. The Metal Ore and Mining industry is discussed separately and quantified in (Figure 7).

Figure 10. Floorspace Quantum and Employment Intensity of Industrial Activities



Source: ABS 2016, LUES 2015-17, Pracsys 2020

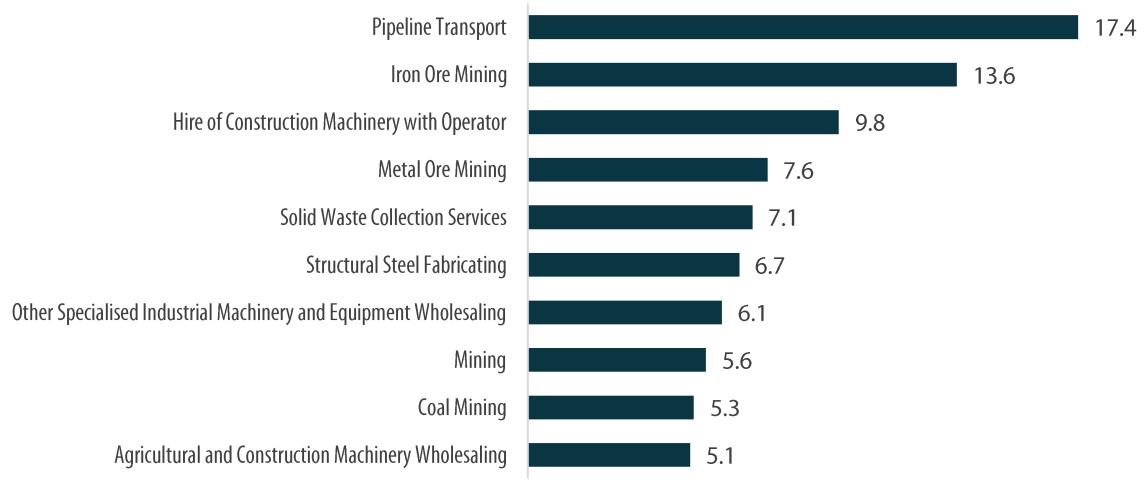
Note: Only industries with more than fifty workers are illustrated. Excludes Metal Ore Mining (see Figure 7).

Mining service industries cannot currently expand in the Town of Newman, the regional centre for the Shire. This is due to a lack of Industrial zoned land around the Town. This undersupply forces mining services to be outsourced to Drive-in, Drive-out (DIDO) or Fly-in, Fly-out (FIFO) workers. Consultation has identified latent demand for access to industrial land that would support local employment opportunities.

Employment Concentration

Newman's economy exhibits a strong employment concentration in export-orientated mining support services. The presence of these local industry specialisations is indicated by high employment concentration factors (ECFs) across a range of export-oriented industries. ECFs are a measure of the concentration of industry employment relative to the State average concentration, with a value of one (1) representing the State average. An ECF greater than one indicates that employment in a particular industry is higher in Newman that in Western Australia as a whole. Industries illustrated below exhibit ECFs greater than five, indicating strong local specialisations which export goods and services outside of Newman to broad catchments (Figure 11).

Figure 11. Top Industries in Newman by Employment Concentration Factors (2016)



Source: ABS 2016, Pracsys 2020

These industry specialisations are predominantly mining-related, with employment at least five times more concentrated within Newman than in Western Australia as a whole in these industries. However, much of this employment is currently filled by FIFO workers, with limited capacity to introduce additional local employment, due in part to a lack of Industrial zoned land.

2.3 Project Detail

The activities permitted at the prospective NGIA will include heavy industrial uses that are not suited to current industrial land in Newman or the DevelopmentWA light industrial precinct. There are proponents that have indicated they require this type of industrial land to expand their local presence in Newman. The proponents operate in the following industries:

- Engineering design and fabrication services
- Engine design and manufacturing
- Automotive and mechanical maintenance services and vehicle diagnostics
- Automotive and mechanical parts wholesaling

Additional support industries are likely to form around these initial proponents over time, taking up the remaining land as demand arises.

3 STRATEGIC ALIGNMENT

Diversify WA (2019)

Diversify WA is an economic development framework that seeks to grow and diversify the Western Australian economy, create jobs, and secure the State's future. The proposal to allow industrial uses at NGIA aligns with three of the framework's priority sectors:

- Mining and Mining Engineering and Technical Services (METS)
- Technology and Advanced Manufacturing
- Primary Industries

The proposed rezoning of the NGIA precinct will provide capacity for activity in Mining Engineering and Technical Services and Technology and Advanced Manufacturing. In the long term, it may also provide opportunities for downstream production associated with primary industries such as agriculture.

Diversify WA identifies that although the State's mining sector is already well established, it will be important to continue to foster innovation in this sector to safeguard economic resilience. Development of the NGIA will support high productivity mining services activities. The location of these activities adjacent to the Newman Airport and Great Northern Highway will create opportunities to attract specialised high-output activity such as advanced manufacturing, with one of the current proponents a leader in engine and power systems. The proposed land zoning and uses for NGIA would also be compatible with downstream processing for agricultural products, which will allow the region to capitalise on the Pilbara Food Bowl and other related projects.

The proposed rezoning of the NGIA precinct therefore aligns with the *Diversify WA* framework.

Shire of East Pilbara Local Planning Strategy (2016)

The Shire of East Pilbara Local Planning Strategy identifies the following objective within the strategic theme of Rural Land Use, Subdivision and Development:

"Facilitate the sustainable use and development of urban land within the Shire, and promote non-urban land for agriculture, mining and other purposes to ensure the protection, enhancement and viability of the Shire."

The goal underpinning this objective is the strengthening and continued development of Newman as a regional service hub, through establishing key industry and logistics investment and development. In order to achieve this goal, the Strategy identifies the following actions:

- **Integrate industrial land with existing infrastructure provisions**, aligning the development and growth of industrial precincts and supporting industrial enterprise
- **Plan and develop the Logistics Hub**, capitalising on the strategic location on key transport freight corridors through co-location of transport and logistic enterprise in Newman (including road freight and air freight) as a central hub that services the sub-region and mining and resource activity

The delivery of the NGIA at Newman Airport responds to these strategic actions, integrating industrial land with the existing transportation infrastructure of Great Northern Highway and Newman Airport. The NGIA will capitalise on this strategic location, improving the productivity of unused land by delivering a centrally located industry hub to service the region's mining and resource activity while avoiding the high cost of infrastructure duplication. The Strategy also identifies rezoning of land to support the creation of Newman Airport Enterprise Zone and the encouragement of industrial development as actions towards economic diversification. The delivery of the NGIA through Industrial rezoning and subdivision development will directly drive the creation of enterprising and innovative clusters of mining-servicing activity at the Newman Airport, maximising economic benefits.

Mining service operators in Newman and the wider Shire area have identified constraints on their business expansion due to a lack of supply of Industrial zoned land. Development of the NGIA through securing Industrial zoning on the subject site will deliver a significant stock of high-quality land for industrial use within Newman, alleviating this constraint on supply. The de-constraining of land for development of the NGIA is therefore a critical facilitator of increasing the potential for local servicing of mining activity in the Shire, as it will enable businesses to operate from the Town rather than on remote mine sites. The direct employment supported through the NGIA will also strengthen and diversify the local economy through the attraction and retention of the population that will maintain and/or create demand for population-driven goods and services activity.

