

TNG LIMITED

SUPPLEMENT

to the

ENVIRONMENTAL IMPACT STATEMENT

DARWIN PROCESSING FACILITY

**MIDDLE ARM, DARWIN, NORTHERN
TERRITORY**

31 JANUARY 2021

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EXECUTIVE SUMMARY

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E.1 INTRODUCTION

TNG Limited (**TNG**), an Australian resource and mineral processing technology company based in Perth, Western Australia (**WA**), is seeking approval from the Northern Territory (**NT**) and Commonwealth governments to develop the proposed Darwin TIVAN® Processing Facility (the **Project**) to process magnetite concentrate to produce high value products for export to international customers.

A Draft Environmental Impact Statement (**Draft EIS**) was submitted to the Northern Territory Environment Protection Authority (**NT EPA**) under the bilateral agreement between the Commonwealth and NT Governments in November 2019. The Draft EIS was released for public review between 30 November 2019 and 21 February 2020. Following closure of the exhibition period, three public submissions were received. A consolidated list of requirements from NT Government agencies and the Commonwealth Department of Agriculture, Water and the Environment (**DAWE**) was also provided in April 2020, along with a direction from the NT EPA Board to develop a Supplement to the Draft EIS (the **Supplement**).

The key purpose of the Supplement is to provide responses to comments made on the Draft EIS during the public review period. It also provides TNG with an opportunity to communicate changes to the Project that have been developed since the submission of the Draft EIS.

Four formal submissions on the Draft EIS were received, including a consolidated response from the NT Government, two non-government organisations (**NGOs**) and one private company. A total of 11 main topics were raised across the submissions, namely:

- Proposal Description
- Marine Environmental Quality
- Benthic Habitat and Communities
- Marine Flora and Fauna
- Terrestrial Flora and Fauna
- Inland Water Quality
- Air Quality and Greenhouse Gases
- Environmental Management Plan
- Consultation
- Approvals and Regulatory Framework
- Social, Cultural and Economic Surroundings

The topic raised most often was marine environmental quality, particularly in regards to impacts associated with the discharge of wastewater streams into the Darwin Harbour. Other topics raised in multiple submissions included the water balance requirements for processing, Project description information and the lack of non-government stakeholder consultation. TNG's responses to stakeholder submissions are presented in **Section 1** of the Supplement; full copies of all submissions are provided at **Appendix A**.

E.2 REVISED PROJECT DESCRIPTION AND CHANGES

E.2.1 CONSTRUCTION PHASE

Construction is scheduled to commence following receipt of statutory approvals and subject to finance and TNG Board Financial Investment Decision approval. The construction period for the Darwin Processing Facility is anticipated to be 24 months, continuing over both wet and dry seasons. The construction phase will involve:

- Site preparation;
- Vegetation clearing,
- Bulk earthworks,
- Civil and architectural construction,
- Structural, mechanical and platework erection;
- Piping installation; and
- Electrical instrument installation.

Table ES-1 provides an indicative construction schedule.

Table ES-1. Indicative schedule for the construction phase

Activity	Month																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Site clearing	■	■																						
Bulk earthworks		■	■	■	■	■	■	■																
Civil and architectural construction			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Structural, mechanical and platework erection				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Piping installation							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Electrical instrument installation																								
Cold commissioning																								
Startup ⁺																								

+ Startup to occur after Month 24

Further detail on the construction phase has been provided in **Section 2.2** of the Supplement to expand on the information provided in the Draft EIS. The components of the construction phase generally remain consistent with those presented in the Draft EIS, with the exception of concrete batching which will no longer occur on site. Concrete will now be sought from local suppliers.

E.2.2 PROCESSING PHASE

Following submission of the Draft EIS, TNG has progressed the Front-End Engineering and Design (**FEED**) phase of the Project which, along with consideration of comments received through EIS submissions, has led to Project design updates.

The most significant amendment to the Project relates to wastewater discharge. The Draft EIS proposed to dispose of liquid waste from the Processing Facility via a discharge pipeline into Darwin Harbour near East Arm. Following further Project refinements, and noting the feedback from stakeholders, TNG has incorporated a Water Recycling Plant (**WRP**) to treat liquid wastes from the Processing Facility. The WRP will facilitate water recycling and negate the requirement for off-site discharge to the marine environment.

Inclusion of the WRP has also resulted in significant savings in input water requirements for the Project, which are detailed in **Section 2.3.4**. The Project's annual water demand from the Darwin water supply is now expected to be reduced by 65 %.

Project refinement has resulted in variations to the Project waste streams and greenhouse gas (**GHG**) emissions. Re-calculation of emissions has resulted in an expected 15% increase in the GHG emissions from the Project. Further advances in FEED and the inclusion of the WRP has resulted in further waste streams being identified. The key components **Table ES-2** summarises the changes to the Project from the Draft EIS to the Supplement.

Table ES-2. Darwin TIVAN® Processing Facility key components table

Component	Description in the Draft EIS	Change in the EIS Supplement
Operational Requirements		
Development Envelope	264 hectares (ha)	270.5 ha
Throughput	700,000 tonnes per annum (tpa)	No change
Operating hours	The Processing Facility will operate 24 hours per day, seven days per week.	No change
Products	Titanium Dioxide Pigment (TiO₂)	
	TNG's average production: 100,000 tpa (1.5% of world demand)	No change
	Vanadium Pentoxide (V₂O₅)	
	TNG's average production: 6,000 tpa (3.5% of world demand)	No change
	Ferric Oxide (Fe₂O₃)	
	TNG's average production: 500,000 tpa (0.5% of world demand)	No change
Reagents	- Several acids, bases and oxidants; and - Several solid reagents including metals, hydroxides, limestone, diatomaceous earth, sulfur, organic	<u>Processing:</u> Oleum Plant and associated reagents removed from process.

	polymers (flocculants) and inorganic salts	<u>Water Recycling Plant:</u> Addition of Sulphuric acid, Nitric acid, Hydrochloric acid, Sodium hydroxide, Ferric chloride, Sodium hypochlorite, Antiscalant, Sodium metabisulphite, Citric acid, Flocculant (polymer), Defoamer.														
Electricity Consumption (TJ/annum)	1316	1597														
Natural Gas Usage (PJ/per annum)	4.82	5.2														
Water sourced from the Darwin Water + Supply (GL/per annum)	11	3.85														
Wastewater management	Discharged into Darwin Harbour via a pipeline.	No discharge into marine environment, liquid wastes will be treated and recycled in the Wastewater Recycling Plant.														
Train movements	On average: - three train loads of concentrate per week will be delivered to the Processing Facility from Mount Peake; and - seven train movements between the Processing Facility and East Arm Wharf will occur weekly	No change														
Traffic movements (Maximum traffic on external roads; vehicles/day)	985	636														
Operations Phase Waste Streams	- Wastewater from Processing Facility to be disposed through marine discharge at a rate of 9.5 GL/annum. - Filter cake from wastewater precipitate produced in the pigment plant, the TIVAN® Process and collected stormwater., - Neutralised digest residue tailings. - Dry magnetic separation non-magnetics. will be produced at a rate of 570 tpa.	<table><thead><tr><th><u>Waste Product</u></th><th><u>Volume tpa</u></th></tr></thead><tbody><tr><td>Coke ash</td><td>2,500</td></tr><tr><td>Sulphate digest leach residue</td><td>55,000</td></tr><tr><td>Metal hydroxide precipitation #1</td><td>15,000</td></tr><tr><td>Metal hydroxide precipitation #2</td><td>30,000</td></tr><tr><td>WRP Clarifier solids</td><td>4,000</td></tr><tr><td>Sewage</td><td>150 m³/day</td></tr></tbody></table>	<u>Waste Product</u>	<u>Volume tpa</u>	Coke ash	2,500	Sulphate digest leach residue	55,000	Metal hydroxide precipitation #1	15,000	Metal hydroxide precipitation #2	30,000	WRP Clarifier solids	4,000	Sewage	150 m³/day
<u>Waste Product</u>	<u>Volume tpa</u>															
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Metal hydroxide precipitation #2	30,000															
WRP Clarifier solids	4,000															
Sewage	150 m³/day															
By-products from waste streams	None identified	<u>By-Product</u> Gypsum products Digest residue WRP salt residue components (with further processing)														
Workforce	Peak workforce during construction is expected to be approximately 700 to 1000 personnel The operations of the Processing Facility is estimated to require a workforce of approximately 600 personnel.	Construction workforce estimated to be approximately 1200 to 1500 personnel. Operations workforce estimated to be approximately 850 personnel, with 300 personnel on site at any one time.														

Greenhouse gases	Direct emissions – 828,310 t CO ₂ eq Indirect emissions – 204, 711 t CO ₂ eq Total emissions – 1,033,021 t CO ₂ eq	Direct emissions – 944,020 t CO ₂ eq Indirect emissions – 248,383 t CO ₂ eq Total emissions – 1,192,401 CO ₂ eq

E.2.2.1 TIVAN Process

The TIVAN® leach circuit - TNG's proprietary TIVAN® Process is a hydro-extraction process designed to produce very high-purity vanadium pentoxide, titanium dioxide and iron oxide. The simplified Darwin Processing Facility process flowsheet is displayed in **Figure ES-1**.

E.2.2.2 Titanium Pigment Plant

The simplified titanium pigment plant flowsheet is displayed in **Figure ES-2**. Processing broadly involves digestion of titanium from the TIVAN® leach residue, hydrolysis of titanium from solution, calcination of hydrolysed titanium, milling and surface treatment of raw TiO₂, followed by steam milling to produce the titanium pigment product.

E.2.2.3 Other Processing Requirements

Table ES-3 summarises the other processing requirements for the production of the end products.

Table ES-3. Other inputs required in the production process.

Processing Requirement	Description
Oxygen Plant	An oxygen plant will supply oxygen for the hydrometallurgical process and for the pigment plant by air liquefaction. The primary product will be gaseous oxygen. A small percentage of the gaseous or liquid nitrogen will be used in the process plant. The remaining nitrogen will be vented to the atmosphere.
Steam	Steam is required for the titanium pigment plant, for heating in the hydrometallurgical process and for the vanadium purification circuit. The steam for the plant will be generated from waste heat recovery of the off gas. Where required, natural gas will be used to make-up steam requirements for the plant. Water for steam production will be a combination of recycled condensed steam and demineralised makeup water.
Cooling	Air cooling towers will provide cooling for the Processing Facility. 7,850 tph of cooling air will provide a heat sink for 1,270 tph of circulating cooling water required for process units throughout the plant.
Pressurised Air	A pressurised air supply, required for instruments and pressure filters, will be supplied by two air compressors, with one online at any time. Compressed air will be filtered, dried to prevent condensation, and then supplied at 750 kilopascals (kPa) into two air receivers; one for instrument air and one for plant air.

Following submission of the Draft EIS, a key amendment to Processing has been removal of the Oleum Plant at the site. Sulphuric acid will be sourced from local suppliers.

TIVAN® PLANT FLOWSHEET

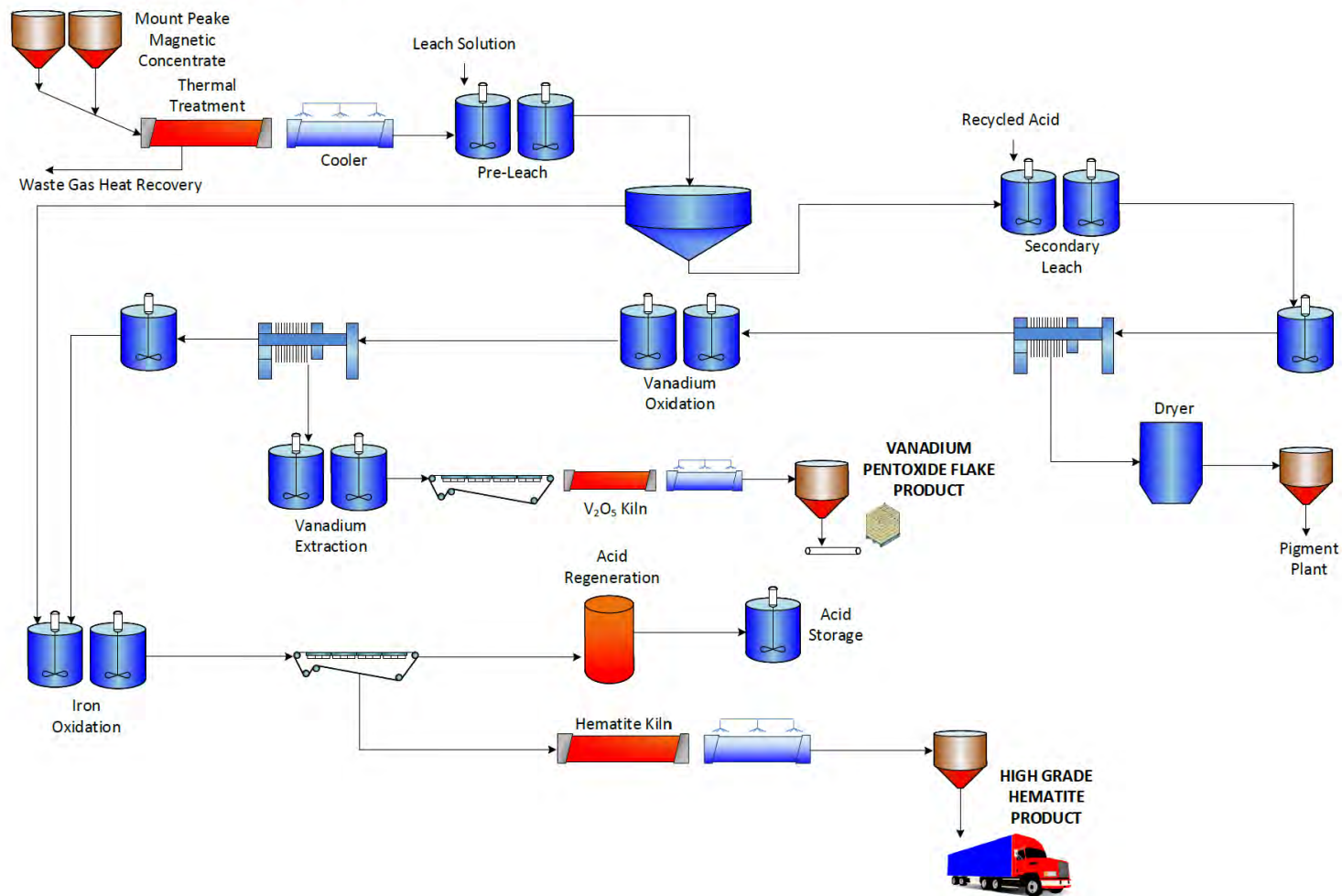


Figure ES-1. Darwin Processing Facility Process Flow Diagram.

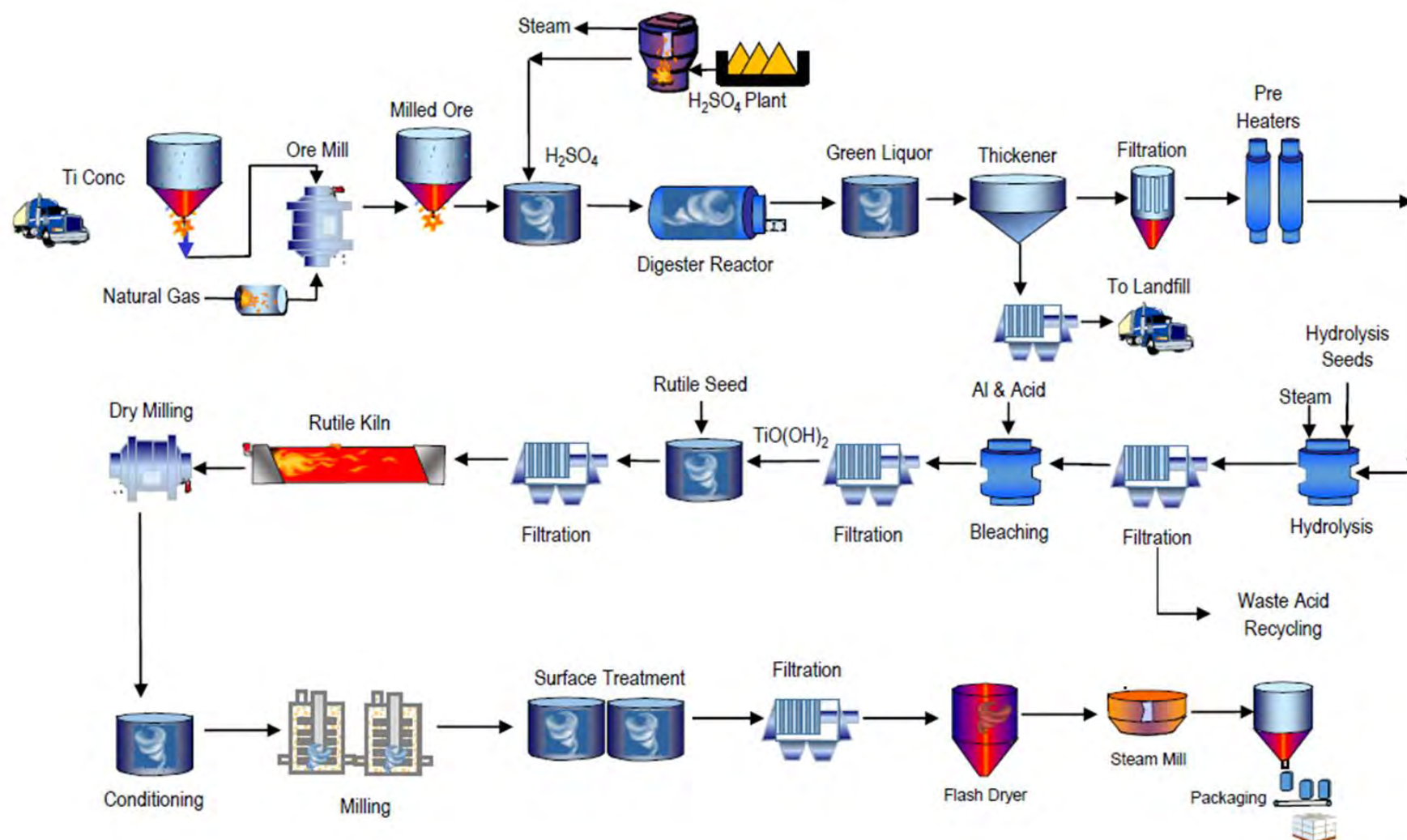


Figure ES-2. Titanium Pigment Processing Facility Process Flow Diagram.

E.3 POTENTIAL IMPACTS OF PROJECT CHANGES AND MITIGATION MEASURES

The Supplement provides updated environmental impact assessment information addressing the relevant Project changes that have occurred since the Draft EIS was submitted. The Supplement also aims to address the public submissions and provide further information on potential risks and impacts to the Environmental Factors associated with the Project changes. **Table ES-4** lists the additional technical reports and assessments commissioned by TNG for the Supplement to inform assessment of the Project changes.

Table ES-4. Technical studies commissioned by TNG to inform the Supplement.

Author	Title	Supplement Appendix
Advisian (2020)	Stormwater Management Plan	Appendix C
Advisian (2021a)	Groundwater Impact Evaluation	Appendix K
Advisian (2021b)	Marine and Coastal Assessment	Appendix P
APM (2020)	Rehabilitation Management Plan	Appendix B
APM (2021)	Significant Fauna Impact Assessment	Appendix Q
Aurora Environmental (2021)	Greenhouse Gas Discussion Paper	Appendix I
Elton Consulting (2021)	Stakeholder and Community Engagement Plan	Appendix O
Environmental Geochemistry International (2021)	Waste Characterisation	Appendix F
SRL Consulting Limited (2021)	Third Party Review of Air Quality Assessment	Appendix G
Tonkin Consulting (2021)	Traffic Impact Assessment	Appendix D
Vipac Engineers and Scientists (2020)	Noise Impact Assessment	Appendix H
Vipac Engineers and Scientists (2021)	Air Quality Assessment	Appendix G

Not all Environmental Factors presented in the Draft EIS are readdressed in the Supplement, as the Project changes did not alter the risks associated with that particular Environmental Factor. Furthermore, a number of Environmental Factors that were considered Key Environmental Factors for the Draft EIS are no longer considered key based on the changes to the Project that negate significant risks to that Environmental Factor. **Table ES-5** lists the factors addressed in the Draft EIS with comments on their inclusion, lack of inclusion, or change in status for the Supplement.

Table ES-5. Factors addressed in the Draft EIS and EIS Supplement

Factor	Draft EIS	Supplement	Key Environmental Factor	Comment
Terrestrial Environmental Quality	✓	✗	Yes	No changes to the Factor as presented in the Draft EIS were required to address NT EPA or public submissions. No amendments to the Project have resulted in changes to the risk to Terrestrial Environmental Quality from the Draft EIS. Submission 57 (Section 4.2) requested further information regarding management measures and Acid Sulphate Soils. This submission has been addressed by updating the Acid Sulphate Soils Management Plan with reference to the updated Groundwater Technical Study and the Stormwater Management Plan prepared for the Supplement. This information is presented in the Factor Inland Water Quality (Section 1.1).
Terrestrial Flora and Fauna (Updated factor is: Terrestrial Ecosystems)	✓	✓	Yes	Additional information is presented on the Existing Environment for terrestrial flora and fauna in relation to the Project. Assessment is made on the Significance of the impact to Matters of National Environmental Significance (MNES). Discussion is provided on how the proposal aligns with guidance. The further detail and Project changes described in Section 1 are taken into account when reviewing the mitigation and monitoring proposed in the Draft EIS and supplementary measures are proposed.
Hydrological Processes	✓	✗	Yes	No changes. Further information is available for groundwater at the site however that has been discussed and interpreted in relation to the risk of pollution and is addressed in the Inland Water Environmental Quality Factor.
Inland Water Environmental Quality	✓	✓	Yes	Further technical studies have been conducted to better understand and assess the risk from potential contaminants to groundwater and surface water. With this increased understanding, the mitigation and monitoring proposed in the Draft EIS has been reviewed and supplementary measures are proposed.
Marine Environmental Quality	✓	✓	No	Considered a Key Environmental Factor for the Draft EIS. Project amendments detailed in Section 1 for the Supplement (particularly removal of wastewater discharge from the Project scope) have changed the status of this Factor. Additional information was requested by Stakeholders through the Draft EIS consultation period. The Factor is addressed in Section 1. (Other Environmental Information) to provide the requested detail or the reasoning for why it is no longer applicable.

Factor	Draft EIS	Supplement	Key Environmental Factor	Comment
Benthic Habitats and Communities (Updated factor is: Marine Ecosystems)	✓	✓	No	Considered a Key Environmental Factor for the Draft EIS. Project amendments detailed in Section 1 for the Supplement (particularly removal of wastewater discharge from the Project scope) have changed the status of this Factor. Additional information was requested by Stakeholders through the Draft EIS consultation period. The Factor is addressed in Section 1 . to provide the requested information or the reasoning for why it is no longer applicable.
Marine Flora and Fauna (Updated factor is: Marine Ecosystems)	✓	✓	No	Considered a Key Environmental Factor for the Draft EIS. Project changes detailed in Section 1 for the Supplement (particularly removal of wastewater discharge from the Project scope) have changed the status of this Factor. Additional information was requested by Stakeholders through the Draft EIS consultation period. The Factor is addressed in Section 1 to provide the requested information or the reasoning for why it is no longer applicable.
Air Quality	✓	✓	Yes	With the progression of FEED, an additional technical study has been prepared to better understand and assess the risk from the Project in relation to Air Quality. An additional sensitive receptor, the Elizabeth River Boat Ramp, was also included in the updated Air Quality Assessment. The further detail described in Section 1 is taken into account when reviewing the mitigation and monitoring proposed in the Draft EIS and supplementary measures are proposed.
Atmospheric Processes	✓	✓	Yes	Further detail is available for impacts to this factor from the Project that are described in Section 1. The further detail described in Section 1 is taken into account and a discussion paper has been developed to explore options for offsetting the impacts to this factor.
Social, Economic and Cultural Surroundings (Updated factor is: Community and Economy)	✓	✓	Yes	Further detail is available for impacts to this factor from the Project amendments described in Section 1. Additional information is presented in the Existing Environment and further technical studies have been prepared to better understand and assess the risk from the Project in relation to Traffic and Noise. The Stakeholder Engagement Strategy has been revised and additional Stakeholder Engagement has taken place. The detail described in Section 1 and the results of Stakeholder Engagement has been taken into account when reviewing the mitigation and monitoring proposed in the Draft EIS and supplementary measures are proposed.

Factor	Draft EIS	Supplement	Key Environmental Factor	Comment
Human Health	✓	✗	Yes	No changes to the Factor as presented in the Draft EIS were required to address NT EPA or public submissions. No changes to the Project have resulted in changes to the risk to Human Health from the Draft EIS.

The updated impact assessment broadly determines that the proposed project changes will have a positive influence on the modelled potential impacts presented in the Draft EIS. Impacts to the marine environment (Environmental Factors: Marine Environmental Quality; Benthic Habitat and Communities and Marine Flora and Fauna) have been significantly reduced, or completely negated in some circumstances, as a result of the improvements made to the Project design. Wastewater discharge to the marine environment is no longer proposed as the updated Project design incorporates a WRP to treat and recycle all wastewater. Additional Project design updates and further mitigation measures have reduced the impact to other Environmental Factors. Information presented in the Supplement on the predicted impacts to the Environmental Factors and mitigation measures employed to reduce the impacts are provided in **Table ES-6**.

Table ES-6. Summary of the NT EPA Environmental Factors included in the Darwin Processing Facility Supplement to the EIS

EPA Factor	EPA Objective	Background Information	Additional Potential Impacts	Additional Proposed Environmental Management Measures
Terrestrial Ecosystems	Protect terrestrial habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.	- Twenty-six species of migratory shorebird have been regularly recorded across the Darwin Harbour region. Of these, seven are listed threatened species under the EPBC Act. - One area of high quality shorebird habitat is within proximity of the Project however, shorebird foraging grounds and roosting habitats are well distributed around the harbour and no direct impacts to this vegetation will occur from Project activities. - Several fauna species listed as threatened under the EPBC Act and considered MNES are known to occur in the Middle Arm region: - Eastern Curlew (Critically Endangered) - Greater Sand Plover (VU) - Red Knot (Endangered); - Curlew Sandpiper (Critically Endangered); - Great Knot (Critically Endangered); - Lesser Sand Plover (Endangered); - Black-footed Tree-rat (Endangered) - Northern Quoll (Endangered) - A number of fauna species listed as threatened under the TPWC Act are known to occur in the Middle Arm region: - Eastern Curlew (VU); - Greater Sand Plover (VU); - Black-footed Tree-rat (VU); - Red Knot (VU); - Curlew Sandpiper (VU); - Great Knot (VU); - Lesser Sand Plover (VU); - Northern Quoll (Critically Endangered); - Pale Field Rat (VU); and - Howard River Toadlet (VU)	- Fauna entrapment in infrastructure, ensnarement in fencing and/or attraction to settling ponds; - Habitat fragmentation; - Construction and operations activities causing uncontrolled fire leading to reduction in habitat quality, death of individuals and/or loss of fire sensitive species or vegetation;	- To mitigate, or avoid where possible, fauna entrapment in infrastructure: - Fence ponds; - Install fauna egress points in water storage dams and/or sumps; - Engineering settling ponds to have steep raised embankments with no edges. - Avoid the use of barbed wire in fences where possible - Site layout design to be compact and reduce areas of habitat fragmentation where possible; - Minimise the impact of fragmentation through rehabilitation of disturbed areas identified in the Rehabilitation Management Plan; and - The Environmental Management Plan (EMP; Appendix M) and Fire Management Plan (FMP; Appendix N) has been updated to include the eradication of gamba grass.
Inland Water Environmental Quality	Protect the quality of groundwater and surface water so that environmental values including ecological health, land uses and the welfare and amenity of people are maintained.	- Nine stormwater catchments have been defined for the Site. - The groundwater table is within the silts and clays of the weathered Burrell Creek Formation during the dry season. - During the wet season, groundwater levels rise due to rainfall recharge, resulting in the laterite becoming partially saturated with localised groundwater inundation/ponding where the laterite is thin. - Two aquifers exist with the site and are in hydraulic continuity. Regional flow is in a north-westerly direction towards the Elizabeth River, with local groundwater flowing radially from the higher elevated areas in the centre of each peninsular. Final groundwater discharges are into the	- Stormwater transporting sediment during the construction phase resulting in increased sediment loads in the downstream water courses; - Contamination of surface and groundwater from erosion and sedimentation; and - Contamination of surface water and groundwater due to Contaminants of Interest (COIs) entering via surface run-off, seepage and/or spillage.	Implement the Hazardous Material Management Procedure (EP-10), within the EMP to mitigate, or avoid where possible, contamination of surface and groundwater systems. To avoid surface runoff transporting potential COIs into surface waters: - Infrastructure associated with sources of COIs will be located above the 1000-year storm surge elevation; - All runoff waters within areas where sources of COIs are stored, transported or used will be diverted into a managed water circuit separate from the general stormwater circuit, which incorporates appropriate bunding, sumps and isolation points where required. Water from these areas will be directed to the WRP for treatment;

EPA Factor	EPA Objective	Background Information	Additional Potential Impacts	Additional Proposed Environmental Management Measures
		tributaries to the west, and north east of the site and the Elizabeth River to the north. Considering the lithology of the Weathered Burrell Creek Formation and its aquifer characteristics of low permeability and hydraulic conductivity, flow/movement of groundwater through this layer is likely to be very low.		- All runoff waters within the Development Envelope (outside of areas where COIs are stored, transported or used) will be diverted into a managed water circuit for monitoring and treatment (if required) in the stormwater system or WRP; - Rainfall will be intercepted on roofed spaces and diverted to a rainwater pond; - The chemical bulk storage tanks will be located in suitably bunded areas adjacent to the dedicated chemical transfer bay, with consideration for <i>Australian Standard AS1940:2017</i>; - Update of the Conceptual Site Based Stormwater Management Plan (Appendix C) to a detailed design including: - Detailed water quality modelling; - Final design of the minor and major stormwater systems, minor diversion systems and stormwater quality management features (e.g. SQUIDs, bioretention basins etc); - Detailed engineering hydraulic design/modelling; - Determine the optimised stormwater harvesting design; - Operational management, monitoring and maintenance plans developed with clear responsibilities assigned to relevant site personnel; and - The stormwater management system will be designed to effectively treat sediment, gross pollutants, nutrients and incidental hydrocarbons within stormwater runoff from non-process areas of the site. To avoid seepage via misting/fogging/spray transporting potential COIs into groundwater: - Low permeability bases will be used in areas where COIs are stored, i.e., concrete floors or hardstanding; - Ponds will be lined with impermeable liners to prevent seepage; - Ponds will be placed above the wet season water table; - Water used for dust suppression will be of suitable quality; and - Waste will be containerised immediately and not stockpiled. To avoid seepage from contaminated water used for irrigation: - Recycle greywater through the WRP prior to use for irrigation; and - All waters are managed within the water circuit and monitored for quality prior to use for irrigation. To avoid seepage of potential COIs within existing soils at site including AASS in irrigated/bare land/unlined operational areas: - AASS sites identified and managed according to Acid Sulfate Soils (AASS) Management Plan (Appendix L); - Low permeability covering for operational areas associated with COIs i.e. hardstanding/ buildings/roads; and - Interception of rainwater on roofed spaces.

EPA Factor	EPA Objective	Background Information	Additional Potential Impacts	Additional Proposed Environmental Management Measures
				To avoid seepage of potential COIs within ponds: - Ponds are lined with an impervious liner; and - Ponds are placed above the water table
Marine Environmental Quality	Protect the quality and productivity of water, sediment and biota so that environmental values are maintained.	- The existing pollutants that enter the Elizabeth Estuary originate from both point and diffuse sources. - Point sources include the Palmerston wastewater treatment plant and INPEX Ichthys Gas Field Development project. - Diffuse sources include urban and rural storm-water, leaching through soil, river bank erosion, and roads. These pollutants mainly enter Darwin Harbour during the wet season. - The Darwin Processing Facility Project will not contribute directly to the Elizabeth River system with the removal of the wastewater discharge from the Project design.	- Litter entering waterways and reducing visual amenity and water quality; - Sedimentation of marine environment via windblown, surface water or stormwater transportation; - Contamination of marine environment resulting from terrestrial based chemical spills and/or leaks entering marine environment through soil, surface water and groundwater pathways; and - Contamination of marine environment resulting from disturbance of AASS.	- Appropriate Domestic and Industrial Waste Management Procedure (EP-11), within the EMP (Appendix M), to be implemented for the Site: - Littering on site is prohibited and work and office sites are to be kept clean and tidy; - Housekeeping inspections of all work areas will be undertaken weekly; and - Waste management will be addressed in the site induction. - To avoid chemical spills the Hazardous Material Management Procedure (EP-10) of the EMP will be implemented; - To minimise, or avoid where possible, the sedimentation impacts from clearing by including the following: - No clearing of mangrove habitats; - Implement management procedures detailed in EMP (refer to Ground Disturbance and Vegetation Clearing Procedure (EP-05) contained within the EMP (Appendix M); - Implementation of appropriate site drainage to avoid or mitigate sedimentation impacts during the construction phase of the Project; - The GDP application will include risk based assessment of all environmental risks and identify controls to reduce the impacts of ground disturbance; - An estimate of the area to be disturbed and topsoil volumes to be moved and stored should be included in the GDP request submission where possible; - Lay down, parking and other storage areas will be located in approved GDP areas only. Where possible, existing cleared areas will be used for laydown areas. Vegetation clearing for these areas will be avoided where possible; and - Topsoil and subsoil will be stripped prior to earthworks and managed in accordance with the Rehabilitation Management Plan (Appendix B) and ASS Management Plan (Appendix L)
Air Quality	Protect air quality and minimise emissions and their impact so that environmental values are maintained.	- All predictions of particulate matter (including dust) at the modelled sensitive receptors for the operational phase of the Project are below the relevant criteria; - Maximum predicted concentrations of NO₂ and SO₂ are below the adopted criteria for all sensitive receptors; and - Maximum predicted concentrations of NH₃, Cl₂ and HCl are below the adopted criteria for all sensitive receptors.	- Increased dust entering the atmosphere due to earthmoving, construction activities, wind erosion and vehicle movements; and - Stack gaseous emissions entering the atmosphere through processing operations.	- Implement the Dust Emission Management Procedures (EP-08) within the EMP, including: - Regular watering of active areas and stockpiles areas; - Use of dust control equipment and housekeeping practices within the Processing Facility; - Enclosing a significant portion of the Facility into purpose built sheds; and - Vehicle speeds on site roads will be restricted. - Use scrubbers and/or filters for the control of atmospheric emissions from the Project stack sources, in accordance with the Air Quality Management Plan.

EPA Factor	EPA Objective	Background Information	Additional Potential Impacts	Additional Proposed Environmental Management Measures
				Develop an air quality monitoring program consistent with the requirements of environmental protection licensing.
Atmospheric Processes	Minimise greenhouse gas (GHG) emissions so as to contribute to the NT Government's goal of achieving net zero greenhouse gas emissions by 2050.	- Direct GHG emissions resulting from the Project will equate to approximately 944,020 tpa of CO₂eq based on 7000 hours of operation. - Indirect annual emissions are expected to equate to 248,383 tpa of CO₂eq.	Contribution of carbon emissions to global climate change.	Implement the Greenhouse Gas Emissions Procedures (EP-09) within the EMP (Appendix M), including: - Develop a detailed GGMP prior to the commencement of operations that will: - Outline strategies to avoid, reduce, mitigate and offset the Projects direct emissions contributing towards the State's aspiration of net zero GHG emissions by 2050; - Review the final facility design in relation to GHG intensity/efficiency; - Commit to five-yearly reviews of energy efficiency and renewable use over the life of the project with a view of reducing Scope 1 emission by an average of 1% a year over 20 years; and - Prepare an offset package. - Energy saving devices will be used where possible and based on the energy star ranking standard; - Rehabilitate disturbed areas as soon as possible; and - Utilise lowest GHG emitting fuel / energy sources that are feasible. Consideration will be given to the use of alternative energy sources such as solar panels where feasible, as the Project progresses. Key process vessels and equipment should be insulated to minimise energy loss; and Key process vessels and equipment should be insulated to minimise energy loss where appropriate; and - Minimise use of vehicles where possible.
Community and Economy	Enhance communities and the economy for the welfare, amenity and benefit of current and future generations of Territorians.	<u>Noise</u> - Noise levels during construction and operations were re-assessed to account for Project changes occurring through progression of the design stage. A conservative, worst case scenario approach was undertaken for the Assessment. - Construction noise is predicted to comply with the standard hours criteria during all climatic conditions. During non-standard hours, construction noise is predicted to exceed criteria during worst case climatic conditions. - Operation noise, including process plant and rail operations, is predicted to comply with the day, evening and night time criteria at all receivers during neutral and worst case climatic conditions	- Noise from construction activities impacting sensitive receivers during non-standard hours (7pm to 7am); - Reduced visual amenity due to sulphate plant stack; - Community members dissatisfaction if communication processes are ineffective; and - Inequitable use of resources such as water and power for Project operations.	- Implement the Noise Management Plan (EP-17) within the EMP including: - Avoid noise generating construction activities in non-standard hours and recommend construction activities occur during standard hours (7am – 7pm); and - If out of hours construction is required, avoid operating particularly noisy machinery before 7am and after 7pm; - Ensuring core Processing Facility infrastructure is constructed on the southern peninsula of the site and the sulphate stack is located in an area aimed at minimising visual impacts as much as practical. - Implement the Community and Stakeholder Engagement Strategy to guide the long-term consultation outcomes for the Project. - Implement efficiency measures into the final design phase to reduce use of community resources as much as practicable.

EPA Factor	EPA Objective	Background Information	Additional Potential Impacts	Additional Proposed Environmental Management Measures
		<u>Traffic</u> • A total of 195 vehicle movements per day (vpd) are predicted during construction (assuming the use of buses) and up to 636 vpd during operations (assuming no use of buses). • Adding the maximum traffic anticipated to be generated by the site at any time (636 vpd), to the existing traffic, a total daily traffic of 2530 vpd may result. This is less than the traffic volumes experienced in 2014 and therefore could reasonably be accommodated by the existing road network. • The expected maximum extent of delays is 9 minutes for departing trains and 17 minutes for arriving trains. This represents a significant delay to traffic along both Channel Island Road and Jenkins Road for those trains arriving/departing during peak hours (anticipated to be two movements per week). <u>Visual Amenity</u> • The updated Project design includes the addition of multiple ventilation stacks and the height of these stacks remain consistent with those proposed in the Draft EIS (between 9 m to 40 m); the ventilation stack proposed for the sulphate plant, however, measures 100 m in height. <u>Fairness and Equity</u> • The Supplement has resulted in a significant increase in fairness and equity with regards to consumption of community resources compared to that presented in the Draft EIS. The water requirement has reduced from 26% of Darwin's current water demand to 9.1%. • The economic and social benefits of the Processing Facility to the Darwin community, particularly through employment opportunities, support for local businesses and implementation of a Community Benefit Fund by TNG are expected to outweigh the Project costs such as use of community resources, traffic delays due to rail movements and GHG emissions.		• Implement a complaints and grievance procedure for community members, incorporating an investigation and corrective action process, as appropriate.

E.4 RISK ASSESSMENT

The updated Risk Assessment broadly determines that the proposed Project changes have resulted in an overall reduction of impacts on the Environmental Factors, with the majority of residual impacts posing a low to moderate risk to all of the NT EPA's environmental objectives. This is particularly the case following removal of wastewater discharge to the Darwin Harbour and a reduction in water use requirements, which were identified through submissions to the Draft EIS as the main concerns raised. Impacts to the marine environment have been significantly reduced, or completely negated in some circumstances, as a result of the amended wastewater management strategy to treat and recycle all wastewater at the WRP rather than discharge into the Darwin Harbour.

Whilst the overall impact of the Project on the Environmental Factors has been reduced, a number of new impacts have arisen or have been upgraded to a higher risk rating as a result of Project changes. Further advances in FEED and the inclusion of the WRP has resulted in additional waste streams being identified, which has created new risk pathways; however, through the development of appropriate mitigation measures and good management practices these risks are not likely to have a negative impact on the Environmental Factors and will be consistent with the NT EPA Environmental Objectives.

There is only one high residual risk associated with the following:

- Contamination of surface water due to breaching of processing or wastewater treatment ponds during storm surge inundation from a tertiary or 1 in 10,000 year event.

These risks are not expected to be unacceptable, but rather the high risk rating indicates that this would be a catastrophic event that can be mitigated to some extent by management and design, however it cannot be fully controlled or the risk eliminated. The likelihood of occurrence of this event is identified as rare.

E.5 CONCLUSION

Following submission of the Draft EIS, TNG has progressed the FEED phase of the Project which, along with consideration of comments received through Draft EIS submissions, has led to Project design updates. Amendments made to the Project have resulted in a reduction in the impact on the NT EPA's Environmental Objectives.

The updated Project design has ensured that the Project can achieve the Environmental Objectives. Furthermore, the Project presents a number of positive economic and social benefits to the Darwin community particularly through employment opportunities, support for local businesses and implementation of a Community Benefit Fund by TNG. Finally, with the Project life expected to be 40 years, the Project will provide benefits for the economy and community for many years.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	I
E.1 INTRODUCTION	I
E.2 REVISED PROJECT DESCRIPTION AND CHANGES	II
E.2.1 Construction Phase	ii
E.2.2 Processing Phase.....	iii
E.2.2.1 TIVAN Process	v
E.2.2.2 Titanium Pigment Plant.....	v
E.2.2.3 Other Processing Requirements	v
E.3 POTENTIAL IMPACTS OF PROJECT CHANGES AND MITIGATION MEASURES	VIII
E.4 RISK ASSESSMENT	XVIII
E.5 CONCLUSION	XVIII
1. INTRODUCTION	1
1.1 Overview	1
1.2 Transition period for the EP Act.....	1
1.3 Scope and purpose of the Supplement.....	2
1.4 Structure of the Supplement	2
2. PROJECT DESIGN UPDATES	5
2.1 Disturbance footprint and site layout.....	11
2.2 Construction Phase	13
2.2.1 Overview	13
2.2.2 Site preparation and earthworks	14
2.2.3 Erosion and Sediment Control	17
2.2.4 Vegetation clearing	20
2.2.5 Construction Materials Required	24
2.2.6 Workforce	24
2.2.7 Traffic	24
2.2.8 Construction Waste Streams	29
2.3 Operational Phase.....	30
2.3.1 Processing	30
2.3.2 Stockpiles	36
2.3.3 Process Ponds	43
2.3.4 Water Recycling Plant	46
2.3.5 Process Water Treatment Plant.....	52
2.3.6 Chemicals and Reagents	52
2.3.7 Stormwater System.....	57
2.3.8 Sewage and Grey water	65

2.3.9	Water Requirements	68
2.3.10	Power Requirement	71
2.3.11	Workforce	71
2.3.12	Traffic	71
2.4	Operational Phase Waste Streams	78
2.4.1	Coke Ash.....	79
2.4.2	SDLR	79
2.4.3	Acid Waste Neutralisation Metal Hydroxide #1.....	79
2.4.4	Acid Waste Neutralisation Metal Hydroxide #2.....	80
2.4.5	WRP Clarifier solids	80
2.4.6	Sewage	81
2.4.7	Waste Storage and Handling.....	81
2.5	By-Products.....	81
2.5.1	WRP Salt residue	81
2.5.2	Acid waste neutralisation gypsum and Scrubber gypsum	82
2.6	Discharges and emissions	83
2.6.1	Stormwater discharge.....	83
2.6.2	Atmospheric emissions	85
2.6.3	Greenhouse Gas Emissions	89
2.6.4	Odours.....	89
2.6.5	Noise	89
2.7	Alternatives.....	91
2.7.1	Alternative Energy Sources	91
2.7.2	Alternatives water sources	92
2.7.3	Alternatives development envelope.....	93
3.	UPDATES TO KEY ENVIRONMENTAL FACTORS	95
3.1	Inland Water Environmental Quality	99
3.1.1	NT EPA Objective	99
3.1.2	Technical Studies.....	99
3.1.3	Background Information	99
3.1.4	Potential Impacts and Risks	108
3.1.5	Mitigation and Management	113
3.1.6	Monitoring and Reporting	115
3.1.7	Statement of Residual Impacts	116
3.2	Terrestrial Ecosystems	118
3.2.1	NT EPA Objective	118
3.2.2	Technical Studies.....	118
3.2.3	Background Information	118

3.2.4	Potential Impacts and Risks	143
3.2.5	Significant Impact assessments	153
3.2.6	Mitigation and Management	153
3.2.7	Monitoring and Reporting	157
3.2.8	Statement of Residual Impact.....	158
3.3	Air Quality	160
3.3.1	NT EPA Objective	160
3.3.2	Technical Studies.....	160
3.3.3	Background Information	160
3.3.4	Potential Impacts and Risks	162
3.3.5	Mitigation and Management	167
3.3.6	Monitoring and Reporting	168
3.3.7	Statement of Residual Impacts	169
3.4	Atmospheric Processes	171
3.4.1	NT EPA Objective	171
3.4.2	Technical Studies.....	171
3.4.3	Background Information	171
3.4.4	Potential Impacts	172
3.4.5	Mitigation and Management	172
3.4.6	Statement of Residual Impacts	173
3.5	Community and Economy.....	175
3.5.1	NT EPA Objective	175
3.5.2	Technical Studies.....	175
3.5.3	Background Information	175
3.5.4	Potential Impacts and Risks	186
3.5.5	Mitigation and Management	192
3.5.6	Monitoring and Reporting	193
3.5.7	Statement of Residual Impacts	194
4.	OTHER ENVIRONMENTAL INFORMATION	196
4.1	Marine Environmental Quality	196
4.1.1	Location Characteristics	196
4.1.2	Conceptual Site Model.....	197
4.2	Marine Ecosystems	204
4.2.1	Marine Biota	204
4.2.2	Potential Impacts to Marine Biota	208
4.3	Impacts of the Project on MNES	210
4.3.1	Policy and Guidance	210
4.3.2	Impact of Project Alternatives on MNES.....	215

5.	PRINCIPLES OF ECOLOGICALLY SUSTAINABLE DEVELOPMENT	228
6.	SUMMARY OF SUBMISSIONS RECEIVED	234
6.1	Northern Territory Government	234
6.2	Public Comments	270
7.	UPDATED COMMITMENTS REGISTER AND PROJECT RISK ASSESSMENT.....	276
7.1	Commitments Register	276
7.2	Risk Assessment.....	276
8.	REFERENCES	278
	Chapter 2 References	278
	Chapter 3 References	279
	Chapter 3.1 References	280
	Chapter 3.2 References	281
	Chapter 3.3 References	284
	Chapter 3.4 References	285
	Chapter 3.5 References	286
	Chapter 4 References	287
9.	APPENDICES	288

LIST OF APPENDICES

Appendix A: Draft EIS Submissions	
Appendix B: Rehabilitation Management Plan (APM 2020)	
Appendix C: Stormwater Management Plan (Advisian 2020)	
Appendix D: Traffic Impact Assessment (Tonkin 2021)	
Appendix E: Safety Data Sheets	
Appendix F: Waste Characterisation (Environmental Geochemistry International 2021)	
Appendix G: Air Quality Assessment (Vipac 2021)	
Appendix H: Noise Impact Assessment (Vipac 2020)	
Appendix I: Greenhouse Gas Discussion Paper (Aurora Environmental 2021)	
Appendix J: Significant Fauna Impact Assessment (APM 2021)	
Appendix K: Groundwater Impact Evaluation (Advisian 2021a)	
Appendix L: Acid Sulfate Soils Management Plan	
Appendix M: Environmental Management Plan	
Appendix N: Fire Management Plan	
Appendix O: Stakeholder and Community Engagement Plan (Elton Consulting 2021)	
Appendix P: Marine and Coastal Assessment (Advisian 2021b)	
Appendix Q: Project Risk Assessment	
Appendix R: Consolidated Commitments Register	

TABLES

Table 1-1. Supplement Structure.....	3
Table 2-1. Darwin TIVAN® Processing Facility Key components table.....	6
Table 2-2. Construction Schedule.....	14
Table 2-3. Sediment Control Techniques.....	17
Table 2-4. Sediment basin size	19
Table 2-5. Change to the type and quantity of vegetation to be cleared.....	21
Table 2-6. Construction vehicle fleet	25
Table 2-7. Maximum number of vehicle movements expected per day during construction	26
Table 2-8. Magnetite concentration stockpile details	39
Table 2-9. Petcoke stockpile details	41
Table 2-10. Iron Oxide stockpile details.....	43
Table 2-11. WRP component specification.....	49
Table 2-12. Characteristics of recycled water products from the WRP.....	50
Table 2-13. Type and concentration of chemicals to be used in the WRP	53
Table 2-14. Catchment areas.....	58
Table 2-15. Comparison of pre-development and post-development peak flows.....	60
Table 2-16. Indicative bioretention basin sizing	64
Table 2-17. Effluent quality outlet values.....	68
Table 2-18. Summarised water balance	70
Table 2-19. Water recycling plant outputs	70
Table 2-20. Preliminary train timetable from Adnera Siding to the Darwin Processing Facility.	76
Table 2-21. Train schedule for delivery products to the East Arm wharf from the Processing Facility.....	77
Table 2-22. Solid waste products generated in the Processing Plant.....	78
Table 2-23. Solid waste products generated in the Processing Plant.....	81