The proposed rezoning of land for development of the NGIA precinct therefore aligns with the *Shire of East Pilbara Local Planning Strategy.*

Newman Futures (2019)

The *Newman Futures* (2019) strategy document identifies a vision for Newman's aspirational future state that involves building a diverse and sustainable economy that is inclusive to all. An existing barrier to the achievement of this aspirational state identified within the Strategy is the limited availability and affordability of land for industrial use. The unlocking of vacant land adjacent to the Newman Airport addresses the identified shortage of industrial land which is currently acting as a constraint on business expansion in Newman. This will support additional employment and the retention and attraction of population in the Town. The delivery of the NGIA is therefore in line with the strategic imperatives of the *Newman Futures* document, contributing to the realisation of the Town's sustainable future and enhancing the overall prosperity of the East Pilbara region.

4 ISSUES AND OPPORTUNITIES

Newman and the wider East Pilbara region is home to a significant mining sector, which acts as a driver for a number of related industries including service industries, transportation/logistics and heavy vehicle hire/manufacturing. The Shire has identified a gap in the capacity to accommodate these industries due to a lack of general industrial zoned land within the town of Newman, particularly for large-format mining services operations. There are a number of local businesses that have indicated that they are constrained by the lack of suitable land, with a major proposed project for a mining service centre currently on hold until suitable land is made available.

Latent Demand for Industrial Land

A consultation was undertaken with key industrial businesses in the region to identify the extent of latent demand for Industrial zoned land in Newman. Consultation with prospective proponents identified specific site requirements, detailed by factor below (Figure 12).

Figure 12. Site Requirements of Prospective NGIA Proponents by Factor

Factor	Requirements
Land	There is a preference amongst industrial operators for greenfield development sites rather than pre-used brownfield lots, as the incidence of site contamination is alleviated.
	The sealing of properties is required to avoid the transmission of dust across the area, which has a negative amenity effect and accelerates machinery breakdown.
	There is a demand for approximately 7.5 ha of industrial land
Access	As industrial operators frequently service oversized loads, overhead powerlines are prohibitive and should be sunken beneath the ground if possible.
	Large boundary crossovers into NGIA lots and wide access roads are required to accommodate oversized loads.
	Lots should be designed to allow for drive-through access for heavy vehicles.
	Roadways should be built for high weight tolerance (up to 300 tons).
	As some operators utilise cranes to lift and transport heavy machinery, the Airport-adjacent NGIA must consider aircraft clearance heights and provide appropriate buffers to aeronautic movements.
	Direct highway access from Great Northern Highway is advantageous, preventing the need to transit heavy machinery through the Newman Town Centre.
Parking	Ample parking for staff, customers and heavy vehicles is required. Space to accommodate multiple oversized vehicles at any one time should be provided.
Internet	High-speed internet is required by all prospective operators, with a preference for fiber to premises NBN.
Water	Running water and sewerage is required at all NGIA lots.
	High-pressure water is required for cleaning heavy machinery.

Factor	Requirements
	Some operators also require a water treatment plant to treat and recycle water used to clean their service vehicles and client machinery.
	Adequate site drainage must be delivered to avoid water pooling after/during periods of heavy rain.
Power	Three-phase power is required to run heavy machinery, compressors and water treatment facilities.
Storage	Approximately 500m^2 of warehouse storage is required by most prospective operators.
Office	Modern, flexible office working space with air-conditioning is required by all prospective operators, with an area of between 200m^2 and 500m^2 required (depending on the number of employees).
Wash pad	Wash pads are required for heavy vehicle cleaning.
Hardstand	Hardstand areas are required for heavy vehicle servicing.
Workshop	Workshop spaces for machinery repair are required by most prospective operators.
Amenity	Bathrooms/toilets of amenable standard are required by all prospective operators.

Source: Pracsys 2020

There is currently no capacity to support the 7.5 ha of land in Newman. Furthermore, Newman's existing and proposed future light industrial areas do not meet the requirements of the consulted proponents. The NGIA can therefore deliver a clearly differentiated offering, with larger lot sizes and a subdivision design catering for Restricted Access Vehicles (RAVs) to transit into individual lots and through the site. Existing intersections will be upgraded and a new intersection will be added to the south of the site to accommodate the high volume of heavy vehicle movements. Future access roads within the Airport Reserve and the NGIA will also be upgraded to the standard required for high volume heavy vehicle movements. The NGIA's ability to accommodate larger operations in 'heavier' and more strategic industrial uses addresses the key issues faced by consulted stakeholders.

Industry Expansion Opportunities

Delivery of the proposed NGIA will allow mining service industry operators to expand their operations in Newman and the wider East Pilbara region, delivering a range of direct economic impacts and induced benefits. The co-location of the consulted proponents will likely drive demand from supporting industries in their supply chains and potentially downstream manufacturing industries. This additional demand can be accommodated at the NGIA given its land capacity, creating the opportunity for the development of a significant industrial hub.

COVID-19 Response

The NGIA also reflects an opportunity to fast-track the region's recovery from COVID-19 by boosting local employment through both the construction and ongoing operation stages. In this way, the project will mitigate the long-term effect of the pandemic on the Shire of East Pilbara's economy.

5 ECONOMIC IMPACT

The economic impact of Industrial rezoning of the NGIA has been estimated based on the yield of industrial land derived from the stated requirements of consulted businesses (the demand-based stage). Input-Output modelling has been used to estimate the employment and output impact of the subdivision, construction and operation phases of the demand-based stage of the project.

5.1 Input-Output Tables Methodology

The economic impact of delivering the NGIA's demand-based stage has been assessed using ABS National Input-Output tables at an Input-Output Industry Group (IOIG) level.[5] The methodology involves estimating the total direct and indirect output and employment arising from the industrial development project.

Input-Output tables provide information about the supply and disposition of commodities in the Australian economy as well as the structure and inter-relationships between industries.[6] The National Input-Output tables are used to derive total multipliers, which consider the total supply chain of goods and services for the activity in question. Impact multipliers were calculated for employment and output. The obtained multipliers were then combined with construction expenditure data to estimate the direct and indirect economic effect of the project.

Assumptions and Limitations

The following assumptions and limitations apply to the model:

- Results of the model represent gross impacts in the absence of capacity constraints
- National Input-Output tables approximate the actual patterns of linkages between industries in the regional economy
- The analysis assumes that the industrial structure of the economy is fixed
- Estimates of employment impact are based on the average output per Full-Time Equivalent (FTE) employee. It is likely that a significant component of the impact will result in an increase in the number of hours worked by existing employees, with some additional employment created