Table 2-24. Composition of limestone for scrubber	83
Table 2-25. Ventilation stack diameter, height and location for processing equipment	86
Table 2-26. Ventilation stack air flowrate, height and diameter for WRP equipment.	88
Table 2-27. Fugitive source emissions data	88
Table 2-28. Life cycle CO ₂ equivalent (including albedo effect) from selected electricity supply technologies. Arranged by decreasing median of the amount in grams of CO ₂ equivalent produced per kilowatt (gCO ₂ eq/kWh) values. Source: IPCC (2014).	91
Table 2-29. Alternatives for water requirements, infrastructure and management developed for the Supplement	93
Table 3-1. Factors addressed in the Draft EIS and EIS Supplement	96
Table 3-2. Inland Water Environmental Quality studies undertaken for the EIS Supplement	99
Table 3-3. Monthly R-Factor and Erosion Risk Rating.....	101
Table 3-4. Annual baseline erosion per catchment for construction	102
Table 3-5. Land uses per catchment during the Operations phase	103
Table 3-6. Calculated stormwater flows	104
Table 3-7. Potential pathways for impact to inland water environmental quality.....	109
Table 3-8. Erosion risk rating during the construction phase.....	112
Table 3-9. Predicted monthly average soil loss rate (t/ha/month) during the construction phase	113
Table 3-10. Supplementary mitigation measures for Inland Water Environmental Quality	114
Table 3-11. Supplementary monitoring and reporting for Inland Water Environmental Quality	115
Table 3-12. Supplementary Terrestrial Ecosystems studies	118
Table 3-13. Population estimates for migratory shorebirds in the Northern Territory (NT), the East Asian-Australasian Flyway (EAAF), and sites of significance in the NT (with maximum counts in brackets).	120
Table 3-14. Migratory shorebirds at the Project area	126
Table 3-15. Eastern Curlew records and suitable habitat in relation to the Project.	130
Table 3-16. Greater Sand Plover records and suitable habitat in relation to the Project.	132
Table 3-17. Black-footed Tree-rat records and suitable habitat in relation to the Project.	133
Table 3-18. Curlew Sandpiper records and suitable habitat in relation to the Project.	135
Table 3-19. Red Knot records and suitable habitat in relation to the Project.	136
Table 3-20. Lesser Sand Plover records and suitable habitat in relation to the Project.....	137
Table 3-21. Northern Quoll records and suitable habitat in relation to the Project.	138
Table 3-22. Bare-rumped Sheath-tail Bat records and suitable habitat in relation to the Project.....	140
Table 3-23. Pale Field Rat records and suitable habitat in relation to the Project.	142
Table 3-24. Howard River Toadlet records and suitable habitat in relation to the Project.....	143
Table 3-25. Summary of the relationship between impact sources and outcomes on fauna that may arise from the Project	145
Table 3-26. Species included in the Significant Fauna Impact Assessment	147
Table 3-27. Habitats to be cleared.....	148
Table 3-28. Mitigation and management strategies for each impact source potentially arising from the Project.	153
Table 3-29. Policy and Guidance.....	154
Table 3-30. Supplementary monitoring and reporting for Terrestrial Ecosystems	157
Table 3-31. Air quality studies undertaken for the Supplement.	160
Table 3-32. Assigned air quality background level for the Darwin Processing Facility	162
Table 3-33. Potential pathways for impact to air quality	163
Table 3-34. Maximum ground-level predictions of particle concentrations and dust deposition for the Project ...	164
Table 3-35. Maximum predicted gaseous impacts for SO ₂ and NO ₂ (combustion).....	166
Table 3-36. Maximum predicted gaseous impacts for Cl ₂ , HCl and NH ₃	167
Table 3-37. Additional Air quality mitigation measures	167

Table 3-38. Proposed stack emission sources, pollution controls and monitoring strategy.	169
Table 3-39. Greenhouse gas emission studies undertaken for the Supplement.	171
Table 3-40. Potential pathways for impact to atmospheric processes	172
Table 3-41. Community and Economy studies undertaken for the Supplement.	175
Table 3-42. Summary of Noise Monitoring Results at the Bellamack and Virginia Receptors from the 23 rd to 30 th August 2020.	177
Table 3-43. Channel Island Road Traffic Counts (NTG 2019)	178
Table 3-44. Estimated current extent of delays at level crossings	179
Table 3-45. Stakeholder consultation undertaken to support Supplement development.	180
Table 3-46. Predicted pathways for impact to Community and Economy.	187
Table 3-47. Predicted Construction Noise Levels for both Neutral and Worst-Case Climatic Conditions.	188
Table 3-48. Predicted Operation Noise Levels for both Neutral and Worst-Case Climatic Conditions.	189
Table 3-49. Estimated extent of delays at level crossings as a result of the Project	190
Table 3-50. Additional Community and Economy mitigation measures	192
Table 3-51. Supplementary monitoring and reporting for Community and Economy.	194
Table 4-1. Sensitive environmental receptors and known sensitivities	209
Table 4-2. Policy and guidance for marine fauna in relation to the Project	211
Table 4-3. Expected impacts to MNES as a result of the Project.	215
Table 4-4. The core objectives for the National Strategy for Ecologically Sustainable Development in the context of not proceeding with the Project.	218
Table 4-5. Avoided loss of habitat for MNES fauna as a result of clearing for the ocean outfall pipeline	222
Table 4-6. MNES marine species assessed as likely to occur in the Elizabeth River	223
Table 4-7. Changes to environmental management techniques as proposed in environmental management plans and sub plans for the Supplement.	225
Table 5-1. The Principles of Ecologically Sustainable Development.	228
Table 6-1. Summary of topics raised in each submission.	234
Table 6-2. Northern Territory Government comments on the Draft Environmental Impact Statement for the Darwin Processing Facility.	235
Table 6-3. Public comments on the Draft Environmental Impact Statement for the Darwin Processing Facility	270

FIGURES

Figure 2-1. Darwin Processing Facility indicative site layout	12
Figure 2-2. Artists impression of the southern peninsula towards the north east.	13
Figure 2-3. Cut (red) and Fill (green) areas for levelling of the southern peninsula.	15
Figure 2-4. Rehabilitation areas.	16
Figure 2-5. Catchments and basins in the Development Envelope	18
Figure 2-6. A typical construction sedimentation basin longitudinal section.	20
Figure 2-7. Vegetation clearing.	23
Figure 2-8. Expected number of vehicle movements per day during the construction phase for delivery vehicles (red), light vehicles (green) and buses (purple).	27
Figure 2-9. Construction phase frequent routes	28
Figure 2-10. Construction traffic entering and exiting from Channel Island Road during peak times	29
Figure 2-11. Darwin Processing Facility Process Flow Diagram	31
Figure 2-12. Titanium Pigment Processing Facility Process Flow Diagram	35
Figure 2-13. Example of Concentrate Storage Shed	37
Figure 2-14. Indicative dimensions of concentrate storage area	38

Figure 2-15. Concentrate storage area layout.....	38
Figure 2-16. Location of stockpiles.	40
Figure 2-17. Example of the Petcoke storage area.....	41
Figure 2-18. Iron Oxide Silos and Conveyor System	42
Figure 2-19. Water Injection System at Take-Over Points.....	43
Figure 2-20. Indicative location of process ponds	45
Figure 2-21. Location of the WRP	47
Figure 2-22. WRP Layout	48
Figure 2-23. Process flow diagram	51
Figure 2-24. Bulk chemical transfer typical arrangement.....	54
Figure 2-25. Typical layout for the Chlorine gas plant.....	55
Figure 2-26. Locations of chemical and reagent storage.....	56
Figure 2-27. Catchments, diversion and bioretention basin locations	59
Figure 2-28. Indicative locations of bioretention basins	63
Figure 2-29. A typical arrangement for a bioretention basin	63
Figure 2-30. 3D Model of the Sewage Treatment Facility Package System.....	65
Figure 2-31. Sewage treatment facility overview diagram.....	66
Figure 2-32. Location of the sewage treatment plant	67
Figure 2-33. Location of Traffic Features	73
Figure 2-34. Operations traffic entering and exiting from Channel Island Road during peak times	74
Figure 2-35. Cumulative Peak Hour Traffic Volumes at the Kittyhawk Access Point.....	75
Figure 2-36. Example of container wagons to be used for the Project	77
Figure 2-37. Locations of discharges and emissions.....	84
Figure 2-38. Sensitive receptor locations surrounding the Project site	90
Figure 3-1. Catchment Boundaries – Southern Peninsula	100
Figure 3-2. Catchment Boundaries – Northern Peninsula	100
Figure 3-3. Bore locations.....	105
Figure 3-4. Depth to water table for bores BH08 and BH09 September 2020	106
Figure 3-5. Water quality for bores BH08 and BH09 September 2020.....	106
Figure 3-6. Depth to water table for bores BH10, BH07, BH02 and BH08 September 2020	107
Figure 3-7. Water quality for bores BH10, BH07, BH02 and BH08 September 2020	107
Figure 3-8. Source of potential COI's in relation to the 1 in 1000 year storm surge elevation	111
Figure 3-9. Sites of Significant Aggregations of migratory shorebirds in the Greater Darwin Region.....	123
Figure 3-10. Distribution of migratory shorebird habitats types in the Darwin Harbour	125
Figure 3-11. Location of Air Quality sensitive receptors.....	161
Figure 3-12. Location of the sensitive noise receptor surrounding the Project.	176
Figure 3-13. Kittyhawk Estate junction with Channel Island Road (Byrne Consulting)	179
Figure 3-14. International Association of Public Participation (IAP2) Core Values.....	191
Figure 4-1. Elizabeth River estuary pollution sources, processes and ecology in the wet and dry seasons. Source: Drewry, Fortune & Browne (2010).	197
Figure 4-2. Conceptual site model of the Elizabeth River Estuary major point and diffuse pollutant sources.	199
Figure 4-3. Conceptual site model of the ecological characteristics of the Elizabeth River Estuary and general risks associated with major point and diffuse pollutant sources.	201
Figure 4-4. A conceptual diagram showing estuarine activities and their effect on mangroves.....	208
Figure 4-5. MNES fauna field survey records.....	221
Figure 6-1. AAPA Certificate area and the EIS Supplement Development Envelope.	266

PROJECT TERMS

Term	Meaning
The Project, Darwin Processing Facility, Processing Facility	The proposed construction and operation of the Darwin TIVAN® Processing Facility.
The Project area, the Site	Lot 1817, Hundred of Ayers, Middle Arm Industrial Precinct, Wickham, NT. The Project area is approximately 507 hectares (ha) of which 40 ha is mangrove forest and intertidal zone, and 467 ha is terrestrial land.
Concentrate	Magnetite concentrate from the Mount Peake Mine Site.
Development Envelope	That part of the Project area that will be impacted by any development activities. The envelope, in hectares, includes the proposed buildings, infrastructure, associated access roads and services. The Development Envelope is approximately 270.5 ha.
Direct Environmental Impact	Impact caused by direct interaction of the Project with the environment, at the same time and in the same place as construction and/ or operational activities are occurring.
Environmental Aspect	Element of an organisation's activities, products or services that can interact with the environment.
Indirect Environmental Impact	Impact which is not a direct result of construction and/or operation activities. Generally occurs outside of the Development Envelope and may be realised through relatively complex pathways. Sometimes referred to as second or third level impacts, or secondary impacts.
Mount Peake Project, Mount Peake Mine Site	The Mount Peake Mine Site and Darwin Processing Facility are wholly owned by TNG and integrated as the Mount Peake Project and Processing Facility
Northern peninsula	Northern part of Lot 1817, location of support infrastructure for the Processing Facility.
Proponent	Enigma Mining Limited is the operator of the Project and is a wholly owned subsidiary of TNG Limited. Within the Supplement, the Proponent is referred to as TNG Limited (being the parent company).
Southern peninsula	Southern part of Lot 1817, location of the major components of the Processing Facility, along with some support infrastructure.
Water Recycling Plant	A treatment plant for wastewater generated by the Project that produces water for recycling back into the process stream. This replaces the Wastewater Treatment Plant proposed in the Draft EIS.
Wastewater Treatment Plant	Proposed in the Draft EIS. For the EIS Supplement this has been replaced with the Water Recycling Plant.

LIST OF ACRONYMS, ABBREVIATIONS AND DEFINITIONS

Abbreviation	Meaning
AAPA	Aboriginal Areas Protection Authority
AASS	Actual Acid Sulfate Soils
AEP	Annual Exceedance Probability
AFANT	Amateur Fishermen's Association of the Northern Territory
ANZECC	Australian and New Zealand Environment Conservation Council
ASD	Approach Sight Distance
ASS	Acid Sulfate Soils
BCF	Burrell Creek Formation
BHC	Benthic Habitat and Communities
BMP	Biodiversity Management Plan
BOD	Biochemical Oxygen Demand
BPESC	Best Practice Erosion and Sediment Control
CCESCP	Conceptual Construction Erosion and Sediment Control Plan
COD	Chemical Oxygen Demand
COI	Contaminants of Interest
CR	Critically Endangered
CSWMP	Conceptual Site Based Stormwater Management Plan
DAWE	Department of Agriculture, Water and the Environment
DENR	Department the Environment and Natural Resources
DEPWS	Department of Environment, Parks and Water Security
DG	Dangerous Good
DGV	Default Guideline Values
DITT	Department of Industry, Tourism and Trade
DLRM	Department of Land Resource Management
DoEE	Department of the Environment and Energy
DPIL	Department of Infrastructure, Planning and Logistics
Draft EIS	Draft Environmental Impact Statement
EA Act	Environmental Assessment Act 1982
EAAF	East-Asian Australasian Flyway
EAAP	Environmental Assessment Administrative Procedures 1984
ECNT	Environment Centre Northern Territory
EGI	Environmental Geochemistry International Pty Ltd
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement, comprises: - Draft EIS (subject to public exhibition), - Supplement (addressing written comments of the Draft EIS) Additional information requested by NT EPA
EMP	Environment Management Plan
EN	Endangered
Environmental Factors	Aspects of the environment as defined by the NT EPA

Abbreviation	Meaning
EP Act	Environment Protection Act 2019
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EQC	Environmental Quality Criteria
ESD	Ecologically sustainable development as defined in Australia's National Strategy for ESD (1992)
FEED	Front End Engineering and Design
FGD	Flue Gas Desulphurisation
FMP	Fire Management Plan
GGMP	Greenhouse Gas Management Plan
GHG	Greenhouse gas
GSD	Gross Domestic Product
HCl	Hydrochloric acid
HD	Highly Disturbed
HDMF	Horizontal Dual Media Filters
HS	Hazardous Substance
IAP2	International Association for Public Participation
IBC	Intermediate Bulk Container
IECA	International Erosion Control Association
IWL	Integrated Waste Landform
LDC	Land Development Corporation
LNG	Liquid Natural Gas
LSR	Liquid to Solid Ratios
Ma	Marine
MEE	Multiple effect evaporator
MEQMMP	Marine Environmental Quality Monitoring and Management Plan
MGSD	Minimum Gap Sight Distance
Mi	Migratory
MNES	Matters of National Environmental Significance, as listed under the EPBC Act
NEPM	National Environment Protection Measure
NES	(matters of) National Environmental Significance,
NRETAS	NT Department of Natural Resources, Environment, The Arts and Sport
NT	Northern Territory
NT EPA	Northern Territory Environmental Protection Authority
NTG	Northern Territory Government
PMST	Protected Matters Search Tool
PWTP	Process Water Treatment Plant
RO	Reverse Osmosis
SDLR	Sulphate Digest Leach Residue
SDS	Safety Data Sheet
SISD	Safe intersection sight distance
SMBS	Sodium Metabisulphate

Abbreviation	Meaning
SQUID	Stormwater Quality Improvement Device
TIVAN®	TIVAN® leach circuit - TNG's proprietary TIVAN® Process is a hydro-extraction process designed to produce very high-purity vanadium pentoxide, titanium dioxide and iron oxide
TNG	TNG Limited
ToR	Terms of Reference; as prepared by the NT EPA for the proposed Project identifying the matters to be addressed in the EIS
TPWC Act	Territory Parks and Wildlife Conservation Act 2000 (NT)
TSS	Total Suspended Solids
UF	Ultrafiltration
VU	VU
WMPC Act	Waste Management and Pollution Control Act 1998
WRP	EIS Supplement Water Recycling Plant
WSUD	Water Sensitive Urban Design
WWTP	Draft EIS Wastewater Treatment Plant

UNITS OF MEASURE

Unit	Meaning
%	Percentage
GL	Gigalitre
GL/yr	Gigalitres per year
ha	Hectare
kg	Kilogram
km	Kilometre
kPa	Kilopascals
kW	Kilowatt
m	Metre
M ²	Metres squared
m/s	Metres per second
mg	Milligram
mm	Millimetre
ML	Megalitre – million litres
MWh	Megawatt hour
m ³ /hr	Metres cubed per hour
PJ	Petajoules
ppm	Parts per million
t	Tonne (1 t = 1000kg)
TJ	Terajoules
tpa	Tonnes per annum

Unit	Meaning
tph	Tonnes per hour
vpd	Vehicles per day
Elements	
Al	Aluminium
B	Boron
Ba	Barium
BaSO ₄	Barite
C	Carbon
Cd	Cadium
CH ₄	Methane
Cl ₂	Chlorine gas
Co	Cobalt
CO	Carbon monoxide
CO ₂	Carbon dioxide
CO _{2 eq}	Carbon dioxide equivalent
Cr	Chromium
Cu	Copper
Fe	Iron
Fe ₂ O ₃	Iron (III) oxide / Ferric oxide
Mn	Manganese
NaCl	Sodium Chloride
Na ₂ SO ₄	Sodium Sulfate
Nb	Niobium
Ni	Nickel
NO ₂	Nitrogen dioxide
N ₂ O	Nitrous oxide
Si	Silicon
SO ₂	Sulfur dioxide
SO ₃	Sulfur trioxide
Sr	Strontium
SrSO ₄	Celestite
V	Vanadium
V ₂ O ₅	Vanadium pentoxide
Ti	Titanium
TiO ₂	Titanium dioxide
Zn	Zinc
Nb	Nobium

TNG LIMITED

SUPPLEMENT TO THE
ENVIRONMENTAL IMPACT STATEMENT
DARWIN PROCESSING FACILITY

INTRODUCTION AND GENERAL INFORMATION

1. INTRODUCTION

1.1 OVERVIEW

TNG Limited (**TNG**) is seeking approval from the Northern Territory (**NT**) and Commonwealth governments to develop the proposed Darwin TIVAN® Processing Facility (the **Project**) in order to process magnetite concentrate to produce high value products for export to international customers.

In January 2016, it was determined that TNG's proposal to develop a processing facility at a site on the Middle Arm Industrial Precinct, approximately 16 kilometres (**km**) south of Darwin, required assessment under the NT *Environmental Assessment Act 1982 (EA Act)* and is a 'controlled action' under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*. The project is being assessed at the level of an Environmental Impact Statement (**EIS**) under the bilateral agreement between the NT and Federal Governments.

TNG prepared a Draft EIS to address the Terms of Reference (**ToR**) released by the NT Environmental Protection Authority (**NT EPA**). The Draft EIS was made available for comment for a period of 12 weeks from 29 November 2019 to 21 February 2020. Copies of the Draft EIS were made available for public viewing on the NT EPA and TNG websites and in various physical locations in Darwin and Palmerston.

Three public submissions were received by the NT EPA in response to the Draft EIS and forwarded to TNG. The NT EPA also provided consolidated comments from NT Government Agencies. All submissions are provided in full at **Appendix A**.

In accordance with clause 12 of the *Environmental Assessment Administrative Procedures 1984 (EAAP)*, the NT EPA directed TNG to provide a Supplement to the Draft EIS. This Supplement addresses comments raised through submissions on the Draft EIS and details Project amendments undertaken since the Draft EIS was completed.

1.2 TRANSITION PERIOD FOR THE EP ACT

At the time the Project was referred to the NT EPA in 2015, the process for environmental impact assessment was legislated under the EA Act and supporting EAAP.

The *Environment Protection Act 2019 (EP Act)* replaced the EA Act on 28 June 2020. Proposals undergoing an assessment process at the time the EP Act commenced are required to transition into the new assessment system. The NT EPA has prepared a policy to assist proponents required to transition into the new system called *Managing the transition of existing environmental impact assessment processes after commencement of the Environment Protection Act 2019*.

This policy applies to existing environmental impact assessment processes. That is, where:

- a notice of intent has been referred to the NT EPA under clause 6 of the EAAP; and
- the NT EPA has decided, under clause 8 of the EAAP, that assessment is required; and
- the NT EPA has not completed an Assessment Report for the proposed action.

The TNG Project falls within this description and the policy applies to the environmental impact assessment processes for the Project. Matters for which the policy effect this Supplement are listed below.

The EP Act s.296 provides that:

(1) Subject to this Division, if an assessment of a proposed action commenced under the former Act but an assessment report was not completed before the commencement, the former Act continues to apply to that assessment as if section 294 had not commenced.

For the purposes of s.296, the EP Act broadly further provides that:

- references in the EAAP to “days” are to be read as “business days”
- a supplement that is prepared after the commencement of the EP Act is to be made available for public comment for a period of not more than 15 business days.

Where the NT EPA directs a proponent to prepare a Supplement after the commencement of the EP Act, the NT EPA will, in consultation with the proponent, include in the direction any matter that is required to ensure that the NT EPA can fulfil its obligations in preparing an environmental approval. This direction has been received by TNG from the NT EPA in the form of comments on the Draft EIS. Comments from the NT EPA specifically addressing the transition to the EP Act in relation to the Project are included in **Section 0** Topic 13.

As the Supplement has been submitted to the NT EPA after the commencement of the EP Act, the Supplement will, as soon as practicable, be published on the NT EPA website. The NT EPA will also publish a notice advising that the Supplement has been received and is available for public comment. The public comment period will not exceed 15 business days.

The NT EPA may request further information in relation to a Supplement. This information will be requested within 21 business days of the close of the public comment period.

1.3 SCOPE AND PURPOSE OF THE SUPPLEMENT

This Supplement has been prepared to address comments made by the public, government and non-government organisations on the Draft EIS and to provide further Project information, updates and additional management measures to facilitate informed decision-making by the Regulatory Authorities.

The additional information provided in the Supplement reflects the current state of project planning, which has progressed since submission of the Draft EIS in November 2019. The Draft EIS and Supplement combined, along with any additional information requested by the NT EPA, will collectively constitute the EIS for the Darwin TIVAN® Processing Facility.

1.4 STRUCTURE OF THE SUPPLEMENT

The structure of the Supplement is described in **Table 1-1**.

It is intended that the Supplement be read in conjunction with the 2019 Draft EIS. Where contradictions occur between the two documents, the Supplement will supersede the Draft EIS.

Table 1-1. Supplement Structure

Section	Content
Section 1 Introduction	- Provides an overview of the EIS stage relative to the EIA approvals process - Defines the scope and purpose - Summarises the structure of the document
Section 2 Project Design updates	- Describes changes to the Project compared to the Project description presented in the Draft EIS. - Where further technical studies have been conducted to support the design and management of Project changes, these reports are summarised. Technical Reports are provided in full in the Appendices
Section 3 Updates to Key Environmental Factors	- Describes changes to the Key Environmental Factors as a result of the Project amendments described in Section 1. - Provides an updated assessment for each Factor addressed in the Supplement and a revision of the proposed mitigation, management, monitoring and reporting strategies. The residual risk is discussed and the significance of the residual risk calculated.
Section 4 Other Environmental Information	- Provides additional information on the marine environment, relative to operation of the Project. Marine Factors are no longer considered Key Factors for the Project and are included as Other Environmental Information.
Section 5 Principles of Ecological Sustainable Development	- Indicates how the Project has considered the Principles of Environmentally Sustainable Development (ESD) in the planning and operation of the Darwin Processing Facility.
Section 6 Summary of Submissions Received	- Summarises the submissions received on the Draft EIS and provides a detailed response to each submission.
Section 7 Updated Commitments Register and Project Risk Assessment	- Provides an update of the Project Commitments Register, consolidating commitments made for the Supplement with relevant commitments made in the Draft EIS. - Provides an updated Risk Assessment for the Project, based on the revised Project scope presented in Section 1.
Section 8 References	- Provides detail of sources referenced in the Supplement.
Section 9 Appendices	- Appendices associated with the Supplement.

TNG LIMITED

SUPPLEMENT TO THE
ENVIRONMENTAL IMPACT STATEMENT
DARWIN PROCESSING FACILITY

**PROJECT DESIGN
UPDATES**

2. PROJECT DESIGN UPDATES

Following submission of the Draft EIS, TNG has progressed the Front-End Engineering and Design (**FEED**) phase of the Project which, along with consideration of comments received through Draft EIS submissions, has led to Project design updates. The Key Components Table (**Table 2-1**) summarises the changes to the Project from the Draft EIS to the Supplement. **Table 2-1** also identifies the Section where the change is presented in detail.

The most significant amendment to the Project relates to wastewater discharge. The Draft EIS proposed to dispose of liquid waste from the Processing Facility via a discharge pipeline into Darwin Harbour near East Arm. Following further Project refinements, and noting the feedback from stakeholders, TNG has incorporated a Water Recycling Plant (**WRP**) to treat liquid wastes from the Processing Facility, which will facilitate water recycling and negate the requirement for off-site discharge to the marine environment. This alternative plan is detailed in **Section 2.3.4**, with the new waste stream detailed in **Section 2.4**.

Inclusion of the WRP has also resulted in significant savings in input water requirements for the Project, which are detailed in **Section 2.3.4**. The Project's annual water demand from the Darwin water supply is now expected to be reduced by 65%.

Project refinement has resulted in variations to the Project waste streams and greenhouse gas (**GHG**) emissions. Further advances in FEED and the inclusion of the WRP has resulted in additional waste streams being identified. Re-calculation of GHG emissions has resulted in an anticipated increase of 15% from the Project. Detail on these elements of the Project are provided within this Section.

Table 2-1. Darwin TIVAN® Processing Facility Key components table

Component	Description in the Draft EIS	Change in the EIS Supplement	Location in Document
Proponent Name	Enigma Mining Limited (wholly owned subsidiary of TNG Limited). Proponent herein referred to as TNG Limited.	No change	N/A
Site Name	Lot 1817, Hundred of Ayers, Middle Arm Industrial Precinct, (658 Channel Island Road) Wickham	No change	N/A
Short Description	The purpose of the Project is processing magnetite concentrate (concentrate) to produce higher value products titanium dioxide, vanadium pentoxide and ferric oxide, for export from East Arm Wharf to international customers. The proposal includes: • Clearing of a partially vegetated allotment formerly utilised for extractive industries; • Construction and operation of a magnetite concentrate Processing Facility; • Development of support infrastructure, including workshops and stores, office/administration buildings, laydown areas, water storage and treatment facilities, car parking, electrical sub-station, access roads and outfall pipeline; • Construction and operation of a rail siding, unloading and loadout facilities on the Adelaide-Darwin railway; and • Loading of trains at the rail siding, with products to be railed to East Arm Wharf.	The outfall pipeline has been removed from the Project and replaced with a WRP. The Project has added the backloading of trains at the rail siding with solid waste products to be railed to an offsite disposal location.	WRP Section 2.3.5.2 Solid waste disposal Section 2.5
Operational Requirements			
Development Envelope	264 ha	270.5 ha	Section 2.1
Throughput	700,000 tonnes per annum (tpa)	No change	N/A
Operating hours	The Processing Facility will operate 24 hours per day, seven days per week.	No change	N/A

Products	Titanium Dioxide Pigment (TiO ₂)				
	World demand	6,500,000 tpa		No change	N/A
	TNG's average production	100,000 tpa (1.5% of world demand)			
	Main usage	Paint, plastics, paper and inks			
	Vanadium Pentoxide (V ₂ O ₅)				
	World demand	170,000 tpa (equivalent of 90,000 tpa V units)		No change	N/A
	TNG's average production	6,000 tpa (3.5% of world demand)			
	Main usage	Steel, superalloys, chemicals, catalysts and energy storage (vanadium redox batteries)			

	Ferric Oxide (Fe ₂ O ₃)			
	World demand	104 million tpa (seaborne market)	No change	N/A
	TNG's average production	500,000 tpa (0.5% of world demand)		
	Main usage	Steelmaking		
Reagents	- several acids, bases and oxidants - several solid reagents including metals, hydroxides, limestone, diatomaceous earth, sulfur, organic polymers (flocculants) and inorganic salts		Processing: Oleum Plant and associated reagents removed from process.	
			Water Recycling Plant: Addition of Sulphuric acid, Nitric acid, Hydrochloric acid, Sodium hydroxide, Ferric chloride, Sodium hypochlorite, Antiscalant, Sodium metabisulphite, Citric acid, Flocculant (polymer), Defoamer.	
Electricity Consumption (terajoules (TJ) /annum)	1316		1597	Section 2.3.6
Natural Gas Usage (petajoules (PJ) per annum)	4.82		5.2	Section 2.3.6

Water sourced from the Darwin Water + Supply (Gigalitres (GL) per annum)	11	3.85	Section 2.3.9.1															
Train movements	On average: - three train loads of concentrate per week will be delivered to the Processing Facility from Mount Peake; and - seven train movements between the Processing Facility and East Arm Wharf will occur weekly	No change	Section 2.2.6															
Traffic movements (Maximum traffic on external roads; vehicles per day; vpd)	985	636	Section 2.3.12															
Operations Phase Waste Streams	- Wastewater from Processing Facility to be disposed through marine discharge at a rate of 9.5 GL/annum. - Filter cake from wastewater precipitate produced in the pigment plant, the TIVAN® Process and collected stormwater., - Neutralised digest residue tailings. - Dry magnetic separation non-magnetics. will be produced at a rate of 570 tpa.	<table><thead><tr><th>Waste Product</th><th>Volume tpa</th></tr></thead><tbody><tr><td>Coke ash</td><td>2,500</td></tr><tr><td>Sulphate digest leach residue</td><td>55,000</td></tr><tr><td>Metal hydroxide precipitation #1</td><td>15,000</td></tr><tr><td>Metal hydroxide precipitation #2</td><td>30,000</td></tr><tr><td>WRP Clarifier solids</td><td>4,000</td></tr><tr><td>Sewage</td><td>150 m³/d</td></tr></tbody></table>	Waste Product	Volume tpa	Coke ash	2,500	Sulphate digest leach residue	55,000	Metal hydroxide precipitation #1	15,000	Metal hydroxide precipitation #2	30,000	WRP Clarifier solids	4,000	Sewage	150 m³/d	Section 2.4	
Waste Product	Volume tpa																	
Coke ash	2,500																	
Sulphate digest leach residue	55,000																	
Metal hydroxide precipitation #1	15,000																	
Metal hydroxide precipitation #2	30,000																	
WRP Clarifier solids	4,000																	
Sewage	150 m³/d																	
By-products from waste streams	None identified	<table><thead><tr><th>Potential By-Product</th></tr></thead><tbody><tr><td>Gypsum products</td></tr><tr><td>Digest residue</td></tr><tr><td>WRP salt residue components (with further processing)</td></tr></tbody></table>	Potential By-Product	Gypsum products	Digest residue	WRP salt residue components (with further processing)	Section 2.5											
Potential By-Product																		
Gypsum products																		
Digest residue																		
WRP salt residue components (with further processing)																		
Workforce	Peak workforce during construction is expected to be approximately 700-1000 personnel The operations of the Processing Facility is estimated to require a workforce of approximately 600 personnel.	Construction workforce estimated to be approximately 1200 – 1500 personnel. Operations workforce estimated to be approximately 850 personnel, with 300 personnel on site at any one time.	Construction workforce Section 0 Operations workforce Section 2.2.6															

Greenhouse gases	Direct emissions – 828,310 t CO ₂ eq	Direct emissions – 944,020 t CO ₂ eq	Section 0
	Indirect emissions – 204, 711 t CO ₂ eq	Indirect emissions – 248,383 t CO ₂ eq	
	Total emissions – 1,033,021 t CO ₂ eq	Total emissions – 1,192,401 t CO ₂ eq	

2.1 DISTURBANCE FOOTPRINT AND SITE LAYOUT

Modifications to the site layout and inclusion of the WRP have resulted in an increase in the size of the Project Development Envelope by 6.5 ha. The total disturbance area described in the Draft EIS was 264 ha; the revised Development Envelope is 270.5 ha, incorporating 75.2 ha of existing disturbed land, 88 ha of degraded vegetation and 107.3 ha of good to excellent quality vegetation. Amendments to clearing requirements are described in **Section 2.2.4**.

The Processing Facility is retained predominantly on the southern peninsula of Lot 1817, Hundreds of Ayres, Middle Arm Industrial Precinct, Wickham, NT. Project support infrastructure will adjoin the Processing Facility on the southern peninsula, with additional support infrastructure established on the northern peninsula of Lot 1817. The wastewater discharge pipeline corridor has been removed from the layout and additional stormwater management infrastructure has been included.

The layout of the Project appears as **Figure 2-1**. An artist impression of the southern peninsula is provided as **Figure 2-2**.

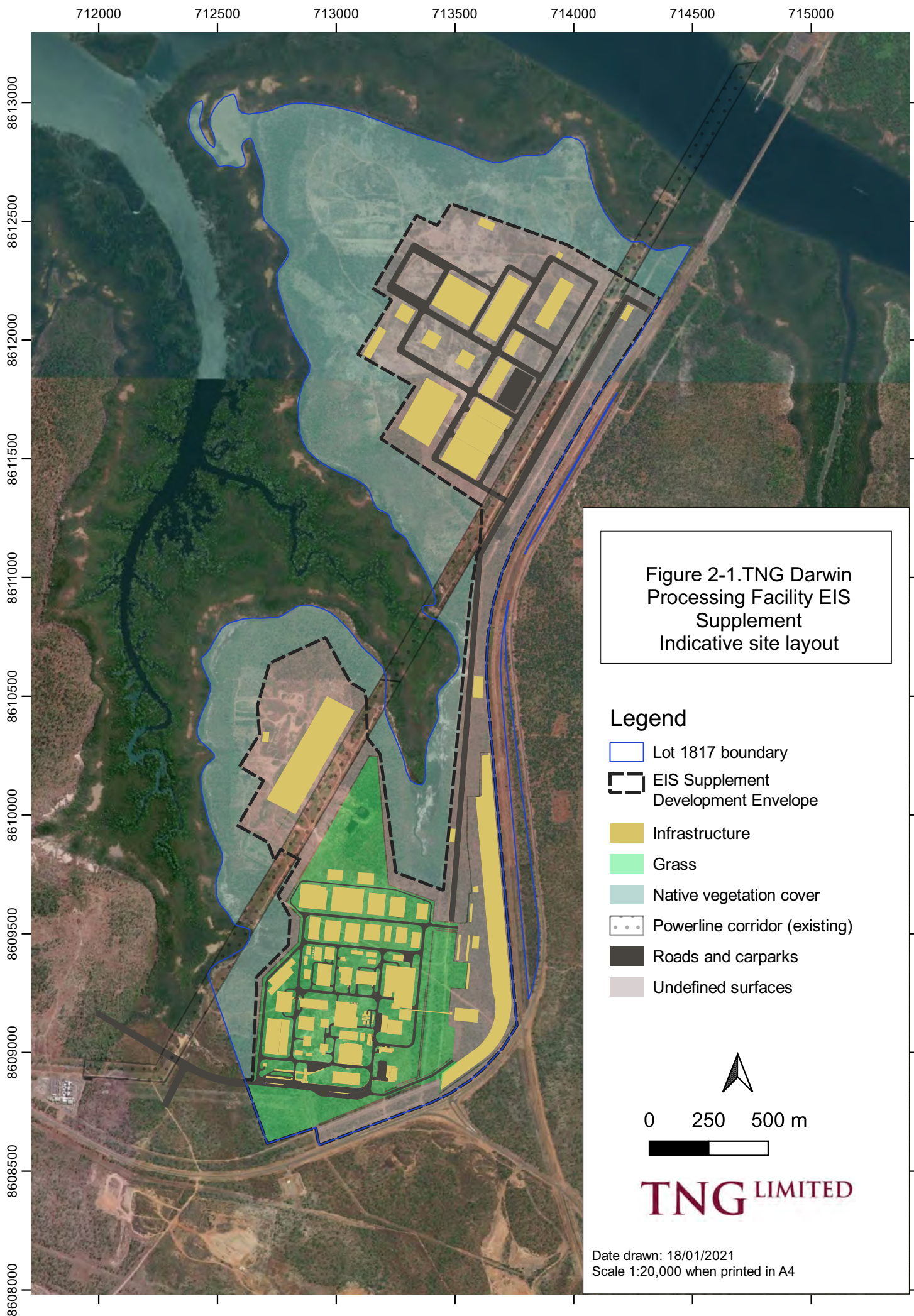




Figure 2-2. Artists impression of the southern peninsula towards the north east

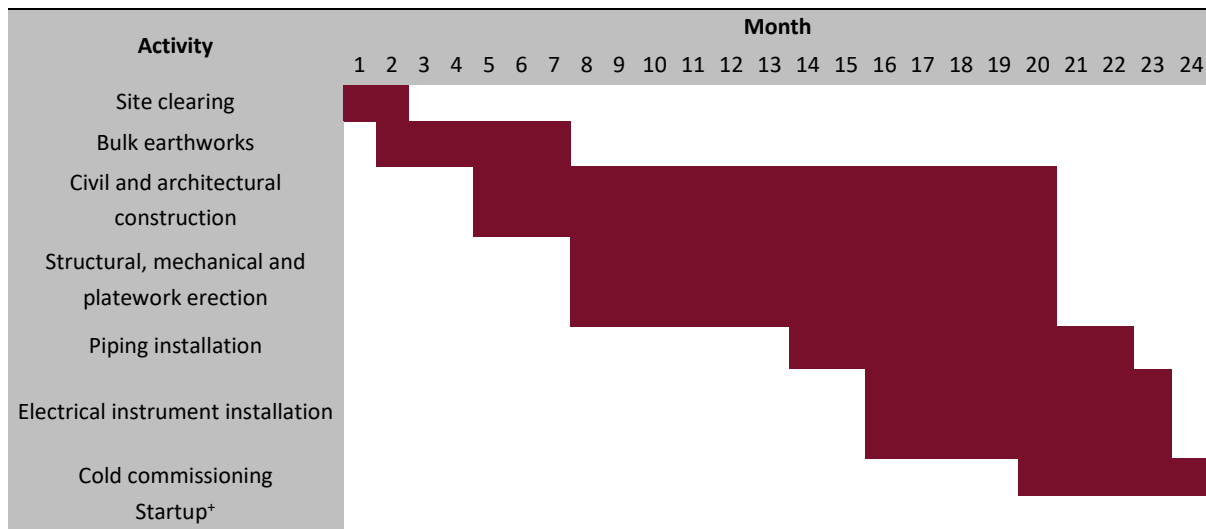
2.2 CONSTRUCTION PHASE

2.2.1 Overview

Additional information to supplement or revise construction details presented in Section 4.5 of the Draft EIS is provided below.

Construction is scheduled to commence following receipt of statutory approvals and is subject to finance and TNG Board Financial Investment Decision approval. The construction period for the Darwin Processing Facility is anticipated to be 24 months, continuing over both wet and dry seasons. **Table 2-2** provides an indicative construction schedule, although the ultimate construction timetable will be determined at the final design phase.

Table 2-2. Construction Schedule



+ Startup to occur after Month 24

2.2.2 Site preparation and earthworks

In the southern peninsula, excavation (or cut) of approximately 575,000 m³ of earth, and 545,000 m³ of fill are required for the purposes of levelling areas to two elevation categories. The Processing plant area will be levelled to 8.7 m above sea level (asl). The railway siding will descend from 13.5 m to 10.5 m asl.

Figure 2-3 indicates the areas where cut and fill will occur on the southern peninsula. A degree of levelling is also anticipated for the northern peninsula. If insufficient fill is available for the required areas, clean fill will be imported to the site.

Approximately 30,000 m³ of excavated earth will be unsuitable for fill as it is expected to contain tree roots or other biomatter. This will be used as additional subsoil in rehabilitation areas or removed from site where it is not suitable for rehabilitation purposes.

The top 30 cm of topsoil will be stripped from suitable areas and moved to areas nominated for immediate rehabilitation outside of the Development Envelope (**Figure 2-4**). Within the site approximately 88 ha (32% of the Development Envelope) is expected to have sufficient topsoil for harvesting, totalling 265,230 cubic metres (m³).

A Rehabilitation Management Plan has been prepared to direct this work (**Appendix B**).

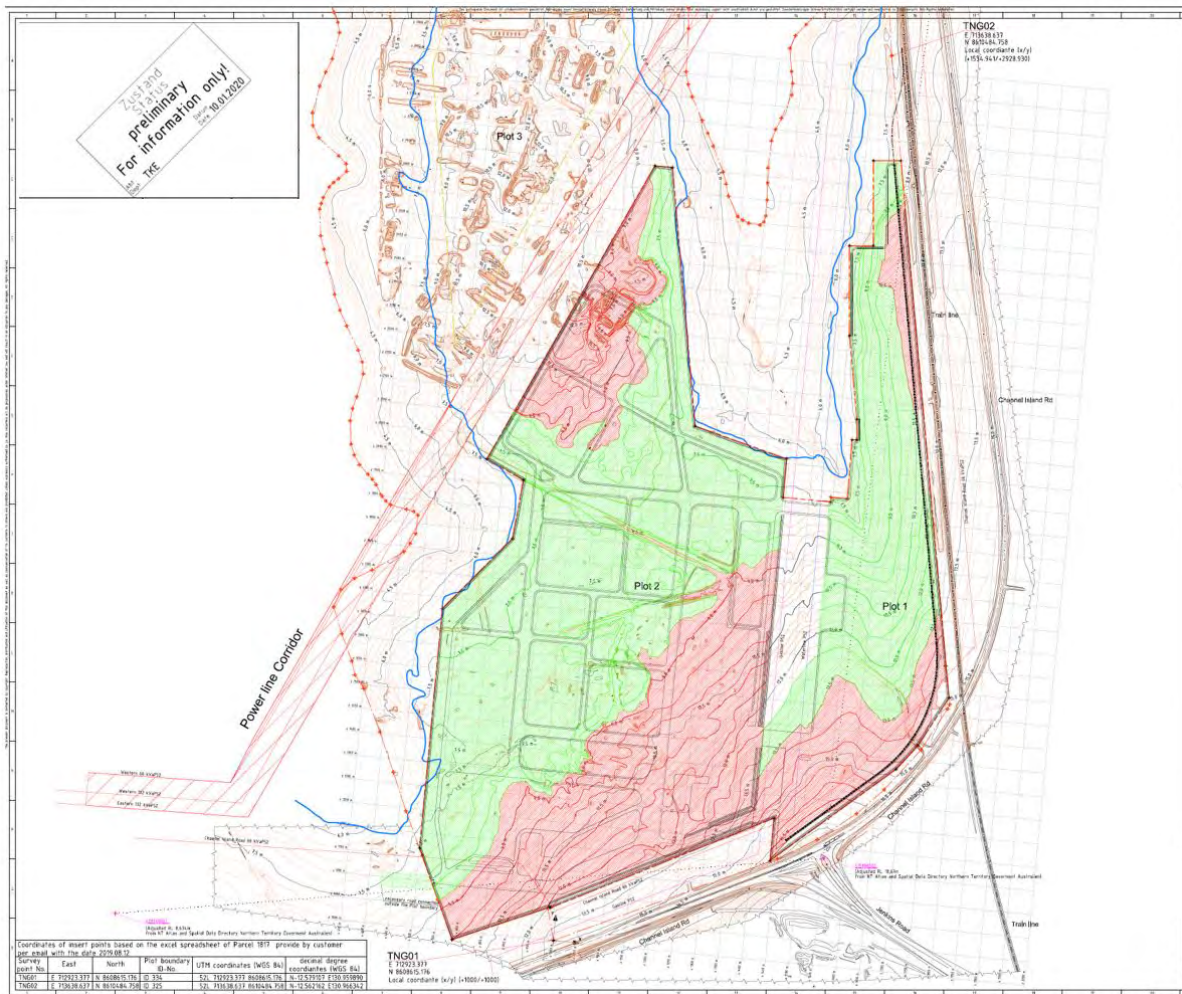
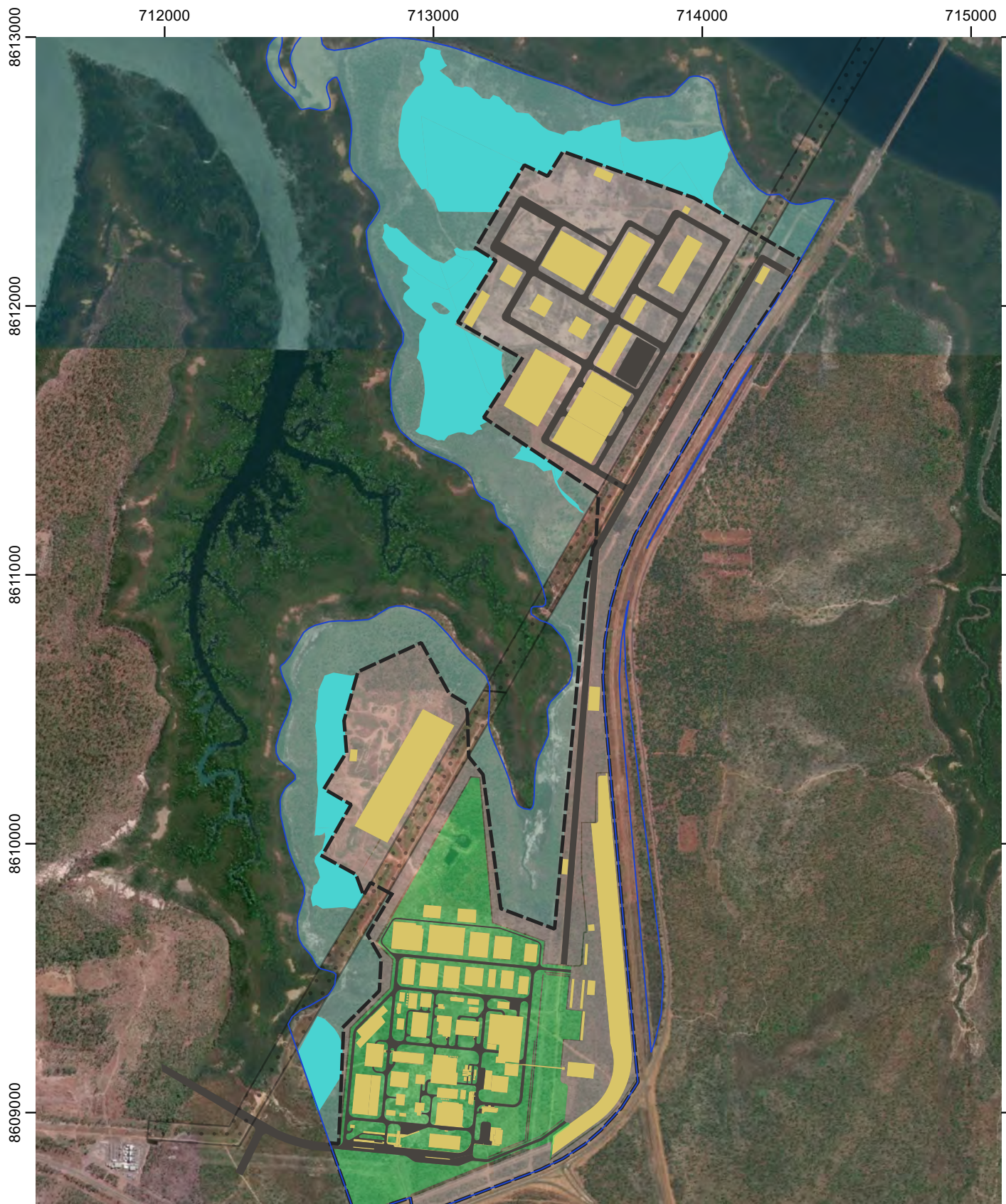


Figure 2-3. Cut (red) and Fill (green) areas for levelling of the southern peninsula



Legend

Rehabilitation areas

Lot 1817 boundary

EIS Supplement
Development Envelope

TNG Darwin Processing Facility
EIS Supplement

Figure 2-4.
Rehabilitation areas

TNG LIMITED



0 250 500 m



Scale when printed in A4 is 1: 20,000
Date drawn: 08/01/2021
CRS: GDA 1994 MGA Zone 52

2.2.3 Erosion and Sediment Control

A Conceptual Construction Erosion and Sediment Control Plan (**CCESCP**; **Appendix C**) has been prepared to ensure environmental risk to the Elizabeth Estuary from construction activities is managed in accordance with the concepts of Chapter 5.2 of *Best Practice Erosion and Sediment Control (BPESC)* (IECA 2008). Management of erosion and sedimentation in the CCESCP is based on the following principles:

- Diversion of clean water around disturbed areas
- Minimise the extent and duration of soil disturbance
- Control the location and velocity of drainage flow
- Minimise soil erosion initiated by wind, rain or concentrated flow
- Minimise sediment flow from site
- Promptly revegetate/stabilise all exposed and/or unstable soil surfaces
- Install, operate and maintain appropriate erosion and sediment control (**ESC**) measures.

The type of sediment control required is determined based upon the Revised Universal Soil Loss Equation (**RUSLE**), which accounts for factors such as soil texture, the predicted soil loss rate and other site specific factors such as the size of the catchment. **Table 2-3** lists the type of controls envisaged for the Project in different months of the year due to the variation in expected rainfall and the site-specific factors considered in the CCESCP.

The site-specific factors were assessed on a catchment by catchment basis for the site, with nine catchments present within the Development Envelope as shown in **Figure 2-5**. Indicative sediment basin locations are also shown in **Figure 2-5**. Preliminarily siting has been determined based upon catchment boundaries and the natural surface profile.

Table 2-3. Sediment Control Techniques

Type	Threshold area	Concentrated flow techniques	Sheet flow techniques	Months
Type 1	Disturbance > 2,500 m ²	Sediment basin in accordance with IECA 2018	Buffer zone capable of infiltrating 100% of stormwater runoff	November to April - All Catchments
			Infiltration basin or sand filter bed capable of infiltrating 100% of stormwater runoff	October - Catchments S1-S4; R1 and R2.
Type 3	Disturbance area 250 – 1,000 m ²	Coarse Sediment Trap	Buffer zone	May to September - All catchments.
		Modular Sediment Trap	Filter fence	
		U-Shaped Sediment Trap	Straw bale barrier (short term only)	October - Catchments N1, N2 and R3



Figure 2-5. Catchments and basins in the Development Envelope

All catchments require Type 1 controls of a sediment basin unless work is conducted solely between May and September inclusive (to October for catchments N1, N2 and R3), as detailed in **Table 2-3**.