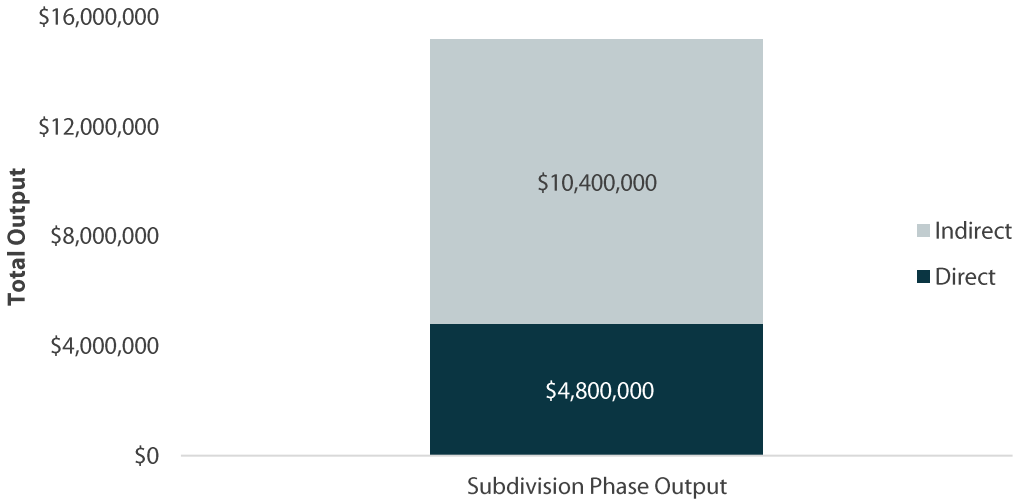
A high-level estimate of the project cost has been used to demonstrate subdivision and construction impacts. These costs are estimates only and are subject to change based on the nature of built form which is ultimately constructed at the NGIA. Due to this degree of uncertainty, conservative estimates of the nature of industrial built form have been made based on benchmarking to existing industrial centres in Perth. As advice received from the Shire of East Pilbara has indicated that the prospective NGIA is likely to exhibit ongoing operations with higher-than-average output productivities, impact modelling undertaken here should be viewed as a conservative lower bound of likely project impact.

[5] Industry grouping used by the ABS for constructing National Input-Output Tables
[6] Australian Bureau of Statistics 1995, *Australian National Accounts: Introduction to Input-Output Multipliers*, Information Paper. Available from: https://bit.ly/2uYbauL.

5.2 Subdivision Impact

Economic impact associated with the clearing of land and the creation of lots was calculated based on a total estimated subdivision cost of $4.8 million for the development of 7.5 hectares of land. This cost was estimated through application of per-hectare costs for heavy and civil engineering construction, construction services and professional services components of industrial subdivision, derived from benchmarking to comparable industrial development projects. This $4.8 million of direct expenditure is estimated to stimulate a further $10.4 million of indirect output in the wider economy, reflecting a total subdivision phase output of $15.2 million (Figure 13).

Figure 13. NGIA Demand-Based Stage Subdivision Phase Output



Source: Shire of East Pilbara 2020, Pracsys 2020

The employment impact of subdivision for the demand-based stage of the NGIA has been estimated by applying industry-specific output-per-employee values (derived from ABS Input-Output Tables) to the indicative subdivision expenditure of $4.8 million. It has been estimated that the subdivision of the NGIA will directly generate 5 FTE jobs. In addition to these direct employment opportunities, a further 35 FTE jobs are expected to be stimulated in the wider economy through the subdivision process, yielding a total of 40 FTE jobs (Figure 14).

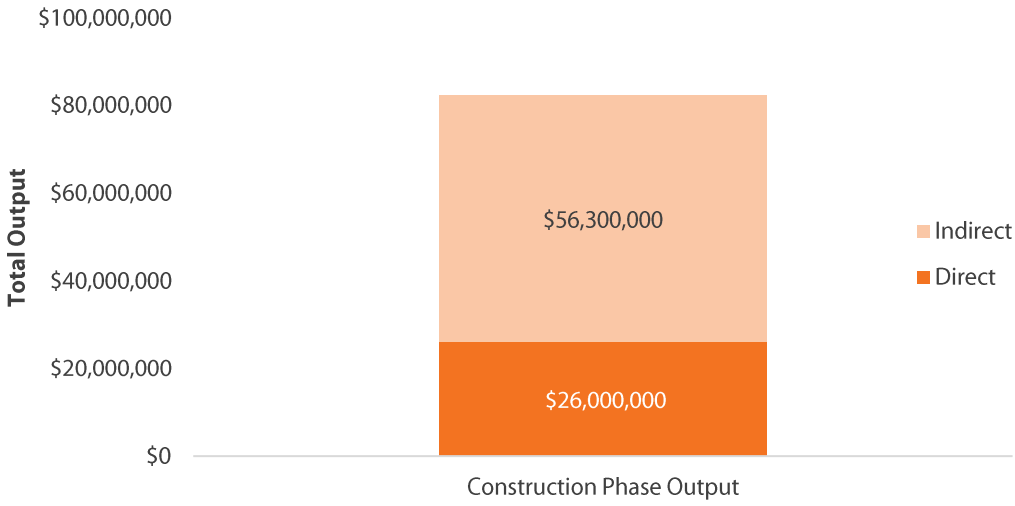
Figure 14. NGIA Demand-Based Stage Subdivision Phase Employment (FTE)

Source: Shire of East Pilbara 2020, Pracsys 2020

5.3 Construction Impact

The economic impact in the construction phase of the demand-based stage of the NGIA was calculated based on an estimated construction cost of $26 million, derived from benchmarking to comparable industrial centres in Perth. The nature of built form likely to locate within the NGIA was estimated by benchmarking to a mix of comparable industrial areas, with the construction expenditure applied to the appropriate sector. The $26 million of direct construction expenditure is estimated to stimulate a further $56 million of indirect output, combining for an estimated $82 million in total output (Figure 15). The large multiplying effect on total output is indicative of the significant industry-to-industry inputs within the construction sector.

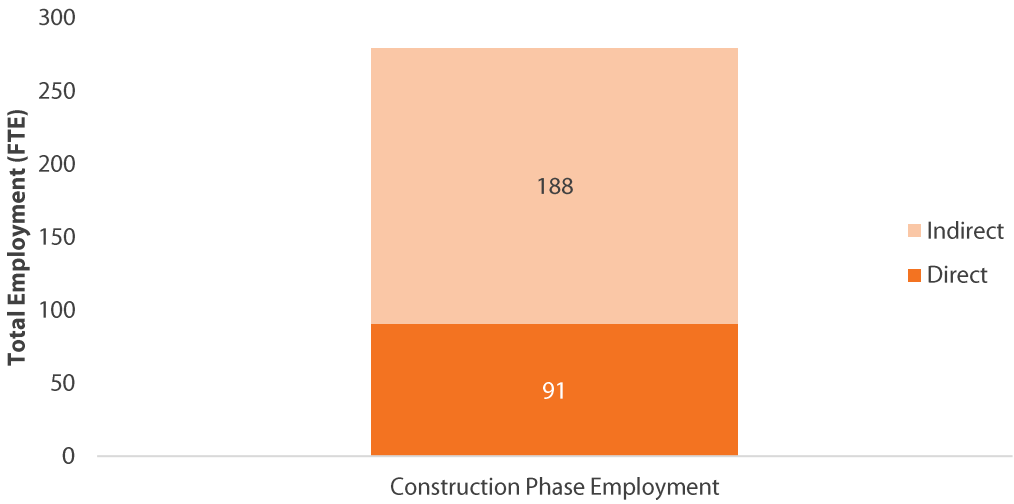
Figure 15. NGIA Demand-Based Stage Construction Phase Output



Source: Shire of East Pilbara 2020, Pracsys 2020

The employment impact of the construction process at the NGIA has been estimated by applying industry-specific output-per-employee values (derived from ABS Input-Output Tables) to the direct construction expenditure of $26 million. It has been estimated that the construction phase will directly generate 91 FTE employment opportunities. A further 188 FTE jobs are expected to be stimulated in the wider economy through the construction process, yielding a total additional employment effect of approximately 279 FTE jobs (Figure 16).