The indicative sizing of basins is calculated assuming a Type D sediment basin, discharging to a sensitive environment. A Type D basin has been chosen for the preliminary assessment as it is the largest and most stringent type and ensures sufficient space is made available for all options of sediment control described in the BPESC (IECA, 2018). Conceptual phase sediment basin sizes are listed in **Table 2-4**. Final designs and confirmation of sediment basin types will be undertaken during the detailed engineering stage and incorporated into applicable development approvals.

Table 2-4. Sediment basin size

Catchment name	Length (m)	Width (m)
N1	47	141
N2	45	135
S1	39	117
S2	42	126
S3	52	156
S4	38	114
R1	24	72
R2	26	78
R3	27	81

A typical construction sediment basin longitudinal section showing the proposed settlement zone depth, storage zone depth, natural surface profile and groundwater levels are provided on the drawings in **Figure 2-6**. As detailed on the drawings, the maximum seasonal groundwater level (adopted as nominally one (1) metre below the natural surface profile) will potentially be above the basin base, therefore an impermeable liner will be installed on the base and sides of the basin. The liner is proposed to be a multi-component geo-synthetic clay liner as detailed in **Appendix C** (Section 1.5.1).

Provided the basins are not constructed during the “wet” season, the groundwater levels should be low enough at the basin site to enable construction of the basin to occur without the need for groundwater dewatering.

In order to ensure that the liner can accommodate equipment used to remove sediment from the basin, a 300 mm gravel protection layer is proposed over the liner. The gravel protection layer will also act as a “marker” to ensure the equipment removing sediment does not impact the liner.

These longitudinal sections are conceptual. During the detailed design phase of the Project the CCESCP will be updated and, dependant on results of additional soil sampling/analysis and groundwater monitoring undertaken at the time, a less conservative approach may be adopted where acceptable performance criteria can be achieved.

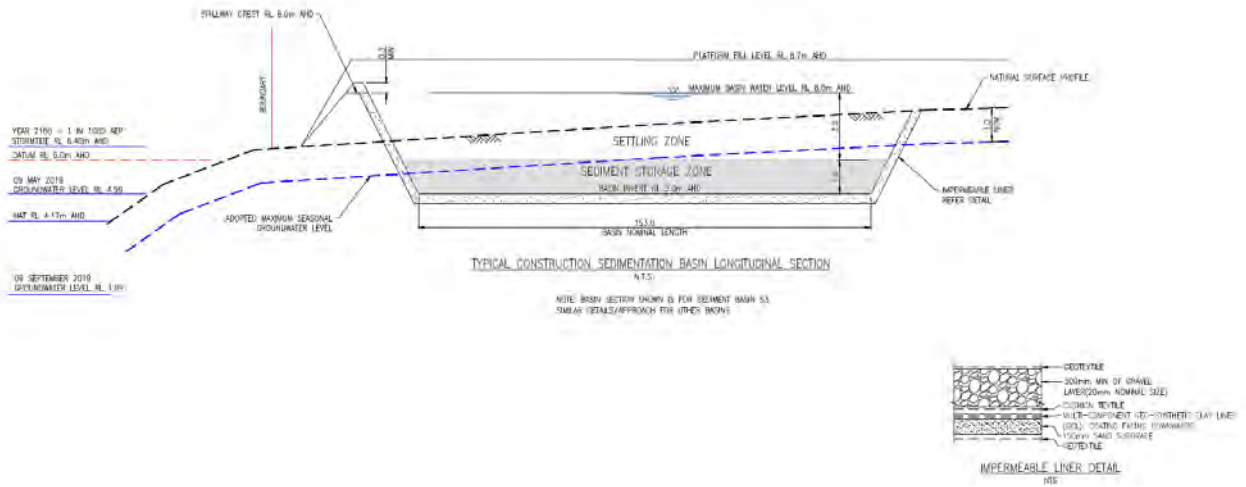


Figure 2-6. A typical construction sedimentation basin longitudinal section

2.2.4 Vegetation clearing

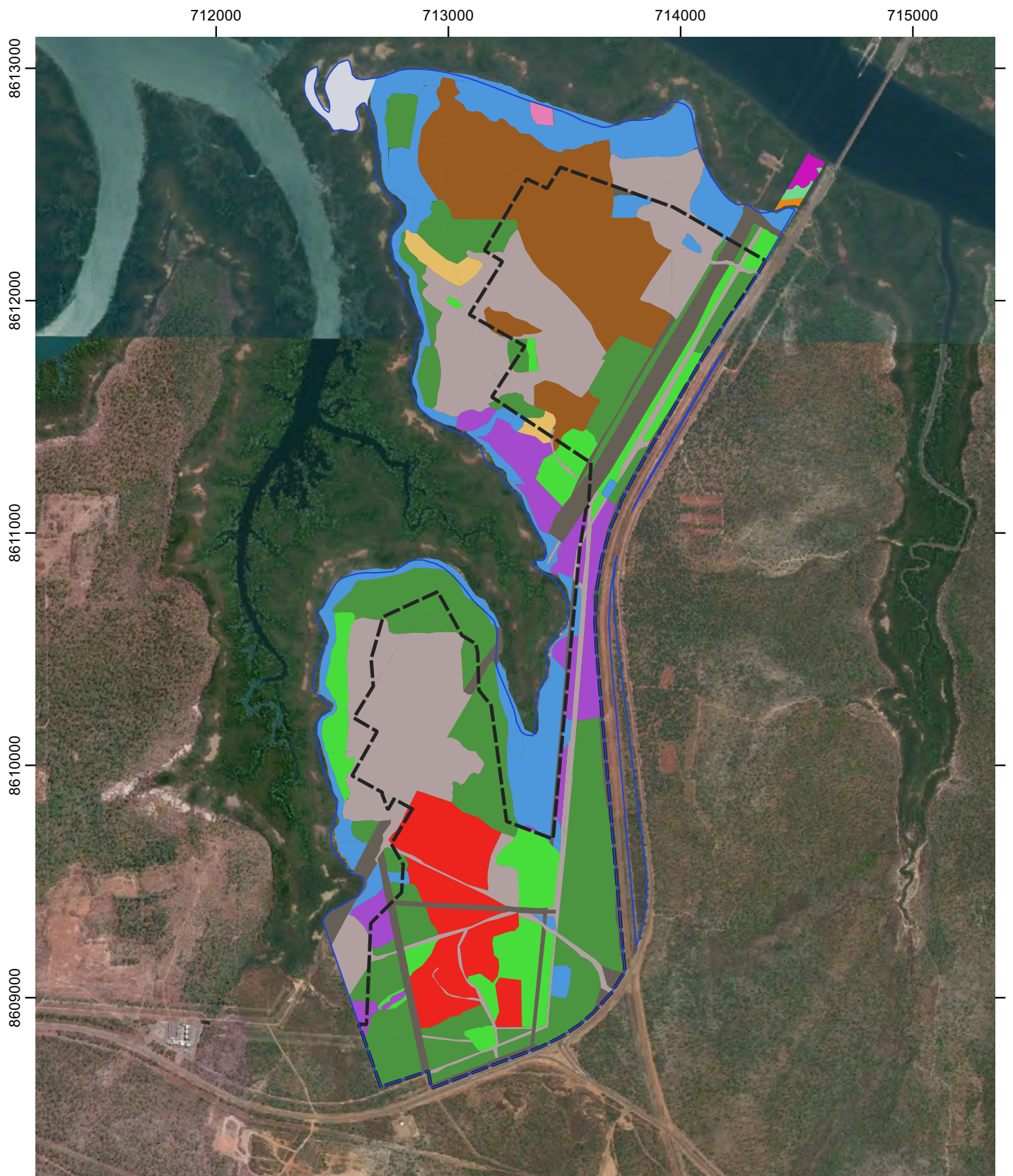
Given the changes made to the Development Envelope for the Supplement, the type and quantity of vegetation to be cleared has also altered. The differences between the Draft EIS and the Supplement are presented in **Table 2-5** and shown in **Figure 2-7**.

Table 2-5. Change to the type and quantity of vegetation to be cleared

Veg Code	Veg Association	Veg Condition	Extent to be disturbed by the proposed clearing (ha)		Difference (ha)
			Draft EIS	EIS Supplement	
VA1	Eucalyptus woodland	Very Good	67.1	72.1	5
VA2	Regenerating Eucalyptus woodland	Good	11.9	20.4	8.5
VA3	Melaleuca woodland/open forest	Excellent	17.1	2.5	- 14.6
	Melaleuca woodland/open forest – previously disturbed	Good	10.1	3.4	- 6.7
VA4	Grevillea open shrubland	Degraded	30.5	30.4	- 0.1
VA5	Closed grassland	Degraded	0.7	0.7	0
VA6	Disturbed rehabilitated Acacia shrubland	Degraded	35.2	37.1	1.9
VA7	Disturbed not rehabilitated	Completely degraded	67.3	75.2	7.9
VA8	Mangroves Sub association 2	Excellent	0.3	0	- 0.3
	Mangroves Sub association 4		0.1	0	- 0.1
	Mangroves Sub association 6		1.1	0	- 1.1
VA9	Monsoon closed forest	Good	0	0	0
VA10	Tussock grassland	Excellent	0.6	8.9	8.3
VA11	Slashed for infrastructure	Degraded	19.3	19.8	0.5
Total			261.3	270.5	9.2

Selection of the Development Envelope and the associated clearing has prioritised the use of previously disturbed areas within Lot 1817, with consideration for the limitation of excluding the 1:1000 year storm surge areas.

Removal of the wastewater discharge pipeline from the Project scope has negated any requirement to clear mangrove vegetation. Development Envelopment amendments have also resulted in a reduction of Melaleuca woodland vegetation clearing, although a slight increase in Eucalyptus woodland is required. The expanded disturbance footprint is not expected to increase the severity of impacts to terrestrial ecosystems compared to those presented in the Draft EIS.



Legend

	VA1		Lot 1817 boundary
	VA2		EIS Supplement Development Envelope
	VA3		
	VA4		
	VA5		
	VA6		
	VA7		
	VA8 saltpan		
	VA8 hinterland		
	VA8 mid tidal flat		
	VA8 tidal creek		VA10
	VA9		VA11

TNG Darwin Processing Facility
EIS Supplement

Figure 2-7.
Vegetation clearing

TNG LIMITED



0 250 500 m



Scale when printed in A4 is 1: 23,000
Date drawn: 19/01/2021
CRS: GDA 1994 MGA Zone 52

2.2.5 Construction Materials Required

Construction material requirements have been updated since completion of the Draft EIS. A concrete batching plant is no longer proposed at this stage, with the current preference being concrete supply from the local Darwin region. The volumes of construction materials necessary for construction, particularly concrete and steel, are expected to increase from the estimates provided in the Draft EIS, with the exact volumes to be determined at the final design stage.

Approximately 0.42 GL of water is projected to be used during the construction period for dust suppression, soil conditioning and washdown requirements. Personal water usage by construction workers can vary from 40 litres per person per day to 160 litres per person per day depending on the facilities available. Using the maximum of the estimates, employee water usage would total 0.08 GL over the course of the construction period. This results in a total estimated construction water demand of 0.5 GL. This volume replaces the 2.5 GL estimate presented in the Draft EIS.

2.2.6 Workforce

A recent review of labour requirements concluded that approximately 1,200 to 1,500 personnel are expected to be required for the construction of the Project; the Draft EIS indicated 700 to 1000 personnel. It is anticipated that construction staff and external/FIFO contractor workforce will be accommodated at the existing Bladin Workers Village operated by Trepang Services (capacity to accommodate 1500) or Ahrens operated INPEX accommodation village (capacity to accommodate over 2000).

2.2.7 Traffic

No changes have occurred to the traffic infrastructure to be constructed for the Project, however further detail is available for the type, frequency and external routes that Project traffic will use during the construction phase.

Construction of the Darwin Processing Facility will occur generally 10 - 12 hours a day, seven days a week, with some periods of 24 hour activity also occurring. The traffic to be generated during construction was calculated by determining the type and quantity of construction materials required to be delivered to site throughout the construction phase in addition to the number of light vehicles and buses required to transport construction workers from accommodation camps or local towns. The expected construction vehicle fleet is provided in **Table 2-6**, however, not all vehicles are required simultaneously, with different types of equipment required at different stages of the construction phase.

The maximum number of vehicle movements on external roads expected per day for each discipline during the construction phase is shown in **Table 2-7**.

Table 2-6. Construction vehicle fleet

Discipline	Equipment	No. required
Earthworks	Front end loader	10
	Back Hoe/Excavator	32
	Bull dozer	16
	Roller	8
	Scraper	8
	Grader	8
	Truck	32
	Paver	8
Material Handling	Concrete mixer truck	5
	Concrete pump	5
	Mobile crane	25
	Cherry picker/tele handler	50
	Derrick	4
Power Supply	Generators	10
	Compressors	20
Impact	Pile driver (diesel)	6
	Pile driver (gravity, bored)	6
	Pneumatic breaker	2
	Hydraulic breaker	2
	Pneumatic chipper	4
Other	Poker vibrator	8
	Compressed air blower	10
	Power saw	40
	Electric drill	40
	Air track drill	40
	Light vehicles	29
	Buses	13
	Water Tankers	2

Table 2-7. Maximum number of vehicle movements expected per day during construction

Discipline	Equipment	Maximum trips/day
Earthworks	Mobilisation and demobilisation	38
Civil works	Concrete mixer trucks	64
Structural steel	Trucks delivering steel	4
Mechanical Equipment	Trucks delivering equipment	2
Piping and valves	Trucks delivering pipes and valves	1
Electrical and instrumentation	Racking, cabling, equipment and instrument delivery	1
Worker transport to site	Light vehicles from camp or local towns	58
	Buses from Bladin Workers Village	26
Other	Ad-hoc deliveries and visitors	1
Total		195*

* This is a conservative figure as, in reality, not all vehicles will be used simultaneously.

Delivery vehicles transporting construction materials will operate between the hours of 8 am to 5 pm. Management personnel will likely utilise carpooling to limit the number of vehicle movements. The Draft EIS considered the scenario where construction workers would drive individual cars to and from site. In the Supplement it is assumed the construction workforce will predominantly commute to site from the Bladin Workers Village using a bus service at 7 am and 5 pm.

Figure 2-8 indicates the total number of vehicle movements per day expected for the duration of the construction phase. Vehicle movements on external roads are expected to peak at 195 vehicle movements per day in the 16th month of the construction phase. Peak traffic times during the day will occur at 7 am and 5 pm, with an estimated 39 vehicle movements. The majority of traffic movements will be travelling to and from the Bladin Workers Village, East Arm Wharf and the concrete batch plant located in Palmerston. Details of the most frequented routes are provided in **Figure 2-9**.

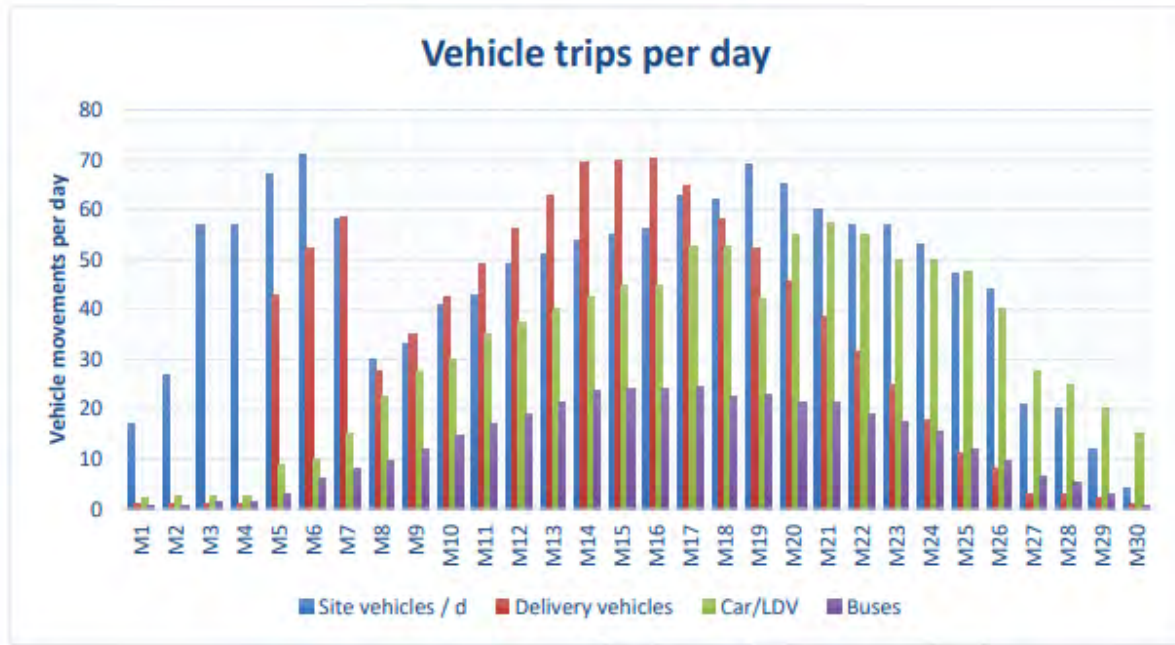


Figure 2-8. Expected number of vehicle movements per day during the construction phase for delivery vehicles (red), light vehicles (green) and buses (purple).

Based on staffing predictions, it is anticipated that a total provision of up to 50 car parking spaces will be provided for Staff movements for the construction period, based on 29 light vehicles, 13 buses and 8 other vehicles parking at the site.



Legend

- Lot 1817 boundary
- East Arm Wharf
- Concrete Batching Plant
- Workers Camp

Darwin Processing Facility EIS
Supplement

Figure 2-9.
Construction phase
frequent routes

TNG LIMITED



0 1 2 km



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Traffic entering and leaving the site will access to Lot 1817 via the newly established Kittyhawk Estate junction. **Figure 2-10** presents the traffic volumes generated by the Project construction phase at the Kittyhawk Estate junction on Channel Island Road in the morning (7:30 – 8:30 am) and afternoon (4:30 – 5:30 pm) peak traffic times.

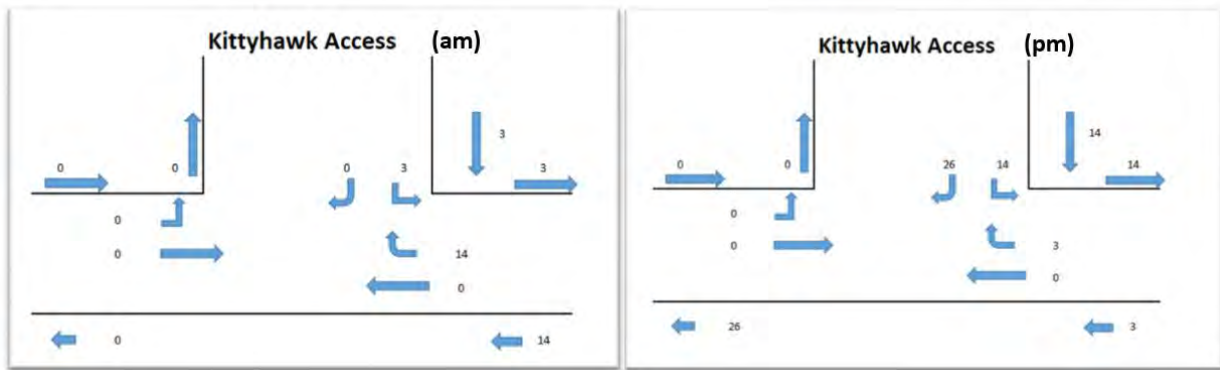


Figure 2-10. Construction traffic entering and exiting from Channel Island Road during peak times

An updated Traffic Impact Assessment has been provided as **Appendix D**.

2.2.8 Construction Waste Streams

Section 4.5.10 of the Draft EIS described construction phase waste streams. The following updates are required as part of the Supplement:

- Wastes associated with the concrete batching plant are no longer applicable and are removed from the construction waste types
- A total of 7,500 t of solid waste is expected to be generated during the construction phase. This figure is based on published data from construction sites that indicate an average of 25 kilograms (**kg**) of construction waste is generated per square metre (**m²**) of built area (Osmani, 2011). Wastes include construction waste, fabrication consumables, domestic waste, rubble and shipment packaging.

All wastes will be managed in accordance with the requirements of the *Waste Management and Pollution Control Act 1998 (WMPC Act)* and with consideration for the waste management hierarchy. Where possible, waste materials will be re-used or recycled. Wastes not suitable for recycling will be disposed off-site via licenced contractors, appropriate.

2.3 OPERATIONAL PHASE

Modifications to the operational phase of the Project resulting from the progression of FEED and consideration of comments on the Draft EIS are described below. This information updates that provided in Section 4.6 of the Draft EIS.

Key changes include:

- Update of Processing flow sheets and description
- Removal of the Oleum Plant
- Removal of wastewater discharge to Elizabeth River and inclusion of a WRP
- Additional information on stockpiles, ponds and chemicals/reagents used
- Stormwater management processes detailed
- Water and power requirements updated
- Review of workforce numbers
- Traffic volumes during the operational phase updated
- Waste streams identified and detailed
- Air emissions reviewed and updated

2.3.1 Processing

The following provides an overview of the key features of the proposed processing operations, with flow charts supplied as **Figure 2-11**. The description is provided in sufficient detail to afford the reader with an understanding of the various processes, transfer points and waste streams. The description is based on the Processing Facility operating at full capacity.

TIVAN® PLANT FLOWSHEET

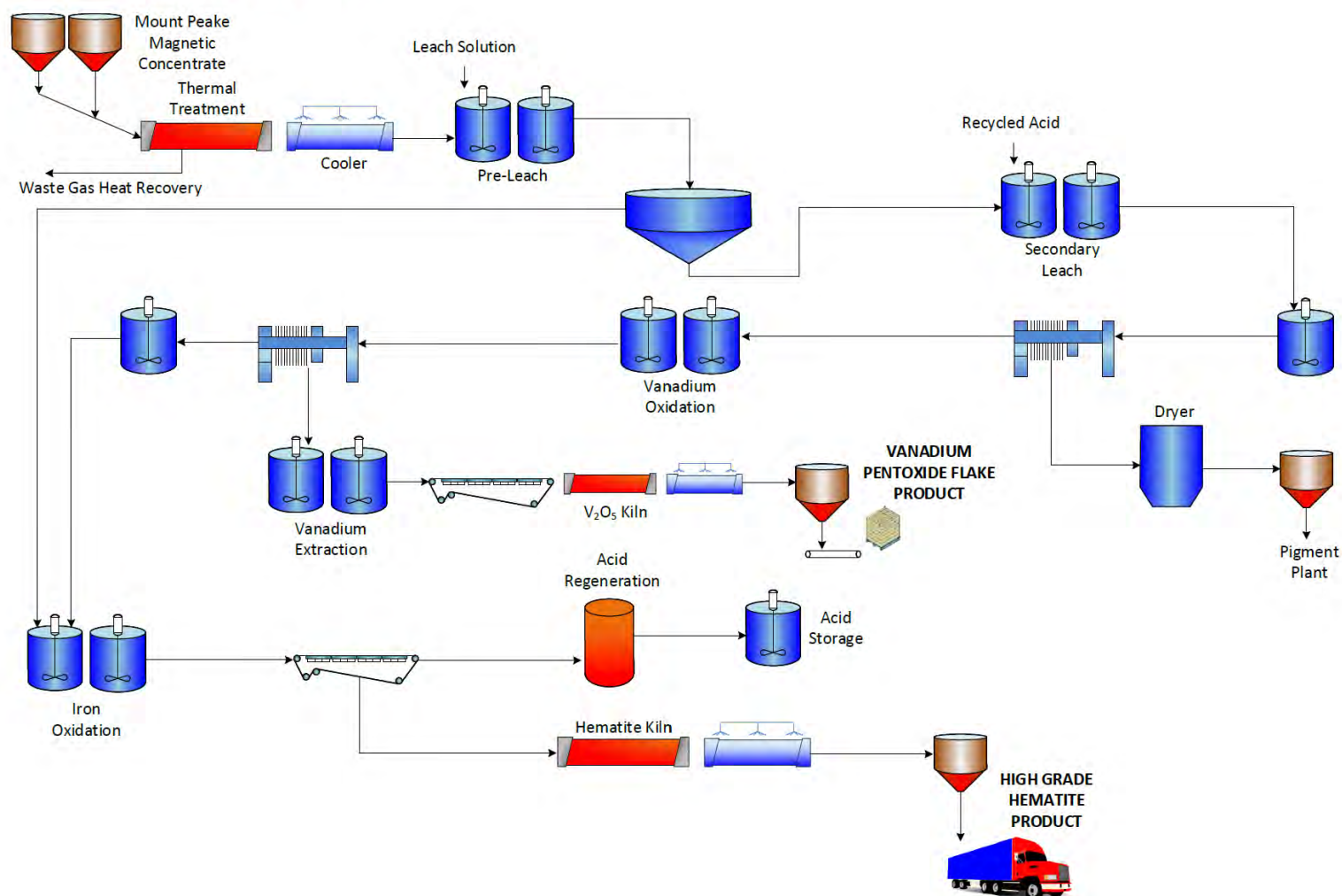


Figure 2-11. Darwin Processing Facility Process Flow Diagram

2.3.1.1 TIVAN® Process Updates

From the processing stockpile, the concentrate is transferred to thermal processing where the concentrate is heated in a rotary kiln with coke. The ore concentrate is discharged into a cooler to reduce the temperature prior to feeding the leaching circuit. The cooled ore is fed to dry magnetic separation, generating a magnetic concentrate for further processing and a non-magnetic solid waste for disposal at Mount Peake or other suitable location. The non-magnetic waste material is transferred into lidded containers for transport by rail.

The off gas is fed to a boiler for heat recovery and scrubbed in a limestone scrubber to reduce sulfur levels prior to release to the atmosphere. Gypsum generated in the limestone scrubber is filtered and transferred into lidded containers. The separated liquor is forwarded to the WRP.

The magnetic concentrate is transferred to the pre-leach circuit where impurities are dissolved in a corrosive salt solution to prepare the feed for the TIVAN® leach. The leach slurry is thickened, generating a higher pulp density slurry and an overflow stream, which feeds the reagent recovery circuit.

The thickened slurry is transferred to the TIVAN® leach circuit where the feed is heated and acid is added to extract vanadium in a series of leaching vessels. The slurry from the leaching process is filtered to produce a filter cake ('feedstock') for the titanium pigment plant and the filtrate recovered for vanadium extraction. The feedstock, which is high in titanium dioxide (TiO_2), is dried in a fluidised bed and pneumatically conveyed to the titanium pigment plant.

The TIVAN® leach solution is pumped to the vanadium oxidation process. In the vanadium oxidation process an impure vanadium solid is precipitated from solution through oxygen sparging in a pressure vessel. The precipitated solid is filtered and the filtrate is transferred to the tank farm before recycling back to the leaching circuit. The impure vanadium solid is transferred to the vanadium purification process.

In the vanadium purification process vanadium is leached from the impure vanadium solids using sodium hydroxide. The slurry is filtered and the residue conveyed to the hematite roast area.

The vanadium bearing filtrate is added to an ammoniated solution which, precipitates as vanadium salt. The slurry is filtered and the precipitate fed to a furnace that decomposes the vanadium salt to vanadium pentoxide (V_2O_5). The off gas from the process is scrubbed with acid to remove any ammonia and released to the atmosphere. The scrub solution is recycled back to the vanadium salt precipitation tanks. The V_2O_5 is packaged as the final vanadium pentoxide product in bulk bags.

The thickener overflow from the pre-leach circuit is split into two streams; one stream is fed to the hematite precipitation circuit and the other stream is fed to the acid regeneration circuit.

In the hematite precipitation process the solution is sparged with oxygen in a pressure vessel causing iron oxide to precipitate from solution, along with some impurity oxides. The slurry from iron oxidation is thickened and filtered to separate the ferric oxide (Fe_2O_3) and the solution is recirculated back to the leaching circuit.

The split stream from the thickener overflow is stored in the tank farm prior to feeding the acid regeneration process. The acid is regenerated through the industry standard Ruthner acid regeneration process. In the process the waste acid is pre-concentrated with the roaster off gas and injected into the roaster. Water and hydrochloric acid are evaporated and the metal chloride salts in solution are converted to their metal oxides. Hydrochloric acid in the off gas is recovered by absorption into a counter-current flowing stream of water. A secondary column reduces the hydrochloric acid in the gas to acceptable levels for release to the atmosphere. The oxide solids residue is predominantly hematite, with impurity oxides of aluminium, magnesium, vanadium and titanium.

The wet hematite products from the plant are processed in a rotary kiln at elevated temperatures to decompose any impurities and dry the hematite, the rotary kiln hematite product and acid regeneration hematite product are stored in silos. The product is conveyed to a short-term stockpile and loaded into lidded containers by front end loader for transport by rail to the port.

A number of liquor streams from the plant require neutralisation to separate heavy metals from solution prior to being directed to the WRP. These streams are collected in a tank before feeding to the Process Water Treatment Plant (**PWTP**), which incorporates a neutralisation reactor. Milk of lime is fed to the neutralisation reactor to precipitate a mixed metal hydroxide solid. The resultant slurry is dewatered to generate a solid waste which is discharged from the filter press into lidded containers for transport to Mount Peake or other suitable location. The separated liquor is forwarded to the WRP.

The WRP accepts the waste solution from both the titanium pigment plant and the TIVAN® Process. The resultant mix is clarified to remove any precipitates and suspended solids prior to the ultrafiltration/Reverse Osmosis (**UF/RO**) trains. The clarifier slurry solids are filtered, dried and loaded into lidded containers for rail transport. In the UF/RO trains the solution is processed to generate three streams, a high purity water product, a low purity water product and a reject solution which requires further processing. A multiple effect evaporator (**MEE**) recovers water from the RO plant reject water and remaining waste stream(s) from the TIVAN® Process Plant. The MEE generates a soluble salt which is centrifuged and loaded into lidded containers for rail transport.

2.3.1.2 Titanium Pigment Plant Updates

The simplified titanium pigment plant flowsheet is displayed in **Figure 2-12**. Processing broadly involves digestion of titanium from the TIVAN® leach residue, hydrolysis of titanium from solution, calcination of hydrolysed titanium, milling and surface treatment of raw TiO₂, followed by steam milling to produce the titanium pigment product.

In the process the TIVAN® leach residue will be pneumatically conveyed to the titanium pigment plant and stored in a silo. The feedstock is conveyed to the ore mill where the particle size is reduced prior to the sulfate digestion process.

Recycled sulfuric acid and fresh sulfuric acid are introduced to the feedstock to produce a paste. The paste is fed to the digester which operates at elevated temperature, converting oxides to metal sulfates. Water formed in the sulfation reactions is evaporated due to the heat released in the exothermic reactions. The off gas from the process is scrubbed to remove sulfur dioxide (**SO₂**) prior to release to the atmosphere. The digester product is transferred to green liquor tanks where a dilute acid solution dissolves the metal sulfates formed. In a separate unit the slurry reacts with scrap iron to reduce the impurity elements in preparation for titanium precipitation.

The slurry is pumped to a thickener and pressure filter arrangement where the insoluble waste product that is primarily silica is separated from the titanium bearing liquor. The residue solids are neutralised with limestone and transferred into lidded containers, where they will be stored until they are sold as a by-product. The thickener overflow and filtrate are combined and further filtered to minimise particulate matter entering titanium precipitation. The filter cake formed is neutralised along with the pressure filter cake.

The remaining liquor is pumped to the titanium precipitation process. In the titanium precipitation process the hydrolysis seeds are added and the process is heated. Titanium hydrolyses from solution, while the impurities remain. The slurry is filtered and the cake is washed to remove residual solution in the cake. The filtrate is pumped to the waste acid concentration process and the cake is transferred to a tank, where aluminium powder and acid are added to bleach the solids. The slurry is again filtered and fed to the doping tank where a rutile seed is added. The slurry is filtered, and the doped titanium precipitate is transferred to the rutile kiln.

In the rutile kiln the seed and titanium precipitate will be calcined to produce a raw TiO_2 product. The off gas from the kiln containing dust and SO_2 is first cleaned of dust. The separated dust is recycled back to the calcination feed. The dedusted gas containing SO_2 is then scrubbed to remove the SO_2 and the cleaned off gas is released to the atmosphere. The TiO_2 from the kiln, which has agglomerated, is milled to achieve the desired particle size distribution for surface treatment. The slurry is filtered to separate the wet solids and dried in a flash dryer. The dried solids are milled further in a steam mill to achieve the final product size distribution and transferred to the packaging plant where it is stored in silos.

In the packaging plant the titanium pigment is packaged and stacked on wooden pallets. The wooden pallets are then double stacked in 20-foot shipping containers for transport offsite.

The waste acid concentration plant will reconcentrate process sulfuric acid to 60-70% through a multiple stage concentration process wherein excess water is removed. As the solution is concentrated, metal sulfates precipitate from solution. The precipitated metal sulfates are reintroduced into the waste solution streams for neutralisation.

The various waste acid and solution streams are collected and neutralised in the PWTP's two-stage neutralisation process. The solution is first neutralised by limestone, the resultant slurry is fed to a hydrocyclone to separate gypsum from the impurities. The gypsum product is filtered and transferred into lidded containers for transport. The remaining slurry and filtrate are recombined and neutralised with milk of lime. The product slurry is fed to a hydrocyclone to separate the metal hydroxides from gypsum. The gypsum is fed to the gypsum filter and the metal hydroxides are filtered separately. The metal hydroxide filter cake is transferred into lidded containers for transport by rail to for disposal.

The separated neutralised liquor is pumped to the WRP for water recovery.

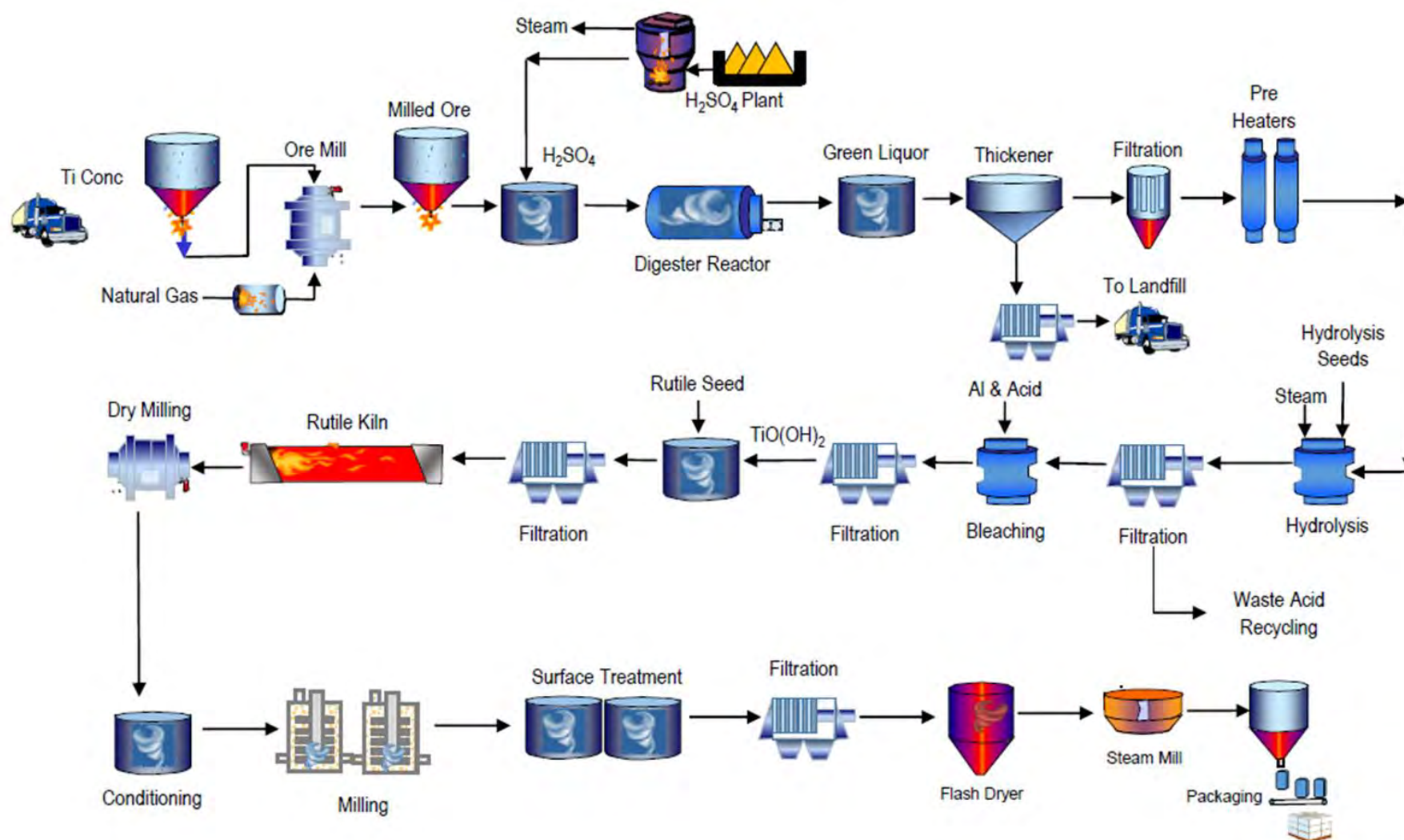


Figure 2-12. Titanium Pigment Processing Facility Process Flow Diagram

2.3.1.3 Oleum Plant

The revised process no longer requires inclusion of an Oleum Plant on site. Sulphuric acid will be sourced from commercial suppliers.

2.3.1.4 Oxygen Plant

An oxygen plant will supply oxygen for the hydrometallurgical process and for the pigment plant by air liquefaction. The primary product will be gaseous oxygen. A small percentage of the gaseous or liquid nitrogen will be used in the process plant. The remaining nitrogen will be vented to the atmosphere. The oxygen plant will require electricity and process water.

2.3.1.5 Steam

Steam is required for the titanium pigment plant, for heating in the hydrometallurgical process and for the vanadium purification circuit.

The steam for the plant will be generated from waste heat recovery of the off gas. Where required, natural gas will be used to make-up steam requirements for the plant. The steam will be generated in the waste heat recovery unit, located in the thermal pre-treatment area and distributed throughout the plant. Water for steam production will be a combination of recycled condensed steam and demineralised makeup water.

2.3.1.6 Cooling

Air cooling towers will provide cooling for the Processing Facility for the 4,614 tph of circulating cooling water required for process units throughout the plant.

2.3.1.7 Pressurised Air

A pressurised air supply, required for instruments and pressure filters, will be supplied by two air compressors, with one online at any time. Compressed air will be filtered, dried to prevent condensation, and then supplied at 750 kilopascals (kPa) into two air receivers; one for instrument air and one for plant air.

2.3.2 Stockpiles

Three materials will be stockpiled at the Processing Facility. The feed concentrate and petcoke are materials for use in the Processing facility; the third, iron oxide, is a product of the Processing circuit.

All stockpiles will be protected from rainfall by being placed in designated storage and handling areas that are covered, three sided structures. All stockpiles have dedicated dust suppression systems that will use water. This water will be collected using formal drainage networks where potential pollutants will be contained within controlled bunded areas and collected in sumps. This water will then be diverted to the PWTP.

2.3.2.1 Feed Concentrate

The indicative Safety Data Sheet (SDS) for magnetite concentrate is included as **Appendix E**. The health effect, flammability, reactivity and contact risk for this material is low. The product is insoluble, stable under normal storage conditions and is non-toxic to flora and fauna.

The magnetite concentrate will be stored in a Concentrate Storage Shed at the Darwin Processing Facility similar to that illustrated in **Figure 2-13**. The concentrate will be transported from the beneficiation plant at Mount

Peake Mine Site to Darwin by train in sealed containers. Reach stackers will move the containers from the site railway siding and to the concentrate storage building. The containers will then be unloaded onto the stockpile with trucks, which tilt the container, or through a mobile unloading device.



Figure 2-13. Example of Concentrate Storage Shed

The magnetite concentrate stockpile will be stored in a fully covered membrane structure on a concrete hardstand that has a surface area of 5000 m² and a storage capacity the equivalent of two weeks of material for processing (approximately 8000 m³). Indicative dimensions are illustrated in Figure 2-14.

The covered storage structure is accessible from the side so that material can be sequentially removed, with the first material placed being the first removed (**Figure 2-15**). This method ensures every material section has the same storage duration. This method of storage also ensures that while one compartment can be emptied for the process, the other one can be filled with material.

Watering of active, potentially dust generating stockpiles will be undertaken regularly at the site at an estimated rate of 0.3 t/hr. Any runoff generated from internal dust suppression will be directed into the formal drainage network and treated in the PWTP prior to being directed to the WRP.

Concentrate will be stored in the southern peninsula, as indicated on **Figure 2-16**. The magnetite is transported from the concentrate stockpile by conveyor to the concentrate reduction building.

Details of the magnetite concentration stockpile are provided in **Table 2-8**.

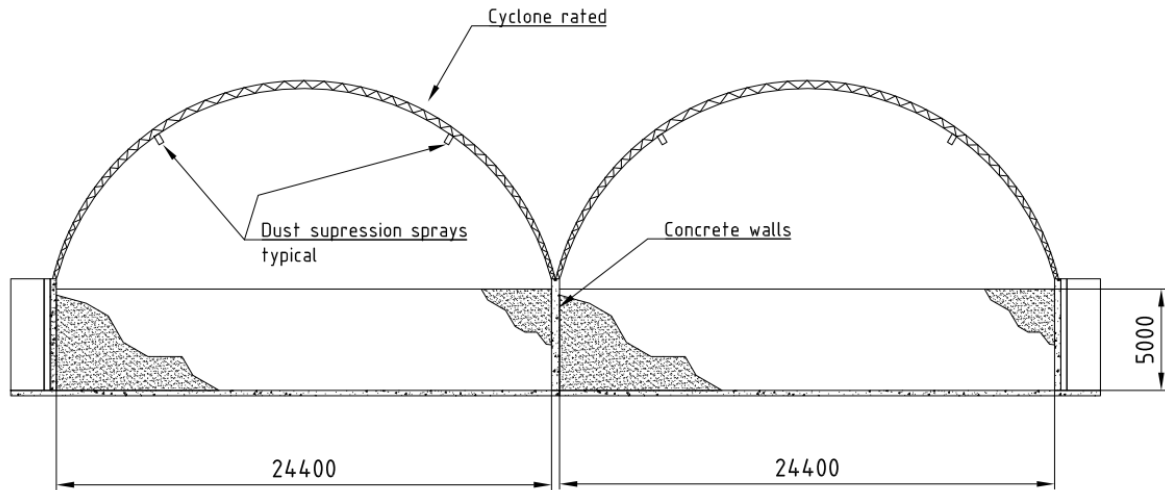


Figure 2-14. Indicative dimensions of concentrate storage area

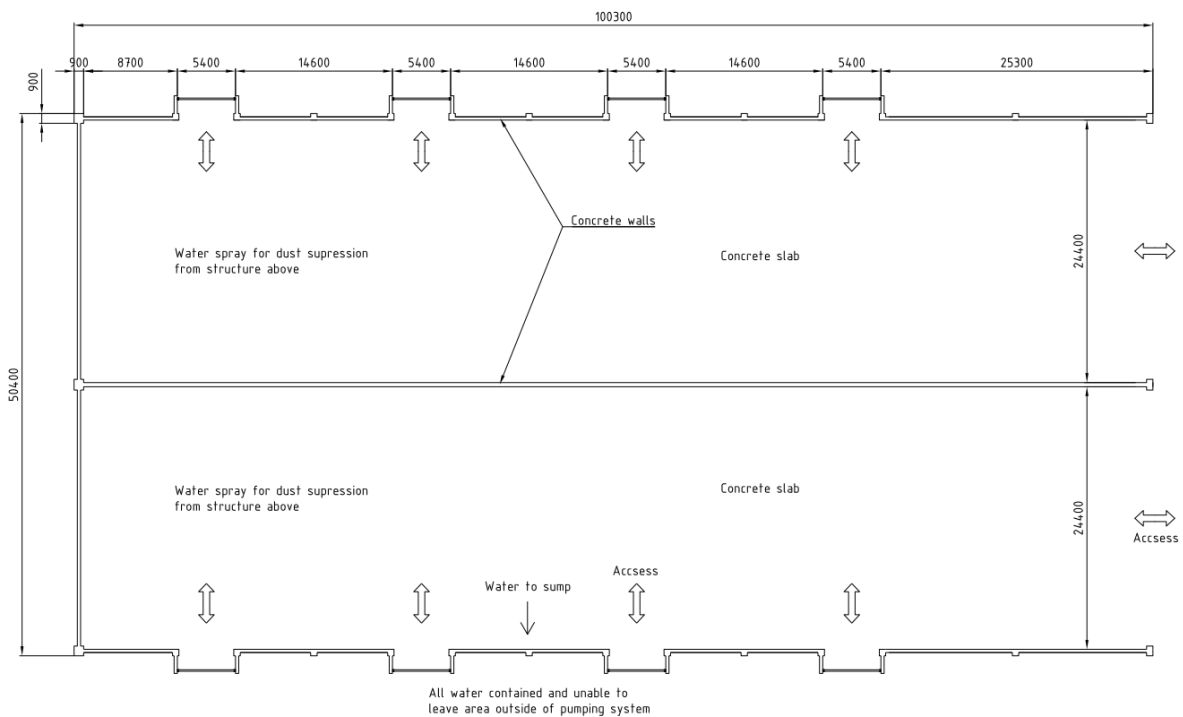
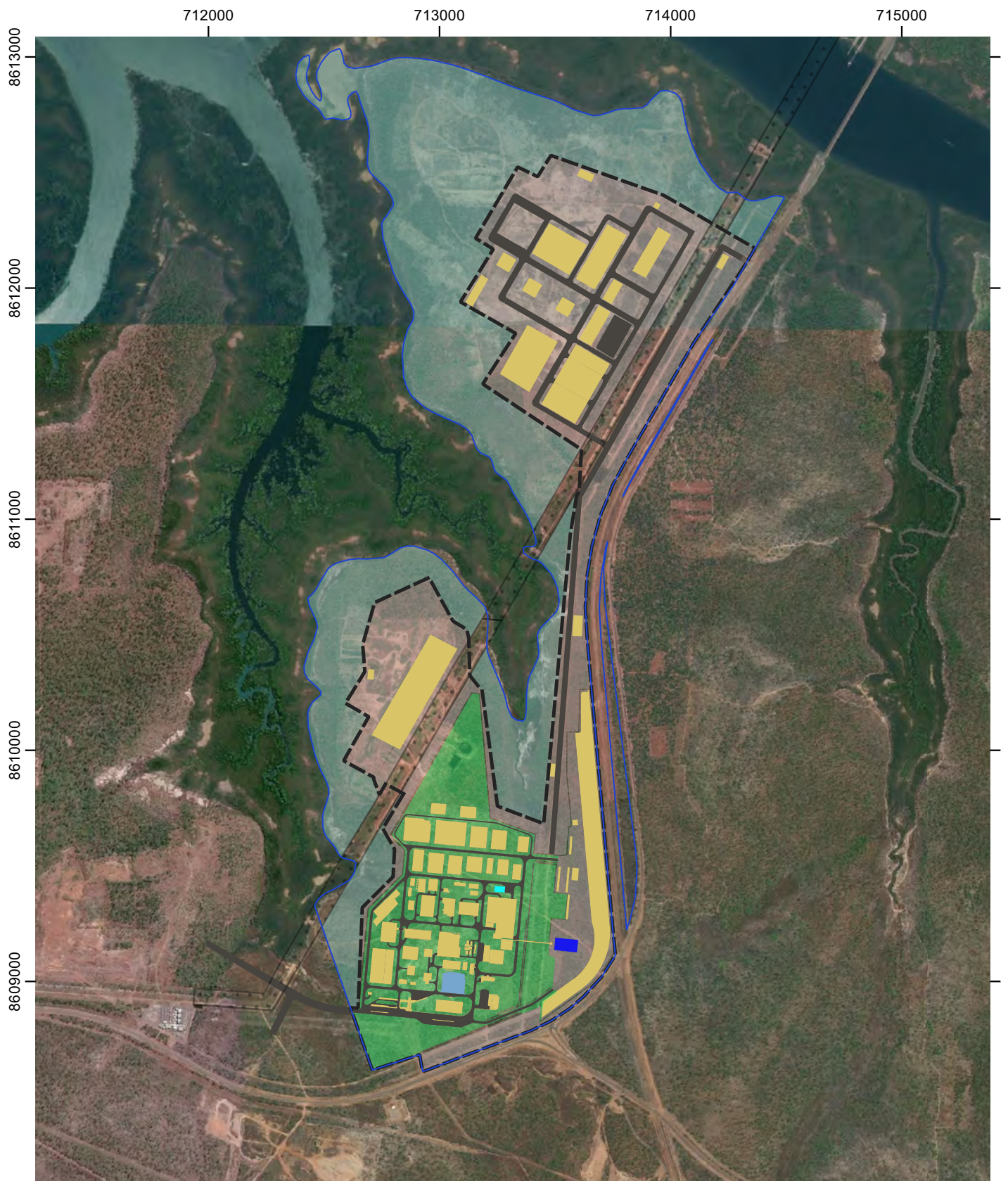


Figure 2-15. Concentrate storage area layout

Table 2-8. Magnetite concentration stockpile details

Stockpile Specifications	
Material	Concentrate
Volume	~8000 m ³
Surface Area	5000 m ²
Location	Figure 2-16
Approximate Material Composition	
Size	d50=~75µm
Magnetite	59.6%
Ilmenite	36.5%
Fe ₂ O ₃	74.8%
TiO ₂	17.6%
V	0.52%



Legend

- Concentrate Storage
- Iron Oxide Storage
- Petcoke Storage
- Lot 1817 boundary
- EIS Supplement Development Envelope

TNG Darwin Processing Facility
EIS Supplement

Figure 2-16. Location of stockpiles

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0 250 500 m



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2.3.2.2 Petcoke

The generic Safety Data Sheet (SDS) for Petcoke is included as **Appendix E**. The Petcoke stockpile is located in the southern peninsula (**Figure 2-16**). Petcoke is transported to the processing plant within sealed containers via road haulage. The trucks unload the material either directly into a covered, concrete lined structure on hardstand, or onto a mobile truck unloader for unload onto the stockpile.