Figure 16. NGIA Demand-Based Stage Construction Phase Employment (FTE)



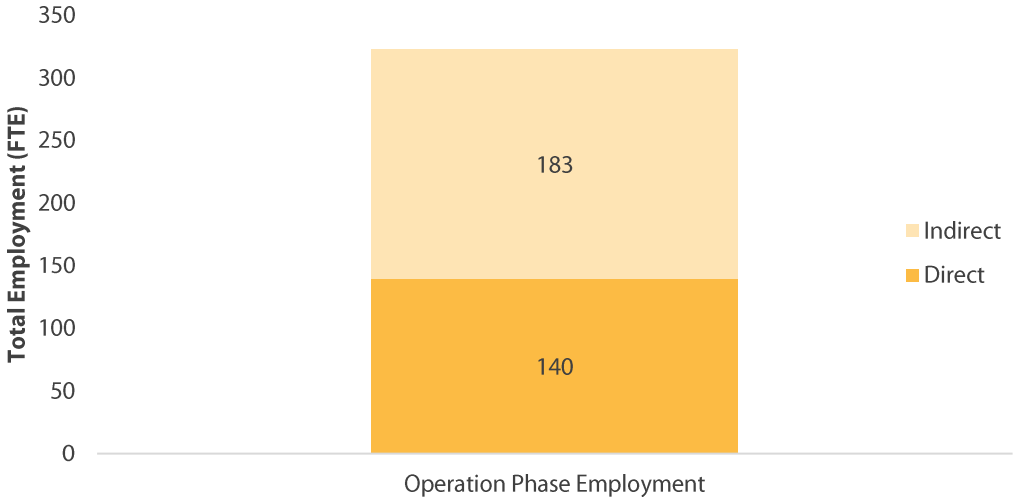
Source: Shire of East Pilbara 2020, Pracsys 2020

The actual number of employment opportunities unlocked through the construction of industrial facilities at the NGIA will depend on the nature of built form that is ultimately delivered, as indicated above under the Assumptions and Limitations section. Furthermore, this employment generation is not expected to occur immediately, but rather will be spread over a potentially multi-year buildout timeline.

5.4 Operational Impact

The operation phase impact of the demand-based stage of the NGIA project has been estimated through consultation with business operators in the East Pilbara region. Additional direct employment has been estimated as the total number of additional persons to be employed on a full-time basis by businesses intending to establish additional operations in Newman at the NGIA, should it be rezoned. Consulted businesses indicated that approximately 140 additional FTE employment opportunities would be created through the establishment of industry activity at the demand-based stage of the NGIA. These 140 direct jobs are estimated to stimulate a further 183 FTE indirect jobs in the wider economy, based on the application of a composite Input-Output Industry Group multiplier. This reflects a total ongoing operational phase employment impact of approximately 323 FTE jobs per annum in the demand-based stage.

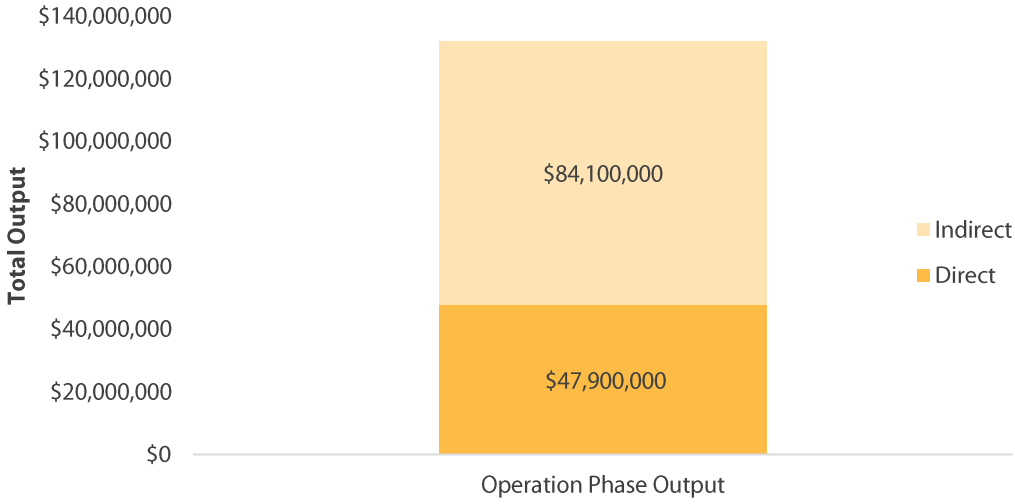
Figure 17. NGIA Demand-Based Stage Operational Phase Employment (FTE per annum)



Source: Shire of East Pilbara 2020, Pracsys 2020

The creation of approximately 140 direct operational jobs per annum at the NGIA is associated with $48 million of direct output each year. This direct output will stimulate further indirect output of approximately $84 million in the wider Shire and State economies, reflecting a total value of operational output in the order of $132 million (Figure 18).

Figure 18. NGIA Demand-Based Stage Operational Phase Output ($ per annum)



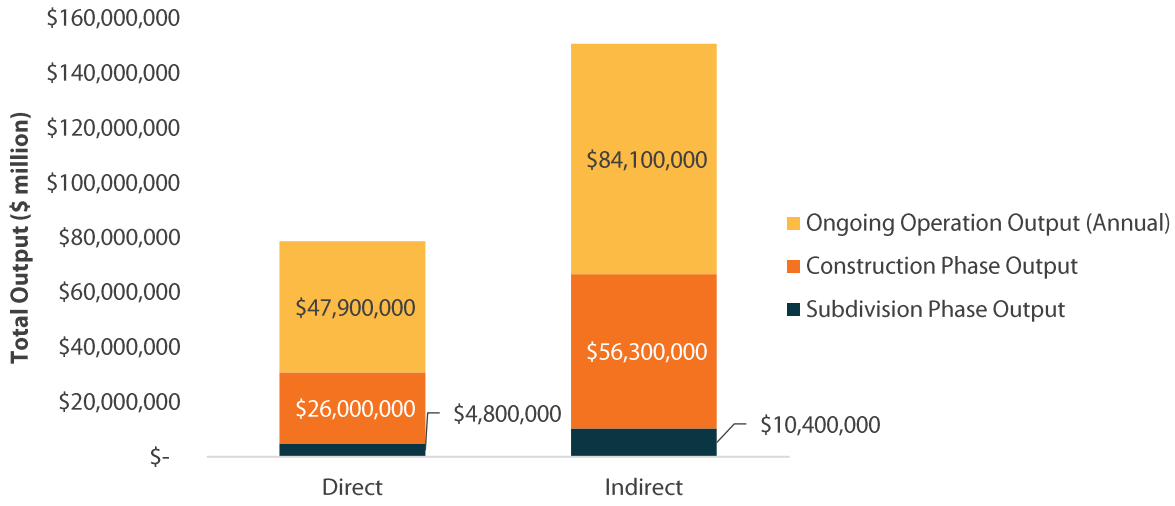
Source: Shire of East Pilbara 2020, Pracsys 2020

5.5 Total Impact

The development of the demand-based stage of the NGIA has been estimated to stimulate $98 million of total output in the East Pilbara economy across the subdivision and construction phases, with $31 million generated directly in Newman and a further $67 million stimulated in the wider economy (Figure 19). In

addition to this static impact, the ongoing operations of the NGIA's demand-based stage could dynamically generate $132 million of output per annum, $48 million of which would be captured locally.

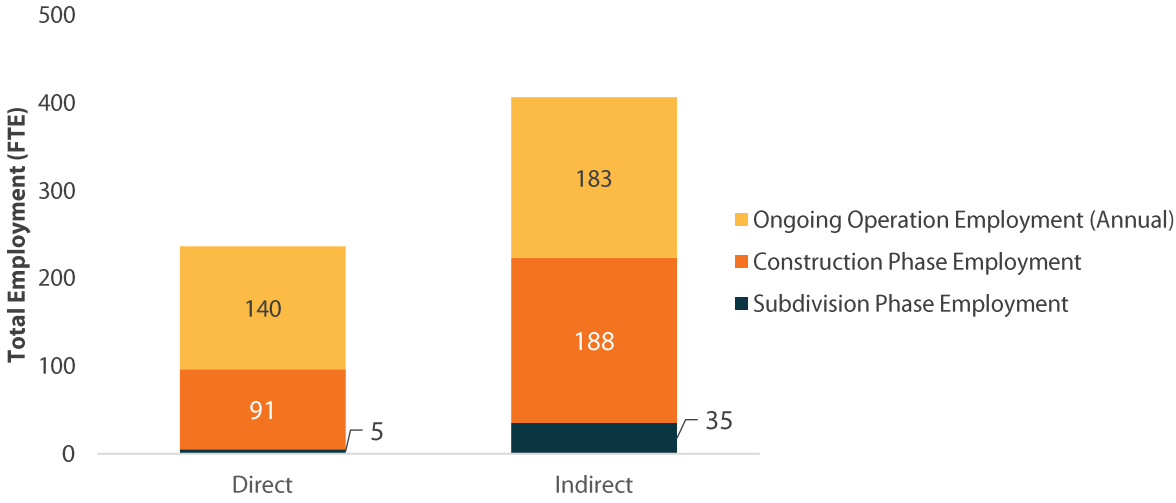
Figure 19. Direct and Indirect Output of Demand-Based Stage of NGIA Development



Source: Shire of East Pilbara 2020, Pracsys 2020

The development of the demand-based stage of the NGIA has been estimated to generate 320 FTE employment opportunities across the subdivision and construction phases, with 96 generated directly in Newman and a further 223 stimulated in the wider economy (see Figure 20). In addition to this static impact, the ongoing operations of the NGIA's demand-based stage could dynamically support a further 323 FTE jobs per annum, 140 of which would be captured in Newman.

Figure 20. Direct and Indirect Employment Generated by Demand-Based Stage of NGIA Development



Source: Shire of East Pilbara 2020, Pracsys 2020

Full Development Impacts

The subdivision and construction of the total NGIA land area of 36.9 hectares could create an estimated 474 FTE direct jobs and stimulate a further 1,100 FTE indirect employment opportunities. Over these static development phases, $152 million of direct output could be generated, inducing a further $328 million of output in the wider economy.

At full build-out, the ongoing operations of the NGIA could generate approximately 1,589 FTE jobs each year, 689 of which would be supported directly in Newman and 900 of which would be induced in the wider economy. This annual employment effect could produce over $649 million per annum in total output, with $236 million generated directly within Newman and $414 million stimulated in the wider economy.

6 BENEFITS

6.1 Qualitative Economic Benefits

Benefits arising from the rezoning of land for Industrial use at the proposed NGIA have been quantified based on the development of approximately 7.5 hectares in the demand-based stage. Where possible, benefits have been quantified. Where benefits are not readily quantifiable, they have been discussed qualitatively. The benefits below are discussed qualitatively, with Section 6.2 applying a monetary value to quantified benefits in order to compare them to project costs through a Cost-Benefit Analysis.

Increased Productivity

The productivity benefits from having centrally-located industrial land are significant. These benefits are, likewise, compounded when the land is serviced by multiple forms of logistical transport, including air transport. Some of these benefits are likely to include:

- Reduction in business costs and general increases in productivity
- Cluster development
- Reduction in infrastructure spend to generate employment opportunities
- Reduction in travel times for employees

This encompasses savings across government, private enterprise and public expenditure, representing productivity benefits across all layers of the economy.

Given the nature of industrial land and the employment and businesses it supports, industrial land often services a high proportion of business-to-business transactions. On average, a central location will therefore afford the greatest cost efficiencies for companies. This is further compounded when this location is adjacent to transportation options such as rail, primary freight routes and/or specialised transportation options such as air, reflected by the subject site's proximity to Newman Airport. The NGIA's location on Great Northern Highway is also key, as it will provide large freight vehicles direct access to the industrial area. This locational factor will alleviate current issues with oversized vehicle accessibility, as road trains cannot currently transit through Newman to the existing industrial area. Due to these innate locational advantages, the costs to businesses requiring these specialised forms of transportation are reduced. This in turn will drive higher business profits which can be passed on as gains for capital owners and higher wages for employees.

Industry Capacity Building

Development of the NGIA has the capacity to drive the expansion of Newman's mining services sector. The ongoing activities at the site could deliver significant job creation locally, supporting innovative, high-output activities in a positively reinforcing cycle. Private operators attracted by the NGIA could demand additional inputs from local supply chains, supporting the development of the existing human capital and technical expertise present within the region's mining services. This capacity-building should see the economic

contribution of the sector continue to grow over time, assisting in the sustained development of the Shire of East Pilbara and Western Australian economies. Such capacity-building could take many forms, including:

- **Industry Reputation / Brand Building:** The reputation of the NGIA will likely develop over time as more businesses establish industrial operations there. Ideally, the reputation of the facility would become synonymous with the standing of Newman and the Shire of East Pilbara, sending a positive signal to the business community and serving to attract more private industrial operators over time. This positively-reinforcing cycle would support high-quality business outcomes at the NGIA and in the wider Shire region.
- **Agglomeration:** The project could capitalise on Newman's existing competitive advantage in the mining services industry. It would lay the foundation for the establishment of further industry agglomeration around the physical asset of the NGIA, allowing all operators to benefit from pooled resources. Related activities would begin to consolidate around the facility's core industrial operations, with high-value industries (i.e. Metal Ore Mining, Mining Support Services and Machinery and Equipment Repair and Maintenance) having the potential to form a cluster that continues to diversify and strengthen the East Pilbara and Western Australia economies.
- **Knowledge Spillover:** The technical expertise and human capital developed by the facility's operations could spill over to neighbouring industries, allowing for a cross-pollination of ideas, skills and technology.
- **Specialisation:** The facility should enhance the existing competitive advantage of Newman's mining services industry, adding specialist skillsets which become attractors of further activity.

Inward Investment Attraction

There is demonstrated latent demand for industrial land in Newman. The business proponents who have expressed interest in establishing additional operations at the NGIA will require facilities to support their operation. Allowing industrial land uses at the NGIA should therefore be the impetus for significant private investment. This investment would directly support construction employment and indirectly contribute to sustaining population-driven industries such as retail, tourism, health and education in Newman. In the long term, the attractiveness of the NGIA as a place to do business is likely to support continued interest from operators and induce the private investment required for additional industrial uses.