The dimensions of the Petcoke storage structure are approximately 25 m x 40 m with an average filling height of about 5 m. **Figure 2-17** illustrates the style of storage area proposed for Petcoke. The stockyard has been designed to be as close as possible to the receiving bin for the grinding plant (concentrate reduction building) to avoid the need for a conveying system. Details of the Petcoke stockpile are provided in **Table 2-9**.



Figure 2-17. Example of the Petcoke storage area

Table 2-9. Petcoke stockpile details

Stockpile Specifications	
Material	Petcoke
Volume	2700 m ³
Surface Area	960 m ²
Location	Figure 2-16
Material Composition	
Size	d50=~2mm
Ash	0.3%
Volatiles	11.2%
Fixed carbon	80.7%
Moisture	7.9%

2.3.2.3 Iron Oxide

The Safety Data Sheet (SDS) for Iron Oxide is included as **Appendix E**. The Iron Oxide storage area location is indicated on **Figure 2-16**. Iron Oxide is one of the three main processing products. The material is transported through a pneumatic conveying system to silos outside the Iron Oxide storage area. A belt conveyor transports the material into the building and drops it onto the ground into a covered three wall bunker area, where it is picked up by a front-end loader for storage within containers, as illustrated in **Figure 2-18**.

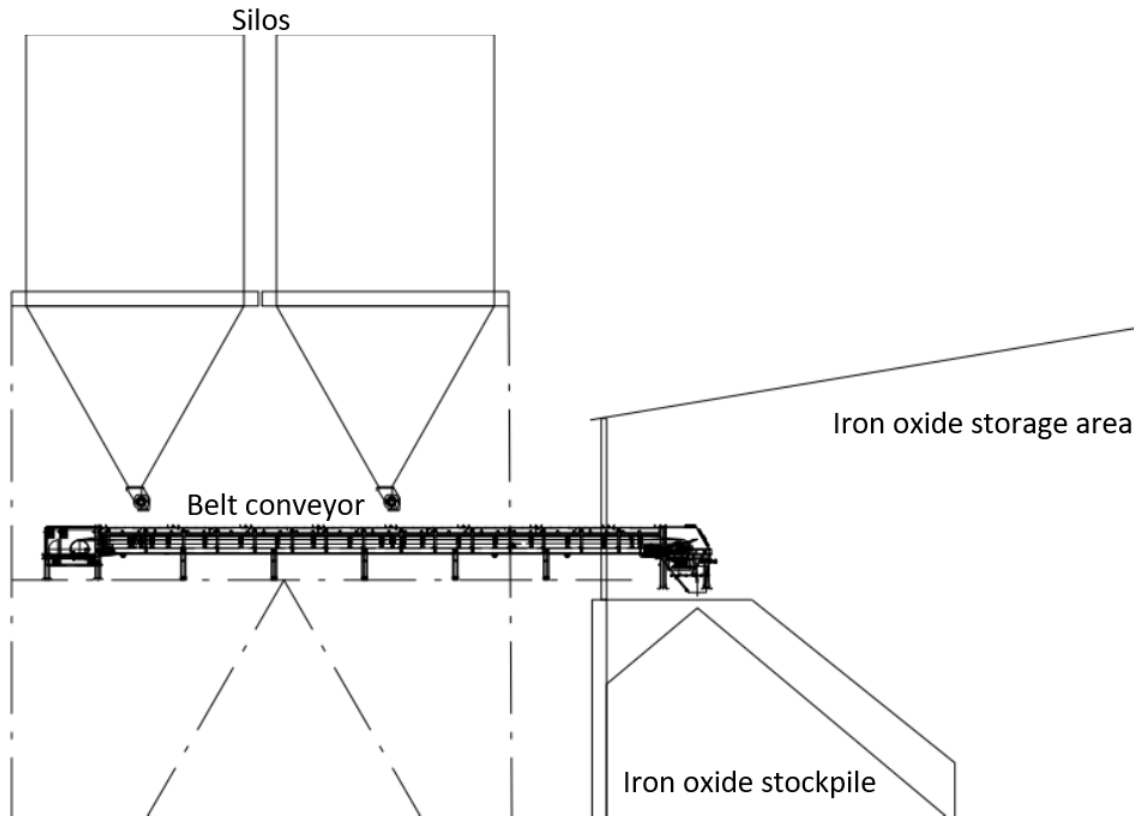


Figure 2-18. Iron Oxide Silos and Conveyor System

The majority of the building will host containerised product, the stockpiled material will be limited to 100 m² with an approximate residence time of 3 h between the silo discharge and containerisation. To eliminate any generation of dust during the silo discharge and dropping the material onto the ground within the Iron Oxide storage area, a dust suppression system will be installed. **Figure 2-19** illustrates the water injection system at takeover points within the conveyor. Water injection will also be utilised within the stockpile bunker area.

Any runoff water from the dust suppression system will be collected in sumps and directed to the PWTP.

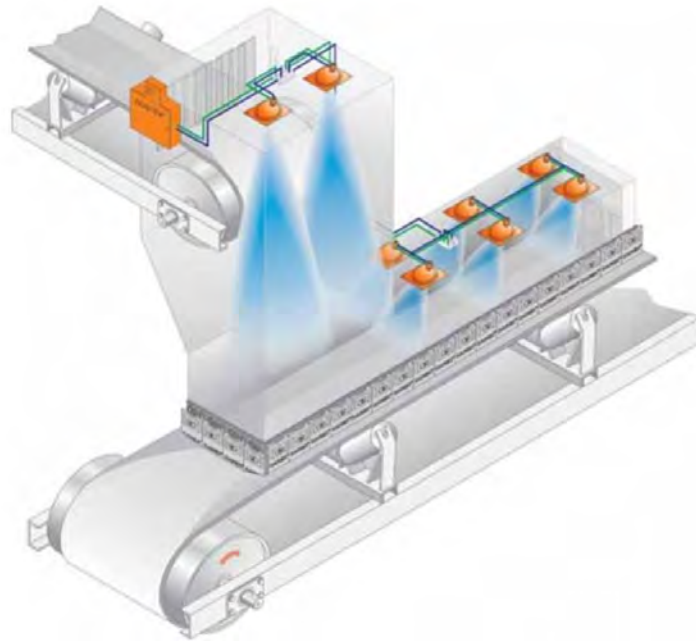


Figure 2-19. Water Injection System at Take-Over Points

Details on the iron oxide stockpile are provided in **Table 2-10**.

Table 2-10. Iron Oxide stockpile details

Stockpile Specifications	
Material	Iron Oxide
Surface Area	100 m ²
Location	Figure 2-16
Material Composition	
Fe ₂ O ₃	92%

2.3.3 Process Ponds

NT EPA comment #2 on the Draft EIS requested further detail on the process ponds associated with the Project.

A Raw Water Pond is required for the storage of water prior to entering the Processing circuit. Water stored in the pond will be sourced from the Darwin water supply, the WRP and harvested from the Stormwater system. The quality of water entering the Raw Water Pond from the WRP is described in **Section 2.3.4.3**, and from the Stormwater system in **Section 2.3.4.3**. The location of the raw water pond is shown in **Figure 2-20**.

A Rainwater pond has been allocated to receive rainwater from the roof spaces of buildings within the Process area to reduce the volume of stormwater received in areas where potential contamination may occur. The location of the rainwater pond is shown in **Figure 2-20**.

Both ponds will be lined with impermeable HDPE liners to prevent loss to the groundwater. Due to the high groundwater levels, it is noted that the base of the ponds will not be any deeper than approximately one (1) metre below the natural ground level. Due to this restriction the ponds will likely be an embankment type construction to achieve the desired storage volume.

The ponds will have sufficient freeboard to accommodate a 100 Year ARI major storm event. The Raw Water Pond location has been allocated and the structure designed in a manner that if the extreme Year 2100 – 1 in 1,000 year Annual Exceedance Probability (**AEP**) storm tide event occurred, inundation of the pond would not result.

Particularly in the dry season, fauna may be attracted to the ponds, which puts them at risk of injury or death. The ponds are located within the fenced area for the Processing Facility. The ponds will be designed in a manner that allows for fauna egress points should fauna enters the water. In order not to attract wading birds, ponds will be designed with steep slopes and a lack of suitable wading habitat. In the event that fauna and wading birds are intermittently attracted to the pond, the high quality of the water will not pose a risk to them.

Small additional ponds may be added to accommodate the intercepted rainwater. Design of these ponds would follow the same design principles as described.

All other water storage, such as process wastewater prior to treatment, will be stored in tanks.



Legend

■ Rainwater Pond

■ Raw Water Pond

 Lot 1817 boundary

 EIS Supplement
Development Envelope

TNG Darwin Processing Facility
EIS Supplement

Figure 2-20.
Indicative location of
process ponds

TNG LIMITED



0 250 500 m



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2.3.4 Water Recycling Plant

A significant change to the Project is transition to a Zero Liquid Discharge WRP as an alternative to marine discharge of process wastewater.

The WRP has been designed by an established Australian wastewater specialist, utilising proven technology.

2.3.4.1 Layout

The plant footprint is approximately 500 m x 134 m, with an indicative location adjacent to the Processing infrastructure in the southern peninsula (**Figure 2-21**). The final location will be determined at the detailed design stage.

The Plant Layout Drawing for the WRP is shown in **Figure 2-22**. Component specifications are provided in **Table 2-11**.

2.3.4.2 Design basis

The over-riding design criteria is that all liquid waste waters generated within the site, including process area stormwater and domestic wastewater, shall be treated for re-use within the Production facility. The only liquids not re-used for Production purposes will be evaporative losses and the residual moisture content contained in the dried waste products to be disposed of off-site.

2.3.4.3 WRP inputs

Primary treatment occurs for a number of liquid waste streams before they enter the WRP. Several liquid waste streams from the process will be pre-treated in the PWTP before entering the WRP.

A dedicated stormwater treatment system will provide initial management of stormwater and is described in **Section 2.3.5**. If systematic stormwater quality testing identifies the presence of pollutants, the water will be redirected to the WRP for processing prior to re-use.

2.3.4.4 WRP output

The WRP will produce the following treated water streams for return to Production.

1. Soft Water
2. Process Water
3. RO Water

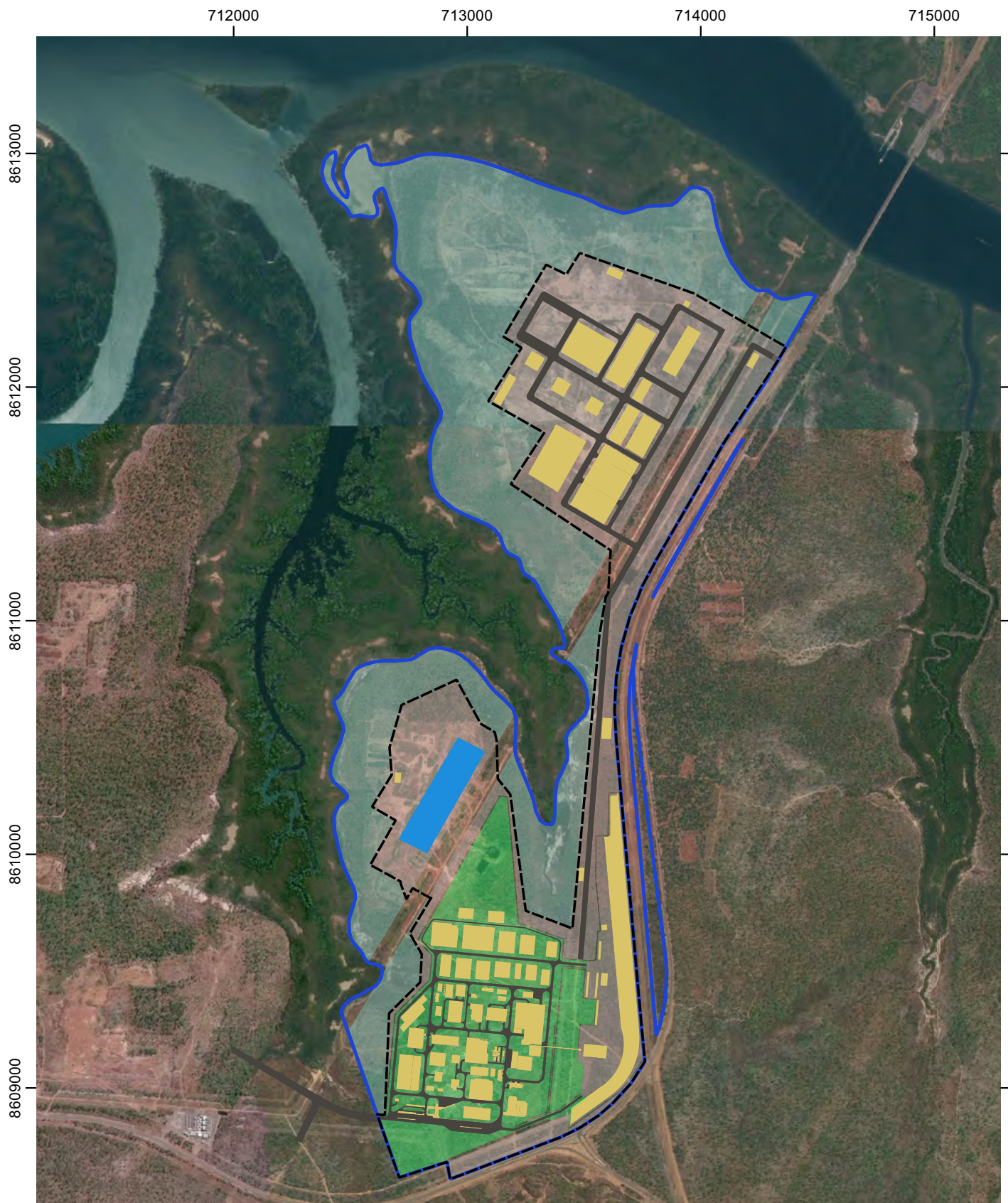
The intermediate process storage details and volumes for these streams is described in **Table 2-11** and the specifications of each stream are described in **Table 2-12**.

It is envisaged that the three streams will be entirely recycled to the process plant and therefore no process liquid will be discharged to the environment.

The WRP will produce two solid waste products for disposal off site:

1. Dried Clarifier Sludge
2. Dried Salt:

The disposal volumes and characterisation details for the two wastes are described in detail in **Section 2.4**.



Legend

 Water Recycling Plant

 Lot 1817 boundary

 EIS Supplement
Development Envelope

TNG Darwin Processing Facility
EIS Supplement

Figure 2-21. Location
of Water Recycling
Plant

TNG LIMITED



0 250 500 m



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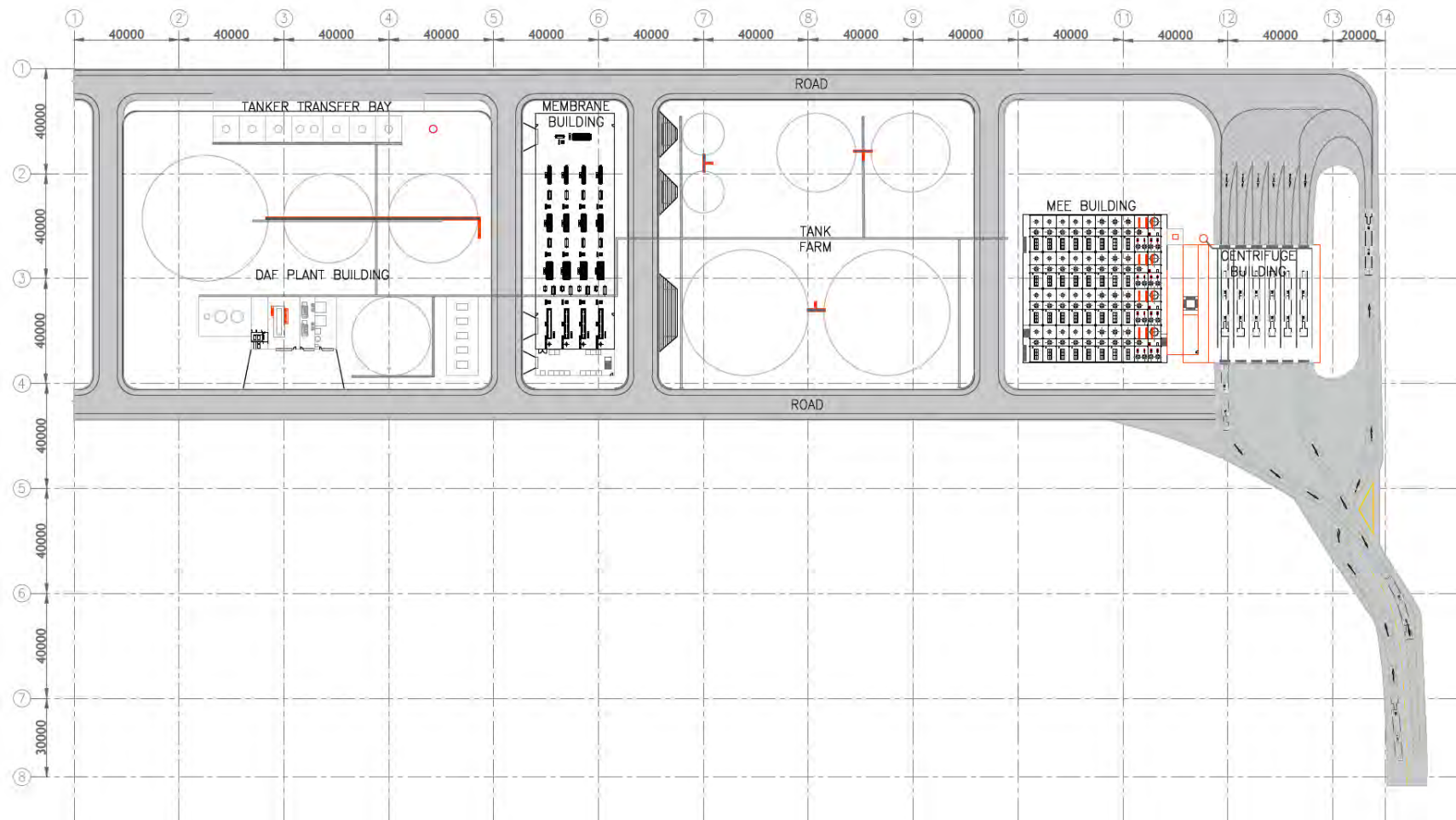


Figure 2-22. WRP Layout

Table 2-11. WRP component specification

Type	Item	Dimensions	Specification
			Volume m ³
Large circular reinforced concrete tanks (located outside and above ground), covered with Colourbond steel.	Raw water storage tank	48 m diameter	10,000
	RO4 Permeate Water Tank (Soft Water return tank)	6 m high	10,000
	RO3 Reject Water Tank (Multi Effect Evaporator (MEE) Plant Feed Tank)		1,000
	Epoxy coated internally	16 m diameter	
	Process Water #2 Storage Tank	6 m high	1,000
	Epoxy coated internally		
	Process Water #1 Storage Tank		1,000
Bunds	Bulk chemical storage tanks	-	Epoxy coated concrete
Reagent and utility	Chlorine gas cylinders, storage cylinders and chlorine dosing equipment		
	Air compressors and air blowers	-	-
	2 x polymer batching and dosing plants		
	Intermediate Bulk Container (IBC) chemical storage and dosing for citric acid and antifoam		
A purpose designed building for the Membrane plants	UF/RO Plant	100 m long 30 m wide 8 m high	-
A purpose designed building for the MEE Plant	MEE Plant	56.4 m long 55 m wide 14 m high	-
A purpose designed building for the Centrifuges and salt loadout	Centrifuges and Salt Loadout	60 m long 45 m wide 14 m high	-
Electricity sub-station and Transformer	WRP Power Supply	-	-
Internal roads	Truck loadout building turning circle roadway (entrance and exit)	-	-
Services gantry	Delivering services from points of origin to their destinations within the WRP	-	-
Underground drainage	Pump wells and gravity drain lines	-	-
Concrete foundation pads	For pump sets located externally (not inside a building)	-	-

Table 2-12. Characteristics of recycled water products from the WRP

Description	Unit	Soft Water	Process Water #2	Process Water #1
Destination		Return to Process	Return to Process	Return to Process
Flowrate	m ³ /hr	1051	100	244
pH		7-7.5	7-7.5	7-8
Conductivity	µs/cm	53.27	-	<650
Total dissolved solids	mg/l	37	2370	<200

2.3.4.5 WRP Process Description and Flow Diagram

The Zero Liquid Discharge WRP will process, treat and return to production all liquid discharges with the exception of the residual liquid in the solid waste products and losses to evaporation. The WRP has been designed to operate 24 hours per day, up to 355 days per year.

The treatment process is summarised in the treatment stages described below and shown diagrammatically in **Figure 2-23**.

The liquid waste streams from the TIVAN® Process Plant and titanium pigment plant are collected in the Raw Water Storage Tank; it is here that pH adjustments are made to control the pH for subsequent processing. Stream A from the TIVAN® Process Plant is disinfected using chlorine gas prior to addition to the Raw Water Storage Tank. The combined solution is fed to clarifiers with coagulant and flocculant dosing to separate the suspended solids. Horizontal Dual Media Filters (**HDMFs**) and basket filters remove residual suspended solids prior to the UF/RO plant.

Sludge underflow from the clarifiers will be pumped to a sludge holding tank from where the sludge will be pumped to a Dissolved Air Flotation Unit for primary thickening, prior to dewatering by filter press. The dewatered sludge is dried in a gas fired continuous drying oven, the final product will be 85-92% wt solids. The dried sludge will be discharged directly into lidded containers for transport and disposal.

The treated water discharging from the basket strainers is treated in the UF Plant and the permeate is collected in a tank. Chemically enhanced water for backwashing the UF membranes is recycled to the raw water tank.

The UF Permeate Tank feeds into the RO trains. The multiple stage RO process produces two water product streams which are pumped to storage tanks prior to feeding to the main process plant. The reject water from the plant is collected in a buffer tank which feeds the MEE process. Each RO Train is preceded by a Micron Cartridge Filter. The cartridges are disposable and replaced when spent. Acid, Sodium Metabisulphite (**SMBS**), Antiscalant are used to dose the water for the RO process.

The MEE process progressively concentrates the salt in the RO plant reject water by evaporating the water phase. Heat is supplied by steam which is generated by excess heat in the main process plant. The evaporated water from the MEE is condensed and delivered to the MEE Condensate Storage Tank for recycling to the Process Plant.

The concentrated salt slurry from the MEE is fed to the Salt Settler tank which feeds the centrifuges. The centrifuges will generate a 90-92% wt solids spadeable salt. The salt is discharged into lidded containers for transport and disposal.

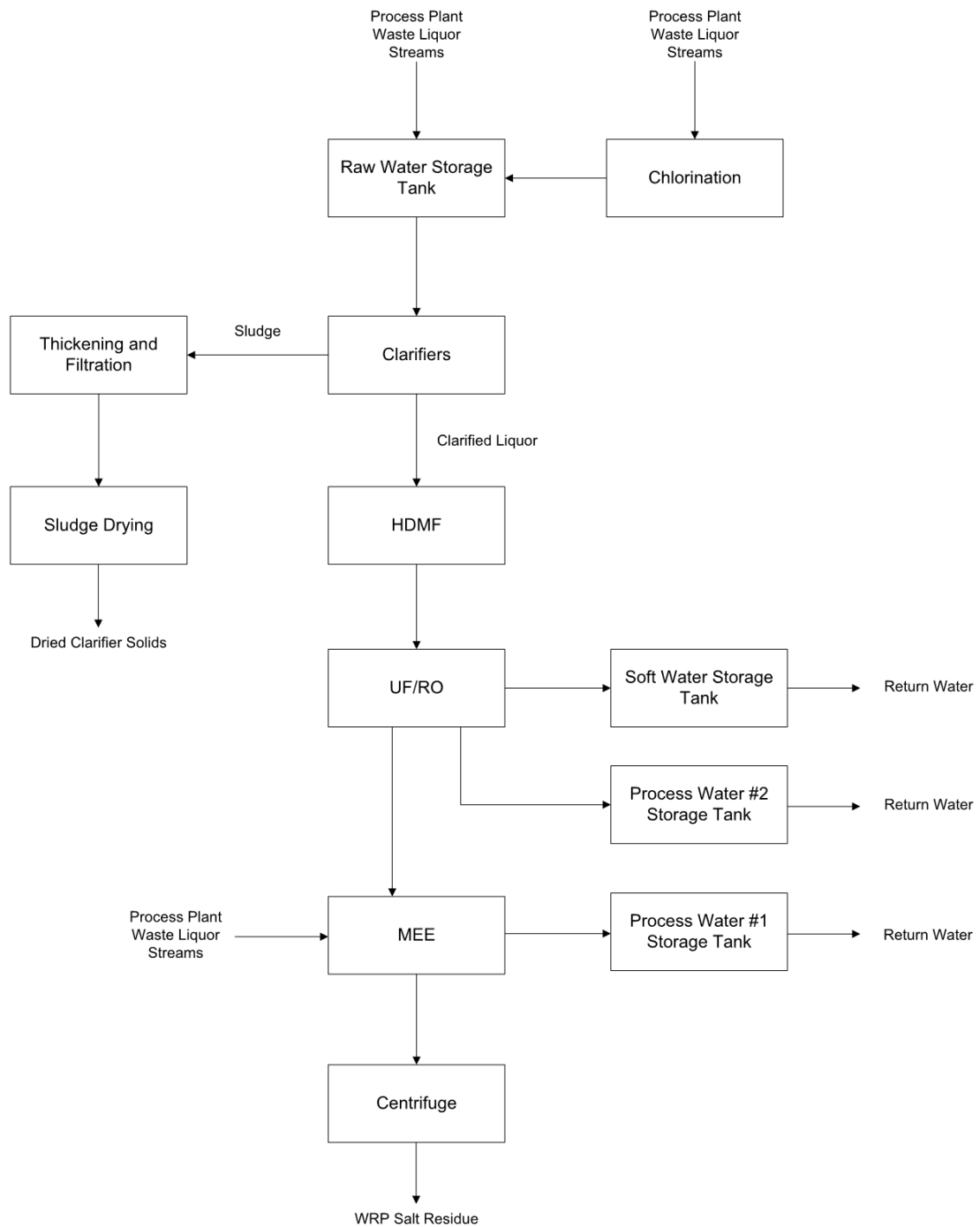


Figure 2-23. Process flow diagram

As the WRP is in preliminary developmental phase the design information available in some instances is limited and therefore certain design assumptions have been made. Work is continuing to clarify the remaining design assumptions.

2.3.5 Process Water Treatment Plant

The PWTP has two neutralisation processes; one located in the TIVAN® Process Plant and one located in the titanium pigment plant.

2.3.5.1 TIVAN® Neutralisation Process

To reduce the heavy metal levels in solution a number of streams in the TIVAN® Process Plant are neutralised.

- Process spillages
- Process water blowdown
- Demineralisation plant reject
- Low-quality stormwater

The streams to be treated are fed to the neutralisation reactor. The pH is adjusted by milk of lime addition, precipitating a mixed metal hydroxide solid from solution. The neutralised slurry is forwarded to clarifiers and the underflow generated in the clarifiers is dewatered in filter presses. The filtrate from the filter presses is introduced to sand filters and the neutralised wastewater is forwarded to the WRP.

The solid waste from the filters (acid waste neutralisation metal hydroxides #2) is described in **Section 2.4**.

2.3.5.2 Pigment Plant Neutralisation Process

Waste acid from the titanium digestion process undergoes a two-step neutralisation process separate to the TIVAN® Process Plant neutralisation, in pigment plant. In the first neutralisation step limestone slurry is added to the waste acid solution. The neutralised slurry is fed to a hydrocyclone station from which the underflow is fed to the gypsum filter and the overflow is fed to the second neutralisation step. The solids (Acid Waste Neutralisation Gypsum) separated by the gypsum filter are collected in lidded containers for transport and the filtrate is forwarded onto the second neutralisation step.

In the second neutralisation step milk of lime slurry is added to the hydrocyclone overflow and filtrate increasing the pH further and precipitating the majority of the remaining heavy metals in solution. The neutralised slurry is fed to a hydrocyclone station, the underflow is fed to the gypsum filter. The overflow is fed to filter presses and the filter cake (acid waste neutralisation metal hydroxides #1) is collected in lidded containers for transport and disposal.

The solids from the pigment plant neutralisation process are described in **Section 2.4**.

2.3.6 Chemicals and Reagents

2.3.6.1 Process Plant

Due to the removal of the oleum plant, a number of reagents from the Draft EIS submission are no longer required for the process. The oleum plant reagents were simplified to a third-party sulfuric acid supplier.

Sulfuric acid will be delivered to the site by road in tankers and unloaded into storage tanks contained in a bunded area. Any spillages within the bunded area will be collected and neutralised.

2.3.6.2 Water Recycling Plant

Inclusion of the WRP will require additional chemicals and reagents beyond those described in Section 4.6.11.2 of the Draft EIS. The WRP will use chemicals for maintaining optimum pH, treatment purposes, coagulation and flocculation purposes and for cleaning, sanitising and disinfecting equipment.

Table 2-13 details the concentrations, description and classification of the chemicals to be used at the WRP at the Darwin Processing Facility. Safety Data Sheets (SDS) are included in **Appendix E**.

Table 2-13. Type and concentration of chemicals to be used in the WRP

Chemical	Concentration (%)	Description	Dangerous Good (DG)* Hazardous Substance (HS)#
Sulphuric Acid	98.5	Mineral acid	DG and HS
Sodium Hydroxide	50	Strong base	DG and HS
Ferric Chloride	42	Inorganic salt solution	DG and HS
Polymer 1	100	Polymer	-
Polymer 2	100	Polymer	-
Hydrochloric Acid	33	Mineral acid	DG and HS
Sodium Hypochlorite	12	Weak base	DG and HS
Sodium Metabisulphite	10	Inorganic salt solution	DG and HS
Antiscalant (ROSC 1001)	10	Strong base	DG and HS
Nitric Acid	60	Strong acid	DG and HS
Chlorine	100	Acid	DG and HS
Defoamer	10	Hydrocarbon	HS
Citric acid	50	Weak organic acid	HS

* Dangerous good under the classification of the Australian Dangerous Goods Code (ADG Code) for Transport by Road or Rail.

Hazardous substance in accordance with classification of Safe Work Australia.

2.3.6.3 Storage and Handling

The following chemicals will be purchased, delivered and stored in bulk storage tanks as ready to use chemicals.

- Sulphuric acid
- Nitric acid
- Hydrochloric acid
- Sodium hydroxide
- Coagulant – ferric chloride
- Sodium hypochlorite
- Antiscalant
- SMBS

These chemicals will be delivered by road tanker, most likely in 20 tonne (t) drops. There will be a dedicated chemical tanker parking bay for chemical transfer to the specific chemical tanks (**Figure 2-24**). Any spillage of chemicals within the transfer bay will be captured and drained to a sump from where it will be pumped to the Raw Water Storage Tank for treatment.

There will be a dedicated Local Control Panel at each chemical bund, allowing operation by the chemical tanker driver, who would control the delivery of the chemical from the tanker into the storage tank.



01 Chemical Tanker delivery bay



02 Chemical Transfer



03 Chemical Transfer hose connection and tanker operators local control panel

Figure 2-24. Bulk chemical transfer typical arrangement

The following chemicals will be purchased, delivered and stored in 1,000 L Intermediate Bulk Containers:

- Citric Acid
- Flocculant (Polymer)
- Defoamer

A 3t forklift will be kept on site for off-loading the IBC containers, for placing them into storage and for loading empty containers for offsite disposal.

Chlorine Gas will be delivered in 1t gas cylinders. The chlorine gas plant (**Figure 2-25**) will have two 1t cylinders arranged in operation at any given time. It is expected that chlorine gas cylinders would be delivered in pairs, exchanging two empty cylinders for two full cylinders. A forklift would be required for handling the chlorine cylinders. The chlorine plant will have appropriate chlorine gas leak detection, alarms and automatic shutdown in the event of a detected gas leak.

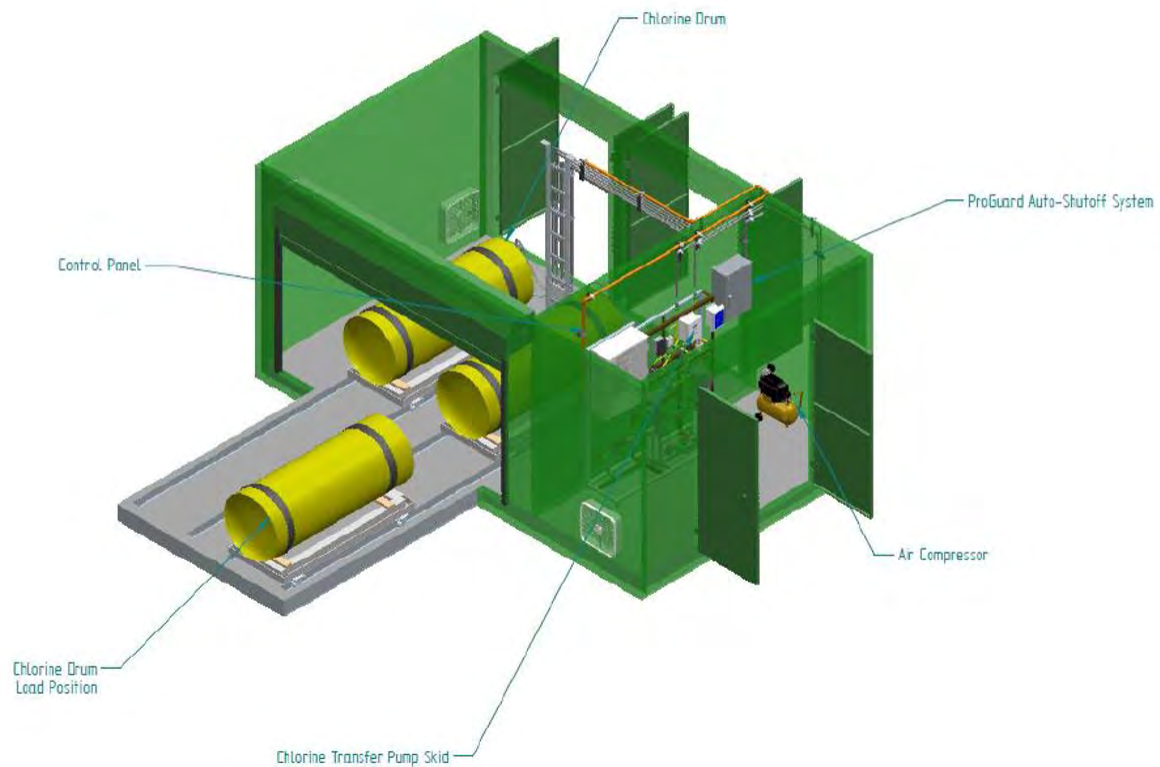
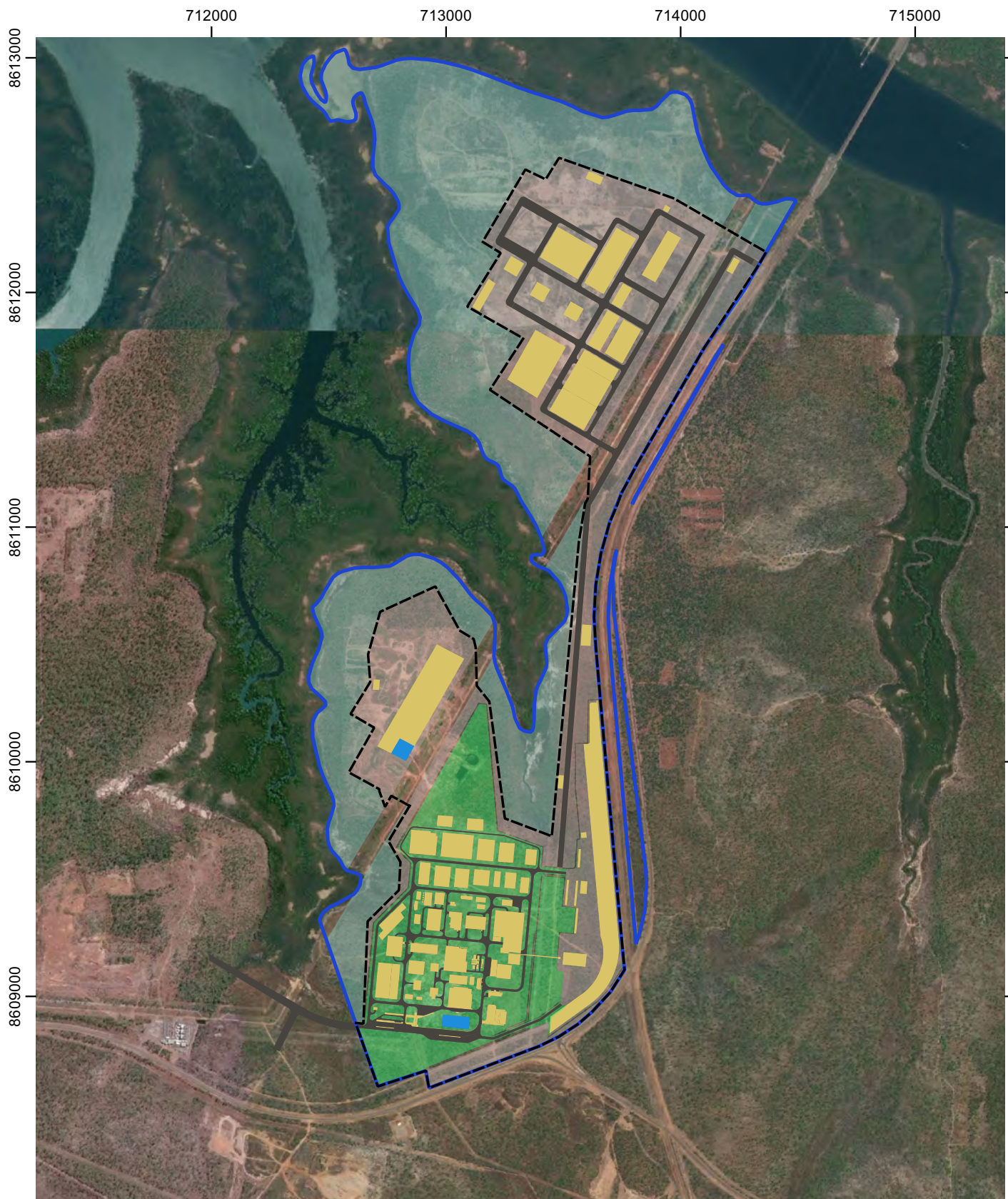


Figure 2-25. Typical layout for the Chlorine gas plant

The indicative locations for chemical and reagent storage are shown in **Figure 2-26**. All buildings housing chemicals and reagents will be built on concrete hardstand and will have appropriate segregation measures in place.



Legend

- Chemical and Reagents storage
- Lot 1817 boundary
- EIS Supplement Development Envelope

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EIS Supplement

Figure 2-26. Locations
of chemical and
reagent storage

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0 250 500 m



Scale when printed in A4 is 1: 23,000
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CRS: GDA 1994, MGA Zone 52

Chemical bulk storage tanks will be located in suitably bunded areas in accordance with Australian Standard AS1940:2017 *The Storage and Handling of Flammable and Combustible Liquids*, adjacent to the dedicated chemical transfer bay at the reagents storage building in the southern peninsula. As proposed in the Draft EIS, chemical storage and handling areas shall be bunded and have drainage lines separate from the stormwater drainage system to reduce the likelihood of chemical contamination of stormwater. Further to the information supplied in the Draft EIS, the bunded areas will have isolation valves installed so that in the unlikely event of leakages from the bunded area, the isolation valve can be engaged to prevent contamination of stormwater.

The IBCs for citric acid and polymer will be stored and dispensed inside the polymer batching plant building.

2.3.7 Stormwater System

A Conceptual Site Based Stormwater Management Plan (**CSWMP**) has been prepared for the Supplement and is included in **Appendix C**. The stormwater management system is designed mainly to address the treatment of sediment, gross pollutants, nutrients and incidental hydrocarbons within stormwater runoff from the non-process areas of the site (e.g. roads / roofs / paved and unpaved areas), that may decrease the environmental values of downstream receiving waters. The CSWMP identifies and presents a conceptual design of stormwater management measures to minimise this impact.

The system also provides a secondary management network to capture and identify issues with the primary containment systems for chemicals, reagents and potential pollutants from the process areas. These areas have primary containment and treatment measures separate from the stormwater system that are described in **Sections 2.3.1, 2.3.2 and 2.3.5**.

As the Project is not yet at the final design stage, generic design intents are specified for this Supplement. The design of the stormwater minor and major conveyance systems, minor diversion systems and other stormwater management features (such as stormwater quality improvement devices (**SQUIDS**), bioretention basins etc) are expected to be undertaken during the detailed design phases of the project, once site layouts and design constraints are finalised. Additionally, operational management, monitoring and maintenance plans will be developed with clear responsibilities assigned to relevant site personnel following completion of detailed design.

It is noted that whilst potential treatment devices and indicative sizing of these devices is nominated here, alternative treatments could be adopted in the final design provided that the devices achieve the required water quality objectives. As part of the detailed design process, water quality modelling will be undertaken to confirm the design intents for individual elements of the proposed water quality treatment train for the site and to demonstrate that the water quality objectives can be met. Similarly, nominal locations for surface water infrastructure have been allocated in the plan that conserve the natural locations of stormwater discharge to the Elizabeth River; however, the detailed design phase will need to determine the precise location of these infrastructure items in consideration of engineering constraints such as elevation and depth to water table.

Nine catchments are defined for the Development Envelope, as described in **Table 2-14** and shown in **Figure 2-27**.

Table 2-14: Catchment areas

Catchment	Area (ha)
Southern Peninsula	
S1	27.3
S2	32.9
S3	50.4
S4	26.0
R1	10.4
R2	12.0
Northern Peninsula	
R3	13.6
N1	41.0
N2	37.6

2.3.7.1 Diversion of upstream catchment flows

There are two locations where upstream catchment flows can potentially enter through the site. The locations, as shown in the insets on **Figure 2-27** are;

- Upstream of catchments S1 and S3, there is a small catchment on the Channel Island Road reserve that will need to be diverted to the west of the site by means of a diversion channel, and
- The catchment upstream of R2 will need to be conveyed directly across the site's road reserve. The culvert system under the road reserve will need to be sized to ensure conveyance of the site and upstream catchment flow, whilst providing the required flood immunity for the crossing.

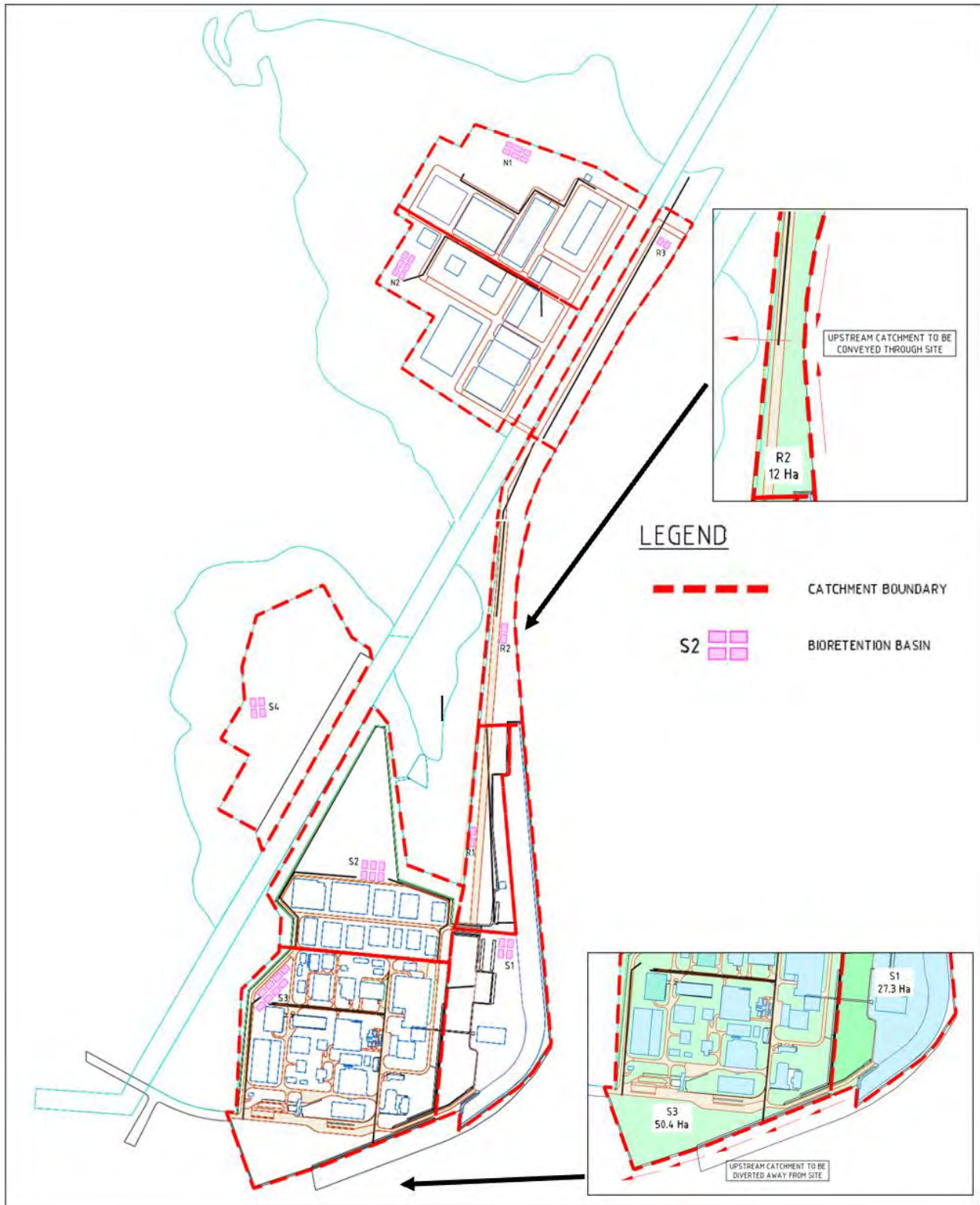


Figure 2-27. Catchments, diversion and bioretention basin locations

2.3.7.2 Pre- and post-development flows

Peak pre- and post-development flows at the site were determined. With the increase in impervious areas and formalisation of stormwater systems, the post-development peak flows from the site will be greater than the pre-development peak flows. **Table 2-15** provides a summary of the increase per catchment for the 100 Year ARI flood event.

Table 2-15. Comparison of pre-development and post-development peak flows

Catchment	100 year ARI pre-development peak flow (m ³ /s)	100 year ARI post-development peak flow (m ³ /s)	100 year ARI peak flow increase (m ³ /s)
S1	10.4	14.9	4.5
S2	18.9	19.5	0.6
S3	18.6	26.2	7.6
S4	11.8	15.8	4.0
N1	18.5	21.5	3.0
N2	16.6	19.7	3.1
R1	4.7	5.2	0.5
R2	4.5	6.1	1.6
R3	4.9	6.9	2.0

Although there are increases in the peak flows from the project site as a result of the development, it is considered that there will be no perceived impacts on the downstream receiving waterways resulting from stormwater quantity changes, given the location of the site adjacent to the East Arm, i.e. there is no downstream properties or infrastructure that would be impacted by the increase in peak flows.

As a result, it is considered that there is no requirement to attenuate the peak flows from the project site to ensure that the post development flows are less than the predevelopment flows (*i.e.* there is no requirement to incorporate detention basins or other on site detention devices) due to the legal point of discharge being East Arm.

It is noted however that other stormwater management strategies proposed (discussed further below), such as the adoption of stormwater harvesting, will have the effect of reducing the post development peak flows and volumes.

2.3.7.3 Stormwater system design

As noted in **Sections 2.3.1, 2.3.2 and 2.3.5** the main process plant infrastructure and chemical storage areas will predominantly be within the plant buildings; bunding/containments systems will be in place that will divert any potentially pollutant discharge that may contain processing reagents, mineral concentrates, hydrocarbons etc., to collection sumps. The discharge quality shall be assessed and if of suitable quality it will be released into the internal stormwater system, which could include discharging into stormwater ponds or tanks for re-use. Any potentially pollutant discharge will be diverted to one of the wastewater treatments plants.

The internal stormwater system design approach for the balance of the project site will comply with the requirements of the *Development and Subdivision Standards of the Litchfield Council* (Litchfield Council, 2017) and the relevant stormwater standards, guidelines and codes referenced by the document, which includes *Queensland Urban Drainage Manual* (IPWEA 2016) and *Australian Rainfall and Runoff Guidelines* (2019).

The design philosophy for the internal stormwater system, that mainly addresses the treatment of sediment, gross pollutants, nutrients and incidental hydrocarbons, will be as follows:

- The drainage system will need to cater for the major and minor storm events, through the appropriate development of the major and minor drainage systems. These systems must be designed to control and convey the storm flows through and within the site.
- For the project site the appropriate design events would be 20 Year ARI for the minor storm and 100 Year ARI for the major storm.
- The minor system within the main process areas, typified by buildings and hardstands, will generally comprise of an underground piped system discharging to a perimeter channel system.
- The minor system within the main site areas and roads will be limited generally to an open channel/drain system that conveys stormwater discharge to the outlet. The open channels, which would typically be aligned along the sides of the internal roads, would need to have a minimum longitudinal slope in the order of 1 in 500 (0.2%).
- The minor system shall be designed to ensure that at least a minimum of three (3) metres of the roadway are flood free during the minor flood event (20 Year ARI) to ensure continued safe access throughout the plant. During the major flood event the flow may spread to the road boundary but the maximum depth of flow in the roadway should not exceed 150 mm above the crown of the road, nor should the depth of flow (m) x the flow velocity (m/s) exceed 0.32 (Litchfield Council, 2017).
- A minimum freeboard to all building floor levels of 300mm should be achieved for the major flood event (100 year ARI). To achieve the requirements for the major flood event, it may be necessary to increase the capacity of the minor drainage system at some locations within the site, *i.e.* the minor drainage channel system may require a capacity greater than the 20 Year ARI flow.

As part of the detailed design of the stormwater system particular attention will be paid to limiting the post development flow velocities at all outlets in order to minimise scour risk to the receiving environment. It should be noted that generally it is expected that velocities in channels in the development will not be high due to the adoption of minimal longitudinal slopes to suit the developed site topography. However, the following strategies can be adopted to further minimise the velocities to the site;

- At the approach to the outlet ensure that channel slope is minimised.
- At the approach to the outlet widen the channel profile including increasing the base width and / or flatten the channel side slopes, and
- At the approach to the outlet increase the channel roughness (*e.g.* introduce vegetation, rock line the base and batters and if required introduce rock elements for energy dissipation).

2.3.7.4 Stormwater Quality

With respect to the water quality outcomes for the development, the project will adopt a holistic water sensitive urban design (**WSUD**) approach that aims to minimize the impacts of the development on the natural water cycle and downstream environmental systems.

The water quality targets for the development shall be set based on a number of guidelines including the following:

- A Stormwater Strategy for the Darwin Harbour Region (NT EPA)
- Darwin Harbour Water Quality Protection Plan (DENR)
- Guidelines for Fresh and Marine Water Quality (ANZECC)
- Australian Guideline for Urban Stormwater Management (ANZECC, 2000)

Following these guidelines, stormwater quality objectives after development of a site should be as a minimum:

- 80% reduction of the typical urban annual load for Total Suspended Solids (**TSS**).
- 45% reduction of the typical urban annual load for Total Phosphorus (**TP**).
- 45% reduction of the typical urban annual load for Total Nitrogen (**TN**).

The stormwater quality objectives for the site may be achieved through implementation of the following “structural” measures on the site;

- The maximisation of pervious (grassed) areas on the site, which will minimise stormwater runoff and also provide an opportunity for infiltration of rainfall into the groundwater. Additionally, the establishment and maintenance of 100% of grass cover will assist in minimising the amount of sediment load potentially produced by the development.
- In the process plant areas, typified by buildings and paved hardstands, SQUIDS should be installed to capture the high frequency flood events (typically the three-month ARI flood event). These devices are typically underground tanks/structures that feature two compartments, the first compartments captures sediment and the second compartment has a coalescer unit to capture oil/hydrocarbons and other light liquids.
- On pits and grates within the project site install litter baskets to collect gross pollutants.
- On paved areas and road pavement area install bioretention pods where practical.
- At the outlet to each catchment provide a regional bioretention basin

Other non- structural operational WSUD measures to be adopted would include:

- Access to the facility shall be limited to authorised vehicles through a controlled access point.
- Transport loads shall be covered to prevent entry of pollutants to the stormwater system.
- Any spillage of wastes, contaminants or other materials shall be cleaned up as quickly as practicable using procedures that prevent contaminants or material being transferred to the stormwater drainage system. It is noted that the adoption of SQUIDS and the bioretention basins provide the opportunity to isolate / contain any accidental spills on the site, including along the access road reserve between the southern and northern peninsula sites.
- The stormwater system for the site shall be inspected regularly to identify any failures and, if necessary, repairs shall be undertaken; and
- Trapped sediment shall be removed from SQUIDS and bioretention sediment forebays and relocated to a stabilised stockpile, either onsite or offsite, or taken to an appropriate land fill area.

2.3.7.5 Bioretention basins

Bioretention systems use ponding above a treatment surface to maximise the volume of runoff flowing through the filtration media. The treatment system operates by firstly filtering surface flows through vegetation and then percolating runoff through prescribed filtration media. This media provides treatment through fine filtration, extended detention and biological uptake of nutrients.

The indicative locations of bioretention basins are shown in **Figure 2-28**. A typical arrangement and details for a bioretention basin to be implemented on the site is provide in **Figure 2-29**.

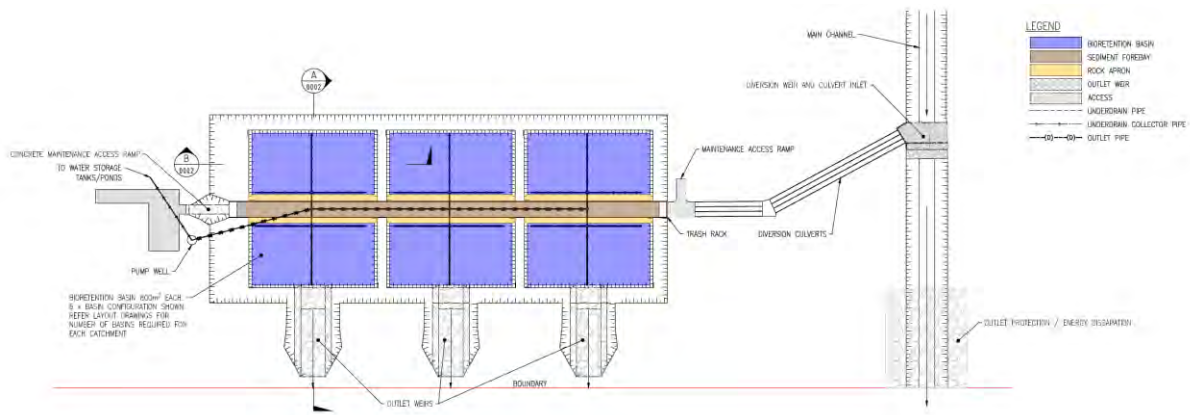


Figure 2-28. Indicative locations of bioretention basins

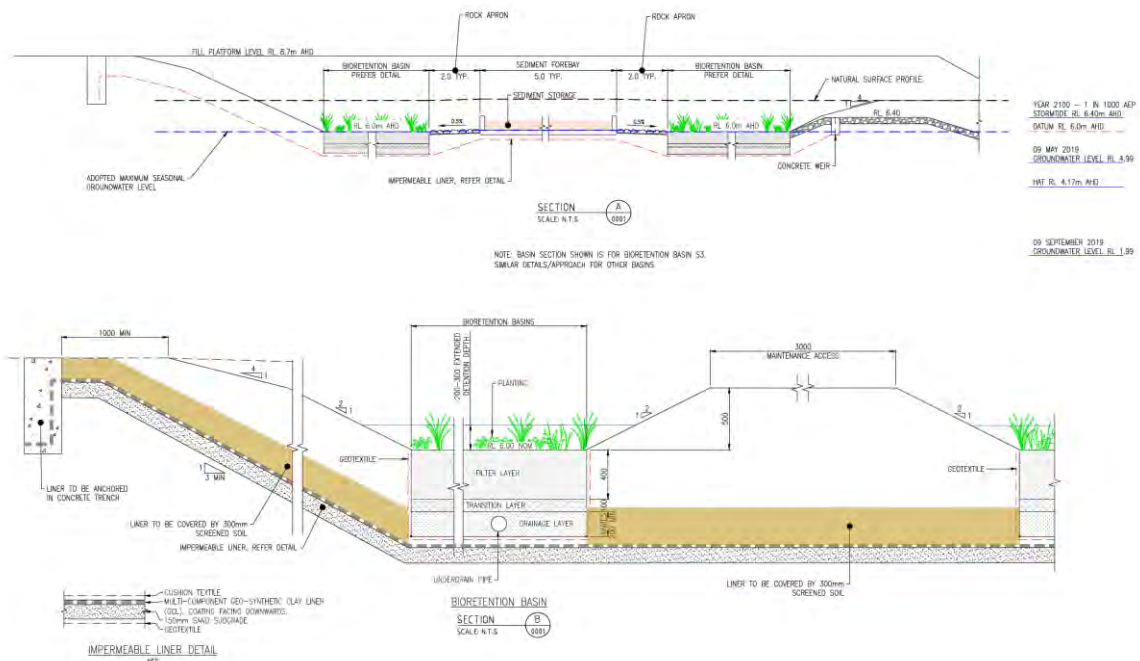


Figure 2-29. A typical arrangement for a bioretention basin

An underdrain system will collect the flow that has passed through the filter media and discharge to a sump structure. From the sump the treated stormwater flow can be directed to the rainwater pond before being reused in the process.

The basin will be designed to accept a specific flow (typically equivalent to the three-month ARI flow). The flows above the design event direct through overflow pits or via the outlet weir. The design flow is diverted from the main channel via a diversion weir and culverts. Higher flows (i.e. the flows that exceed the treatment flow) will bypass the basin by overtopping the diversion weir and continuing along the main channel to the outlet.

The basin would feature:

- a trash rack, located at the outlet to the bypass culverts, to capture gross pollutants prior to entering the bioretention basin system.
- Pre-treatment sediment forebays.
- a multi-component geo-synthetic impermeable clay liner to account for the high groundwater levels at the site.

Indicative sizing of the bioretention basins is provided in **Table 2-16**. Actual sizing will be engineered during the final design stage of the Project.

Table 2-16: Indicative bioretention basin sizing

Catchment Name	Catchment area (ha)	1% Catchment Area (m ²)	Cell Numbers	Cell Length (m)	Cell Width (m)	Bioretention Area (m ³)
N1	41.0	4,100	6	34	20	4,100
N2	37.6	3,760	6	31	20	3,760
S1	27.3	2,730	4	34	20	2,730
S2	39.2	3,920	6	33	20	3,920
S3	50.4	5,400	8	32	20	5,040
S4	26.0	2,600	4	33	20	2,600
R1	10.4	1,040	2	26	20	1,040
R2	12.0	1,200	2	30	20	1,200
R3	13.6	1,360	2	34	20	1,360

2.3.8 Sewage and Grey water

Sewage waste and grey water will be generated throughout the life of the Project, with the volumes fluctuating depending on the number of people on the site. An on-site sewage treatment plant will be constructed to treat sewage and greywater produced in process and non-process buildings.

The sewage treatment facility will be a compact packaged system for treatment of wastewater based on a membrane bioreactor type process.

Figure 2-30 illustrates a 3D model of the package unit, whilst Figure 2-31 provides an overview of the facility. The facility, located in the southern peninsula (Figure 2-32), combines a biological treatment process and a membrane filtration system. It uses the submerged low-pressure ultrafiltration hollow fiber membranes to separate activated sludge from the biologically treated wastewater, thus providing an effective barrier for bacteria and significant removal of viruses.

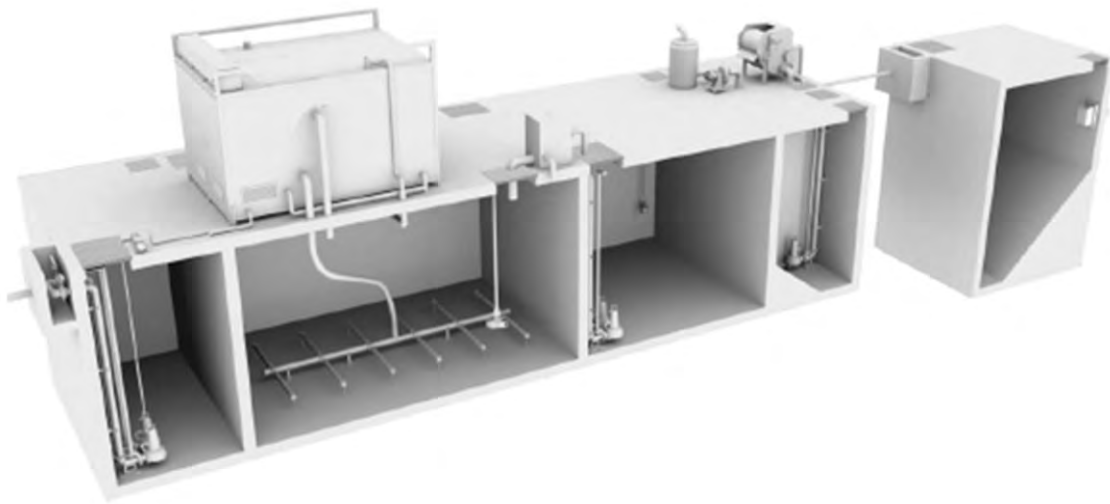


Figure 2-30. 3D Model of the Sewage Treatment Facility Package System

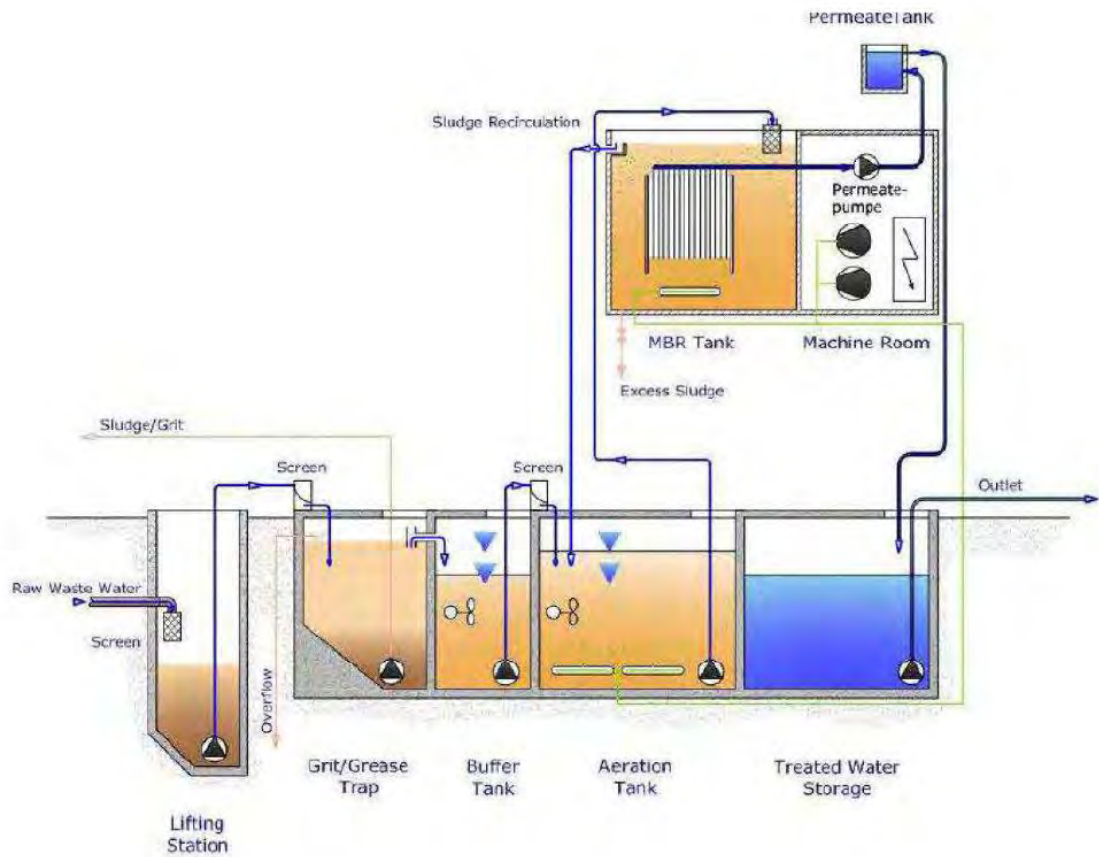
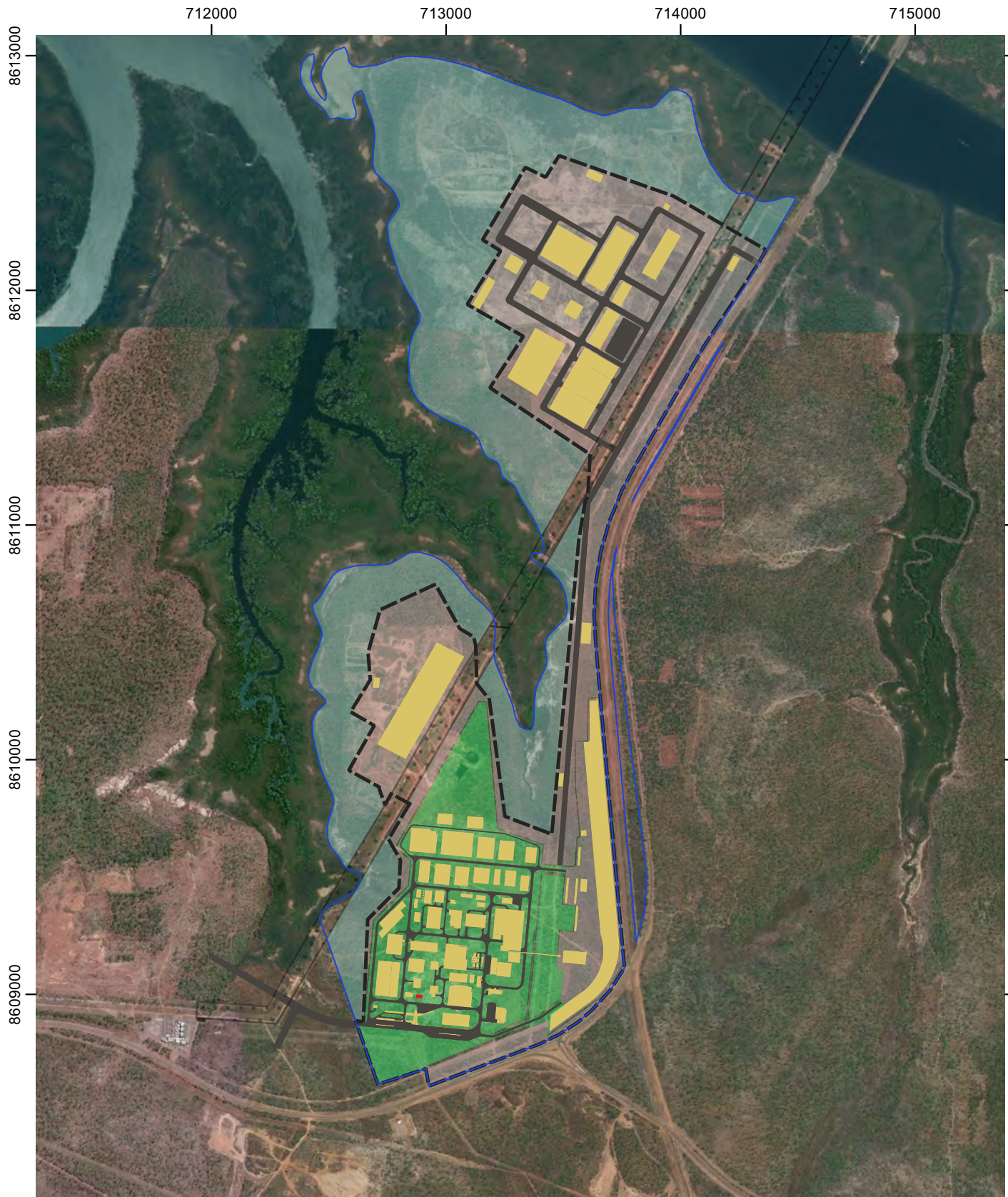


Figure 2-31. Sewage treatment facility overview diagram



Legend

- Sewage treatment plant
- Lot 1817 boundary
- EIS Supplement Development Envelope

TNG Darwin Processing Facility
EIS Supplement

Figure 2-32. Location
of sewage treatment
plant

TNG LIMITED



0 250 500 m



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Date drawn: 19/01/2021
CRS: GDA 1994 MGA Zone 52

The sewage treatment facility has the capacity to process a population equivalent of 750; with an average daily flow of 150 m³/d, an average hourly flow of 6.25 m³/hr and a peak hourly flow of 12.5 m³/hr (for a maximum of four hours). **Table 2-17** describes the quality of the treated wastewater. Once treated, the wastewater will be sent to the WRP for recycling. Solids collected in the sewage treatment plant are described in **Section 2.4.6**.

Table 2-17. Effluent quality outlet values

Parameter	Unit	Inlet	Required values	Operating values
COD	mg/l	600	125	< 30
BOD5	mg/l	300	25	< 5
Suspended solids	mg/l	350	35	< 8
Fat, oil and grease	mg/l	< 20	< 5	< 1
Coliform bacteria (MPN)	-		100 KBE /100	10 KBE / 100
Viruses	%			red. 99.99

2.3.9 Water Requirements

The Draft EIS indicated an average of 11 GL / annum and up to a maximum of 13.6 GL / annum of water was required from the Darwin Water Supply to sustain processing for the Project. With the change in Project scope to include water recycling through the WRP, the volume required from the Darwin Water Supply has been revised to an average of 3.85 GL/ annum. Stormwater harvesting is not included in the annual water consumption, therefore actual water consumption is expected to be lower than the value indicated.

The inputs, outputs and recycled volumes are summarised in **Table 2-18**. Further detail on the water supply and requirements is provided below.

2.3.9.1 Water supply

The three main water supply sources for the Project are:

- Darwin water supply
- Recycled water from the WRP
- Stormwater harvesting

Incidental water will also arise through moisture content in concentrate, chemicals and reagents used and will be consumed or generated by chemical reactions within the process.

Darwin water supply

Supplement water will be purchased from the Darwin water supply and stored in the Raw Water Pond. The Raw Water Pond is described in **Section 2.3.3**.

Whilst the volume of water sourced from the Darwin water supply may initially be higher as recycling processes and stormwater harvesting may not yet have commenced, as these systems come online the amount sourced from the Darwin Water Supply will be reduced from that described in the Draft EIS.

Recycled water from the WRP

The balance of the water required for the Project is sourced primarily from process water recycled through the WRP. It is envisaged that the three streams generated in the WRP will be entirely recycled to the process plant, therefore significantly reducing the overall water requirements for the project and removing the requirement for water discharge to the environment.

Following treatment through the WRP, the output water streams will be stored in dedicated tanks prior to feeding to the main processing plant water distribution area.

Stormwater harvesting

Through SQUIDS and bioretention basins installed on the site there will be an opportunity to harvest the treated stormwater for reuse within the process plant and for irrigation of the site. Rainfall capture from buildings will also be contained for reuse. Retained water will be stored in the rainfall containment pond described in **Section 2.3.3** or other designated ponds/tanks.

Where appropriate, stormwater will be diverted to the WRP either directly or via the PWTP. The design value as determined by TNG for storm water discharging to the WRP is 50 m³/h. This water is recycled back into the process circuit.

It is noted that with respect to the potential harvesting of stormwater on the site, as a significant portion of the annual stormwater runoff volume from urbanised catchments occurs from the frequent, smaller flood events and from a proportion of the less frequent, larger events, treating the nominal three-month ARI flow will potentially capture in the order of ninety percent of the mean annual runoff volume from the site (ANZECC 2000). Therefore, the possibility for stormwater harvesting is potentially only limited by the ability to provide storage on the site.

Further detail on stormwater management is provided in **Section 2.3.7**.

2.3.9.2 Water balance model

The revised water demand for the Project is 13.78 gigalitres per annum (GL/a). Water inputs required from the Darwin water supply during operations include: 3.81 GL/a of Raw Water for processing, 0.0004 GL/a for dust suppression and 0.044 GL/a for potable water. The total water input required from the Darwin water supply for the Project during Operations is 3.85 GL/a. The WRP generates three water products which will total 9.76 GL/a.

The balance of water is primarily generated within the process plant through the burning of natural gas and chemical reactions within unit processes, therefore the output from the plant is a little higher than the fresh water inputs.

The water demand may be further reduced through the harvest of stormwater and rainwater from building roof surfaces, when available.

A revised Water Balance Model has been prepared for the Project operational phase, with a summary provided in **Table 2-18**. The input to the plant is not equivalent to the output. This is because water is generated within the process plant which primarily reports to the off-gas.

Table 2-18. Summarised water balance

Source	Volume (GL/a)
Inputs	
Darwin Water Supply	3.81
Reagents	0.08
Concentrate	0.08
Potable Water	0.04
Dust suppression	0.0004
Total	4.02
Outputs	
Off-gas	3.98
Solids	0.19
Evaporation	0.05
Total	4.23

In addition to input and output water identified above, water is continuously recycled through the WRP in a closed circuit process. **Table 2-19** indicates the different water quantities output from the WRP back into the Process.

Table 2-19. Water recycling plant outputs

Source	Volume (GL/a)
Recycled Water	
Soft Water	7.36
Process Water #1	0.70
Process Water #2	1.71
Total	9.76

2.3.10 Power Requirement

Electricity consumption presented in the Draft EIS was estimated to be 1316 terajoules per annum (**TJ/annum**). A review of power requirements for the Supplement has increase this estimate to 1597 TJ/annum.

Consistent with the Draft EIS, the onsite power requirements will be met by a natural gas fired power plant that will be built, owned and operated by a third party. It is estimated that approximately 6.3 petajoules (**PJ**) of natural gas will be required per year to meet the 63.4 megawatt hour (**MWh**) energy demand of the facility. An on-site electrical power substation will transform the High Voltage power supply to the process facility.

The natural gas requirement for the Processing Facility remains at approximately 5.2 PJ/annum, with gas to be sourced from the Amadeus Gas Pipeline.

2.3.11 Workforce

During operations it is expected there will be approximately 300 roles across the following areas:

- Administration staff (8am to 4pm, 5 days per week) – 26 roles
- Operations staff (8am to 4pm, 5 days per week) – 31 roles
- Operations staff (8am to 6pm, 7 days a week) – 3 roles
- Operations staff (8am to 6pm and 7pm to 7am, shift) – 240 roles

It is noted that the anticipated employment would be higher to ensure full coverage of the 24 hour per day 365 day per year operations, with an expectation that approximately 850 personnel will be employed for the project during operations.

2.3.12 Traffic

In response to NT EPA comments on the Draft EIS, the Traffic Impact Assessment has been revised to consider potential transport impacts, including consideration of wider transport network conditions and development proposals in the vicinity of the Project site.

The revised Traffic Impact Assessment is included as **Appendix D**; an update on site access, anticipated vehicle movements and rail activities is detailed below.

2.3.12.1 Site Access

Ongoing discussions with Land Development Corporation (**LDC**) regarding the location of the site access point has resulted in agreement being reached to allow the TNG Project to connect to the internal road network of the Kittyhawk Estate rather than providing direct access to and from Channel Island Road.

The Project will utilise the recently constructed access into the Stage 1 Kittyhawk Estate. This intersection has been designed and built to provide access to the future industrial subdivision, which is adjacent to the TNG site. This access is located approximately 2.4km west of the intersection with Jenkins Road and is indicated on **Figure 2-33**.

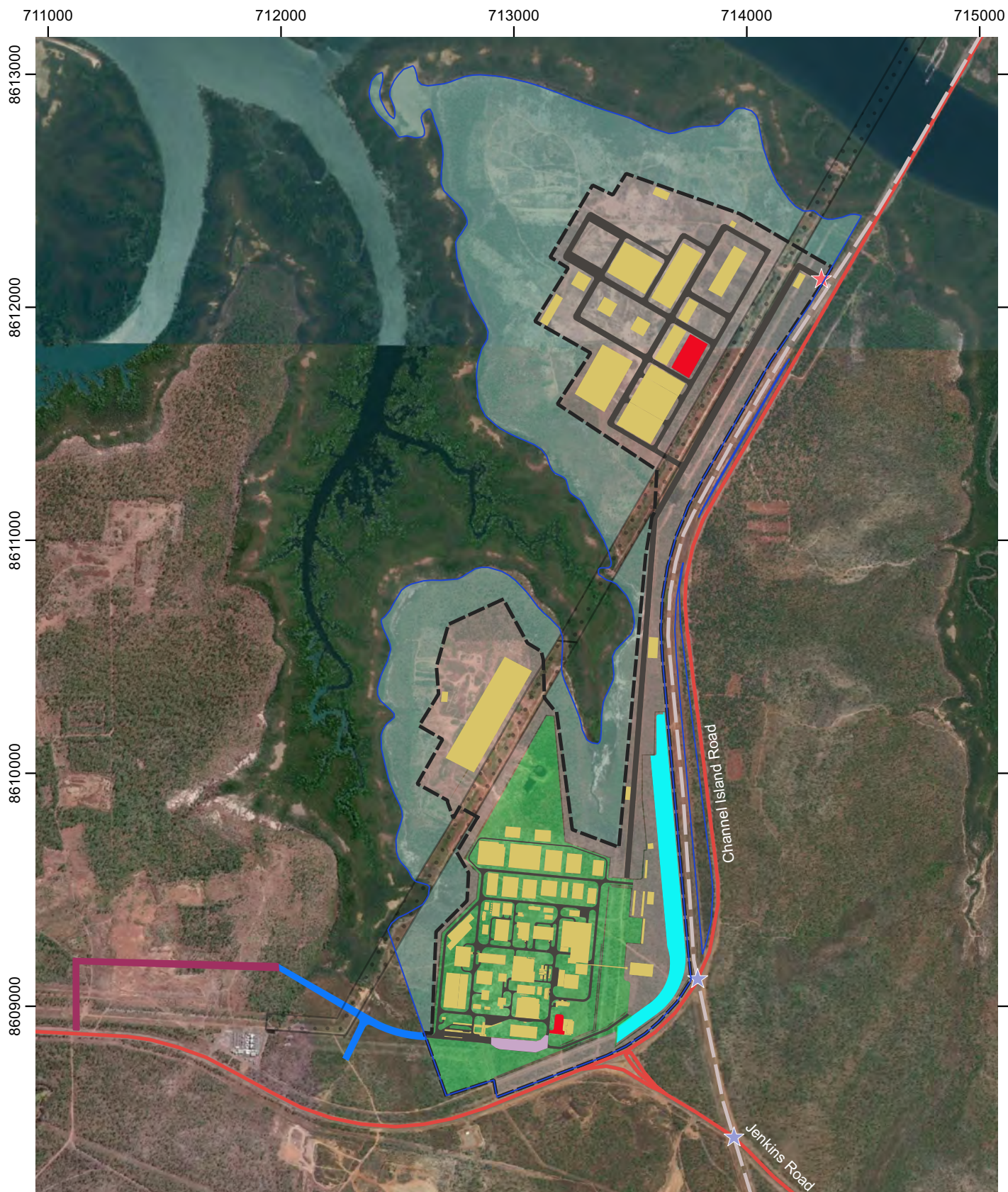
Based on the *Austroads Guide to Road Design Part 4A* (Austroads 2017), the required sight distances at the Kittyhawk Estate junction are:

- approach sight distance (**ASD**),
- safe intersection sight distance (**SISD**), and
- minimum gap sight distance (**MGSD**).

The design speed of Channel Island Road is 110 km/hr (posted speed limit of 100km/h). The required ASD for trucks is 241m and for cars is 209 m; the required SISD for trucks is 241 m and for cars is 300 m; and the required MGSD for both trucks and cars is between 275 m and 305m.

The available sight distance to and from the site exceeds 350 m in both directions, and therefore the minimum sight distance requirements are met.

Whilst the southern access route will be the main site entry point, access to the northern peninsula will also be maintained for use in an emergency situation. The emergency access point is indicated on **Figure 2-33**.



Legend

- Railway Line
- Roads
- ★ Emergency site access
- ★ Level Crossing
- Carpark
- Kittyhawk access road
- Railway siding
- Site access
- Truck turning and parking

TNG Darwin Processing Facility
EIS Supplement

Figure 2-33.
Location of
traffic features

TNG LIMITED



0 250 500 m



Scale when printed in A4 is 1: 23,000
Date drawn: 19/01/2020
CRS: GDA 1994 MGA Zone 52

2.3.12.2 Processing Facility Vehicle Movements

Daily operational vehicle movements external to the site (primarily between the site and the Darwin Port) have not changed from the Draft EIS, with an expected 36 road movements per day. Subsequent to the Draft EIS, however, expected maximum traffic movements for Staff have been revised.

In the maximum traffic scenario (if all staff drive independently to and from the site rather than commuting by bus) the total daily traffic movements for the operations phase will be approximately 636 vehicles per day, with the following hourly movements:

- 7:00am – 120 movements away from the site
- 8:00am – 180 movements towards the site
- 4:00pm – 58 movements away from the site
- 6:00pm – 122 movements away from the site
- 7:00pm – 120 movements towards the site

Alternatively, if all staff movements were to be accommodated in buses, based on a large coach capacity of 57 seats, a total of 6 buses would be required in the morning and evening, noting that the morning would be spread over a two hour window and the evening over a three hour window. That is, the actual number of buses per hour is likely to be at the most 4 buses.

Figure 2-34 shows the traffic volumes generated by the maximum traffic scenario during Project operation at the Kittyhawk Estate junction on Channel Island Road in the morning (7:30 – 8:30 am) and afternoon (4:30 – 5:30 pm) peak traffic times.

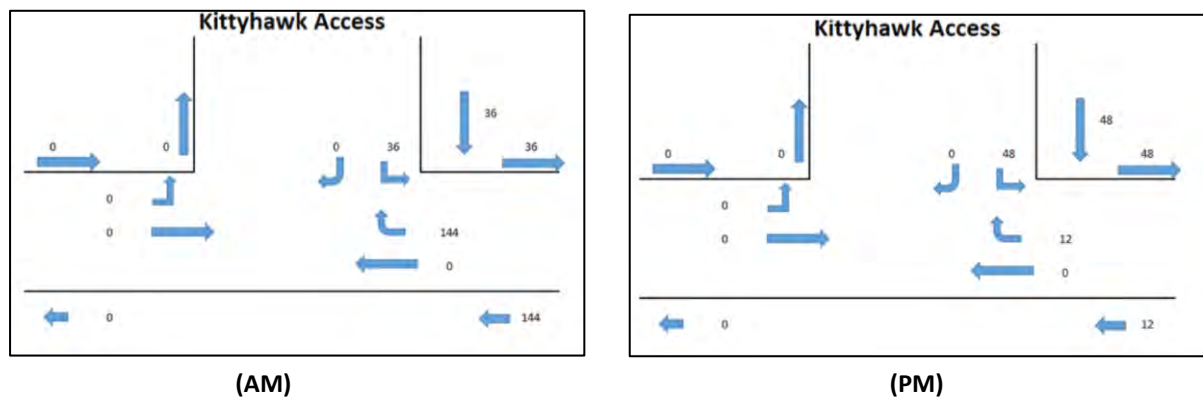


Figure 2-34. Operations traffic entering and exiting from Channel Island Road during peak times (Darwin Processing Facility movements only)

2.3.12.3 Cumulative Vehicle Movements

Adding the maximum traffic anticipated during Project operations (636vpd) and the identified traffic from Kittyhawk development (1,920vpd) (i3 Consultants Updated Kittyhawk Traffic Impact Assessment) to the current daily traffic volume (1,895vpd) (DIPL Annual Traffic Report, 2019), a total daily traffic volume of approximately 4,725vpd would be expected (worst case). This is higher than the volume experienced in 2014 by approximately 138 vehicle trips per day or approximately 3%.

It is anticipated that all the expected traffic commuters to the site will travel through either Palmerston (via Elrundie Avenue and Chung Wah Terrace) or Berry Springs (via Finn Rd and Jenkins Rd).

Based on the proposed shift times, there would be approximately 180 vehicle trips in the morning peak hour (80% in and 20% out) and 60 vehicle trips within the evening peak hour period (20% in and 80% out). The calculated cumulative AM and PM traffic volumes to be generated during the operational phase are shown in **Figure 2-35**.

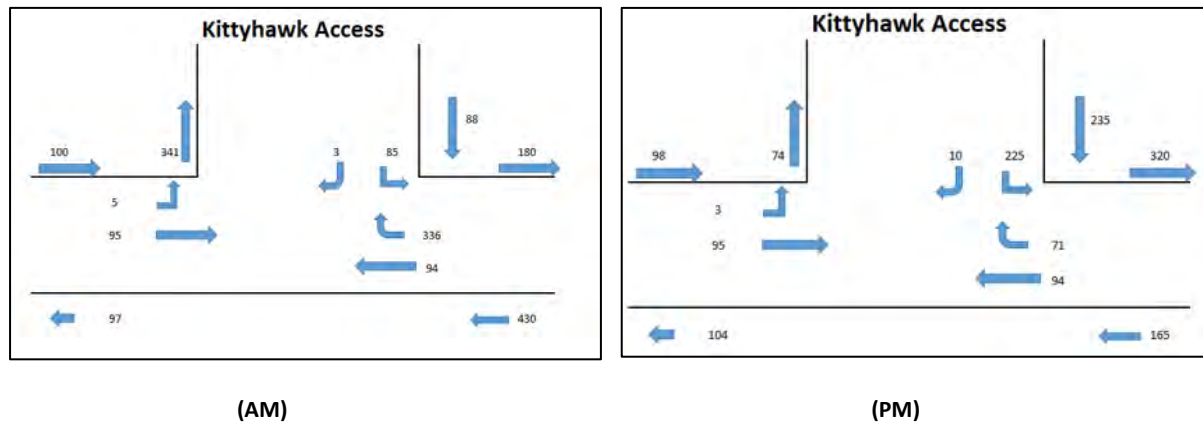


Figure 2-35: Cumulative Peak Hour Traffic Volumes at the Kittyhawk Access Point (includes Darwin Processing Facility, Kittyhawk Development and 2019 existing traffic volumes)

2.3.12.4 Parking

Parking will be provided on site during operations. The site has sufficient space to provide adequate parking for the identified uses (**Figure 2-33**).

A dedicated area has been allocated for the parking of quad road trains (**Figure 2-33**).

For the ongoing operations, and assuming all staff will drive their own vehicle to and from site, a total of 320 parking spaces would be required. However, if buses are provided to transport workers to and from the site, this could be reduced to 26 parking bays. It is likely the actual scenario will be somewhere in between these two, with adequate parking for both scenarios provided.

2.3.12.5 Rail Operations

A 3.8 km long rail siding will be constructed in the Project area, connecting it with the Adelaide-Darwin railway (**Figure 2-33**). Each train will be approximately 1365 m in length.

Two level crossings are proximal to the site, along Jenkins Road and Channel Island Road. Both crossings have advance warning systems and signage on the approach to the crossing. The operation of these level crossings will be impacted by trains travelling to and from the south of the Project (6 crossings per week). Traffic delays can range from 1.85 minutes for a train travelling at 70 km/hr to 17 minutes for a train travelling at 5 km/hr. TNG are working with the train operators to finalise the details of train operations; the anticipated speeds at each level crossing are yet to be confirmed.

No change has been made to the frequency of train movements, however a preliminary timetable has been developed for train arrivals and departures in conjunction with the train operator. **Table 2-20** details the anticipated train timetable from Adnera Siding to the Darwin Processing Facility. There is limited flexibility for the timing of trains as this is controlled by the train operator to fit with other demands on the train line. Consequently, there may be changes to the final train schedule, which will be determined nearer to operations commencing.

Table 2-20. Preliminary train timetable from Adnera Siding to the Darwin Processing Facility.

Indicative Train Pathing – Adnera to Darwin Processing Plant				
Day	Adnera		Darwin Processing Plant	
	Arrive	Depart	Arrive	Depart
Sunday				1200
Monday	0200	1100		
Tuesday			0630	1600
Wednesday	0600	1500		
Thursday			0830	2000
Friday	0930	1800		
Saturday			1200	

Seven train movements between the Processing Facility and East Arm Wharf will occur weekly, for delivery of final products. **Table 2-21** details the indicative rail schedules for each of the seven train paths.

Each cycle will haul ~62 containers on 31 two-slot container wagons per delivery for a total net load of approximately 1,950 tonnes of products per cycle. **Figure 2-36** provides an example of similar container wagons.

Table 2-21. Train schedule for delivery products to the East Arm wharf from the Processing Facility

Indicative Train Pathing – Darwin Processing Plant to Wharf					
Day	Darwin Processing Plant		East Arm Wharf		Train Number
	Arrive	Depart	Arrive	Depart	
Sunday				2330	
Monday	0001	0430	0500	1500	Train 1
Monday	1530	1930	2000		Train 2
Tuesday					
Wednesday	0100	0530	0600	0030	Train 3
Thursday	0030	0530		0001	Train 4
Thursday	2200		0600	2130	
Friday		0200	0230	1500	Train 5
Friday	1530	1830	1900	0600	Train 6
Saturday	0630	1100	1130		Train 7



Figure 2-36. Example of container wagons to be used for the Project

2.4 OPERATIONAL PHASE WASTE STREAMS

With the progression of FEED since completion of the Draft EIS, the waste streams associated with the Project are better understood. This section provides updated information on the types and volumes of wastes that will be generated during the operational phase of the Project. As the Project moves into the detailed-design phase, these estimates will be refined and appropriate waste-disposal pathways identified and documented in TNG's waste-management documentation.

There are no longer liquid waste streams from the Project, as described in **Section 2.3.4**. This is a significant change from the Draft EIS, which detailed the disposal of liquid waste through the ocean outfall pipeline. Process wastewater is retained through the WRP where liquids are treated, recovered and reused.

Several solid waste products have been identified for the Project, as listed in **Table 2-22**. Further detail on process wastes is provided below in **Sections 2.4.1 to 2.4.6**. This information supersedes that detailed in Section 4.6.16 of the Draft EIS.

Non-process solids wastes remain the same as described in section 4.6.16.3 of the Draft EIS and have not been discussed further in this section.

Table 2-22. Solid waste products generated in the Processing Plant

Waste Product	Area	Plant	% Moisture	Volume (tpa)
Coke Ash	200	Tivan	0	2,500
Sulphate digest leach residue (SDLR)	500	Pigment	25.0	55,000
Acid waste neutralization gypsum	500	Pigment	27.5	264,500
Acid waste neutralisation metal hydroxides #1	500	Pigment	52.5	15,000
Acid waste neutralisation metal hydroxides #2	770	Tivan	30.0	30,000
Soluble Salt Waste	-	WRP	10.0	130,000
Clarifier Solids	-	WRP	10.0	4,000
Scrubber gypsum	200	Tivan	10.0	26,000
Total				527,000

Laboratory characterisation of the available Processing Plant waste products was carried out by Environmental Geochemistry International Pty Ltd (EGI).

WRP clarified solids were not generated for this assessment as the process could not be reliably conducted on a bench scale. The composition of this product is expected to be a combination of the acid waste neutralisation gypsum, the acid waste neutralisation metal hydroxide #1 and acid waste neutralisation metal hydroxide #2.

The scrubber gypsum was also not generated for this study, as it is a standard industrial product that is well understood. There are no reasons to believe that the TNG scrubber gypsum will differ significantly from other industrial samples.

The full waste characterisation report is included as **Appendix F** and the results are summarised below.

2.4.1 Coke Ash

The coke ash sample is dominated by carbon particles 20 – 200 µm in size (66 wt.% organic C), possibly containing adsorbed sulphate. The remainder of the sample is comprised of relatively large (0.2 – 1 mm) metal oxides, including Fe, Al, and Ti oxides, together with calcium silicates and metallic iron. Most phases are amorphous or poorly crystalline. Trace heavy metals of significance include, in decreasing concentration, Ni, V, Zn, Cr and Mn.

Batch leach tests show leachates had neutral to slightly acidic pH with very low salinity, principally from Fe, Cl and SO₄. Metal concentrations were generally below ANZECC Default Guideline Values (**DGV**) at all but the lowest liquid to solid ratios (**LSR**), with the exception of Ni which was present at slightly elevated concentrations (up to 10 times the DGV). Overall, the watershed risk profile of the material appears to be low in terms of readily soluble fraction of this material.

2.4.2 SDLR

The SDLR sample includes major crystalline phases rutile (20%), calcium sulphates (gypsum, bassanite and anhydrite (7%)) and silicates (7%), mainly as diopside (6.6%), with minor quartz. The remaining Al, Fe and Si is probably present as x-ray invisible silicates and metal oxides/sulphates. However, together these substances account for only 81% of the material. The total carbon content is only 2%, so a significant portion (17%) of the sample is not defined. Hydration water, especially with amorphous metal oxides, may account for some of the unaccounted material, as the sample was dried to a constant weight at only 60°C to avoid conversion of amorphous phases to crystalline phases. Trace heavy metals of significance include, in decreasing concentration, Cr, Mn, V, Zn and Ni.

Leachates had low pH (1.2 – 1.9), significant acidity (1400 – 9200 mg CaCO₃/L) and high salinity principally from calcium and sulphate which appear to be at equilibrium with gypsum at all LSR. Leachate also contained metals including Al, B, Ba, Cd, Co, Cr, Ni, U, V and Zn at concentrations up to 4 orders of magnitude above the DGVs and across all LSR. Overall, the watershed risk profile of the material appears to be high in terms of readily soluble fraction of this material. The sample received for testing was, however, insufficiently neutralised; the industrial sample will be neutralised with additional limestone/lime to reduce the risk associated with potential spillage of waste material during handling and transport.

2.4.3 Acid Waste Neutralisation Metal Hydroxide #1

The major compounds identified in the metal hydroxide precipitation #1 residue sample were calcium sulphate as gypsum and anhydrite/bassanite, together with Fe, Al oxides, some crystalline some amorphous. Assayed elements account for only 75% of the mass, suggesting the samples dried to a constant weight at 60°C may still contain hydration water.

This material contains significant concentrations of a number of heavy metals including, in decreasing concentration, Nb, Mn, V, Zn and Cr. The sample also contains a significant amount of Nb. Approximately 25% of particles are <2.5 µm in size, meaning the respirable content of this material is potentially high, but most of this is likely Fe/Al oxyhydroxides with a low quartz content (≈1%).

A higher LSR was required to produce leachates from the material. Leachates were slightly alkaline (pH around 9) and had high salinity (5 – 13.5 g/L), principally from calcium, chloride, and sulphate. Calcium and sulphate may be at equilibrium with gypsum at all LSRs. Metal concentrations in leachates were generally very low, presumably due to low solubility at higher pH. However, both Al and Cr concentrations in leachate were one to two orders of magnitude above DGVs, particularly at higher LSR. This suggests solubility control on these metals, with soluble aluminium possibly present as an anionic species (e.g., $\text{Al}(\text{OH})_4^-$). Overall, the watershed risk profile of the material appears to be low to moderate in terms of readily soluble fraction of this material.

2.4.4 Acid Waste Neutralisation Metal Hydroxide #2

The residue consists principally of iron oxide/hydroxides, together with lesser amounts aluminium oxide/hydroxide and minor titanium oxide. The particles of metal oxide/hydroxide are coated in calcium/magnesium chloride, possibly as a result of drying the sample prior to analysis, which was received as a slurry. In the plant it is likely that chloride content would be substantially lower, and considerably more neutralisation liquor would be removed during press filtering. Consequently, the plant waste neutralisation residue would potentially contain less calcium chloride. The sample also contains a number of heavy metals including in decreasing concentration V, Mn, Zn, Cr, Ni, Nb. It is likely there is very little respirable size quartz in this material.

A higher LSR was required to produce leachates from the material. Leachates had neutral pH and high salinity (9 – 27 g/L), principally from calcium and chloride. It is likely this would be reduced in the plant due to the filtering process. Leachates contained elevated concentrations of a number of metals including Ba and Sr. Higher concentrations of these metals are probably as a result of the high concentration of calcium chloride in leachates. Barite (BaSO_4) and celestite (SrSO_4) solubility increases as calcium chloride concentration increases. Al, Cu and Zn were also present in leachates. Overall, the watershed risk profile of the material appears to be low to moderate in terms of readily soluble fraction of this material.

2.4.5 WRP Clarifier solids

WRP Clarifier solids were not characterised by EGI as the process for generating the product could not be reliably conducted on a bench scale. The composition of this product is expected to be similar to a combination of the acid waste neutralisation gypsum, the acid waste neutralisation metal hydroxide #1 and acid waste neutralisation metal hydroxide #2. TNG envisage the worst case outcomes from the characterisation of the associated three solid wastes can also be applied to this waste product; however, are unable to demonstrate this until a representative sample is generated during production. The process for collection and transport of the clarifier solids minimises the risk of their exposure to the environment. The load out bins have a capacity of approximately 25 m³, hence one bin will be filled every 10 to 12 days. The filter presses and drying oven will be located in the Centrifuge Building. The Drying Oven will discharge dried sludge by conveyor into a holding hopper from where it can be loaded into containers.

At the start of production TNG will classify the WRP clarifier solids to a similar standard as the other waste products described herein to ensure all relevant environmental criteria are met for transport and disposal.

2.4.6 Sewage

There are no liquid wastes to be disposed of from the Sewage Treatment Plant. Liquid wastes are fed into the WRP and recycled back to the Process circuit. Some liquid is retained as moisture in the solid waste.

Solid waste from the sludge that has been settled out during the Sewage Treatment process will be transferred to the sludge storage chamber until it gets transported off site for disposal. Grease and fats are retained in the settling chamber and will be removed manually by hand rake approximately once a week. Once removed, the grease and fats will be transported off site for appropriate disposal. Approximately 135 kg/day of wet sludge is anticipated to be produced from the Sewage Treatment Plant.

2.4.7 Waste Storage and Handling

All waste products will be directly containerised, with no requirement for stockpiling or additional handling. Containers will be stored on bunded hardstands, with sumps and appropriate containment systems installed.

The final destination of waste products is still to be finalised, although there is an expectation that the products will be disposed within the Integrated Waste Landform (IWL) at the Mount Peake Mine Site or within a disused mine site, if available. Further studies will be undertaken to determine the most appropriate disposal option and applicable environmental impact assessment will be conducted as required during the next phase of Project design.

2.5 BY-PRODUCTS

Saleable by-products are generated in the Processing Facility. These products have industrial and civil useability and market and end-users will be sought for them. Saleability and end-users will be subject to determination of the product value and the required containment, transport and product specifications. If a suitable buyer or end-user cannot be determined, they will be reclassified as solid waste products and a suitable disposal option be sought.

Saleable by-products generated in the Processing Facility are listed in **Table 2-23**.

Table 2-23. Solid waste products generated in the Processing Plant

Waste Product	Location	Quantity tpa
Processed WRP salt residue	Water Recycling Plant	40,000 ¹
Gypsum	Sulphate pigment plant	220,000
Digest Residue	Steam and Bag filter	55,000

¹Combined total of potentially recoverable salt products from the WRP salt residue

2.5.1 WRP Salt residue

The by-product from the RO Plants is a salty water phase, which is high in daily volume and corrosive because of the high chloride content. The RO Reject Water will be treated by the MEE Plant, which is a high temperature vacuum distillation/condensing process, followed by pusher centrifuges to produce a dried salt of approximately 90% dry solids content.

The bulk crystallisation slurry residue assays for 73-76% NaCl and 23-27% Na₂SO₄. The sample also contains minor calcium and potassium salts. The only heavy metal at significant levels is vanadium (≈0.1%).

The product is highly soluble, producing high salinity (80 – 170 g/L), moderately low pH (3 – 4.5) leachates. Leachates also contained Al, Cu, V and Zn concentrations two to three orders of magnitude above DGVs.

The centrifuges will be located in a Centrifuge Building. The centrifuges will be elevated on a mezzanine level to allow the dried salt from each of the five centrifuges to discharge dried salt into a holding hopper from where it will be loaded into truck mounted bins. The MEE plant is expected to fill 18 to 20 bins with dried salt each day the plant operates at full capacity.