The potential costs associated with the development of the demand-based stage of the NGIA have been estimated at $30.9 million, of which approximately $4.9 million would be expended on subdivision (likely to be borne by Government) and $26 million would be borne by private developers on construction.[7] This $26 million of private investment reflects an approximation of the value of inward investment into the Shire of East Pilbara induced by de-constraining land for development of the demand-based stage of the NGIA.

[7] Based on industrial construction cost benchmarking undertaken in the impact assessment, the value of private investment attraction may be up to $26 million during the demand-based stage of NGIA construction.

Construction expenditure associated with the development of the entire 36.9 hectares NGIA site would be approximately $128 million, reflecting the potential upper-bound of inward investment attracted by the Shire's de-constraining of NGIA land. This significant private investment over the demand-based ($26 million) and full build-out ($128 million) stages of the NGIA would also be likely to attract additional supporting industries around core mining services activities.

Professional Pathways Development and Human Capital Uplift

Business consultation has determined that there is potential for the NGIA to generate economic and social benefit for residents of Newman and the wider Shire region by facilitating increased traineeship/apprenticeship activity. Mining service businesses in Newman have identified that access to a skilled labour force is a vital factor affecting their locational decisions, as well as a key determinant in the ongoing success of their operations. Operators in Newman are currently experiencing difficulty attracting the requisite quality of labour for their business, due in part to constrained supply of local trainees/apprentices and undeveloped professional pathways.

Currently, multiple businesses in the mining services industry are constrained in their ability to host apprentices due to a lack of workshop space and industrial facilities in which to train them. The delivery of large, high-quality industrial lots at the NGIA would assist in overcoming this constraint, allowing businesses to provide professional development pathways to penultimate and final-year apprentices in Newman. This would both incentivise a greater number of skilled young workers to relocate to Newman and improve the professional development pathways available to local secondary school students. These factors should combine to increase employment self-containment within the Shire's mining service industry and drive improved economic and social outcomes in the wider Town and Shire communities.

6.2 Quantified Economic Benefits

Increased Economic Diversity and Sustainability

The sustainability of many regional communities is often based on their ability to support the local population with access to amenity and employment. Liveability is a term frequently used to refer to the characteristics of a city, urban area or town that make people willing to live there. While the definition is highly subjective and dependent on specific geographic and cultural context, the definition considered most relevant for the Shire of East Pilbara is:

"The attractiveness of an area as a place in which to live, work, invest, and do business"[8]

Improving the liveability of regional towns across Western Australia is a key goal of a range of Federal, State and local government strategies, as it contributes to their sustainability. Creating new employment opportunities in regional locations contributes significantly to their liveability. New jobs not only support the individual working but, in many cases, also support their family, making it possible to either retain existing or

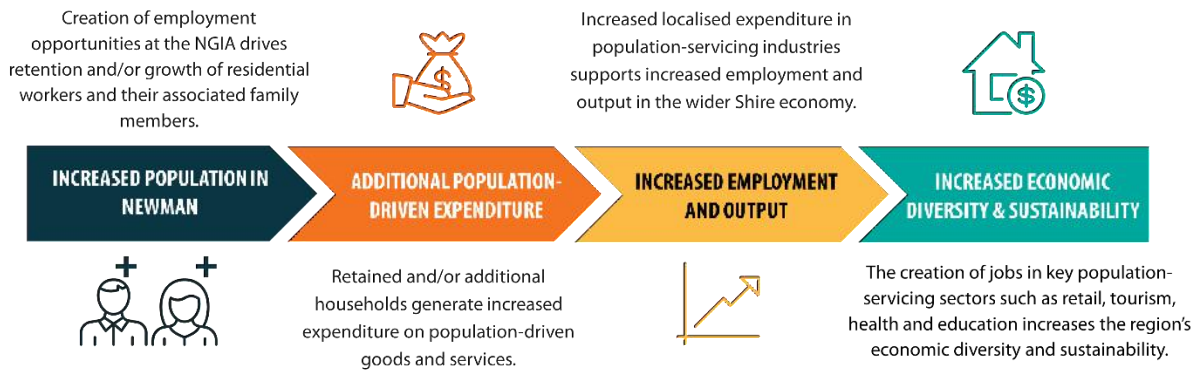
[8] Woolcock, G., 2009, *Measuring Up?: Assessing the Liveability of Australian Cities.* p. 3-5

attract new population. Population stability is required to support sustainable regional centres, contributing to economic activation and social capital. The proposed ongoing activities at the NGIA would support an estimated 140 additional employment opportunities each year for residents of Newman. This employment would contribute to the sustainability of the Shire through:

- Increased economic diversity associated with additional industrial activities that cannot currently be supported in Newman
- Greater economic resilience through:
  - The localisation of supply chains whose activities would normally be sourced externally from DIDO or FIFO workers
  - Greater business-to-business demand for inputs from local suppliers of goods and services
- Greater expenditure on local businesses from the retained and/or additional population supported through the creation of additional local employment opportunities

Each of these factors contributes to the sustainability and liveability of Newman. Project benefits related to increased economic diversity and sustainability have been quantified through the following pathway (Figure 21).

Figure 21. Flow of Economic Diversity and Sustainability Benefits from NGIA Development



Source: Pracsys 2020

1. **Increased population in Newman** due to the creation of employment opportunities at the NGIA, which in turn drives retention and/or growth of residential workers and their associated family members. The consideration of both retained and additional households in Newman reflects the goal of alleviating population decline and transitioning away from FIFO labour utilisation towards increased employment self-containment.
2. **Additional expenditure on population-driven goods and services** would be undertaken by retained and/or additional households. Only the direct value of expenditure by retained and/or additional households is considered as a quantified benefit, with indirect expenditure conservatively excluded from the project Cost-Benefit Analysis. This is due to much of the indirect expenditure

occurring outside the Shire of East Pilbara region (although some would occur within it). Conservatively, this benefit also considers only the benefits attributable to the ongoing activity at the NGIA, although there will also be short-term, one-off economic impacts due to the subdivision and construction stages of development.

3. **Increased employment and output** would be supported in the wider Shire economy through increased localised expenditure.
4. **Increased economic diversity and sustainability** would be enabled through the creation of jobs in key population-servicing sectors such as retail, tourism, health and education.

The monetised value of increased economic diversity and sustainability has been estimated at $10.1 million per annum, equating to a present value of $107 million over the twenty-year project lifetime. The employment-generating effect of additional expenditure by NGIA-worker households in key population-driven sectors has also been quantified through an ABS Input-Output Industry Group analysis (Figure 22).