If separation of the salt into saleable products is technically and commercially viable, appropriate handling, storage and transport solutions will likewise be applied to these products.

2.5.2 Acid waste neutralisation gypsum and Scrubber gypsum

Acid waste neutralisation gypsum is a gypsum product which is expected to have minor impurities. The minor impurities will be similar in composition to metal hydroxides residue #1 and was not exposed to the full suite of characterisations.

The product is approximately 76% gypsum assuming all measured S is present as gypsum. All assayed elements account for just over 80% by mass of the sample (not including water of crystallisation in gypsum). Major impurities include iron and aluminium (≈3.5% each as the oxides), titanium (1.8% as the oxide) and silicon (2.6% as the oxide). Major heavy metal impurities include, in decreasing order of abundance, Nb, V, Zn, Cr and Mn (≈0.6% total).

Batch leaching tests were not conducted on the gypsum residue, however, assay results show the major phase as gypsum so dissolution would be expected to result in solutions containing calcium and sulphate in equilibrium with undissolved gypsum. This would limit leachate salinity. It could be expected that leachates would have neutral to slightly acidic pH

Scrubber gypsum is a common industrial by-product of flue-gas desulphurisation (**FGD**) processes. FGD gypsum is commonly put to beneficial use in the plasterboard and cement industries and is sometimes used in agriculture. Dissolution of the FGD gypsum is expected to generate a solution containing calcium and sulphate in equilibrium with undissolved gypsum. The gypsum may contain heavy metals, which would be introduced through the limestone used for the scrubber. The limestone selected for the process will therefore influence the quality of the FGD gypsum.

The assay analysis of a limestone sample from the potential supplier is summarised in **Table 2-24**. The heavy metals in the limestone are relatively low indicating the FGD gypsum would also have relatively low levels of these heavy metals. FGD gypsum generated at the Project is expected to have comparable qualities to that generated in similar applications and therefore should be suitable for use in industry.

Table 2-24. Composition of limestone for scrubber

Metal	Composition %
Al	0.49
Ca	37.7
Cr	<0.001
Fe	0.36
Mg	0.22
Mn	0.02
Na	0.02
Nb	0.005
Si	1.81
Ti	0.03
V	0.001
Zn	0.002

At the start of production TNG will classify the scrubber gypsum to a similar standard as the other waste products described herein to ensure all relevant environmental criteria are met for storage and transport of the material.

2.6 DISCHARGES AND EMISSIONS

2.6.1 Stormwater discharge

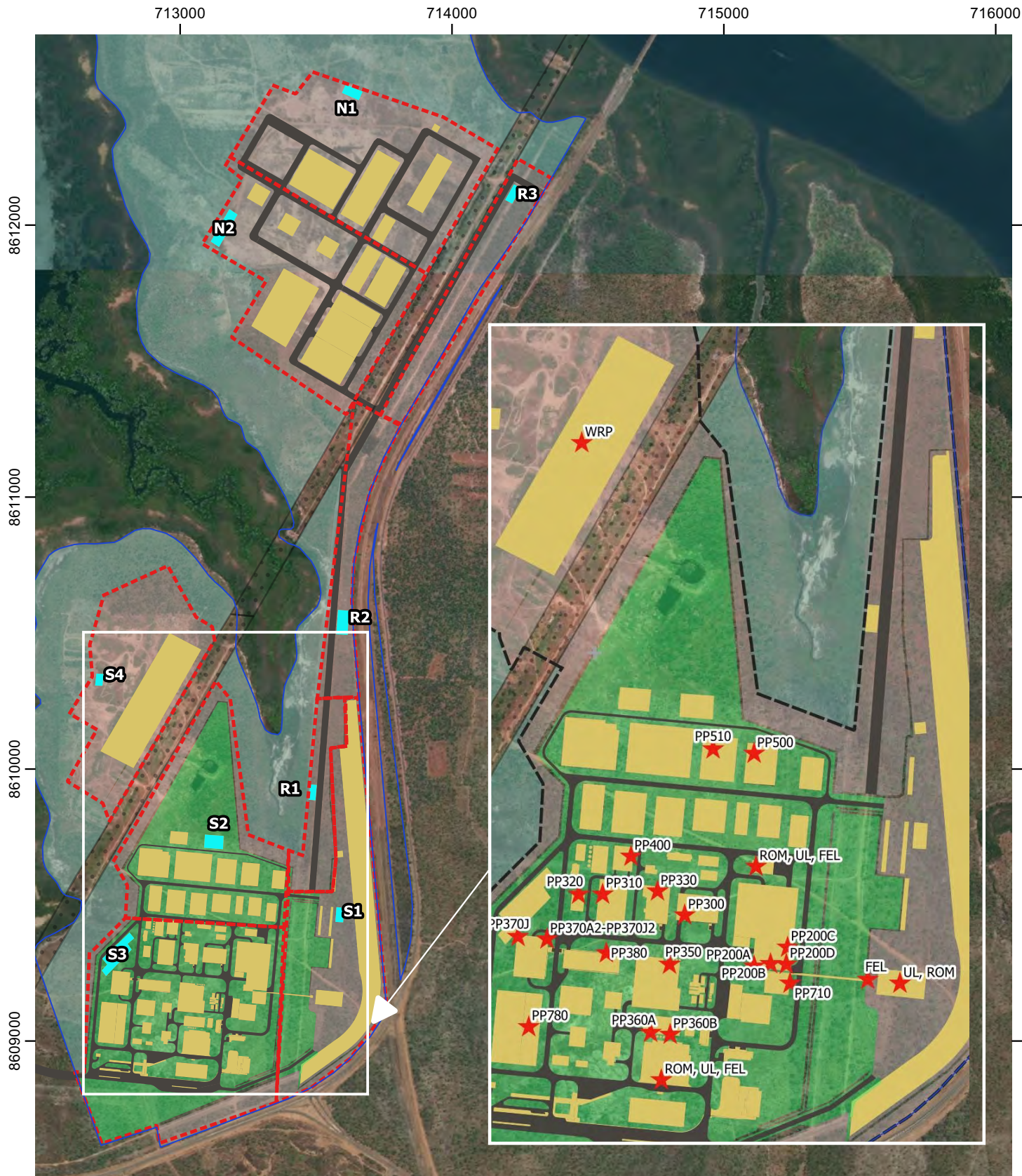
Discharge of water from the site will be limited to stormwater runoff from non-process areas. This discharge will be controlled by the use of sediment basins during construction and bioretention basins during operations. The discharge will be to land.

The volume of water that will be discharged off site from the sediment and bioretention basins depends on the frequency, intensity and duration of rainfall events that occur in any given year. The amount harvested and stored for use in the Project water balance will reduce the discharge from the bioretention basins during operations.

The quality of water that would be discharged from the bioretention basins is detailed in **Section 2.3.7**. The quality has been nominated at a suitably high level so as not to pose any environmental risks to the receiving environment. Detailed engineering of the stormwater infrastructure for construction and operations is required prior to Project commencement and will work from the basis of nominally high quality discharge, specifying the suitable infrastructure to deliver that outcome.

The locations of discharge have been preliminarily placed to retain the natural surface water flow paths and discharge fresh water at locations where freshwater is naturally discharging. Freshwater discharge will be dispersed across the 9 locations, preserving the natural pattern. Locations of discharge are approximately the same for construction and operations and are shown in **Figure 2-37**.

Any stormwater that is discharged from the bioretention basins will be discharged to land. This will provide an opportunity for the water to be infiltrated into the soil and further reduce the quantity of freshwater arriving at the Elizabeth River.



Legend

- ★ Emissions to air
- N2 Discharges to land
- Catchment Boundaries
- Lot 1817 boundary
- EIS Supplement Development Envelope

TNG Darwin Processing Facility
EIS Supplement

Figure 2-37. Locations of
discharges and emissions

TNG LIMITED



0 250 500 m

Scale when printed in A4 is 1: 20,000
Date drawn: 19/01/2021
CRS: GDA 1994 MGA Zone 52

2.6.2 Atmospheric emissions

An updated Air Quality Assessment has been completed for the EIS Supplement and is included in **Appendix G**.

No changes to the construction phase have occurred for Air Quality in the updated assessment.

No significant changes have occurred for the key sources of air emissions during the operations phase, or the primary pollutants of interest. The number and height of stacks has however been revised. Approximately 37 stacks or exhaust pipes are proposed, ranging from 9 m – 40 m in height. In addition, the Sulphate Plant will include a 100 m stack.

Stack diameter, heights and locations for processing equipment that require ventilation stacks for gaseous emissions are listed in **Table 2-25** and locations are shown in **Figure 2-37**.

Table 2-25. Ventilation stack diameter, height and location for processing equipment

Infrastructure	ID	Stack height	Stack diameter	Exit velocity	Pollutant						Pollution control
		(m)	(mm)	(m/s)	HCl	Cl ₂	NH ₃	SO ₂	NO ₂	PM ^a	
Concentrate Reduction	PP200A	40	300	15						0.01	Compact filter
	PP200B	40	300	15						0.01	Compact filter
	PP200C	40	300	15						0.01	Compact filter
	PP200D	25	1800	15						0.01	Filter house
Ferric Leach	PP300	28.5	1800	10	0.25						Scrubber with packing and circulation system
Pressure TIVAN [®] Leach	PP310	28.7	1100	10	0.10						Scrubber with packing and circulation system
Residue Conditioning	PP320	28.7	1300	15	0.40					0.40	Filter and scrubber with packing and circulation system
Vanadium precipitation	PP330	38.5	100	10	0.08						Scrubber with packing and circulation system
Ferric Oxidation	PP350	33.5	1900	10	0.28						Scrubber with packing and circulation system
Oxide Roasting Off gas	PP360	40	1900	10	0.57					0.57	Venturi scrubber and scrubber with packing and circulation system
Oxide Roasting Exhaust Air	PP360	18	800	15	0.00					0.08	Filter
Acid Regeneration Off gas	PP370A-PP370J	40	1200	10	0.23	0.11				0.23	Venturi scrubber and scrubber with packing and circulation system
Acid Regeneration bin vent	PP370A2-PP370J2	20	700	15						0.06	Filter on bin
Tank Fume Exhaust	PP380	9	100	0	1.2 x 10 ⁻⁵						Scrubber with packing and circulation system

Infrastructure	ID	Stack height	Stack diameter	Exit velocity	Pollutant						Pollution control
		(m)	(mm)	(m/s)	HCl	Cl ₂	NH ₃	SO ₂	NO ₂	PM ^a	
Vanadium Upgrade	PP400	22	400	15			0.39				Venturi scrubber and scrubber with packing and circulation system
Sulphate Plant	PP500	100	1600	15				39.53			Multiple scrubber system
Sulphate Plant	PP500A	40	700	15				1.5			Not yet determined
Pigment Treatment	PP510	10	1300	15							Dust filter scrubber
Steam Supply Off gas Cleaning	PP710	25	3900	15	1.79			53.8		1.79	Dust filter scrubber
Power Station	PP780	20	2700	15				0.43	12.88		Not yet determined

* 1.5 times the highest wind velocity recorded in Darwin in 2020

^a PM emission rate conservatively modelled as TSP, PM₁₀ and PM_{2.5} emissions

The WRP will also require ventilation stacks within the facility. **Table 2-26** details the stack diameter, heights and location. The key pollutant expected as a result of the WRP is ammonia, however emissions are anticipated to be less than 5 parts per million (**ppm**). An ammonia monitoring station will be installed at the vacuum pumps to monitor these emissions.

Table 2-26. Ventilation stack air flowrate, height and diameter for WRP equipment.

Infrastructure	Source	Air flowrate	Stack height	Stack diameter	Exit velocity	Pollution control
		(m ³ /h)	(m)	(mm)	(m/s)	
WRP	Raw water storage tank	1351	9	300	5*	
	Clarified Water Storage Tank	1351	8	300		
	UF Permeate Tank	1238	9	300		
	RO3 Permeate Tank	1076	11	300		
	RO3 Reject Water Tank	162	11	100		
	RO4 Permeate Tank	982	11	250		
	RO4 Reject Water Tank	94	11	100		
	MEE Condensate Tank	227	17	150		
	Sludge Drying Oven	1400	17	300		Air filter
	Vacuum Pump	3.2	17	100		Ammonia monitoring station

Fugitive source emissions data from Project operations are listed in **Table 2-27**.

Table 2-27. Fugitive source emissions data

Source type	Effective height (m)	Initial sigma y (m)	Initial sigma z (m)	TSP emission rate (g/s)	PM ₁₀ emission rate (g/s)	PM _{2.5} emission rate (g/s)
Stockpile wind erosion (ROM)	10		0.5	0.4	0.2	0.04
Handling of stockpiles (FEL)	8	2	2	0.07	0.03	0.007
Truck unloading (UL)	10	2.5	2.5	0.3	0.1	0.03

2.6.3 Greenhouse Gas Emissions

GHG emissions from Project operations have been updated and calculated in terms of CO₂ equivalence (CO₂eq). Direct emissions are likely to be 944,020 tonnes per annum (**tpa**) CO₂eq based on 7000 hrs per year of operation. Indirect CO₂ emission are calculated at 248,383 tpa CO₂eq. Thus, the updated total of the annual Direct and Indirect Emissions for the Project is 1,192,401 tpa CO₂eq.

Further discussion on GHG impacts are included in **Section 1.1** of this Supplement.

2.6.4 Odours

Given the sources and compositions of emissions to the atmosphere described above there are no significant sources of odour and as a consequence, impacts on odour in the surrounding air environment from the Project are expected to be negligible.

2.6.5 Noise

An updated Noise Impact Assessment has been undertaken for the EIS Supplement and is included in **Appendix H**.

As part of the revised Noise Impact Assessment, baseline noise monitoring was conducted over a longer time period (seven days) than the previous assessment presented in the Draft EIS (three days). The longer period of noise monitoring has provided the assessment with a more robust baseline for the Project.

A review of sensitive receptors was also undertaken and resulted in the removal of the future Weddell Urban Area from the updated Noise Impact Assessment, as this development is no longer proposed to occur. The suburbs of Bellamack (2.7 km from nearest boundary) and Virginia (4.8 km from nearest site boundary) remain as sensitive receptors, along with the Bladin Village workers accommodation camp (4.3 km from nearest boundary). **Figure 2-38** indicates the location of these receptors.



Figure 2-38: Sensitive receptor locations surrounding the Project site

The latest design information was input to update the noise modelling for the Project. Noise emission impacts during the construction phase of the Project are predicted to improve as a result of the updated Noise Impact Assessment, largely due to the exclusion of the Weddell Urban Area as a sensitive receptor. With the exclusion of the Weddell receptor, construction noise emissions have improved from what was presented in the Draft EIS (section 7.11.6.4). Noise emissions are now predicted to comply in every scenario, at every sensitive receptor except during non-standard hours (7pm – 7am) in worst case climatic conditions. In this scenario, noise emissions at all three sensitive receptors will not comply with the relevant criteria. Information on how this noise exceedance will be mitigated is detailed in **Section 1.1** of the Supplement.

Outcomes of the noise assessment during the operational Phase are not predicted to change as a result of the updated noise modelling. Operational noise emissions from fixed and mobile plant on site, including rail siding operations and freight are predicted to comply with the applicable criteria during all time periods and in both neutral and worst case weather conditions at all sensitive receivers surrounding the Project site. Further information on noise impacts can be found in the section 3.5 (Environmental Factor: Community and Economy).

2.7 ALTERNATIVES

Section 4.3 of the Draft EIS discusses alternatives considered for the Project relating to the following:

- Alternative Project Locations
- Alternative Processing Methods
- Alternative Management Techniques
- Alternative Energy Sources
- Alternative Decommissioning and Rehabilitation Options

The Supplement provides additional information on the following:

- Alternative Energy Sources (**Section 2.7.1**)
- Alternative Water Sources (**Section 2.7.2**)
- Alternative Development Envelope (**Section 2.7.3**)

The impact of the proposed Project and alternatives on Matters of National Environmental Significance (**MNES**) is discussed in **Section 4.3**.

2.7.1 Alternative Energy Sources

The Darwin Processing Facility will require 1597 TJ/annum of electrical power. TNG has considered alternative energy sources to generate power for the Project. A Greenhouse Gas Discussion Paper produced for the Project identifies suitable technologies and compares the carbon-equivalent cost of these in terms of GHG production per energy production. The full report is included in **Appendix I**.

When considering emissions for different sources of energy for power generation, TNG used life cycle assessments of each energy source to provide a realistic comparison. **Table 2-28** lists the emission outputs for different energy sources, some of which are not likely to be considered for the TNG processing operation. Technologies such as offshore wind, tidal, wave and roof top solar photo voltaics have not been included as they are either pre commercial technologies or unsuitable for the location or application.

Table 2-28. Life cycle CO₂ equivalent (including albedo effect) from selected electricity supply technologies. Arranged by decreasing median of the amount in grams of CO₂ equivalent produced per kilowatt (gCO₂eq/kWh) values. Source: IPCC (2014).

Technology	gCO ₂ eq/kWh		
	Minimum	Medium	Maximum
Coal – PC	740	820	910
Natural Gas – Combined Cycle	410	490	650
Oil	325	375	430
Biomass – Dedicated	130	230	420
Solar Photo Voltaics – Utility Scale	18	48	180
Geothermal	6	38	79
Concentrated Solar Power	8.8	27	63
Nuclear	3.7	12	110
Wind Onshore	7	11	56

Although the life cycle analysis presented above suggest that technologies such as biomass, large scale solar, wind power and nuclear are very attractive, there are a range of other factors which render many of them problematic in terms of servicing a large, energy intensive, industrial facility. Nuclear power for example can be excluded given the very long lead times for approval and construction, lack of scalability to suit the energy demands of the Northern Territory grid and significant socio-political concerns. Biomass power is superficially attractive but faces difficulties in locating and securing long-term sources of Biomass fuel.

Wind velocity is too low in the Darwin area to be practically viable. Regular cyclone activity in the Darwin area also makes the safety and reliability of wind power unacceptably low.

The intermittent nature of wind and solar power mean they need to be supported by expensive batteries or be able to secure back-up power from the grid. A solar array capable of supplying the required power would require several hundred hectares of space for the panels alone. It is assumed other support infrastructure would be required in addition to this such as roads and buildings. The array would need to be close to the Facility for power efficiency reasons. As the land parcels surrounding the Project are predominantly high quality habitat, the land clearing required would present significant environmental impact.

Given the size and scale of the activities to be undertaken at the site during construction and operations, solar energy is not considered a viable power supply. The technology required to supply reliable baseload power from wind and solar sources is still evolving, with solar likely to be the most attractive alternative source of electricity for the Darwin Processing Facility in the future. TNG will continue to evaluate progress on solar technology, with a view to incorporate solar into the Project in the future, is applicable.

In view of the current situation, gas represents the most consistent, viable and reliable option for power generation during operation of the Darwin Processing Facility. The availability of Natural Gas in the Darwin area supports low cost electricity generation for the Project. TNG has committed to developing a Greenhouse Gas Management Plan (GGMP) that will include an appropriate GHG offset package.

2.7.2 Alternatives water sources

The Draft EIS proposed the key water source for the Project to be the Darwin Water Supply. A review of water requirements has been undertaken, however, the Processing Facility remains a water intensive process. The option of Darwin Water Supply being the main source of water has been considered and determined inappropriate based on social and environmental grounds.

Project components related to water requirements, infrastructure and management have been assessed, for which alternatives have been identified for the Supplement. These alternatives have been developed with consideration for issues raised by stakeholders through submissions following the public comment period of the Draft EIS.

Table 2-29 lists the alternatives that have been adopted for the Supplement and how they adopt the hierarchy of approaches in accordance with Part 2 Section 27 of the EP Act.

Through the detail design phase of the Project it is expected that further alternatives may become available. Alternatives will be preferentially adopted where the outcome complies with the hierarchy of approaches in accordance with Part 2 Section 27 of the EP Act.

Table 2-29. Alternatives for water requirements, infrastructure and management developed for the Supplement

Aspect	Draft EIS	Supplement	Waste Management Hierarchy
Stormwater	All stormwater within the Development Envelope will be directed to the WWTP and disposed of as liquid waste through the Ocean Outfall	Rainwater will be intercepted on roof surfaces within the Development Envelope and diverted to a rainwater pond for reuse Stormwater captured on ground surfaces within the Development Envelope will be recycled through the bioretention basins or the WRP	Avoidance of the production of waste Recycling of waste
Wastewater	Wastewater from Production will be disposed of through the Ocean Outfall Wastewater from the Sewage treatment plant will be used to irrigate lawns	Wastewater from Production will be recycled through the WRP Wastewater from the Sewage Treatment Plant will be recycled through the WRP	Avoidance of the production of waste Recycling of waste
Water supply	11 GL/a of water demand from the Darwin Water Supply	3.85 GL/a of water demand from the Darwin Water Supply with the deficit made up with recycled water from the WRP and harvested water from Stormwater	Minimise waste

2.7.3 Alternatives development envelope

An increase in development envelope of 6.5 ha is required, following progression of FEED and inclusion of the WRP. An alternative considered for the additional disturbance area was an increase in footprint in the northern peninsula.

Upon review of terrestrial factors and consideration of potential rehabilitation areas, it was determined that a more appropriate option was inclusion of the WRP on the southern peninsula and a reconfiguration of the southern peninsula development footprint, which provided a better environmental outcome.

TNG LIMITED

SUPPLEMENT TO THE
ENVIRONMENTAL IMPACT STATEMENT
DARWIN PROCESSING FACILITY

**UPDATES TO KEY
ENVIRONMENTAL
FACTORS**

3. UPDATES TO KEY ENVIRONMENTAL FACTORS

Environmental factors are elements of the environment that may be impacted by any aspect of a proposal. NT EPA Environmental Factors and Objectives Version 2.0 (NT EPA 2021), classifies 14 environmental factors to guide the structure of formal EIA in the NT. The potential impacts of a proposal are assessed against the NT EPA's Objectives for each factor to determine whether the impacts of a proposal are likely be significant.

As the ToR for the Project (NT EPA 2016) was released prior to the publication of NT EPA Environmental Factors and Objectives (NT EPA 2018), it does not identify specific Environmental Factors that the EIS must address. Discussions between the NT EPA and the Proponent subsequent to publication of the NT EPA (2018c) document identified Environmental Factors that were applicable to the Draft EIS.

Not all Factors applicable to the Project are addressed in the EIS Supplement, as the impacts and risks for those Factors has not changed from that presented in the Draft EIS as a result of Project amendments.

Factors associated with the marine environment were considered Key Factors through the Draft EIS, given that wastewater was proposed to discharge directly to the Darwin Harbour. The revised Project presented in this Supplement does not incorporate any direct impacts to the marine environment, with the removal of wastewater discharge. As such, it has been determined that Factors related to marine impacts are no longer Key Factors for the Project. It is, however, acknowledged that the Project is operating adjacent to a sensitive marine environment and therefore additional information and assessment of impacts has been included in the Supplement in **Section 1** and the Project risk assessment (**Appendix Q**).

Table 3-1 lists the factors addressed in the Draft EIS with comments on their inclusion, lack of inclusion, or change in status for the Supplement.

Table 3-1. Factors addressed in the Draft EIS and EIS Supplement

Factor	Draft EIS	Supplement	Key Environmental Factor	Comment
Terrestrial Environmental Quality	✓	✗	Yes	No changes to the Factor as presented in the Draft EIS were required to address NT EPA or public submissions. No amendments to the Project have resulted in changes to the risk to Terrestrial Environmental Quality from the Draft EIS. Submission 57 (Section 4.2) requested further information regarding management measures and Acid Sulphate Soils. This submission has been addressed by updating the Acid Sulphate Soils Management Plan with reference to the updated Groundwater Technical Study and the Stormwater Management Plan prepared for the EIS Supplement. This information is presented in the Factor Inland Water Quality (Section 1.1).
Terrestrial Flora and Fauna (Updated factor is: Terrestrial Ecosystems)	✓	✓	Yes	Additional information is presented on the Existing Environment for terrestrial flora and fauna in relation to the Project. Assessment is made on the Significance of the impact to MNES. Discussion is provided on how the proposal aligns with guidance. The further detail and Project changes described in Section 2 are taken into account when reviewing the mitigation and monitoring proposed in the Draft EIS and supplementary measures are proposed.
Hydrological Processes	✓	✗	Yes	No changes. Further information is available for groundwater at the site however that has been discussed and interpreted in relation to the risk of pollution and is addressed in the Inland Water Environmental Quality Factor.
Inland Water Environmental Quality	✓	✓	Yes	Further technical studies have been conducted to better understand and assess the risk from potential contaminants to groundwater and surface water. With this increased understanding, the mitigation and monitoring proposed in the Draft EIS has been reviewed and supplementary measures are proposed.
Marine Environmental Quality	✓	✓	No	Considered a Key Environmental Factor for the Draft EIS. Project amendments detailed in Section 2 for the EIS Supplement (particularly removal of wastewater discharge from the Project scope) have changed the status of this Factor. Additional information was requested by Stakeholders through the Draft EIS consultation period. The Factor is addressed in Section 1 (Other Environmental Information) to provide the requested detail or the reasoning for why it is no longer applicable.

Benthic Habitats and Communities (Updated factor is: Marine Ecosystems)	✓	✓	No	Considered a Key Environmental Factor for the Draft EIS. Project amendments detailed in Section 2 for the EIS Supplement (particularly removal of wastewater discharge from the Project scope) have changed the status of this Factor. Additional information was requested by Stakeholders through the Draft EIS consultation period. The Factor is addressed in Section 1 to provide the requested information or the reasoning for why it is no longer applicable.
Marine Flora and Fauna (Updated factor is: Marine Ecosystems)	✓	✓	No	Considered a Key Environmental Factor for the Draft EIS. Project changes detailed in Section 2 for the EIS Supplement (particularly removal of wastewater discharge from the Project scope) have changed the status of this Factor. Additional information was requested by Stakeholders through the Draft EIS consultation period. The Factor is addressed in Section 1 to provide the requested information or the reasoning for why it is no longer applicable.
Air Quality	✓	✓	Yes	With the progression of FEED, an additional technical study has been prepared to better understand and assess the risk from the Project in relation to Air Quality. An additional sensitive receptor, the Elizabeth River Boat Ramp, was also included in the updated Air Quality Assessment. The further detail described in Section 2 is taken into account when reviewing the mitigation and monitoring proposed in the Draft EIS and supplementary measures are proposed.
Atmospheric Processes	✓	✓	Yes	Further detail is available for impacts to this factor from the Project that are described in Section 2 . The further detail described in Section 2 is taken into account and a discussion paper has been developed to explore options for offsetting the impacts to this factor.
Social, Economic and Cultural Surroundings (Updated factor is: Community and Economy)	✓	✓	Yes	Further detail is available for impacts to this factor from the Project amendments described in Section 2 . Additional information is presented in the Existing Environment and further technical studies have been prepared to better understand and assess the risk from the Project in relation to Traffic and Noise. The Stakeholder Engagement Strategy has been revised and additional Stakeholder Engagement has taken place. The detail described in Section 2 and the results of Stakeholder Engagement has been taken into account when reviewing the mitigation and monitoring proposed in the Draft EIS and supplementary measures are proposed.
Human Health	✓	✗	Yes	No changes to the Factor as presented in the Draft EIS were required to address NT EPA or public submissions. No changes to the Project have resulted in changes to the risk to Human Health from the Draft EIS.

TNG LIMITED

SUPPLEMENT TO THE
ENVIRONMENTAL IMPACT STATEMENT
DARWIN PROCESSING FACILITY

**INLAND WATER
ENVIRONMENTAL
QUALITY**

3.1 INLAND WATER ENVIRONMENTAL QUALITY

3.1.1 NT EPA Objective

The NT EPA objective for the environmental factor Inland Water Environmental Quality (EPA 2021), is to:

Protect the quality of groundwater and surface water so that environmental values including ecological health, land uses and the welfare and amenity of people are maintained.

Whilst some aspects of the Project have changed during revision of the Draft EIS, the Project will continue to achieve the above objective for Inland Water Environmental Quality.

3.1.2 Technical Studies

Further technical studies were undertaken for the Supplement to better inform assessment of potential impacts on Inland Water Environmental Quality, due to the updated Project design and submissions from stakeholders on the Draft EIS.

Details of the technical studies are listed below in **Table 3-2**.

Table 3-2. Inland Water Environmental Quality studies undertaken for the EIS Supplement

Date	Study Title	Consultant	Description	Report
December 2020	TNG Darwin Processing Facility Stormwater Management Plan	Advisian	CSWMP and CCESCP	Appendix C
January 2021	TNG DARWIN – Groundwater Impact Evaluation	Advisian	Analysis of the risk to groundwater including the development of a simple seepage model to estimate the infiltration of dust suppression and irrigation water and subsequent mobilisation of COI's and assess the potential of COI's to migrate into groundwaters and receiving waters in Darwin Harbour and Elizabeth River.	Appendix K
January 2021	Darwin Process Plant – Waste Characterisation	Environmental Geochemistry International	Characterisation of waste products to aid in the assessment of risk associated with transport, handling and storage.	Appendix F

3.1.3 Background Information

This section is informed by the technical studies listed in **Table 3-2**, which detail further information for the existing environment to take into account any Project changes described in **Section 1**.

3.1.3.1 Stormwater

Catchments

Nine catchments have been defined for the Site, as shown in **Figure 3-1** and **Figure 3-2**. Details of the catchment sub-division are also presented in **Figure 2-27** and **Table 2-15** of **Section 1**.



Figure 3-1. Catchment Boundaries – Southern Peninsula



Figure 3-2. Catchment Boundaries – Northern Peninsula

Erosion

An erosion risk assessment was performed for the site during construction using the revised universal soil loss equation (RUSLE). The equation requires the adoption of values for the parameters rainfall erosivity factor (R), soil erodibility factor (K), combined slope length and gradient (LS), the type of ground cover (C) and the land management practice (P).

R is a measure of the ability of rainfall to cause erosion. The BPESC (IECA, 2008) provides tables of R values for various locations in Australia, with Darwin's annual R-Factor = 4,245 (Table E2 in BPESC). An R-Factor of 13,738 is the current recommendation from the Darwin Harbour Advisory Committee (NT Department of Environment, Parks and Water Security 2020, Advisian personal communication 12 November); the more conservative R-Factor of 13,738 has been used for the Site.

Monthly R-Factor and erosion risk rating has been assessed based on the annual R-Factor (13,738) and Table 4.4.1 of BPESC (IECA 2008), as shown in **Table 3-3**.

Table 3-3. Monthly R-Factor and Erosion Risk Rating

Month	R-Factor	Erosion Risk Rating
January	4,208	Extreme
February	3,025	High
March	2,145	Low
April	798	Very Low
May	83	Very Low
June	14	Very Low
July	0	Very Low
August	0	Very Low
September	55	Very Low
October	344	High
November	894	High
December	2,173	Extreme

K is a measure of the susceptibility of soil particles to detach and transport by rainfall and runoff. The K-factor for each catchment has been selected based on soil baseline assessment work conducted for the Draft EIS, soil analysis at the nearby Ichthys INPEX site and Tables E3 and E4 in BPESC (IECA, 2008).

For LS, a default slope length for overland flows of 80m has been used as recommended by IECA (2018) and LS-factors were determined for each catchment using Table E3 in BPESC (IECA, 2008).

C measures the combined effect of all the interrelated cover and management variables. C for undisturbed land is derived from satellite imagery (Viscarra Rossel et al. 2016). Disturbed areas assume the default C-Factor for construction sites of 1.

P measures the combined effect of all support practices and management variables, along with structural methods for controlling erosion. P-Factor for undisturbed land was determined by averaging values derived from satellite imagery (Viscarra Rossel et al. 2016). Disturbed areas assume the default P-Factor for construction sites of 1.3 (IECA 2008).

Using the parameter values as described above, the baseline erosion for the Site was predicted and is listed in **Table 3-4** for each catchment.

Table 3-4. Annual baseline erosion per catchment for construction

Catchment	LS-Factor	Baseline K-factor	Baseline erosion (t/ha/yr)
N1	0.41	0.02	2.53
N2	0.41	0.03	5.07
S1	0.41	0.03	5.07
S2	0.65	0.03	5.36
S3	0.65	0.03	8.04
S4	0.41	0.03	3.38
R1	0.78	0.03	9.64
R2	0.65	0.03	5.36
R3	0.30	0.03	2.47

Stormwater flows

Stormwater is a potential pathway for Contaminants of Interest (COIs) to be transported from sources to receptors. The CSWMP prepared for the EIS Supplement provides further detail on the expected changes to stormwater as a result of the Project, and allows a refinement of the assessment of risk.

The proposed land use at the Site will vary the amount of stormwater runoff generated during rainfall. **Table 3-5** lists the proposed land surface covers for each catchment during the Operations phase.

Table 3-5. Land uses per catchment during the Operations phase

Catchment	Road area		Buildings/hardstand		Grassed areas	
	ha	%	ha	%	ha	%
S1	0.15	0.5	18.29	67.0	8.86	32.5
S2	1.61	4.9	6.99	21.2	24.30	73.9
S3	8.04	16.0	12.31	24.4	30.05	59.6
S4	3.79	14.6	5.93	22.8	16.28	62.6
N1	9.58	23.4	9.59	23.4	21.83	53.2
N2	5.90	15.7	11.07	31.1	20.63	54.9
R1	2.03	19.5	0.17	1.6	8.20	78.8
R2	3.03	25.3	0	0	8.97	74.8
R3	3.60	26.5	0	0	10.00	73.5

The peak pre-development stormwater flows at the Site were determined for each catchment based on the following parameters:

- The runoff coefficients were selected based on guidance from *Australian Rainfall and Runoff Guideline (ARR)* (2019), assuming a land description of light cover bushland and a medium to low soil permeability. The adopted coefficient was 0.74 for the 20 Year Average Recurrence Interval (ARI) and 0.77 for the 100 Year ARI events
- The time of concentration was determined, as recommended by ARR (2019), by use of the Bransby Williams equation.

Parameters used for post-development flows calculations were:

- The runoff coefficients were selected based on guidance from the *Development and Subdivision Standards of the Litchfield Council* (2017). As per the standards, the impervious coefficients adopted were 0.95 for the 20 Year ARI event and 1.0 for the 100 Year ARI event. For the pervious areas, the higher conservative coefficients from the *Queensland Urban Drainage Manual* (IPWEA 2016) were adopted as 0.74 for the 20 Year ARI event and 0.84 for the 100 Year ARI event.
- The time of concentration was determined based on sheet flow from the pervious areas up to a maximum of 200 m using Friend's equation and assuming a Norton's roughness of 0.035 and a velocity in the open channel drainage system in the order of 1.0 to 1.2 m/s. Alternatively for the building and hardstand areas a standard inlet time of 5 minutes was adopted. As per the *Development and Subdivision Standards of the Litchfield Council* (2017), for urban areas a typical maximum time of concentration of 20 minutes is adopted; therefore, conservatively a 20 minute maximum time of concentration has been adopted for all sub-catchments on the site.

The calculated pre-development and post-development flows are presented in **Table 3-6**, along with an indication of the differences. There is a general increase in the peak flow for the 20 year and 100 year ARI events post-development, although it should be noted that post-development flows are conservative as attenuation measures have not been factored into calculations.

Further detail is contained within **Appendix C**.

Table 3-6. Calculated stormwater flows

Catchment	Catchment Area (ha)	20 Year ARI Peak Flow (m ³ /s)			100 Year ARI Peak Flow (m ³ /s)		
		Pre-development	Post-development	Difference	Pre-development	Post-development	Difference
S1	27.3	7.8	10.7	2.9	10.4	14.9	4.5
S2	32.9	14.1	13.6	-0.5	18.9	19.5	0.6
S3	50.4	13.9	18.4	4.5	18.6	26.2	7.6
S4	26.0	8.8	11.1	2.3	11.8	15.8	4.0
N1	41.0	13.9	15.3	1.4	18.5	21.5	3.0
N2	37.6	12.4	13.9	1.5	16.6	19.7	3.1
R1	10.4	3.5	3.6	0.1	4.7	5.2	0.5
R2	12.0	3.4	4.2	0.8	4.5	6.1	1.6
R3	13.6	3.7	4.8	1.1	4.9	6.9	2.0

This increase in peak flow will be offset by stormwater harvesting for the Processing circuit. The volume of water to be harvested is not yet determined, and further water balance modelling will be conducted to optimise this volume. The volume of stormwater reporting to the Elizabeth River will also likely be attenuated by infiltration. The locations of discharge are dispersed across the site and are discharged to land. This will allow opportunity for the water to infiltrate into the shallow lateritic aquifer and be available for transpiration by the vegetation fringing the Development Envelope.

3.1.3.2 Groundwater

Additional wet season groundwater monitoring is required to augment the data from the May to September 2019 sampling (Golder 2019). This is necessary to inform detailed design of water storage infrastructure and provide baseline data to allow long term monitoring to identify any changes.

Loggers were installed in September 2020 in the locations shown in **Figure 3-3**. Depth of the water table and water quality parameters taken in September 2020 are shown in **Figure 3-4** and **Figure 3-5** respectively for the cross section running east-west through the southern peninsula and intersecting with bores BH08 and BH09.

Depth of the water table and water quality parameters taken in September 2020 for the cross section running north-south through the southern peninsula and intersecting with bores BH10, BH07, BH02 and BH08 are shown in **Figure 3-6** and **Figure 3-7** respectively. Depth to the water table and water quality will continue to be monitored through the 2020/21 wet season.

TNG LIMITED

**MOUNT PEAKE PROJECT
DARWIN SITE**

**Waterbore Locations
Parcel 1817 and
Kittyhawk Site**

Author: CW	Date: Nov 2020
Enigma Mining Ltd	Filename.mxd

PLAN 1

8612000

8610000

8608000

712000

714000

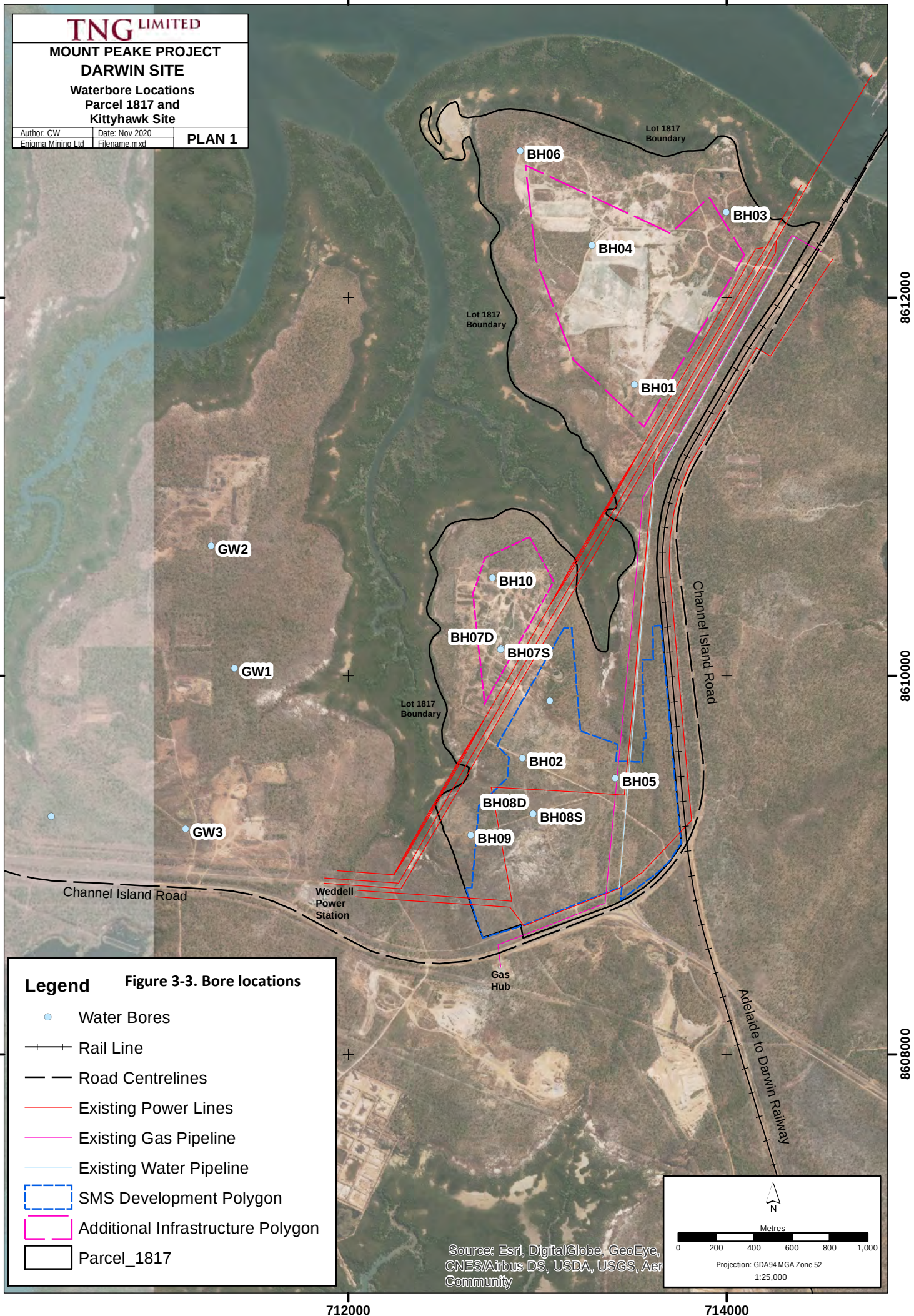
8612000

8610000

8608000

712000

714000



Logger Installation Record

TNG Darwin Plant Site Hydrogeology

Cross Section B – Plant Site, East-West

Standing Groundwater Level – September 2020

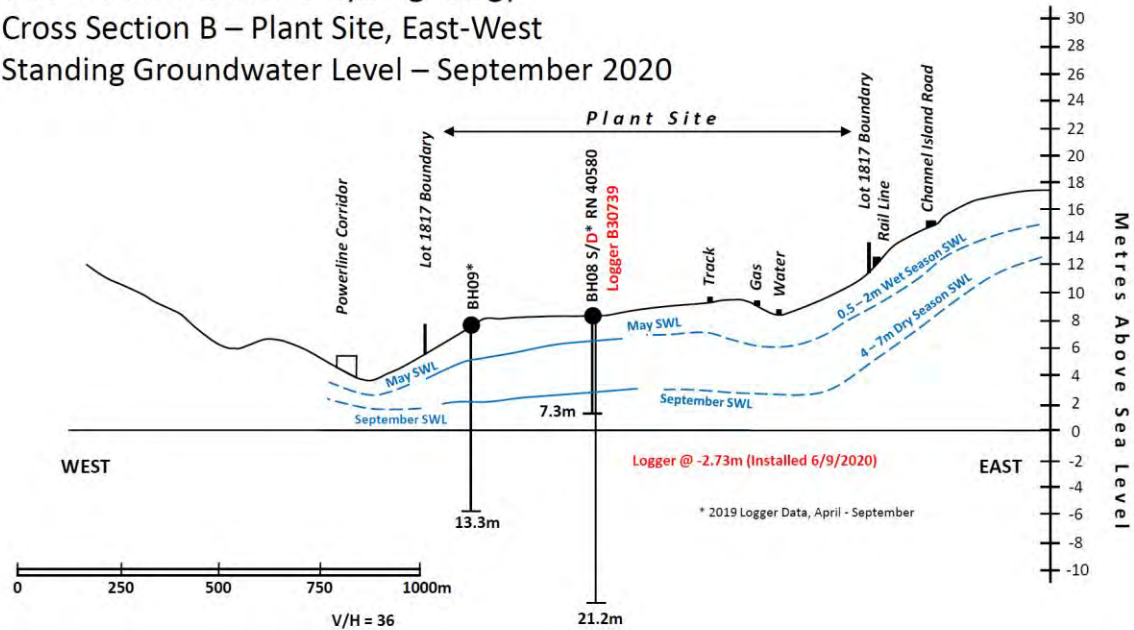


Figure 3-4. Depth to water table for bores BH08 and BH09 September 2020

TNG Darwin Plant Site Hydrogeology

Cross Section B – Plant Site, East-West

Water Quality – September 2020

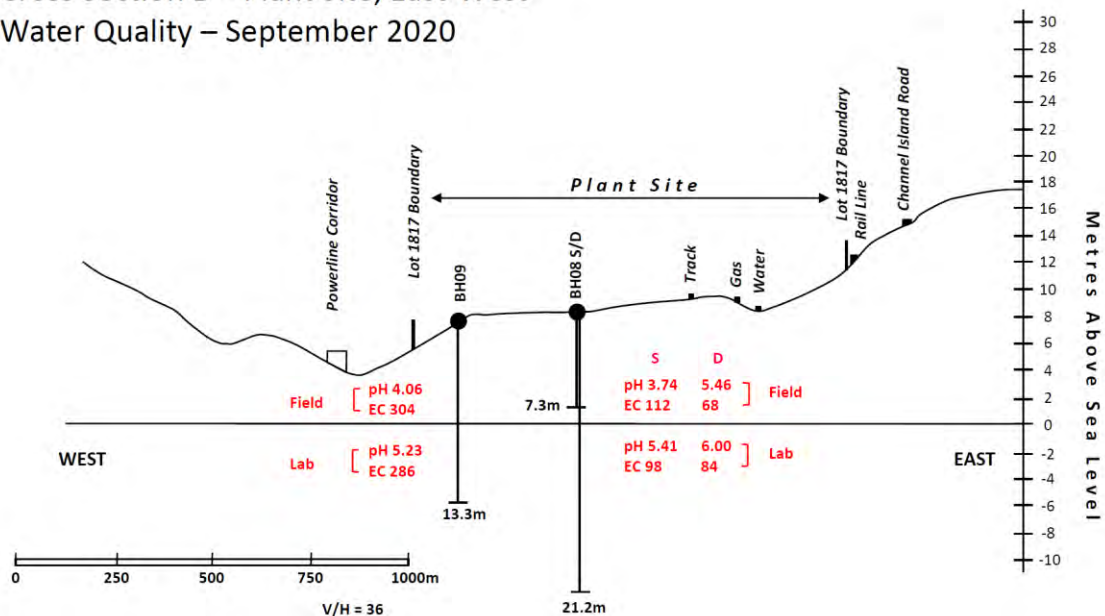


Figure 3-5. Water quality for bores BH08 and BH09 September 2020

Logger Installation Record

TNG Darwin Plant Site Hydrogeology

Cross Section A – Plant Site, North-South

Standing Groundwater Level – September 2020

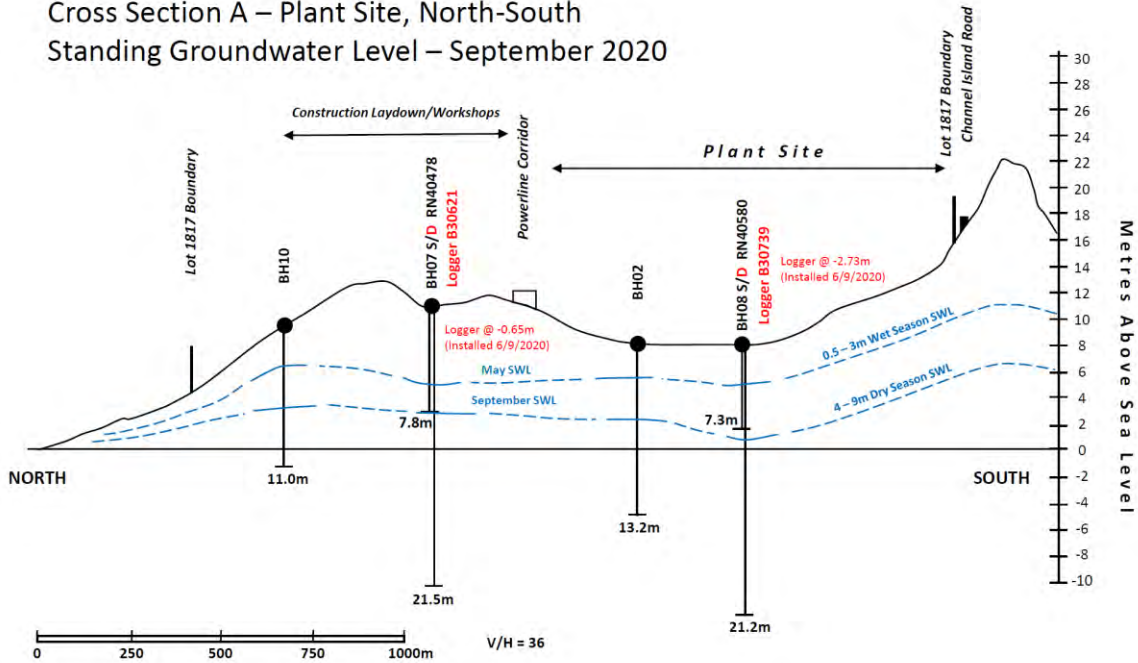


Figure 3-6. Depth to water table for bores BH10, BH07, BH02 and BH08 September 2020

TNG Darwin Plant Site Hydrogeology

Cross Section A – Plant Site, North-South

Water Quality – September 2020

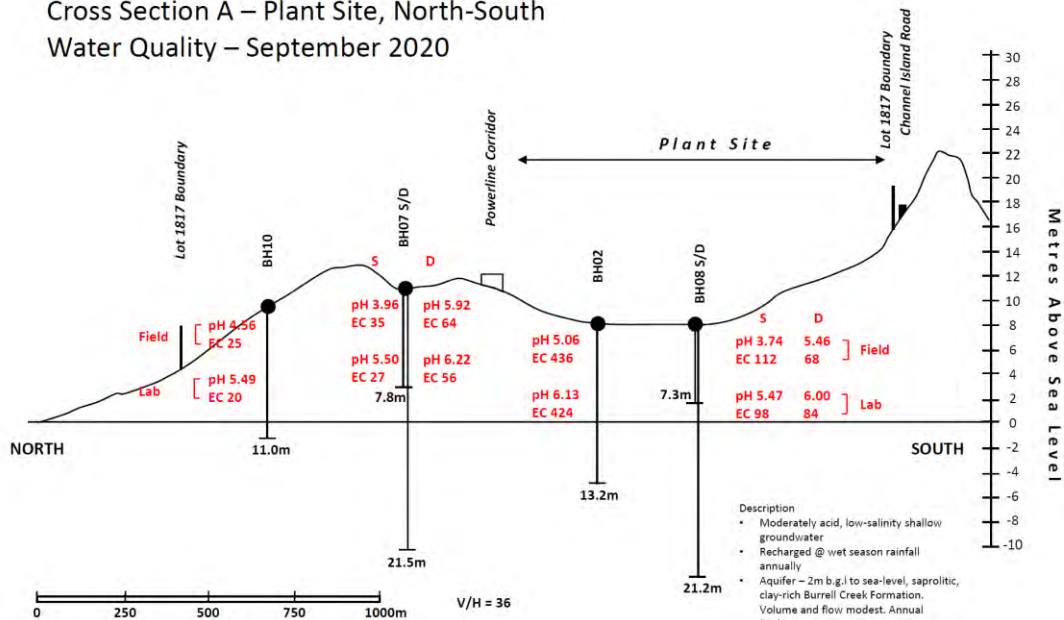


Figure 3-7. Water quality for bores BH10, BH07, BH02 and BH08 September 2020

The groundwater table is within the silts and clays of the weathered Burrell Creek Formation (**BCF**) during the dry season. The overlying laterite is mainly unsaturated, with groundwater flow occurring in the low permeability weathered BCF. During the wet season, groundwater levels rise due to rainfall recharge, resulting in the laterite becoming partially saturated with localised groundwater inundation/ponding where the laterite is thin (Advisian, 2021b).

Two aquifers exist with the site and are in hydraulic continuity. The shallow unconsolidated lateritic aquifer behaves as unconfined (Golder, 2019) and the cohesive weathered BCF aquifer, which is of low permeability. Regional flow is in a north-westerly direction towards the Elizabeth River, with local groundwater flowing radially from the higher elevated areas in the centre of each peninsular. Final groundwater discharges are into the tributaries to the west, and north east of the site and the Elizabeth River to the north (Golder, 2019).

Considering the lithology of the weathered BCF and its aquifer characteristics of low permeability and hydraulic conductivity, flow/movement of groundwater through this layer is likely to be very low (Advisian, 2021b). Further detail on groundwater characteristics is also presented in **Section 4.1.2.5**.

3.1.3.3 Wastes

Waste streams have been assessed by EGI (2021), as described in **Section 2.4** and **Appendix F**. The environmental risk profile in terms of readily soluble fraction was noted as moderate to high for the following wastes (or by-products):

- Acid waste neutralisation gypsum
- WRP salt residue

In order to manage waste materials, TNG has incorporated immediate deposition of waste products into transport containers to negate any requirement for stockpiling. In addition, handling of waste materials will be within bunded operational areas.

3.1.4 Potential Impacts and Risks

The source-pathway-receptor model (**Table 3-7**) used in the Draft EIS has been adopted to identify the additional impacts and risks to this factor, with further detail provided in the sections below. **Table 3-7** supersedes Table 7- 38 in the Draft EIS.

Table 3-7. Potential pathways for impact to inland water environmental quality

Source	Pathway	Receptor
Sedimentation from construction activities	- Clearing of vegetation - Earthworks for site preparation	
Potential COIs in stockpiles	- Surface run-off - Seepage via misting / fogging / spray	
Potential COIs within chemicals and reagents	Surface run-off following spillage	
Potential COIs within waste	Surface run-off following spillage	Groundwater under site
Potential COIs within products	Surface run-off following spillage	Tributaries
Potential COIs within treated waste water used for irrigation	Seepage in irrigated areas	Sensitive Environmental Receptors in Elizabeth River and Darwin Harbour
Potential COIs within existing soils at site including Actual Acid Sulfate Soils (AASS)	- Exposure of AASS through excavation during construction - Seepage in irrigated / bare land / unlined operational areas	
Potential COI's within water storage infrastructure	Seepage	

3.1.4.1 Potential COI's

There are five potential sources of COIs associated with the operation of the Project;

1. Products (V_2O_5 , TiO_2 , ferric oxide)
2. Stockpiled materials (magnetite concentrate, petcoke)
3. Chemicals and Reagents (including several acids, bases, oxides, hydroxides, polymers, inorganic salts, hydrocarbons)
4. Waste (as listed in **Section 2.4**)
5. AASS

Despite the addition of chemicals and reagents associated with the WRP, and the inclusion of several different waste streams within the Supplement, potential impacts described in the Draft EIS (section 7.6.4.2) remain current.

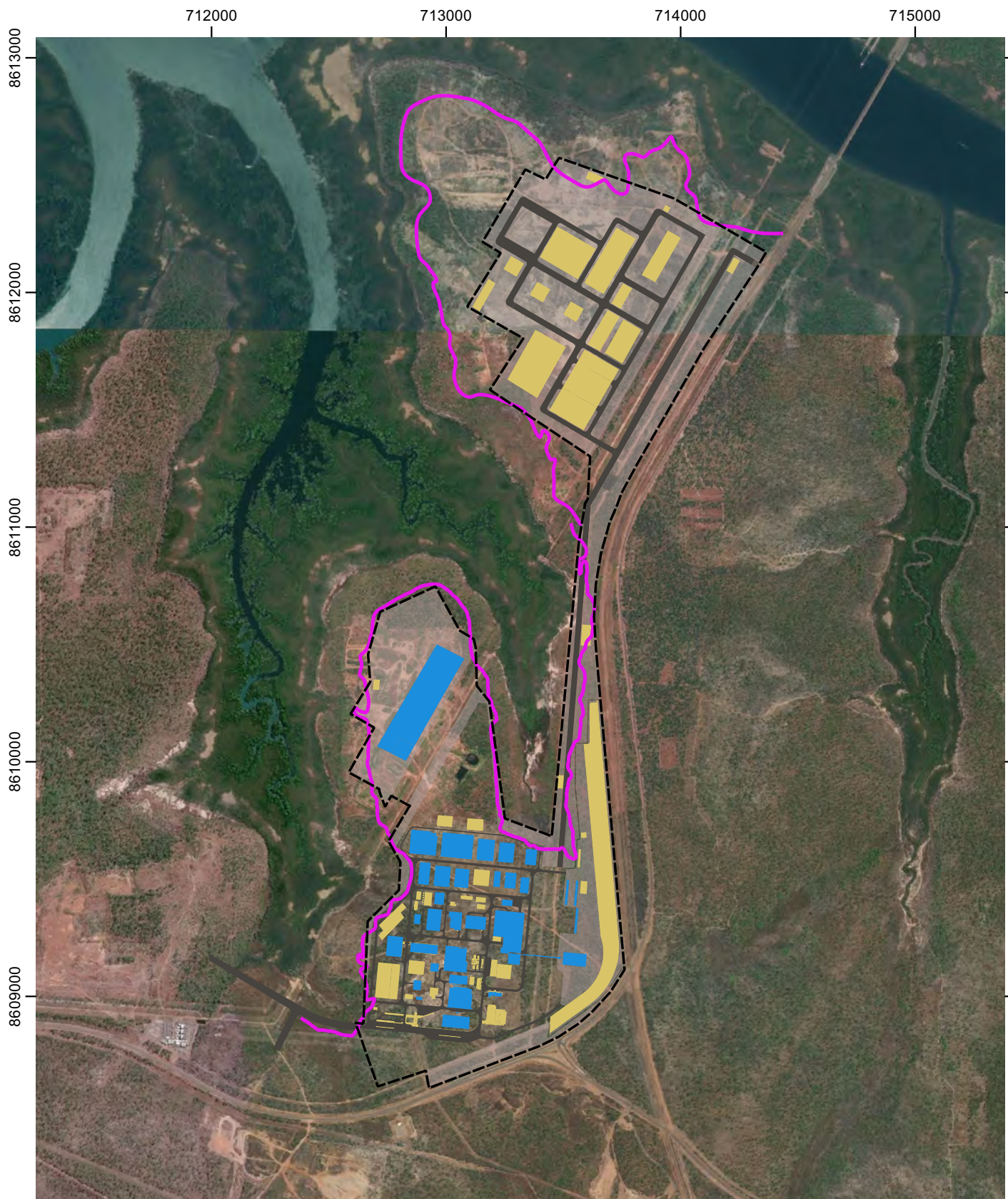
Specifically, there is potential that the chemical qualities of the surface and groundwater could be impacted by leaks or spills of chemicals, reagents, concentrates, hydrocarbons or waste products during construction and processing activities, should containment measures fail. There is a higher level of inherent risk (pre-mitigation) associated with alteration of the chemical characteristics of the surface water and groundwater considering it is likely to discharge to the Elizabeth River, tributaries and ultimately, Darwin Harbour.

Project infrastructure has been situated outside of the 1:1000 year storm surge elevation (**Figure 3-8**). It is, however, recognised that a 1 in 10,000 year event has the capacity to result in a significant release of hazardous materials. It is considered that the likelihood of such an event occurring is extremely low and impacts from substance release may be reduced through amplified dilution rates associated with increased water volumes from the storm surge.

The risk associated with increased stormwater flows is acknowledged as a potential pathway for transporting COIs from sources to receptors. Implementing primary containment measures will reduce the risk of COIs entering the stormwater system. Reducing the volume of untreated stormwater discharging to the environment from operational areas will also reduce the transportation of COIs off site.

The potential for liberation of acid through exposure of AASS is a possibility, given requirements for excavation works during the construction period. Project updates detailed in the Supplement have not altered the potential impacts for AASS described in section 7.6.4.1 of the Draft EIS; risk to inland water quality from AASS remains as a medium to high risk if there is no active management of exposed AASS.

The Project updates have been incorporated into a revised ASS Management Plan, provided as **Appendix L**.



Legend

- Sources of potential COIs are stored, used or transported
- General infrastructure
- EIS Supplement Development Envelope
- 1 in 1,000 year Storm Surge Elevation

Darwin Processing Facility EIS Supplement

Figure 3-8. Source of potential COIs in relation to the 1 in 1000 year storm surge elevation

TNG LIMITED



0 250 500 m



Scale when printed in A4 is 1: 23,000
Date drawn: 30/01/2021
CRS: GDA 1994 MGA Zone 52

3.1.4.2 Sedimentation

The Draft EIS identified sedimentation of surface water as a result of clearing activities and earthworks during construction to be a risk to the quality of inland waters (Section 7.6.4.3). The CCESCP prepared for the Supplement provides further detail on the nature and magnitude of the risk.

The RUSLE was applied to the site using parameter values estimate to reflect the construction phase. These were compared to the baseline values and the risk of erosion determined. The risk of erosion for each catchment during the construction phase is listed in **Table 3-8**.

Table 3-8. Erosion risk rating during the construction phase

Catchment	Construction K-factor	Construction erosion rate (t/ha/yr)	Erosion risk
N1	0.03	219.67	low
N2	0.03	219.67	low
S1	0.07	483.28	moderate
S2	0.07	766.17	high
S3	0.07	766.17	high
S4	0.04	322.18	moderate
R1	0.03	417.91	moderate
R2	0.03	348.26	moderate
R3	0.03	160.73	low

As the R factor has a high monthly variability due to the distinct wet and dry seasons in Darwin, the erosion risk was calculated on a monthly basis. The predicted monthly erosion rate during the construction phase for each catchment is listed in **Table 3-9**.

Table 3-9. Predicted monthly average soil loss rate (t/ha/month) during the construction phase

Month	Catchment						
	N1 and N2	S1	S2 and S3	S4	R1	R2	R3
January	67.3	148.0	234.7	98.7	128.0	106.7	49.2
February	48.4	106.4	168.7	70.9	92.0	76.7	35.4
March	34.3	75.5	119.6	50.3	65.3	54.4	25.1
April	12.8	28.1	44.5	18.7	24.3	20.2	9.3
May	1.3	2.9	4.6	1.9	2.5	2.1	1.0
June	0.2	0.5	0.8	0.3	0.4	0.4	0.2
July	0.0	0.0	0.0	0.0	0.0	0.0	0.0
August	0.0	0.0	0.0	0.0	0.0	0.0	0.0
September	0.9	1.9	3.1	1.3	1.7	1.4	0.6
October	5.5	12.1	19.2	8.1	10.5	8.7	4.0
November	14.3	31.4	49.9	21.0	27.2	22.7	10.5
December	34.7	76.4	121.2	51.0	66.1	55.1	25.4

The earthworks component of construction phase is expected to take approximately six months. Given the short timeframe, the seasonality of the risk, the relatively flat topography of the site and the availability of proven management strategies, it is not considered that sedimentation and erosion will present a long term significant impact for the Project.

3.1.5 Mitigation and Management

Mitigation measures listed in **Table 3-10** are supplementary to those in the Draft EIS. A CSWMP has been prepared for the Supplement and is included as **Appendix C**. This plan will continue to be refined through a detailed design phase.

Table 3-10. Supplementary mitigation measures for Inland Water Environmental Quality

Pathway	Mitigation hierarchy	Mitigation measure
Stormwater transporting sediment during the Construction phase	Avoid	- o Upgrade of the CCESCP (Appendix C) to include a more detailed design, incorporating further soil sampling, such as Emerson Class sampling and Jar testing, to inform sediment basin design • Install appropriate sediment control mechanisms, as determined through the updated CCESCP and the detailed design phase
Surface runoff transporting potential COIs into surface waters	Avoid	• Infrastructure associated with sources of COIs will be located above the 1000-year storm surge elevation • All runoff waters within areas where sources of COIs are stored, transported or used will be diverted into a managed water circuit separate from the general stormwater circuit, which incorporates appropriate bunding, sumps and isolation points where required. Water from these areas will be directed to the WRP for treatment. • All runoff waters within the Development Envelope (outside of areas where COIs are stored, transported or used) will be diverted into a managed water circuit for monitoring and treatment (if required) in the stormwater system or WRP • Rainfall will be intercepted on roofed spaces and diverted to a rainwater pond • The chemical bulk storage tanks will be located in suitably bunded areas adjacent to the dedicated chemical transfer bay, with consideration for <i>Australian Standard AS1940:2017</i> • Update of the CSWMP (Appendix C) to a detailed design including: - o Detailed water quality modelling - o final design of the minor and major stormwater systems, minor diversion systems and stormwater quality management features (e.g. SQUIDs, bioretention basins etc) - o detailed engineering hydraulic design/modelling - o determine the optimised stormwater harvesting design - o Operational management, monitoring and maintenance plans developed with clear responsibilities assigned to relevant site personnel; and - o The stormwater management system will be designed to effectively treats sediment, gross pollutants, nutrients and incidental hydrocarbons within stormwater runoff from non-process areas of the site.
Seepage via misting / fogging / spray transporting potential COIs into groundwater	Avoid	• Low permeability bases will be used in areas where COIs are stored, i.e., concrete floors or hardstanding • Ponds will be lined with impermeable liners to prevent seepage • Ponds will be placed above the wet season water table • Water used for dust suppression will be of suitable quality

Pathway	Mitigation hierarchy	Mitigation measure
		Waste will be containerised immediately and not stockpiled
Seepage from contaminated water used for irrigation	Avoid	- Recycle greywater through the WRP prior to use for irrigation - All waters are managed within the water circuit and monitored for quality prior to use for irrigation
Seepage of potential COIs within existing soils at the site including AASS in irrigated / bare land / unlined operational areas	Avoid	- AASS sites identified and managed according to ASS Management Plan (Appendix L) - Low permeability covering for operational areas associated with COI's ie hardstanding/ buildings/ roads - Interception of rainwater on roofed spaces
Seepage of potential COIs within ponds	Avoid	- Ponds are lined with an impervious liner - Ponds are placed above the water table

3.1.6 Monitoring and Reporting

In addition to the monitoring and reporting for Inland Water Environmental Quality proposed in the Draft EIS, the supplementary monitoring and reporting requirements are listed in **Table 3-11**.

Table 3-11. Supplementary monitoring and reporting for Inland Water Environmental Quality

Relevant Plan	Monitoring	Reporting
Stormwater Management Plan	Sediment levels in basins	Monthly Environmental Performance Report
	Condition of ESC structures and stabilised surfaces	
	Rainfall including duration and times	
Stormwater Management Plan	Periodic water quality monitoring of discharges leaving the sediment basins	Annual Environmental Report
Stormwater Management Plan	Periodic water quality monitoring of discharges leaving the bioretention basins	Annual Environmental Report

3.1.7 Statement of Residual Impacts

Inland water quality is a key consideration for construction and operation of the Darwin Processing Facility. Consistent with the outcomes of the Draft EIS, it is considered that:

- Inland surface water quality can be effectively maintained through appropriate design of facilities and integration of management of surface water infrastructure into the construction and operation of the Project;
- Groundwater quality can be maintained so that environmental values associated with groundwater are not likely to be significantly impacted.

Through implementation of the mitigating measures described above, the residual impact on inland water quality from the Project is not expected to be significant.

TNG LIMITED

SUPPLEMENT TO THE
ENVIRONMENTAL IMPACT STATEMENT
DARWIN PROCESSING FACILITY

TERRESTRIAL ECOSYSTEMS

3.2 TERRESTRIAL ECOSYSTEMS

3.2.1 NT EPA Objective

The NT EPA Environmental Objective for the Factor Terrestrial Ecosystems (NT EPA 2021) is to:

Protect terrestrial habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.

Information associated with Terrestrial Ecosystems was presented in the Draft EIS under the environmental factors Terrestrial Flora and Terrestrial Fauna. Under the combined factor, Terrestrial Ecosystems, additional information arising from amendment of the site layout, removal of mangrove clearing and consideration of submissions on the Draft EIS has been presented below.

The Project scope presented in this Supplement is congruent with the NT EPA Objective for Terrestrial Ecosystems.

3.2.2 Technical Studies

Further technical studies were undertaken for the EIS Supplement to better inform assessment of potential impacts on Terrestrial Ecosystems due to the updated Project design and submissions from Stakeholders on the Draft EIS. Details of the technical studies are listed below in **Table 3-12**.

Table 3-12. Supplementary Terrestrial Ecosystems studies

Date	Study Title	Consultant	Description	Report
January 2021	Significant Fauna Impact Assessment	APM	Impact Assessment for Significant Terrestrial Fauna	Appendix J
January 2021	Rehabilitation Management Plan	APM	Management Plan for the Rehabilitation of degraded land outside the Development Envelope	Appendix B

3.2.3 Background Information

This section supplements and updates, where appropriate, Sections 7.3 and 7.4 of the Draft EIS and considers Project changes described in **Section 1** and comments received following submission of the Draft EIS.

3.2.3.1 EPBC Matters

Comments #15 and #16 from the consolidated comments provided by the NT EPA relate to species listed under the Commonwealth EPBC Act. The proposal is a controlled action under the EPBC Act and is being assessed at the level of an EIS under the bilateral agreement between the Northern Territory and Australian Governments.

The Australian Government requires MNES to be addressed, including assessing potential significant impacts on Listed threatened species and communities (sections 18 & 18A) and Listed migratory species (sections 20 & 20A). An additional assessment of MNES relative to the updated Project scope is presented below.

Migratory Shorebirds Significant Aggregations

Twenty-six species of migratory shorebird have been regularly recorded across the Darwin Harbour region, and a further species, the Ruff (*Calidris pugnax*) has recently been recorded in the area (Lilleyman & Garnett, 2019).

Of the regularly recorded shorebird species, seven are listed threatened species under the EPBC Act. All species are listed under international conventions and bilateral agreements. **Table 3-13** lists the migratory shorebirds regularly recorded in the Darwin Harbour and their conservation status under the EPBC Act. These species are all considered MNES.

Section 4.2.2 of the ToR indicates the EIA for the Project must include an assessment of all the relevant risks of the Project to nationally significant aggregations of waterbirds. The widely accepted and applied approach to identifying internationally important shorebird habitat throughout the world has been through the use of criteria adopted under the Ramsar Convention.

According to this approach, wetland habitat should be considered internationally important if it regularly supports:

- one percent of the individuals in a population of one species or subspecies of waterbird; or
- a total abundance of at least 20,000 waterbirds.

Nationally important habitat for migratory shorebirds is defined using a similar approach to these international criteria, i.e. if it regularly supports:

- 0.1% of the flyway population of a single species of migratory shorebird; or
- 2,000 migratory shorebirds; or
- 15 migratory shorebird species.

Figure 3-9 and **Table 3-13** identify locations where Significant aggregations have been recorded. These are the beaches north of Darwin (East Point to Lee Point/Buffalo Creek), Darwin Harbour Proper, East Arm Wharf and Middle Arm. Middle Arm and East Arm Wharf are within Darwin Harbour Proper.

Internationally Significant Aggregations have been recorded for three species at Lee Point, approximately 18.5 km from the Project. Eleven species have been recorded in abundances reaching the threshold for Nationally Significant Aggregations. Counts at Darwin's northern beaches, Darwin Harbour Proper, East Arm Wharf and Middle Arm have all reached the threshold for Nationally Significant Aggregations based upon diversity.

Table 3-13. Population estimates for migratory shorebirds in the Northern Territory (NT), the East Asian-Australasian Flyway (EAAF), and sites of significance in the NT (with maximum counts in brackets).

Shorebird	Scientific name	EPBC Act Listing	NT Significant sites (max count)	NT population ^a	Australian population ^b	EAAF population ^b (1 % pop.; 0.1 % pop.)
Common Sandpiper	<i>Actitis hypoleucos</i>	Migratory		180	2,501	190,000 (1,900; 190)
Ruddy Turnstone	<i>Arenaria interpres</i>	Migratory	East Point to Lee Point (≈62)^c	5,000	20,800	30,000 (300; 30)
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	Migratory	East Arm Wharf (≈220)^c	20,100	85,809	85,000 (850; 85)
Sanderling	<i>Calidris alba</i>	Migratory	East Point to Lee Point (≈180)^c	890	15,082	30,000 (300; 30)
Red Knot	<i>Calidris canutus</i>	Endangered, Migratory		24,200	68,927	110,000 (1,100; 110)
Curlew Sandpiper	<i>Calidris ferruginea</i>	Critically Endangered, Migratory		17,800	45,485	90,000 (900; 90)
Red-necked Stint	<i>Calidris ruficollis</i>	Migratory		44,400	389,206	475,000 (4,750; 475)
Long-toed Stint	<i>Calidris subminuta</i>	Migratory		100 ^b	553	230,000 (2,300; 230)
Great Knot	<i>Calidris tenuirostris</i>	Critically Endangered, Migratory	†Lee Point (8000)^c	122,000	381,854	425,000 (4,250; 425)
Little Ringed Plover	<i>Charadrius dubius</i>	Migratory		20 ^b	10	150,000 (1,500; 150)
Greater Sand Plover	<i>Charadrius leschenaultii</i>	VU, Migratory	†Lee Point (2000)^c East Arm Wharf (≈530)^c Greater Darwin area (1,024)^a	40,300	126,616	200,000 – 300,000 (2,000; 200)
Lesser Sand Plover	<i>Charadrius mongolus</i>	Endangered, Migratory	East Arm Wharf (≈280)^c Greater Darwin area (1,440)^a	39,000	27,551	180,000 – 275,000 (1,800; 180)
Oriental Plover	<i>Charadrius veredus</i>	Migratory		130	232,124	230,000 (2,300; 230)
Asian Dowitcher	<i>Limnodromus semipalmatus</i>	Migratory		190	473	14,000 (140; 14)

Shorebird	Scientific name	EPBC Act Listing	NT Significant sites (max count)	NT population ^a	Australian population ^b	EAAF population ^b (1 % pop.; 0.1 % pop.)
Bar-tailed Godwit	<i>Limosa lapponica</i>	VU, Migratory		53,000	189,146	325,000 (3,250; 325)
Black-tailed Godwit	<i>Limosa limosa</i>	Migratory	†Lee Point (1600) ^c	44,000	50,508	160,000 (1,600; 160)
Far Eastern Curlew	<i>Numenius madagascariensis</i>	Critically Endangered, Migratory	East Arm Wharf (≈280) ^c Darwin Harbour Proper (329) ^w Darwin Harbour Middle Arm (102) ^d	6,800	26,405	35,000 (350; 35)
Little Curlew	<i>Numenius minutus</i>	Migratory		12,500	76,908	110,000 (1,100; 110)
Whimbrel	<i>Numenius phaeopus</i>	Migratory	East Point to Lee Point (≈100) ^c East Arm Wharf (≈400) ^c Darwin Harbour Middle Arm (77) ^e	5,100	24,972	65,000 (650; 65)
Pacific Golden Plover	<i>Pluvialis fulva</i>	Migratory	East Arm Wharf (≈145) ^c	200	9,091	120,000 (1,200; 120)
Grey Plover	<i>Pluvialis squatarola</i>	Migratory	East Point to Lee Point (≈160) ^c	5,400	12,120	80,000 (800; 80)
Grey-tailed Tattler	<i>Tringa brevipes</i>	Migratory	East Point to Lee Point (≈75) ^c East Arm Wharf (≈410) ^c Darwin Harbour Middle Arm (101) ^e	16,000	64,360	70,000 (700; 70)
Wood Sandpiper	<i>Tringa glareola</i>	Migratory		40	1,790	130,000 (1,300; 130)
Common Greenshank	<i>Tringa nebularia</i>	Migratory	East Arm Wharf (150) ^c	7,600	27,463	110,000 (1,100; 110)
Marsh Sandpiper	<i>Tringa stagnatilis</i>	Migratory		12,100	53,481	130,000 (1,300; 130)

Shorebird	Scientific name	EPBC Act Listing	NT Significant sites (max count)	NT population ^a	Australian population ^b	EAAF population ^b (1 % pop.; 0.1 % pop.)
Terek Sandpiper	<i>Xenus cinereus</i>	Migratory	East Point to Lee Point (≈64)^c East Arm Wharf (≈280)^c Darwin Harbour Middle Arm (100)^e	15,000	19,115	50,000 (500; 50)

^a Chatto, 2003; ^b Hansen et al., 2016; ^c Lilleyman et al (2020a), ^dLilleyman et al. (2018), ^eLilleyman et al. (2020b).

Internationally significant (1 % EAAF pop.) and nationally significant (0.1 % EAAF pop.) population estimates are presented in brackets.

Species with a nationally or internationally significant site in the Greater Darwin region based upon maximum count data are presented in bold.

† Internationally significant.

≈ approximately.

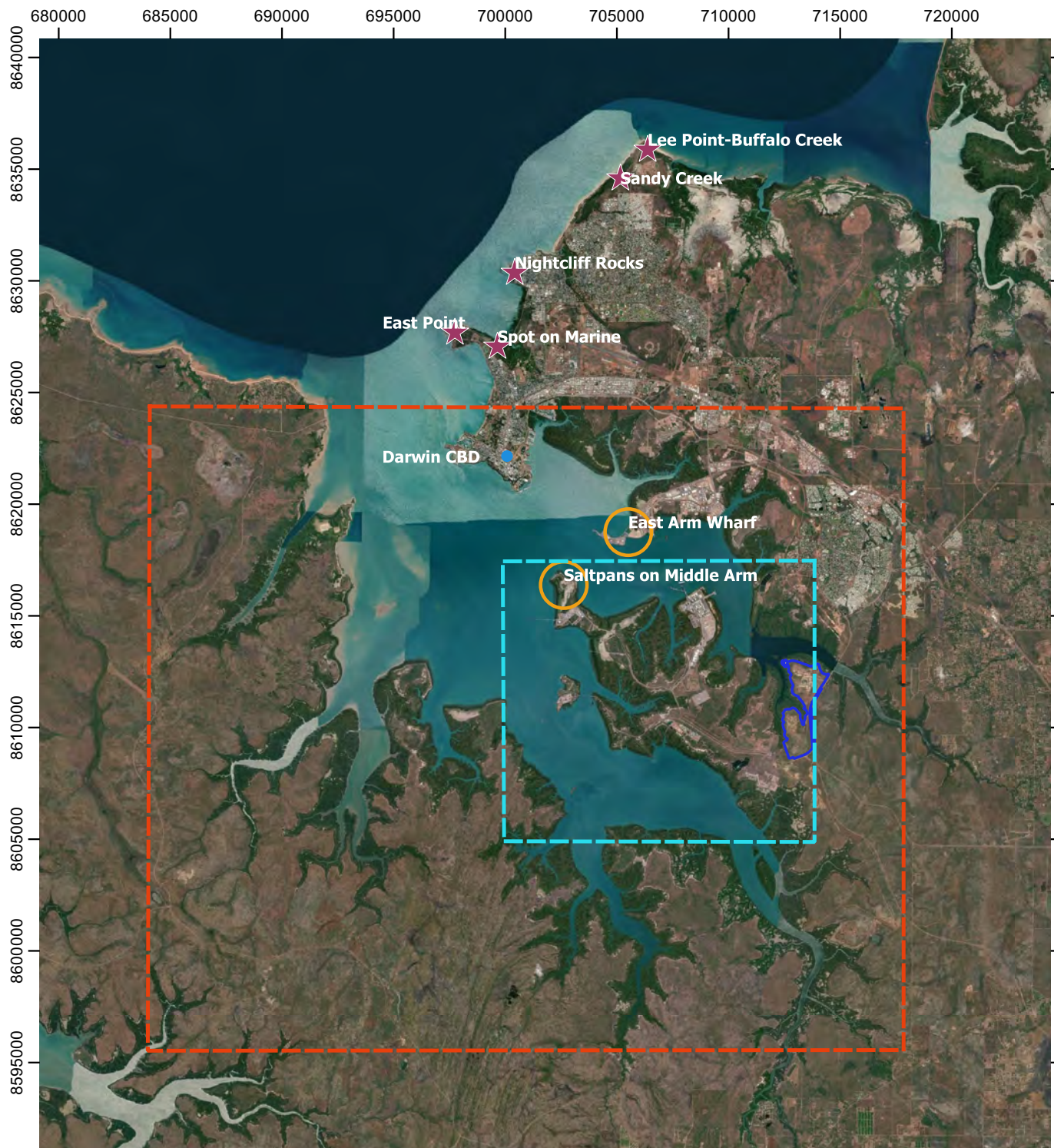


Figure 3-9. Sites of Significant Aggregations
of migratory shorebirds in the Greater Darwin
Region

Legend

 Spring Tide Roosting Habitat

 Northern Beaches

 Darwin Harbour Proper

 Middle Arm

 Lot 1817 boundary



0 2.5 5 km



date: 22/01/2021
CRS: GDA94 MGA Zone 52
basemap: ESRI

Shorebird Habitat

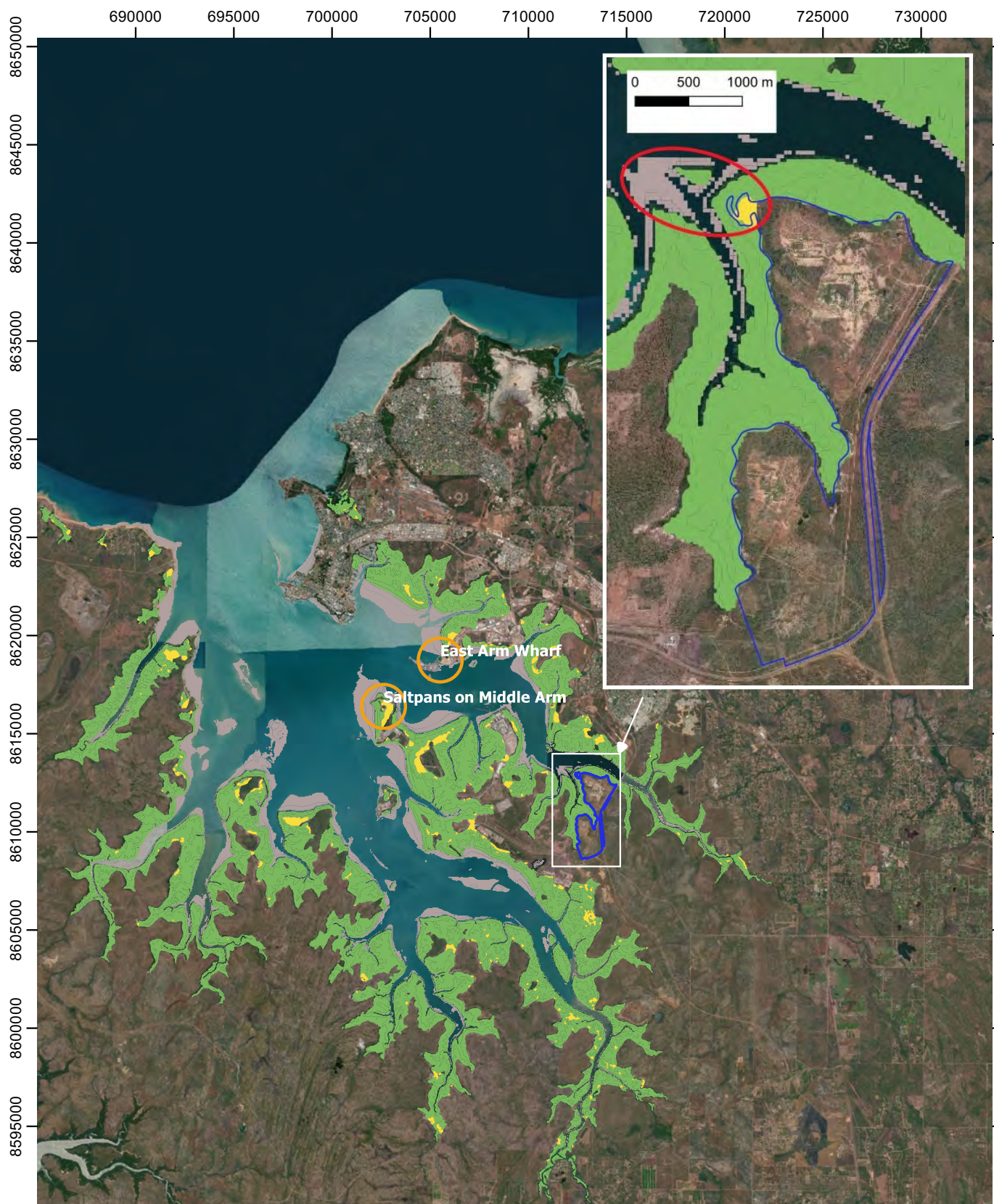
Recent studies of Darwin Harbour have identified shorebirds using a wide range of areas for roosting and foraging (Lilleyman *et al.*, 2018). Individual birds have been shown to use large areas of the Darwin Harbour over the tide cycle to accommodate feeding and roosting requirements (Lilleyman & Garnett, 2019). Migratory shorebirds require a range of roosting and feeding sites in Darwin Harbour so they can move between sites if the optimal habitat is disturbed or unavailable due to tidal conditions (Lilleyman & Garnett, 2019).

Details on the species-specific utilisation of habitats are described in the Significant Fauna Impact Assessment (**Appendix J**). For the 26 species of migratory Shorebird that occur along within the Darwin Harbour Proper, the habitats can be broadly categorised into four types (Lilleyman *et al.*, 2019). These are:

1. Intertidal sand and mudflats used for foraging between high tides. The macro-tidal nature of tides in the Darwin region creates extensive mud and sand flats, available for foraging birds. This area is known as the intertidal zone and shorebirds often feed in this zone on what is considered a 'mudflat' (Lilleyman & Garnett, 2019). Feeding grounds appear to be widely available with extensive intertidal areas within the region, although the quality of these mudflats is yet to be tested (Lilleyman *et al.*, 2018).
2. Mangroves used by some species for foraging and roosting at high tide.
3. Saltpans used for roosting at high tide. On tides less than 7.4 m, most saltpans (or claypans) are available to shorebirds to roost in, but not during tides above this height as these saltpans become inundated.
4. Spring high tide roosting sites used when the saltpans are inundated. The spring tide occurs twice per lunar month when the high and low tides are at their cyclical highest and lowest. Based on a whole-of-harbour aerial survey, the East Arm Wharf high tide roost site supports more than 30% of the total Darwin Harbour waterbird population (Lilleyman *et al.*, 2018). The saltpans on the Middle Arm land peninsula (near Conoco Phillips project site) were used by shorebirds roosting during the 2017 surveys from Lilleyman *et al.* (2018) and considered the next most important spring high tide roosting area after the East Arm Wharf roost site, based on numbers of shorebirds counted at the site during the 2017 aerial survey. In Darwin Harbour, shorebird numbers may be constrained by the availability of roosting sites, particularly high spring tide roosting sites.

The distributions of these habitat types in the Darwin Harbour are shown in **Figure 3-10**. The distribution of Mangroves and Saltpans was obtained from the NT Mangroves 100k spatial polygon dataset (NTG, 2019). The distribution of intertidal mudflats was obtained from the National Intertidal Digital Elevation Model (**NIDEM**; Bishop-Taylor *et al.*, 2019). NIDEM provides three-dimensional representation of Australia's intertidal sandy beaches and shores, tidal flats, and rocky shores and reefs at 25 m spatial resolution. The location of spring high tide roosting sites was taken from Lilleyman *et al.* (2019).

The work of Lilleyman *et al.* (2019, 2020) draws attention to the importance of roost sites near to foraging ground. Whether these are saltpan roost sites or artificial habitat such as at East Arm Wharf, shorebirds appear to prefer to forage in areas close to roosting sites and roost in appropriate sites close to foraging grounds. Whilst foraging grounds and roosting habitats are well distributed around the harbour, it is the foraging and roosting sites in close proximity to each other that are of highest quality to shorebirds. One of these areas is present within proximity of the Project and is shown in **Figure 3-10**.



Legend

Mangrove

Saltpan

Intertidal sand and mudflat

Spring Tide Roosting Habitat

High quality habitat near Project (inset)

Figure 3-10. Distribution of migratory shorebird habitats types in the Darwin Harbour



0 2.5 5 km



date: 22/01/2021
CRS: GDA94 MGA Zone 52
basemap: ESRI

Habitat Condition

The condition of the available habitats in the Darwin Harbour is near pristine (Munksgaard et al., 2018). Darwin Harbour is situated within a region recognised for its relative pristine condition (Halpern et al., 2008). Mangroves fringe the whole embayment of Darwin Harbour and comprise one of the largest (~20,400 ha) and most floristically diverse (~41 species) areas of mangroves in the NT (Duke, 2006). Mangrove communities within the Harbour have been identified and mapped by Brocklehurst and Edmeades (1996) who concluded that overall the communities appear healthy and branch and tree death are generally due to natural processes.

Under the proposed Project changes, no direct impacts will occur to mangrove habitats.

Migratory species at the Project area

Migratory species recorded in the Study Area – including the Project Site and the surrounding marine environment – were reported in the APM (2019) baseline biological survey for the Draft EIS and are listed in **Table 3-14** with their habitat requirements and an indication of the number of individuals recorded in each survey.

Migratory shorebirds that are listed as threatened under the EPBC Act are also discussed in detail in **Section 3.2.3**.

Table 3-14. Migratory shorebirds at the Project area

Scientific (common) name	Distribution, Habitat, Socialness	Suitability of Project site
Fork-tailed Swift <i>Apus pacificus</i>	General habitat: almost exclusively aerial. It occurs over inland plains, and sometimes above coastal areas. It mostly occurs over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland, or saltmarsh. It is also found over treeless grasslands and sandplains covered with spinifex, open farmland, and coastal sand-dunes. Foraging habitat: forages aerially on insects above open areas or over water, and occasionally among tree-tops in open forest. Large flocks often precede or follow low pressure systems in search of food. Roosting habitat: probably roosts aerially but has occasionally been observed to land. It is known to sometimes loaf in the air by allowing strong winds to support it.	Present. An individual was recorded in the Project area during the APM 2019 survey. Suitable habitat exists over the site and adjacent water.
Common Sandpiper <i>Actitis hypoleucos</i>	General habitat: wetlands of varying salinity levels. Found around muddy margins or rocky shores, and rarely on mudflats. The muddy margins are often narrow and may be steep. It is often associated with mangroves and is sometimes found in areas of mud littered with rocks.	Present. During APM and GHD surveys in 2016, 2018, and 2019, this species was recorded 116 times. Suitable general habitat exists on the site. There is

Scientific (common) name	Distribution, Habitat, Socialness	Suitability of Project site
	Foraging habitat: forages in shallow water and on bare soft mud at the edges of wetlands, often where obstacles project from the substrate, e.g. mangrove roots. Roosting habitat: roosts on rocks or in roots or branches of vegetation, especially mangroves. Known to perch on posts, jetties, and other artificial structures.	limited foraging habitat but plentiful roosting habitat. All available habitat is high quality. Non-breeding adults and immature individuals are likely to use the site during the non-breeding season (July to May).
Greater Sand Plover <i>Charadrius leschenaultii</i>	Habitats are described in Section 3.2.3.	Present. Recorded from the Elizabeth River adjacent to Lot 1817 (three records) in 2016, but not in 2018 or 2019
Far Eastern Curlew <i>Numenius madagascariensis</i>	Habitats are described in Section 3.2.3.	Present. There were 27 records of this species within the Project area during APM 2018 and 2019 surveys. The maximum number of Far Eastern Curlew recorded in the study area within a single survey is four individuals.
Whimbrel <i>Numenius phaeopus</i>	General habitat: inhabits intertidal mudflats of sheltered coasts, as well as harbours, lagoons, estuaries, and river deltas, especially those with mangroves or open, unvegetated mudflats. Foraging habitat: forages on intertidal mudflats, along the muddy banks of estuaries and in coastal lagoons, either in open, unvegetated areas or among mangroves. Roosting habitat: it is one of a small group of shorebirds that regularly roost in mangroves and other structures flooded at high tide. It often roosts in the branches of mangroves around mudflats, and may also roost on the ground under mangroves (DoE, 2020).	Present. There were 34 records of this species within the Project area during APM and GHD 2016 and 2018 surveys. Suitable general, foraging, and roosting habitat exists in the mudflats and mangroves adjacent to the Project area. All available habitat is high quality. Non-breeding adults and immature individuals are likely to use the site during the non-breeding season (August to April), while immature individuals may

Scientific (common) name	Distribution, Habitat, Socialness	Suitability of Project site
		remain at the site throughout the austral winter (i.e. year-round until they sexually mature).
Common Greenshank <i>Tringa nebularia</i>	General habitat: inhabits a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. In coastal areas, it prefers large mudflats, with saltmarsh, mangroves, or seagrass in embayments, harbours, river estuaries, deltas, and lagoons. It also uses artificial wetlands, including sewage farms and saltworks dams. Foraging habitat: forages at the edges of wetlands, in soft mud of mudflats, or in shallows around the edges of water among mangroves or other sparse, emergent, or fringing vegetation. Roosting habitat: roosts and loafs around wetlands, in shallow pools and puddles, or slightly elevated on rocks, sandbanks, or muddy islets.	Present. There were 19 records of this species in the Project area during the APM and GHD 2016, 2018, and 2019 surveys, Suitable general, foraging, and roosting habitat exists in the mudflats and mangroves adjacent to the Project area. All available habitat is high quality. Non-breeding adults and immature individuals are likely to use the site during the non-breeding season (August to May).
Little Tern <i>Sternula albifrons</i>	General Habitat: The Little Tern is mainly coastal, being found on beaches, sheltered inlets, estuaries, lakes, sewage farms, lagoons, river mouths and deltas Foraging Habitat: All populations of Little Terns forage by plunging into shallow water, taking small fish from on or just below the water's surface. Roosting habitat: The nest is a shallow scrape in sand or shingle, usually just above the high tide mark on sandy shores	Present: Two records in 2018 from within the Study Area. Suitable foraging habitat in the Elizabeth River. No suitable breeding habitat.
Oriental Cuckoo <i>Cuculus optatus</i>	General Habitat: monsoon forests and rainforest edges, river flats, roadsides, and mangroves. Foraging habitat: Forages in the upper to mid-levels of mixed woodland forests.	Present: One record in 2018 survey. Suitable foraging and roosting habitat exists in the mangroves and Eucalypt woodland habitats.

Scientific (common) name	Distribution, Habitat, Socialness	Suitability of Project site
		No suitable breeding habitat.
Eastern Osprey <i>Pandion cristatus</i>	General habitat: occurs in littoral and coastal habitats, and terrestrial wetlands of tropical and temperate Australia. It requires extensive areas of open fresh, brackish, or saline water for foraging. It frequents a variety of wetland habitats, including inshore waters, reefs, bays, coastal cliffs, beaches, estuaries, mangrove swamps, broad rivers, reservoirs, and large lakes and waterholes. Also known to occur over habitats such as heath, woodland, or forest when travelling to and from foraging sites. Foraging habitat: typically forages by soaring, quartering, or circling above a body of water and scanning below for fish. Also occasionally searches for prey from perches and may snatch birds in flight. Nesting habitat: nests in dead or partly dead trees or bushes on cliffs, rocks, rock stacks, islets, or on the ground on rocky headlands, coral cays, deserted beaches, sandhills, or saltmarshes, and on artificial nest platforms, including cranes, navigation towers, and pylons. Mature adults are mostly resident or sedentary around breeding territories.	Present. There was one record of this species in the Project area during the APM 2018 survey Suitable general and nesting habitat exists in the Project area.

3.2.3.2 EPBC Act Threatened fauna

Several fauna species listed as threatened under the EPBC Act and considered MNES are known to occur in the Middle Arm region. A Significant Fauna Impact Assessment has been prepared for the EIS Supplement to detail the significant fauna known to occur, are likely to occur or may possibly occur within Lot 1817 or any areas that may be impacted by the Project. This assessment is included as **Appendix J**.

The threatened terrestrial MNES species that are known to occur within or adjacent to Lot 1817 are:

- Eastern Curlew (*Numenius madagascariensis*) (Critically Endangered under the EPBC Act, Vulnerable (VU) under the TPWC Act)
- Greater Sand Plover (*Charadrius leschenaultii*) (VU under the EPBC Act and TPWC Acts)
- Black-footed Tree-rat (*Mesembriomys gouldii gouldii*) (Endangered under the EPBC Act, VU under the TPWC Act)

Other species of conservation significance may occur within Lot 1817 or any areas that may be impacted by the Project, despite not having yet been recorded. Based on the occurrence of nearby records and the types of

habitats present, a further seven species listed as threatened under the EPBC Act were identified in the desktop reviews (APM 2019) are considered “Likely” to occur within the Study area. These are:

- Red Knot (*Calidris canutus*) (Endangered and Migratory under the EPBC Act, VU under the TPWC Act)
- Curlew Sandpiper (*Calidris ferruginea*) (Critically Endangered and Migratory under the EPBC Act, VU under the TPWC Act)
- Great Knot (*Calidris tenuirostris*) (Critically Endangered and Migratory under the EPBC Act, VU under the TPWC Act)
- Lesser Sand Plover (*Charadrius mongolus*) (Endangered and Migratory under the EPBC Act, VU under the TPWC Act)
- Northern Quoll (*Dasyurus hallucatus*) (Endangered under the EPBC Act, Critically Endangered under the TPWC Act)

The Bare-rumped Sheath-tailed Bat (*Saccolaimus saccolaimus nudiclunatus*; VU under the EPBC Act) was considered unlikely to occur in the Draft EIS, as suitable habitat is present but no records had been made of the species within a 10 km radius. Subsequent to the Biological survey report (APM 2019), correspondence with the Department of Environment, Parks and Water Security (DEPWS) Flora and Fauna Division identified that the species has been recently recorded on Middle Arm. The species is now considered Likely to occur.

Fauna that are listed as threatened under the EPBC Act may also be listed under the TPWC Act.

The information in **Table 3-15** to **Table 3-22** below are summarised for each of these threatened MNES species from the Significant Fauna Impact Assessment (**Appendix J**). The presence or likely presence of the species or species habitat, importance of the population and expected impacts to habitat in relation to the Project are discussed in detail and maps of suitable habitat and species records are included in the Significant Fauna Impact Assessment. A map of shorebird habitat in the Darwin Harbour is included as **Figure 3-10**.

Table 3-15. Eastern Curlew records and suitable habitat in relation to the Project.

Eastern Curlew (<i>Numenius madagascariensis</i>)	
An assessment of the presence or likely presence of the species in the Proposal area and in any areas that may be impacted;	Eastern curlew was recorded in field surveys initiated by TNG in December 2018 and March 2019. These records show Eastern curlew utilising the mudflats for foraging (8 records), the mangroves for foraging and roosting (12 records), and the saltpan area within Lot 1817 for roosting at high tide (7 records). Only one record occurred in 2019, and the records in 2018 were taken across three tides per day for four days using both helicopter and boat. The maximum number of Far Eastern Curlew recorded in the area within or adjacent to Lot 1817 within a single survey is four individuals. As the species is territorial it is likely the same birds were counted on multiple occasions.
The size and distribution of the local population, including at different life cycle stages, for example, when breeding, foraging, resting and/or migrating;	Foraging and resting occur in the Darwin Harbour. No breeding occurs in Australia. 266 records of Easter Curlew occur on the NT Fauna Atlas for the Darwin Harbour. Lilleyman et al. (2018, 2020b) recorded the distribution of Eastern curlew in the Darwin Harbour and found the species prefers foraging habitats close to suitable saltpan roosting habitat, and roosting habitat close to foraging habitat. A tracking study found the species to maintain small home ranges (Lilleyman & Garnett, 2019). At the peak of the tide, when the saltpans were inundated,

Eastern Curlew (*Numenius madagascariensis*)

	birds moved to two key locations – a large saltpan near the ConocoPhillips Project site on the eastward end of Middle Arm Peninsula (8.5 km from the Project) and a dredging pond in East Arm Wharf (11 km from the Project). According to Lilleyman et al. (2018), the roosting habitat at East Arm Wharf is now particularly important: over 80 % of the local Darwin Harbour population (maximum count of 329 birds in January 2017), roost there during the highest tides.
The importance of the local population in a local, regional, NT, national and international context;	Approximately 35,000 birds use the EAAF. It is estimated that 26,405 birds visit Australia. The population that visits the Northern Territory is estimated to be 6,800 birds. The maximum count of 329 birds is close to 1 % of the EAAF that would qualify the site as an internationally significant aggregation. As recorded occurrences exceed 0.1 % of the total EAAF population the Darwin Harbour Proper population is a Nationally significant aggregations (Lilleyman et al., 2018, 2020b) of this species.
The identification of suitable habitat for the species (for breeding, foraging, aggregation or roosting), the quality of this habitat, and how this may be disturbed or altered by the Proposal.	Low numbers of Eastern Curlew have been recorded using the saltpan within Lot 1817 for high tide roosting on a number of occasions. Eastern Curlew have also been recorded roosting at high tide in the mangroves and foraging at low tide in the mudflats adjacent Lot 1817. No breeding habitat is present in the Darwin Harbour. No aggregating habitat is present at Lot 1817. Intertidal mudflats and sandflats in Darwin Harbour Proper are considered to be in pristine condition. The saltpan area within Lot 1817 is intact, and the mangroves adjacent to Lot 1817 are also in Excellent condition, however it is unknown how the condition or suitability of these habitats has been previously impacted by disturbances present in Lot 1817. Habitat may be impacted by indirect Project impacts such as noise, light, changes to hydrological process and pollution. The risk is a lessening of the quality of habitat. Habitats may be benefitted by the Project due to a decrease in current levels of human disturbance, feral predators, fire risk and pollution. Rehabilitation of degraded land will increase the current hydrological function of areas adjacent to shorebird habitat.