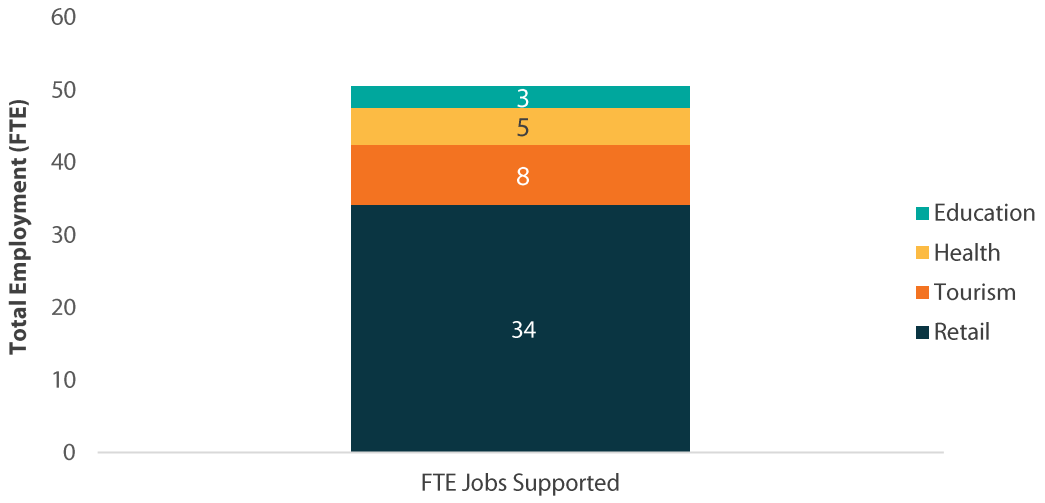
Figure 22. Additional Expenditure and Jobs Supported in Key Population-Driven Sectors

Sector	Input-Output Industry Group	Annual Expenditure	Expenditure per FTE Worker	FTE Jobs Supported
Retail	Retail Trade	$4,710,815	$138,342	**34**
Tourism	Accommodation, Food and Beverage Services	$1,432,250	$171,044	**8**
Health	Health Care Services	$652,251	$128,431	**5**
Education	Primary and Secondary Education Services	$365,543	$124,155	**3**

Source: ABS HES 2015-16, Department of Primary Industries and Regional Development 2019, Pracsys 2020

The total ongoing employment effect of additional expenditure by NGIA-worker households in these sectors is therefore approximately 50 FTE jobs per annum (Figure 23).

Figure 23. Additional Jobs Supported by NGIA in Key Population-Driven Sectors per Annum



Source: ABS HES 2015-16, Department of Primary Industries and Regional Development 2019, Pracsys 2020

Increased Viability of Community Infrastructure and Recreational Facilities

Community infrastructure underpins community wellbeing and fosters social interaction.[9] Social interaction is a key component in building a sense of common purpose and developing social capital, which are hallmarks of a thriving community.[10] Most rural communities do not have the critical mass of population to support financially viable facilities; instead, most infrastructure is developed by local governments who then subsidise facilities during their operation. This is often an expensive endeavour, which is difficult to justify in purely financial terms.

A significant revenue source for local governments is their rate base. Rates are paid by residents and businesses. Rate revenue from commercial and industrial land is especially important, as it generally achieves a surplus; industrial activities generally pay more in rates than the cost of services provided to them, unlike residents. The NGIA, therefore, presents an opportunity for the Shire to expand the share of rates coming from industrial land uses, increasing the revenue available to maintain and operate community facilities in the region. Rate revenue derived from the prospective NGIA is therefore used as a conservative dollar value estimate of the contribution of the project towards supporting community infrastructure investment.

The potential revenue from the NGIA has been estimated based on a conservative application of a 1.90 per cent Industrial rate[11] to an indicative NGIA gross rental value (GRV) of $37 per square metre.[12] Based on this, it is estimated that the Shire would generate approximately $53,400 in additional rate revenue per annum from the NGIA, equating to $0.6 million in additional rate revenue over the twenty-year project lifetime in present value terms. It should be noted that this estimate is likely to be a lower bound estimate, as it is based on a low existing Industrial rate and a conservatively benchmarked GRV. The present value of rate revenue could be as high as $2.5 million over the project lifetime if the Industrial rate were increased in line with other Pilbara shires[13] and up to $3.3 million if both a higher rate and higher GRV[14] could be achieved.

Full Development Quantified Benefits

Benefits arising from the rezoning of land for Industrial use at the proposed NGIA have been quantified based on the demand-based stage development of approximately 7.5 hectares. The long-term benefits of the project, reflective of realisation of the total site area of 36.9 hectares, would be even more significant. It is estimated that the monetised value of increased economic diversity and sustainability attributable to the development of the full site would be in the order of $50 million per annum, equating to a present value of

[9] Australian Local Government Association, 2015. *The Case for a Local Government Community Infrastructure Program – Boosting Productivity and Creating Jobs in Every Australian Community*, p.2.
Available from:
<http://alga.asn.au/site/misc/alga/downloads/transport/CommInfrastructure/ALGA_LGCIP.pdf>
[10] Atherley, K. M., 2006. *Sport, Localism and Social Capital in Rural Western Australia, Geographical Research, Issue 44(4) pp. 348-360.*
Available from: < http://onlinelibrary.wiley.com/doi/10.1111/j.1745-5871.2006.00406.x/abstract >
[11] Shire of East Pilbara, *Schedule of Fees & Charges 2018/2019.*
[12] GRV has been conservatively estimated through rental price benchmarking to a comparable mix of Perth and Newman based industrial property listings.
[13] Based on application of an 8.27 per cent Industrial rate, in line with the City of Karratha, Town of Port Hedland and Shire of Ashburton rates for Industrial land.
[14] Based on achievement of a $50 per square metre GRV for lots at the NGIA.

$528 million. The present value of the contribution of the full-scale project towards supporting community infrastructure investment, as approximated through additional Industrial rate revenue, has been estimated at $2.8 million over the project lifetime (under a conservative Industrial rate and GRV).

7 COST-BENEFIT ANALYSIS

Quantified benefits arising from the rezoning of land for Industrial at the demand-based stage of the NGIA development have been compared to site development and operation costs that could potentially be borne by the Shire of East Pilbara and other government entities through a Cost-Benefit Analysis. The benefits accredited to the project have been calculated based on the marginal benefit associated with the development of the demand-based stage of the NGIA only. Costs are based on benchmarked subdivision and ongoing site management cost estimates.

7.1 Cost Analysis

Costs were analysed over the minimum operational life of the prospective facility, which is a period of twenty years. Project subdivision expenditure and additional ongoing operational / maintenance costs (i.e. road maintenance) were included in the analysis; it was assumed that these costs were likely to be borne by Government, making them suitable for inclusion as the cost component in the CBA. The present value of site development (subdivision) costs to be borne by the Shire of East Pilbara and other government entities equate to approximately $4.5 million. This expenditure is exclusive of construction capital costs, which are likely to be borne by the private market and are therefore not considered as costs to Government.

The present value of operational costs for the production facility equates to approximately $0.8 million over the twenty-year evaluation period. This cost is derived from an estimated annual operating expense to the Shire in the order of $89,000, reflecting an average wage for one FTE worker.[15] This conservatively assumes that one FTE employee is responsible for managing the ongoing operations of the NGIA.

The lifetime present value of costs for developing the NGIA is therefore approximately $5.3 million.

7.2 Quantified Benefits

The project is likely to deliver significant economic and social benefits to Newman, the Shire of East Pilbara and Western Australia. All such benefits were assessed over a twenty-year period using a seven per cent discount rate to determine the present value.[16] A sensitivity analysis was performed to assess the impact of alternative discount rates.

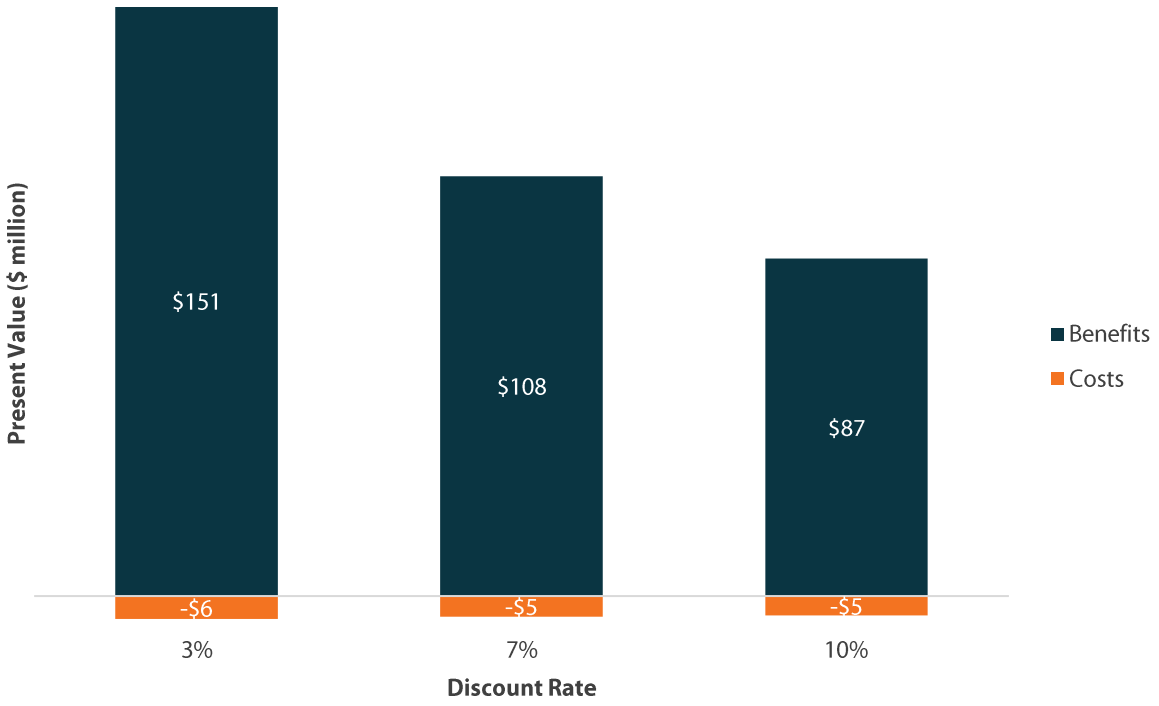
The sum of economic benefits attributable to the project, discounted into present value, is approximately $108 million. Due to the qualitative nature of many of the project's benefits, the full benefit of the project is likely to be higher than the total benefit quantified in this assessment.

[15] Based on ABS data on the annual income of Local Government Administration workers (inflation-adjusted).
[16] The standard approach to valuing costs and benefits that occur at different times is based on the fact that a dollar now is worth more than a dollar next year. Therefore, benefits to be enjoyed in the future must be discounted into present-day terms to inform decision making about future projects. The Department of the Prime Minister and Cabinet (2016) advises that future benefits be discounted at a rate of seven per cent per annum.

7.3 Benefit-Cost Ratio and Net Present Value

The Benefit-Cost Ratio (BCR) was calculated based on the ratio of present value benefits to present value costs, evaluated over the twenty-year project period (Figure 24).

Figure 24. Present Value Benefits and Costs Over Twenty-Year Project Life



Source: Pracsys 2020

The Cost-Benefit Analysis estimates a BCR of 20.28 for the project, indicating that for every dollar in costs there is approximately $20.28 of benefits generated (Figure 25). This BCR reflects the minimum likely total benefit of the project. A positive NPV indicates that the project is good value for money in the long term. The project is likely to provide significant long-term benefits, with an NPV of approximately $102 million.

Figure 25. Project Net Present Value (NPV) and Benefit-Cost Ratio (BCR)[17]

Total Present Value Benefits	$107,803,260
Total Present Value Costs	-$5,314,736
Net Present Value (NPV)	**$102,488,525**
Benefit-Cost Ratio (BCR)	**20.28**

Source: Pracsys 2020

[17] Assumes application of the recommended seven per cent discount rate.

A sensitivity analysis was conducted to test the effect of alternative discount rates on the project NPV and BCR (

Figure 26). All discount rates return a positive NPV and a BCR above 17.

Figure 26. Sensitivity Analysis

	Discount Rate		
	3%	**7%**	**10%**
Present Costs	-$5,862,826	-$5,314,736	-$5,012,305
Present Benefits	$151,391,178	$107,803,260	$86,632,876
NPV	**$145,528,352**	**$102,488,525**	**$81,620,571**
BCR	**25.82**	**20.28**	**17.28**

Source: Pracsys 2020

The results of the Cost-Benefit Analysis reflect that the de-constraining of the NGIA subject site for industrial development by the Shire of East Pilbara is an especially sound economic investment. From the perspective of Government, the project will catalyse a significant amount of private expenditure and industry activity. The high project BCR also reflects the degree of latent demand for these activities, as identified through consultation. The high project BCR and NPV provide definitive evidence to support a Government decision to facilitate the rezoning of land for industrial uses at Newman Airport. This will unlock significant benefits for the Shire of East Pilbara and wider Western Australian economies.

The result of this Cost-Benefit Analysis reflects the likely lower bound return on investment for the full project when the Net Present Value is considered. As the NGIA develops beyond the demand-phase component, the net benefit will grow, as the ratio of benefits to costs is positive and constant. This indicates that de-constraining land for development of the NGIA represents a high-value return on government investment in both the short and long-term.

8 CONCLUSION

There is currently a demonstrated shortage in the supply of industrial land within Newman. The Shire of Newman is proposing to rezone an area of land at the Newman Airport for general industrial uses. The NGIA represents an opportunity to deliver required industrial land within the Town, including a broad range of high-value land uses related to mining-services activities within the General Industrial land use category. The project also represents a significant opportunity for the Shire of East Pilbara and Western Australia economies to realise the suite of benefits associated with high-quality centralised industrial activity. Such benefits include:

- Increased Productivity
- Industry Capacity Building
- Inward Investment Attraction
- Professional Pathways Development and Human Capital Uplift
- Increased Economic Diversity and Sustainability
- Increased Viability of Community Infrastructure and Recreational Facilities

The costs and benefits associated with rezoning the subject site land for Industrial use through the demand-based stage of the NGIA project have been compared through a Cost-Benefit Analysis to illustrate the project's value for money. The project BCR is estimated to be 20.28, with the Net Present Value estimated at $102 million over the twenty-year evaluation period. Therefore, for every dollar invested in the project, there is approximately $20.28 of benefits generated within the local economy over the first twenty years. This evidences that the project is a sound investment opportunity for Government, and one which will deliver significant economic benefits to Newman, the East Pilbara region and Western Australia.

In addition to the demonstrated needs and range of project benefits, the economic impact of the demand-based stage of the NGIA development is also significant. The demand-based project stage will generate a range of localised and economy-wide impacts, with the development estimated to unlock $98 million of total output across the subdivision and construction phases and $132 million of output each year through ongoing operations. This reflects stimulation of approximately 320 one-off FTE employment opportunities through the subdivision and construction phases, with a further 323 FTE jobs supported each year through the NGIA's ongoing operations.

This combination of need, demonstrated benefits, and significant economic impact provides a compelling case for Government to facilitate the rezoning of the land and the delivery of the demand-based stage of the NGIA.