Table 3-16. Greater Sand Plover records and suitable habitat in relation to the Project.

Greater Sand Plover (<i>Charadrius leschenaultii</i>)	
An assessment of the presence or likely presence of the species in the Proposal area and in any areas that may be impacted;	The species has not been recorded in Lot 1817. This species has been recorded from the Elizabeth River adjacent to Lot 1817 (three records) in 2016, but not in 2018 or 2019.
The size and distribution of the local population, including at different life cycle stages, for example, when breeding, foraging, resting and/or migrating;	No breeding occurs in Australia. Foraging and resting occur in the Darwin Harbour. The NT Fauna Atlas includes 174 records within the Darwin Harbour, with the closest record being at the Elizabeth River adjacent to Lot 1817. The Greater Sand Plover is a frequent user of the East Arm Wharf, where a maximum of 560 birds have been counted in one year over the 2013 to 2018 period. The highest monthly counts occur in January to February and September to November (Lilleyman & Garnett, 2019). The number of Greater Sand Plover visiting the East Arm Wharf has shown a significant reduction (12.7 %) over the 9 years of monthly data to 2018 (Lilleyman & Garnett, 2019).
The importance of the local population in a local, regional, NT, national and international context;	An estimated 200,000 to 300,000 birds migrate south along the EAAF for the austral summer. An estimated 126,616 birds migrate to Australia, with approximately 40,300 birds visiting the NT. The Greater Darwin area is considered an internationally significant site (DAWE, 2020), although recent count data do not exceed 1 % of the population (Chatto 2012). Surveys at Lee Point in the Greater Darwin area have recorded Greater Sand Plover in numbers exceeding the benchmark for nationally significant aggregation on one occasion between 1980 and 2018 (Lilleyman et al. 2020a). The numbers recorded by Lilleyman & Garnett, (2019) qualifies the Darwin Harbour Proper as a nationally significant aggregation for the Greater sand plover.
The identification of suitable habitat for the species (for breeding, foraging, aggregation or roosting), and the quality of this habitat, and how this may be disturbed or altered by the Proposal.	The intertidal mudflats and sandflats in the Elizabeth River adjacent to Lot 1817 are suitable foraging habitat for <i>C. leschenaultii</i>. The saltpan area within Lot 1817 may be suitable roosting habitat. No breeding habitat is present in the Darwin Harbour. No aggregating habitat is present at Lot 1817. Intertidal mudflats and sandflats in Darwin Harbour Proper are considered to be in pristine condition. The saltpan area within Lot 1817 is intact, and the mangroves adjacent to Lot 1817 are also in Excellent condition, however it is unknown how the condition or suitability of these habitats has been previously impacted by disturbances present in Lot 1817. Habitat may be impacted by indirect Project impacts such as noise, light, changes to hydrological process and pollution. The risk is a lessening of the quality of habitat. Habitats may be benefitted by the Project due to a decrease in current levels of human disturbance, feral predators, fire risk and pollution. Rehabilitation of degraded land will increase the current hydrological function of areas adjacent to shorebird habitat.

Table 3-17. Black-footed Tree-rat records and suitable habitat in relation to the Project.

Black-footed Tree-rat (<i>Mesembriomys gouldii gouldii</i>)	
An assessment of the presence or likely presence of the species in the Proposal area and in any areas that may be impacted;	This species has been recorded 19 times within the Project area during surveys initiated by TNG in 2017, 2018 and 2019. A road mortality is also recorded in the NT Fauna Atlas (DENR, 2019) from 2016 on Channel Island Road west of the Project area.
The size and distribution of the local population, including at different life cycle stages, for example, when breeding, foraging, resting and/or migrating;	Black-footed Tree-rats have a home range where they spend their entire life cycle, and perform all foraging, resting and breeding behaviours within that area. In un-fragmented open forests home ranges are 67.3 ± 10.4 hectares and in fragmented habitat they are 27.1 ± 8.4 ha (Rankmore 2006). Animals have predominantly been recorded as solitary, however recent evidence by DEPWS suggests this is not exclusively the case. Within Lot 1817 there are 120 ha of suitable habitat in the Eucalypt woodland. It is not known how many Black-footed Tree Rat are present in Lot 1817.
The importance of the local population in a local, regional, NT, national and international context;	The DENR Flora and Fauna Division have conducted a camera trapping exercise on the Middle Arm Peninsula. Results show that Lot 1817 is in the centre of a population of Black-footed Tree-rat that occupies the centre of Middle Arm but not the western extent. All camera traps to the east of Lot 1817 also recorded Black-footed Tree-rat and it is likely the species continues to the east past the end of the trapping array, as suitable habitat is continuous and undisturbed in that direction. The area of undisturbed habitat covered by the DENR study is approximately 3000 ha and reasonably unfragmented. The size of the population in the local area is not known. On a habitat basis, the Eucalypt woodland in Lot 1817 is 4 % of the available habitat for the Black-footed Tree Rat in the central portion of Middle Arm. The Black-footed Tree Rat has undergone notable declines in abundance, area of occupancy, and extent of occurrence in the past few decades (Woinarski, Burbidge, & Harrison, 2014). While there are no published population estimates for subpopulations, or overall, Woinarski <i>et al.</i> (2014) estimated a greater than 50 % reduction in population size in the past decade. Broad wildlife monitoring programs in three NT national parks, Kakadu, Litchfield, and Garig Gunak Barlu National Parks, have been unable to provide population trend data because of low capture rates, although the declines have been marked for the Kakadu area, and broadly across the Top End (TSSC, 2015b). Despite these declines, the species appears to be locally abundant in the Darwin peri-urban area, including in the Charles Darwin National Park (TSSC, 2015b).
The identification of suitable habitat for the species (for breeding, foraging, aggregation or roosting), and the quality of this habitat, and how this may be disturbed or altered by the Proposal.	Within Lot 1817 there are 120 ha of suitable habitat in the Eucalypt woodland. They conduct all life cycle stages within their home range, estimated to be 27.1 ± 8.4 ha (Rankmore 2006) due to the fragmented nature of the site. Rankmore (2006) demonstrates Black-footed Tree Rat do not occupy disturbed areas but if inhabiting fragmented habitats, they may cross disturbed areas into other habitat fragments.

Black-footed Tree-rat (*Mesembriomys gouldii gouldii*)

Habitat suitability within Lot 1817 is high in the Eucalyptus woodland habitat type. The availability of tree hollows is limited at Lot 1817. Tree hollows suitable for denning are common in larger, older trees. The NT Land Clearing Guidelines indicate tree hollows are particularly prevalent in trees with a diameter at breast height (DBH) ≥ 50 cm. All trees in Lot 1817 were systematically measured for DBH. Four small pockets of trees totalling 3.7 ha were found to have the required density of trees with DBH ≥ 50 cm to be considered as significant habitat. The remaining remnant Eucalypt woodland contains trees of a smaller size and thus less likely to have developed a significant tree hollow availability.

It is likely Black-footed Tree Rat individuals inhabiting the site are utilising the commonly available *Pandanus* foliage for denning rather than tree hollows.

Other disturbances at Lot 1817 that have reduced the quality of habitat are:

- historic extraction industry activity that has disturbed 315 ha or 64.5 % of Lot 1817.
- fragmentation of the entire Lot 1817 by the presence of the Channel Island Road, the Adelaide Darwin Railway line, and the Elizabeth River.
- fragmentation within Lot 1817 by the cleared areas and roads.
- frequent human disturbance within Lot 1817 from unregulated access by the general public who use it for recreational purposes, such as off-leash dog walking, motorbike riding, and rally driving, as well as for illegal rubbish dumping, and intentional and accidental fires.
- frequent human disturbance within Lot 1817 for the planned maintenance of existing infrastructure, such as power lines and pipelines, road maintenance, slashing of 28.8 ha of land, and machinery and humans performing maintenance activities.
- poor rehabilitation of 61.5 ha, and no rehabilitation of 106.8 ha, with a high abundance of the weedy Gamba grass, known to exacerbate the risk and intensity of fires
- the presence of introduced fauna, such as Feral Cats and Dogs, that compete for prey and pose risks to Black-footed Tree Rat.

The Project will remove 92.5 ha of suitable remnant habitat for the Black-footed Tree Rat including the 3.7 ha containing larger trees. The remaining suitable habitat may be impacted by indirect impacts such as noise, light, changes to hydrological process and pollution. The quality of this habitat will be impacted if the Project results in an increase of introduced predators to the site.

Habitats may be benefitted by the Project due to a decrease in current levels of human disturbance, feral predators, fire risk and pollution.

Table 3-18. Curlew Sandpiper records and suitable habitat in relation to the Project.

Curlew Sandpiper (<i>Calidris ferruginea</i>)	
An assessment of the presence or likely presence of the species in the Proposal area and in any areas that may be impacted;	The species has not been recorded in Lot 1817. It is likely to be an occasional visitor to the intertidal mudflats and sandflats in the Elizabeth River adjacent to Lot 1817 that are suitable foraging habitat but has not specifically been recorded as doing so in any survey.
The size and distribution of the local population, including at different life cycle stages, for example, when breeding, foraging, resting and/or migrating;	Foraging and resting occur in the Darwin Harbour. No breeding occurs in Australia. The NT Fauna Atlas includes 85 records within the Darwin Harbour, with the closest record being in the Elizabeth River within one km of Lot 1817. The species is frequently recorded at the Palmerston Sewage Treatment Ponds, four km north of Lot 1817. The species is known to occur in low numbers at the East Arm Wharf (Lilleyman et al., 2020).
The importance of the local population in a local, regional, NT, national and international context;	Approximately 13 % (90,000 birds) of the global population uses the EAAF. It is estimated that 45,485 birds visit Australia. The population that visits the Northern Territory is estimated to be 17,800 birds.
The identification of suitable habitat for the species (for breeding, foraging, aggregation or roosting), and the quality of this habitat, and how this may be disturbed or altered by the Proposal.	The intertidal mudflats and sandflats in the Elizabeth River adjacent to Lot 1817 are suitable foraging habitat. While not specifically recorded as doing so, the saltpan area within Lot 1817 and the mangroves adjacent are likely to be suitable roosting habitat for this species. No breeding habitat is present in the Darwin Harbour. No aggregating habitat is present at Lot 1817. Intertidal mudflats and sandflats in Darwin Harbour Proper are considered to be in pristine condition. The saltpan area within Lot 1817 is intact, and the mangroves adjacent to Lot 1817 are also in Excellent condition, however it is unknown how the condition or suitability of these habitats has been previously impacted by disturbances present in Lot 1817. Habitat may be impacted by indirect Project impacts such as noise, light, changes to hydrological process and pollution. The risk is a lessening of the quality of habitat. Habitats may be benefitted by the Project due to a decrease in current levels of human disturbance, feral predators, fire risk and pollution. Rehabilitation of degraded land will increase the current hydrological function of areas adjacent to shorebird habitat.

Table 3-19. Red Knot records and suitable habitat in relation to the Project.

Red Knot (<i>Calidris canutus</i>)	
An assessment of the presence or likely presence of the species in the Proposal area and in any areas that may be impacted;	No records of the species in the Project area. Likely to be an occasional visitor to the intertidal mudflats and sandflats in the Elizabeth River adjacent to Lot 1817 that are suitable foraging habitat.
The size and distribution of the local population, including at different life cycle stages, for example, when breeding, foraging, resting and/or migrating;	Foraging and resting occur in the Darwin Harbour. No breeding occurs in Australia. The NT Fauna Atlas includes 24 records within the Darwin Harbour. Lilleyman et al. (2018) recorded the species as part of the 'small birds' collection, which included 167 combined records of 10 species. BirdLife Australia (2020), reporting the annual monitoring from Darwin's Northern Beaches, identified a maximum of 36 records for the species from a single survey period.
The importance of the local population in a local, regional, NT, national and international context;	The EAAF population is estimated as 110,000 birds, the Australian population is estimated at 68,927 birds and the NT population estimated as 24,200 birds. It is unlikely that the Darwin Harbour is a nationally significant aggregation of this species.
The identification of suitable habitat for the species (for breeding, foraging, aggregation or roosting), and the quality of this habitat, and how this may be disturbed or altered by the Proposal.	The intertidal mudflats and sandflats in the Elizabeth River adjacent to Lot 1817 are suitable foraging habitat. While not specifically recorded as doing so, this species may roost in saltpan areas, such as those present in Lot 1817, due to a lack of preferred roosting habitat in the Darwin Harbour. No breeding habitat is present in the Darwin Harbour. No aggregating habitat is present at Lot 1817. Intertidal mudflats and sandflats in Darwin Harbour Proper are considered to be in pristine condition. The saltpan area within Lot 1817 is intact, and the mangroves adjacent to Lot 1817 are also in Excellent condition, however it is unknown how the condition or suitability of these habitats has been previously impacted by disturbances present in Lot 1817. Habitat may be impacted by indirect impacts such as noise, light, changes to hydrological process and pollution. Habitats may be benefitted by the Project due to a decrease in current levels of human disturbance, feral predators, fire risk and pollution. Rehabilitation of degraded land will increase the current hydrological function of areas adjacent to shorebird habitat.

Table 3-20. Lesser Sand Plover records and suitable habitat in relation to the Project.

Lesser Sand Plover (<i>Charadrius mongolus</i>)	
An assessment of the presence or likely presence of the species in the Proposal area and in any areas that may be impacted;	The species was not recorded in or adjacent to Lot 1817 in the 2018 and 2019 field surveys. The NT Fauna Atlas database has the closest record, being at the Elizabeth River adjacent to Lot 1817. The intertidal mudflats and sandflats in the Elizabeth River adjacent to Lot 1817 are suitable foraging habitat. The saltpan area within Lot 1817 may be suitable roosting habitat for this species, and it may occasionally use the mangroves for roosting. It is likely the species uses these areas at some times.
The size and distribution of the local population, including at different life cycle stages, for example, when breeding, foraging, resting and/or migrating;	Foraging and resting occur in the Darwin Harbour. No breeding occurs in Australia. The NT Fauna Atlas includes 88 records within the Darwin Harbour. The species is a frequent user of the East Arm Wharf (11 km from the Project), where a maximum of 260 birds were counted in one year in 2013. Between 2014 and 2018, numbers declined below 50 per year (Lilleyman & Garnett, 2019). The highest monthly counts occur in February and September (Lilleyman & Garnett, 2019).
The importance of the local population in a local, regional, NT, national and international context;	It is estimated that 180,000 to 220,000 birds use the EAAF. Hansen <i>et al</i> (2016) estimate 27,551 birds visit Australia whereas the NT population was estimated to be 39,000 birds by Chatto (2003). The discrepancy is attributable to the rapid population decline of the species over the time period. Nationally significant aggregations (i.e. occurrences of ≥ 0.1 % of the total EAAF population) are known to occur in the Darwin Harbour Proper, with particularly important habitat at the East Arm Wharf as a spring high tide roosting site (Garnett 2012, Lilleyman and Garnett 2019).
The identification of suitable habitat for the species (for breeding, foraging, aggregation or roosting), and the quality of this habitat, and how this may be disturbed or altered by the Proposal.	The intertidal mudflats and sandflats in the Elizabeth River and the mangroves adjacent to Lot 1817 are suitable habitat for <i>C. mongolus</i>. The saltpan area within Lot 1817 may be suitable roosting habitat. No breeding habitat is present in the Darwin Harbour. No aggregating habitat is present at Lot 1817. Intertidal mudflats and sandflats in Darwin Harbour Proper are considered to be in pristine condition. The saltpan area within Lot 1817 is intact, and the mangroves adjacent to Lot 1817 are also in Excellent condition, however it is unknown how the condition or suitability of these habitats has been previously impacted by disturbances present in Lot 1817. Habitat may be impacted by indirect Project impacts such as noise, light, changes to hydrological process and pollution. The risk is a lessening of the quality of habitat. Habitats may be benefitted by the Project due to a decrease in current levels of human disturbance, feral predators, fire risk and pollution. Rehabilitation of degraded land will increase the current hydrological function of areas adjacent to shorebird habitat.

Table 3-21. Northern Quoll records and suitable habitat in relation to the Project.

Northern Quoll (<i>Dasyurus hallucatus</i>)	
An assessment of the presence or likely presence of the species in the Proposal area and in any areas that may be impacted;	This species has not been recorded in the Project area over the three systematic fauna surveys initiated by TNG and conducted across three years, suggesting there is no critical habitat within Lot 1817 for the Northern Quoll. NT Fauna Atlas has one record of this species 500 m south of the Project from a systematic fauna survey in 2001 and a juvenile was recorded killed on Jenkins Road two km to the south east of the Project area in 2018. Both of these records occurred east of the Channel Island Road and Adelaide-Darwin railway line, which likely pose a significant barrier to accessing Lot 1817 from the more continuous habitat available on Middle Arm to the east. Due to the lack of records despite significant survey effort on Middle Arm west of the Adelaide-Darwin railway line it is considered the likelihood of Northern Quoll being present in Lot 1817 is Low.
The size and distribution of the local population, including at different life cycle stages, for example, when breeding, foraging, resting and/or migrating;	Records in the NT Fauna Atlas on the western extent of Middle Arm are sporadic and infrequent despite numerous systematic fauna surveys initiated by proposed developments on Middle Arm. This indicates colonisation of the area east and north of Channel Island Road by quolls is uncommon and long-term persistence of sustainable populations is unlikely.
The importance of the local population in a local, regional, NT, national and international context;	This species has undergone a significant range contraction and is now restricted to discontinuous populations across northern Australia, from the southwest Kimberley to southeast QLD, and a disjunct population in the Pilbara region of WA. In the NT, it is restricted to the Top End, including a number of islands (Hill & Ward, 2010; Woinarski & Hill, 2012). In the Darwin region it has been recorded from a number of locations including Charles Darwin National Park (Woinarski & Hill, 2012) and in the more continuous habitat to the east of Middle Arm. There is no evidence of a local population. Visitation to the local area appears to be sporadic and infrequent and not an important component of the regional, NT or national population.
The identification of suitable habitat for the species (for breeding, foraging, aggregation or roosting), and the quality of this habitat, and how this may be disturbed or altered by the Proposal.	Habitat suitability within Lot 1817 is moderate. Potentially suitable habitat in the Project area exists in the Eucalypt Woodland and Melaleuca woodland habitat types. The availability of tree hollows is limited at Lot 1817. Tree hollows suitable for denning are common in larger, older trees. All trees in Lot 1817 were systematically measured for DBH. Four small pockets of trees totalling 3.7 ha were found to have the required density of trees with DBH $\geq$ 50 cm to be considered as significant habitat. The remaining remnant Eucalypt woodland contains trees of a smaller size and thus less likely to have developed a significant tree hollow availability. Disturbances at Lot 1817 that have reduced the quality of habitat are: • historic extraction industry activity that has disturbed 315 ha or 64.5 % of Lot 1817

Northern Quoll (*Dasyurus hallucatus*)

- historic extraction industry activity has altered the surface hydrology and large areas of shallow water are available for breeding cane toads in the wet season
- fragmentation of the entire Lot 1817 by the presence of the Channel Island Road, the Adelaide Darwin Railway line, and the Elizabeth River.
- fragmentation within Lot 1817 by the cleared areas and roads.
- frequent human disturbance within Lot 1817 from unregulated access by the general public who use it for recreational purposes, such as off-leash dog walking, motorbike riding, and rally driving, as well as for illegal rubbish dumping, and intentional and accidental fires.
- frequent human disturbance within Lot 1817 for the planned maintenance of existing infrastructure, such as power lines and pipelines, road maintenance, slashing of 28.8 ha of land, and machinery and humans performing maintenance activities.
- poor rehabilitation of 61.5 ha, and no rehabilitation in 106.8 ha, with a high abundance of the weedy Gamba grass, known to exacerbate fire risk and intensity.
- the presence of introduced fauna, such as Cats and Dogs, that compete for prey and pose risks to Northern Quoll.

Despite these disturbances and lack of records, it is considered that occasional use of the site for foraging by Northern Quoll is possible, but it is unlikely that any denning or breeding habitat is present.

The Project will remove 92.5 ha of suitable habitat for the Northern Quoll including the 3.7 ha containing larger trees. The remaining suitable habitat will be impacted by indirect impacts such as noise, light, changes to hydrological process and pollution. This species could be impacted if the Project results in an increase of introduced predators to the site.

Habitats may be benefitted by the Project due to a decrease in current levels of human disturbance, feral predators, fire risk and pollution.

Table 3-22. Bare-rumped Sheath-tail Bat records and suitable habitat in relation to the Project.

Bare-rumped Sheath-tail Bat (<i>Saccolaimus saccolaimus nudicluniatu</i>s)	
An assessment of the presence or likely presence of the species in the Proposal area and in any areas that may be impacted;	This species has not been recorded in the Project area over the three systematic fauna surveys initiated by TNG and conducted across three years, suggesting there is no critical habitat within Lot 1817 for the Bare-rumped Sheath-tail Bat. NT Fauna Atlas has no records of this species within 10 km of the Project but has been recorded on Middle Arm by the DEPWS Flora and Fauna Division in recent unpublished surveys (DEPWS communication). It is likely the species is using the intact high quality habitats to the east of the Project and Channel Island Road.
The size and distribution of the local population, including at different life cycle stages, for example, when breeding, foraging, resting and/or migrating;	The scarcity of records indicates there are few individuals or they are infrequently using the area, possibly for feeding only.
The importance of the local population in a local, regional, NT, national and international context;	The species is poorly known and records are sparsely distributed in the Darwin Region. As the species has only recently been recorded in the area it may be a new population that has expanded into the area.
The identification of suitable habitat for the species (for breeding, foraging, aggregation or roosting), and the quality of this habitat, and how this may be disturbed or altered by the Proposal.	Habitat suitability within Lot 1817 is moderate. Potentially suitable habitat in the Project area exists in the Eucalypt Woodland and Melaleuca woodland habitat types. The availability of tree hollows is limited at Lot 1817. Tree hollows suitable for denning are common in larger, older trees. All trees in Lot 1817 were systematically measured for DBH. Four small pockets of trees totalling 3.7 ha were found to have the required density of trees with DBH $\geq$ 50 cm to be considered as significant habitat. The remaining remnant Eucalypt woodland contains trees of a smaller size and thus less likely to have developed a significant tree hollow availability. Competition for tree hollows is a threatening process for this species and lack of tree hollow availability may explain the lack of records within Lot 1817. Disturbances at Lot 1817 that have reduced the quality of habitat are: • historic extraction industry activity that has disturbed 315 ha or 64.5 % of Lot 1817 • historic extraction industry activity has altered the surface hydrology and large areas of shallow water are available for breeding cane toads in the wet season • fragmentation of the entire Lot 1817 by the presence of the Channel Island Road, the Adelaide Darwin Railway line, and the Elizabeth River. • fragmentation within Lot 1817 by the cleared areas and roads. • frequent human disturbance within Lot 1817 from unregulated access by the general public who use it for recreational purposes, such as off-leash dog walking, motorbike riding, and rally driving, as well as for illegal rubbish dumping, and intentional and accidental fires.

Bare-rumped Sheath-tail Bat (*Saccolaimus saccolaimus nudiclunius*)

- frequent human disturbance within Lot 1817 for the planned maintenance of existing infrastructure, such as power lines and pipelines, road maintenance, slashing of 28.8 ha of land, and machinery and humans performing maintenance activities.
- poor rehabilitation of 61.5 ha, and no rehabilitation in 106.8 ha, with a high abundance of the weedy Gamba grass, known to exacerbate fire risk and intensity.
- the presence of introduced fauna, such as Cats and Dogs

The Project will remove 92.5 ha of suitable habitat for the Bare-rumped Sheath-tail Bat including the 3.7 ha containing larger trees. The remaining suitable habitat may be impacted by indirect impacts such as noise, light, changes to hydrological process and pollution.

Habitats may be benefitted by the Project due to a decrease in current levels of human disturbance, feral predators, fire risk and pollution.

3.2.3.3 TPWC Act Threatened Fauna

Flora and fauna is protected in the NT under the TPWC Act.

A number of fauna species listed as threatened under the TPWC Act are known to occur in the Middle Arm region. The Significant Fauna Impact Assessment, presented as **Appendix J**, details significant fauna listed under the TPWC Act that are known to occur, are likely to occur or may possibly occur within Lot 1817 or any areas that may be impacted by the Project.

Fauna that are listed as threatened under the TPWC Act that are also listed under the EPBC Act include:

- Eastern Curlew (VU under the TPWC Act)
- Greater Sand Plover (VU under the TPWC Acts)
- Black-footed Tree-rat (VU under the TPWC Act)
- Red Knot (VU under the TPWC Act)
- Curlew Sandpiper (VU under the TPWC Act)
- Great Knot (VU under the TPWC Act)
- Lesser Sand Plover (VU under the TPWC Act)
- Northern Quoll (Critically Endangered under the TPWC Act)

These species have been described above in **Section 3.2.5**.

The threatened terrestrial species listed under only the TPWC Act that are known to occur within or adjacent to Lot 1817 are:

- Pale Field Rat (*Rattus tunneyi*) (VU under the TPWC Act)
- Howard River Toadlet (*Uperoleia daviesae*) (VU under the TPWC Act)

The information in **Table 3-23** and **Table 3-24** below are summarised for these species from the Significant Fauna Impact Assessment.

Table 3-23. Pale Field Rat records and suitable habitat in relation to the Project.

Pale Field Rat (<i>Rattus tunneyi</i>)	
An assessment of the presence or likely presence of the species in the Proposal area and in any areas that may be impacted;	Three records were made from the same location within the Monsoon Closed Forest habitat in Lot 1817 during a survey by GHD in 2017. The species was not recorded in subsequent surveys in 2018 and 2019.
The size and distribution of the local population, including at different life cycle stages, for example, when breeding, foraging, resting and/or migrating;	The species is known to occur in the Darwin region, including in Charles Darwin National Park (Young & Hill, 2012). There are also two records of this species less than 10 km west of Lot 1817 on Middle Arm, one from 2001 and one from 2014. The species is sparsely occurring in the locality.
The importance of the local population in a local, regional, NT, national and international context;	Records of the species occur across the Greater Darwin Region, and the Top End. The species occurs across the coastal areas along the northern half of the continent. The sparse nature of the records at Lot 1817 indicate the area is not an important habitat locally or regionally, but may be used as part of a network of habitat patches within the riparian habitats of Middle Arm.
The identification of suitable habitat for the species (for breeding, foraging, aggregation or roosting), and the quality of this habitat, and how this may be disturbed or altered by the Proposal.	Habitat suitability within Lot 1817 is moderate. Potentially suitable habitat in the Project area exists in the Monsoon Closed Forest habitat type. Disturbances at Lot 1817 that have reduced the quality of habitat for <i>Rattus tunneyi</i> are: • historic extraction industry activity that has disturbed 315 ha or 64.5 % of Lot 1817, and removed surface soils suitable for tunnelling • Alteration of surface hydrology and possible reduction of surface water flows • fragmentation of the entire Lot 1817 by the presence of the Channel Island Road, the Adelaide Darwin Railway line, and the Elizabeth River. • fragmentation within Lot 1817 by the cleared areas and roads. • frequent human disturbance within Lot 1817 from unregulated access by the general public who use it for recreational purposes, such as off-leash dog walking, motorbike riding, and rally driving, as well as for illegal rubbish dumping, and intentional and accidental fires. • frequent human disturbance within Lot 1817 for the planned maintenance of existing infrastructure, such as power lines and pipelines, road maintenance, slashing of 28.8 ha of land, and machinery and humans performing maintenance activities. • poor rehabilitation of 61.5 ha, and no rehabilitation in 106.8 ha, with a high abundance of the weedy Gamba grass, known to exacerbate the risk and intensity of fires • the presence of introduced fauna, such as Feral Cats and Dogs, that pose predation risks to <i>R. tunneyi</i>, and feral pigs that reduce habitat quality Habitats may be benefitted by the Project due to a decrease in current levels of human disturbance, feral predators, fire risk and pollution.

Table 3-24. Howard River Toadlet records and suitable habitat in relation to the Project.

Howard River Toadlet (<i>Uperoleia daviesae</i>)	
An assessment of the presence or likely presence of the species in the Proposal area and in any areas that may be impacted;	There have been 15 unconfirmed records of this species within the Project area during surveys by GHD in 2017, however they were made by visual assessment and in Melaleuca woodland. Visual assessment is not a suitable method for identifying the species and Melaleuca woodland is not the known preferred habitat of the Howard River Toadlet, which is sand sheet heath. Targeted surveys with audio (call) playback are required to verify the identification, as its short raspy call of 22 pulses distinguishes it from other sympatric species of <i>Uperoleia</i> (Young, Tyler and Kent 2005). There is no sandsheet heath habitat present in Lot 1817. Previous use of Lot 1817 for extractive industries has removed the sand and laterite layer from much of the area. Land unit mapping identifies the Lot as being Eucalypt woodland prior to disturbance, however some small scale sandsheet heath areas may have occurred. The combination of these factors makes the likelihood of the Howard River Toadlet at Lot 1817 a Low likelihood. The disturbance by the former extractive industries has made significant changes to the substrate and hydrology of the lot and no suitable habitat for the Howard Springs Toadlet is currently present.
The size and distribution of the local population, including at different life cycle stages, for example, when breeding, foraging, resting and/or migrating;	The species spends its entire life cycle within the Sand sheet heath habitats in the Elizabeth and Blackmore River catchments.
The importance of the local population in a local, regional, NT, national and international context;	The species distribution is highly restricted to the suitable habitat in the Sand sheet heath habitats in the Elizabeth and Blackmore River catchments.
The identification of suitable habitat for the species (for breeding, foraging, aggregation or roosting), and the quality of this habitat, and how this may be disturbed or altered by the Proposal.	No suitable habitat for the Howard Springs Toadlet is present within Lot 1817. No suitable habitat for the Howard Springs Toadlet will be impacted by the Project.

3.2.4 Potential Impacts and Risks

Changes to the Project, as detailed in **Section 1**, have resulted in alterations to the potential impacts for threatened flora and fauna. As the site layout and Development Envelope has had minor amendment for the EIS Supplement, a number of the impacts assessed in the Draft EIS have been re-assessed to ensure currency.

Potential impacts have been identified through the ToR, the Draft EIS and Stakeholder engagement through the Draft EIS process. These are discussed in detail in the Significant Fauna Impact Assessment (**Appendix J**) and are summarised in **Table 3-25**.

The Significant Fauna Impact Assessment identifies key receptors, which includes fauna habitats, habitat features and individual species. The risk from each potential impact is evaluated on a species by species basis

for significant fauna that have been recorded, are likely to occur or potentially occur within or surrounding the Project area. The species assessed are listed in **Table 3-26**.

One threatened flora species Darwin Cycad (*Cycas armstrongii*) was identified in the Draft EIS as occurring in the Site. Changes to the impact to this species are also included in **Section 3.2.4.3**.

Table 3-25. Summary of the relationship between impact sources and outcomes on fauna that may arise from the Project

Impact source	Occurrence of impact within the Study area	Impact pathways and potential impacts	Potential outcomes
Vegetation Clearance	Total land disturbance of 270.5 ha	- Habitat loss - Response to disturbance or other behavioural changes in individual animals	- Mortality or displacement of individuals - Decline in population size - Local extinction - Reduction in the carrying capacity of the environment, or a reduction in the species or individuals that the environment can support - Reduction in diversity
Fragmentation	- Habitat loss within Lot 1817 - Increased local traffic	Reduced access to suitable habitat	- Decline in population size - Reduction in the carrying capacity of the environment, or a reduction in the species or individuals that the environment can support - Reduced reproductive success - Reduction in diversity
Vehicle Strike	- Increase in traffic on Channel Island Road and Adelaide-Darwin Railway line. - Records of significant fauna being struck by vehicles on nearby roads (NT Fauna Atlas)	Collision with animals	- Mortality or injury of individuals - Decline in population size
Introduced species	- Introduced fauna Cane Toad, Black Rat, Feral Cat, Dog/Dingo, Feral Pig, and Asian House Gecko have been recorded in the Study area. - Introduced flora Gamba Grass and Annual Mission Grass have been recorded in the Study area.	- Habitat degradation and loss (from weeds) - Competition for resources. - Predation - Increased mortality from toxic introduced species - Introduction/spread of disease. - Increased fuel loads from grassy weeds	- Mortality of individuals - Decline in population size
Increased noise	Noise from the operation of heavy machinery and plant	Responses to noise disturbance or other behavioural changes in individual animals	- Displacement of individuals - Disruption to breeding - Reduced fitness

Impact source	Occurrence of impact within the Study area	Impact pathways and potential impacts	Potential outcomes
		- Species using audible cues for breeding activity may also experience disruption to breeding cycles or reduced breeding success. - Habitat modification or loss due to loss of habitat quality	
Increased light	The Facility will run 24 hours a day so light will be required around buildings	- Responses to disturbance or other behavioural changes in individual animals, especially for light sensitive species - Changes in prey item aggregation for insectivorous species, resulting in changes to foraging behaviour	- Displacement of individuals - Decline in population size - Disruption to breeding
Inappropriate or ineffective rehabilitation	Rehabilitation of 64 ha of land within Lot 1817 outside of the Development Envelope	- Increased weed invasion - Increased fire risk due to grassy weeds - Loss of opportunity to mitigate vegetation clearing	Decline in population size
Altered hydrology	- Changes to groundwater recharge - Changes to surface water flow	Habitat modification arising from local hydrogeological changes, including change in Mangrove or Saltpan composition or condition	Changes in carrying capacity
Uncontrolled fire	- Currently frequent high intensity fires - Fire frequency and intensity expected to decrease	- Habitat modification; high frequency or intensity fires can reduce understorey habitat cover and reduce food sources and reduce the incidence of fire sensitive species or increase dominance of fire resilient species - Low frequency fires can result in dominance of senescent vegetation and high fuel loads.	- Mortality or injury of individuals - Decline in population size - Reduction in carrying capacity - Changes in species - Reduction in faunal diversity
Pollution	- Seepage from disturbance to ASS and Potentially Acid Sulfate Soil areas - Flooding - Seepage from storage areas	- Habitat modification – loss of pollution sensitive species - Loss of habitat quality	- Decline in carrying capacity - Changes in species - Reduction in faunal diversity
Erosion and sedimentation	Ground disturbance during construction	- Habitat modification – loss of pollution sensitive species - Loss of habitat quality	- Reduction in carrying capacity - Changes in species - Reduction in faunal diversity
Settling ponds and Entrapment	- Fencing of the facility - Settling ponds	- Ensnarement in fencing - Attraction to open water	- Mortality or injury of individuals - Decline in population size

Table 3-26. Species included in the Significant Fauna Impact Assessment

Likelihood of occurrence	Species	Conservation Code	
		EPBC Act	TPWC Act
Known to occur	Eastern Curlew	CR and Mi	VU
	Greater Sand Plover	VU and Mi	VU
	Black-footed Tree-rat	EN	VU
	Pale Field Rat		VU
	Howard River Toadlet		VU
	Common Sandpiper	Mi	
	Common Greenshank	Mi	
	Whimbrel	Mi	
	Little Tern	Mi	
	Fork-tailed Swift	Mi	
	Oriental Cuckoo	Mi	
	Eastern Osprey	Mi	
	Saltwater Crocodile	Mi	
Likely to occur	Red Knot	EN and Mi	VU
	Curlew Sandpiper	CR and Mi	VU
	Great Knot	CR and Mi	VU
	Lesser Sand Plover	EN and Mi	VU
	Bar Tailed Godwit	Mi	VU
	Northern Quoll	EN	CR
	Yellow Spotted Monitor		VU
	Bare-rumped Sheath-tailed Bat	VU	
May possibly occur	Fawn Antechinus	VU	EN
	Ghost Bat	VU	
	Mertens Water Monitor		VU
	Barn Swallow	Mi	
	Sharp-tailed Sandpiper	Mi	
	Pectoral Sandpiper	Mi	
	Oriental pranicole	Mi	
	Oriental Plover	Mi	
	Ruddy turnstone	Mi	
	Sanderling	Mi	
	Red-necked Stint	Mi	
	Long-toed Stint	Mi	
	Little Ringed Plover	Mi	
	Asian Dowitcher	Mi	
	Black-tailed Godwit	Mi	
	Little Curlew	Mi	
	Pacific Golden Plover	Mi	
	Grey Plover	Mi	
	Wood Sandpiper	Mi	
	Marsh Sandpiper	Mi	
	Terek Sandpiper	Mi	

Section 3.2.4.1 summarises the impacts and risks habitats, **Section 3.2.4.2** summarises the impacts and risks to habitat features and **Section 3.2.4.3** summarises the impacts and risks to species.

3.2.4.1 Potential impacts to habitats

Land clearance is listed as a Key Threatening Process under the EPBC Act and is a key impact to the significant fauna as a result of the Project. The estimated quantity of each habitat that will be potentially impacted by the Project is current for the EIS Supplement and is presented in **Table 3-27**.

The Draft EIS proposed a processing methodology that required the clearing of 2 ha of Mangroves. Changes to the Project for the EIS Supplement have removed the requirement for this clearing. No Mangroves or Riparian vegetation will be cleared for the Project.

Habitat loss and degradation will occur predominantly in previously disturbed land that is degraded or completely degraded, however some areas of suitable habitat for significant terrestrial fauna, particularly the Mixed Woodland, will be cleared.

Table 3-27. Habitats to be cleared

Habitat	Habitat value	Clearing Area	Regional Extent	
		ha	ha	% loss
Mixed Woodland	High	92.5	7,543	1.22
Native grassland	Low	51.1	3122	1.26
Melaleuca woodland	Low	5.9	4770	0.12
Temporary Water Bodies	Low	11.7	NA	
Disturbed areas	Low	109.3	NA	
		270.5		

*Figures sourced from DEPWS (2020)

NA: Not available, previously disturbed no natural analogue

Figures used to calculate the regional extent of the vegetation type were sourced from the digitisation of the Land Resources of the Elizabeth, Darwin and Blackmore Rivers (DENR 2000), last updated on the 29/06/2016. The regional extent for Temporary Water Bodies is determined as Not Applicable as the bodies in Lot 1817 are created by the historic extractive industries and not equivalent to natural inundation areas in the Elizabeth, Darwin and Blackmore River Catchments.

Habitat loss or degradation will have the greatest impact in the Mixed Woodland. However, there is habitat connectivity outside of the Development Envelope within Lot 1817, and large areas of undisturbed high quality habitat to the east. None of the habitat types to be cleared are restricted to the Study Area and are well represented regionally. Rehabilitation of degraded areas outside of the Development Envelope within Lot 1817 will decrease the fragmentation of remnant areas.

The scale of the impact is limited to the site and the intensity is expected to be low due to the high availability of suitable habitat nearby. The impact will alter the quality, abundance or distribution of environmental values without compromising their integrity.

Potential indirect impacts on terrestrial fauna habitats may include changes to fire regimes, increases in the abundance of introduced species and lowering of habitat quality due to noise and light.

Potential indirect impacts on shorebird fauna habitats are changes to mangrove and saltpan habitats due to changes in hydrology, and lowering of habitat quality from pollution, noise and light.

3.2.4.2 Potential Impacts to habitat features

Within the Mixed Woodland, nominated for clearing is 3.7 ha of significant habitat containing the threshold number of trees ≥ 50 cm dbh that qualifies for Significant Vegetation under the NT Land Clearing Guidelines. This will reduce the availability of nesting or roosting sites for species that require tree hollows.

Other Sensitive and Significant vegetation may be impacted indirectly. Hydrology is important in the distribution and abundance of mangrove vegetation in the Darwin Harbour, with mangrove species distributed based upon the specific mix of freshwater and brackish water and the depth of inundation (Brocklehurst and Edmeades 1996). Low quality water, either sediment laden or containing chemicals or low pH water from ASS would also affect the health of mangroves. The risk of changes to hydrological processes as a result of the Project was determined in the Draft EIS to be low. Further assessment has been conducted in Section 3.1 for the risk of contamination of surface and groundwater as a result of the Project. The risk has been determined to be low for changes to hydrological process and medium for contamination of surface and groundwater.

The saltpan within 1817 may have mangroves encroach if the amount of freshwater flushing through it increases (Brocklehurst & Edmeades, 1996). The Stormwater Management Plan nominates the locations at the site where water would be discharged in a high rainfall event. These areas are following natural drainage lines and are located away from the saltpan; therefore, the risk of saltpan impacts is Low.

The saltpan and mangrove habitats may also be impacted by noise and light originating from the Project. The noise during the construction phase is short term. The Project Layout has been allocated in a way that places the greatest operational noise and light sources as far away from these key habitat receptors as possible within Lot 1817. As recommended by CoA (2017), a vegetation buffer has been allocated between the Development Envelope and these habitats, and as a consequence of the layout and the buffer, the risk of noise and light impacting these habitats during operations is Low. The persistence of shorebirds in similar proximity to other noise sources in the Darwin Harbour indicates the certainty is moderate.

The Internationally and nationally significant aggregations of shorebirds occur at Lee Point, East Arm Wharf and the saltpans on Middle Arm. These locations are 26 km, 10 km and 11 km from the Project respectively. At this distance these areas will not be impacted by noise and light originating from the Project, as the impacts from noise and light are limited to the local scale. The risk from these sources is Low. No impacts arising from the Project are expected to pose any risk to the Nationally or Internationally Significant Aggregations of Waterbirds as the impacts described in **Table 3-25** are not of a scale that will impact those sites. The risk to mangrove, saltpan and intertidal mudflat areas is also Low.

Department of Land Resource Management (DLRM) (2014) and Alongi et al. (2016) identified threats to the future ecological health of Darwin Harbour. Two of these are excess sediment deposition from runoff and dredging and pollution by catchment-derived nutrients and toxicants (DLRM 2014; Alongi et al. 2016). Sedimentation is most likely to affect shorebirds indirectly, through disruption to benthic infauna. Shorebirds are likely to have adaptable foraging strategies that enable them to persist through periods of localised sedimentation and invertebrate decline (see Rogers *et al.*, 2006), however widespread or prolonged decline in food availability will cause eventual loss of habitat quality leading ultimately to habitat loss. A Stormwater Management Plan has been prepared for the Project that minimises the risk of sedimentation through the

application of controls for stormwater in line with guidelines and regulations. The residual risk of sedimentation is Low.

3.2.4.3 Potential impacts to species

The potential impacts to species have been assessed in the Significant Fauna Impact Assessment. Here they are summarised on the basis of the impact with those species identified to be most impacted identified.

Habitat Loss

The impact to the Black-footed Tree-rat is expected to be Moderate. The population within the survey area is most likely permanent, however the species is known to have a large home range (up to 67 ha), travel long distances (up to two km) and flexibility in denning habitats if *Pandanus* is available. Forty-three ha of Mixed Woodland will be retained in the Study Area and Black-footed Tree-rat have demonstrated an ability to persist in smaller habitat areas if they have connectivity to larger habitat patches (Rankmore 2006).

A large area of intact high quality habitat known to support the species occurs to the east of the Project and animals displaced due to habitat loss associated with the Project will likely successfully translocate into the area. The habitats within the Study Area are currently highly fragmented internally by past disturbance, at risk from fire due to high grassy weed occurrence, and subject to high levels of human and introduced fauna disturbances.

The predicted habitat loss is approximately 4% of the available habitats in central middle arm. The impact is assessed as Moderate because loss of the habitat within the Development Envelope would not be expected to compromise the viability of the local population in central middle arm, and the highly mobile individuals will likely relocate, but the impact is permanent.

The impact of habitat loss on other significant fauna species is low to negligible.

Habitat loss for the Darwin Cycad has increased with the minor changes to the Development Envelope. **Table 3-27** lists an increase in clearing of 5 ha of Eucalypt Woodland and 8.5 ha of Regenerating Eucalypt Woodland. This will lead to an estimated increase of 1,925 Darwin Cycad individuals to be cleared. Within Lot 1817 there is an estimated 30,850 individuals of Darwin Cycad. The proposed clearing will reduce this to 8,200. Records on the NT Flora Atlas indicate Darwin Cycad is locally common to the east of the Site, where a large extent of similar, intact habitat occurs. The proposed removal of cycads is unlikely to result in a significant impact on the regional subpopulation of the species.

Potentially suitable habitat for *Typhonium praetermissum* (TPWC Act VU) has been mapped by the NT Government (DLRM 2019) as occurring within the Site. Targeted searches at the appropriate survey period were reported in **Appendix J** of the Draft EIS, including a description of the survey methodology and survey effort and a map of the spatial distribution of the area searched in relation to the predicted suitable habitat provided (Figure 4-8 Draft EIS **Appendix J**). Suitable habitat for *T. praetermissum* was found to be present (using the description in DLRM, 2016) but no individuals were recorded. The likelihood of an important population being present is considered to be low. It is possible that the survey failed to detect a small number of individuals, however it is unlikely the survey failed to detect a large number of individuals. Therefore, any impact to this species as a result of clearing will not be significant.

Habitat fragmentation

The impact of habitat fragmentation to the Black-footed Tree-rat is expected to be High. The Study Area is already fragmented from the intact habitats to the east by Channel Island Road and the railway line. The Project will increase traffic on these corridors by 14%; however, the majority of expected vehicle movement will occur in the day while this species is sleeping.

The habitats available in Lot 1817 are already fragmented by disturbed areas. The further loss of habitat will increase the level of fragmentation between remnant habitat blocks. The impact is assessed as Moderate because the increased fragmentation would not be expected to compromise the viability of the local population in central middle arm, and the highly mobile individuals will likely relocate, but the impact is permanent.

The risk of fragmentation was assessed to be low or negligible for all other fauna species.

Vehicle Strike

The impact of vehicle strike to the Black-footed Tree-rat and Bare-Rumped Sheath-tailed Bat is expected to be High during the vegetation clearing activity in the Construction phase. Without management measures there is a risk of serious or fatal injury to these species from vehicle strike during clearing activities. As the species are nocturnal, clearing during the day may prohibit animals the opportunity to escape. This is short-term and the risk will cease once clearing has been completed – likely a few months following the start of construction.

As the species are highly mobile they are likely to cross from retained habitats in the Study Area into the intact habitats east of the Channel Island Road and the rail line. For Black-footed Tree-rat there is a risk of fatalities during crossing. Construction phase traffic on Channel Island Road is expected to comprise 4 % of total traffic. This is unlikely to pose a significant increased risk, however if a high number of fauna are attempting to cross in a short period during clearing activities the risk is significantly higher.

The impact of vehicle strike on all fauna is expected to be Low during the Operations phase. Operations phase traffic on Channel Island Road is expected to comprise 14 % of total traffic. However the majority of expected vehicle movement will occur in the day while Black-footed Tree-rat and other nocturnal species are sleeping.

Introduced Species

Introduced flora and fauna are already commonly occurring at the site and the Project is likely to cause a reduction in the presence of some introduced species such as Cane Toad and Gamba Grass through utilisation of the previously disturbed land, and domestic dogs through the reduced public access. This will benefit many species.

Increase in the attraction of introduced predators such as feral cats and dogs/dingos to the site would have an impact to the Pale Field Rat, Black-footed Tree-rat and migratory shorebirds such as the Far Eastern Curlew and Greater Sand Plover. The risk is moderate.

Risk from introduced flora is predominantly through the increase to fire risk. This is discussed under fire below. Introduced flora also pose a risk to habitat suitability that can lead to a decline in population size.

Noise and Light

The risk of noise and light impacting significant fauna is likely to be low for most species due to the substantial vegetation buffering the site. The expected noise levels are within the limits of other nearby projects and species such as Black-footed Tree-rat and Eastern Curlew have remained in habitats close to noise sources, indicating they have a high threshold for disturbance from these impacts. Whilst Eastern Curlew will be at a significant distance from noise and light with a substantial buffer, Black-footed Tree-rat habitat is immediately adjacent the Project. Whilst the species is known to persist in noisy areas it is unknown if this has a physiological toll and as such the risk has been considered to be moderate.

Inappropriate or ineffective rehabilitation

Many of the significant fauna have a moderate risk of being impacted by inappropriate or ineffective rehabilitation. This is because poorly rehabilitated land is prone to introduced species discussed above.

The risk of inappropriate or ineffective rehabilitation is the risk of missing the opportunity to improve the quality of the site. Successful rehabilitation will provide improved hydrological function in currently disturbed areas that will benefit shorebird and terrestrial habitats and reduce fragmentation of disturbed areas. The risk is moderate.

Hydrological Processes

The Project poses a low risk to the hydrological processes at the Site and the risk of loss of habitat quality for Significant fauna has been assessed as Low for all species.

Contamination of surface and groundwater, sedimentation and erosion

Following mitigation, the Project poses a medium risk of contamination to surface and groundwater. Significant fauna habitat for migratory shorebirds thus has a medium risk of being impacted from contamination through these pathways.

Post mitigation, the Project has a low risk of sedimentation. Significant fauna habitats are at low risk from this impact.

Uncontrolled fire

The current fire risk at the Site is high due to the presence of weedy grasses and the unrestricted access to the public. There is frequent evidence of intentionally lit fires at the site. The presence of the Project will reduce the risk from these sources but will introduce new sources that occur in industrial settings.

Inappropriate fire regime is a threatening process for many of the significant fauna species and the risk of uncontrolled fire as a result of the project, while unlikely, has a high consequence so is of medium risk.

Ponds and fauna entrapment

The risk to fauna from ponds is low as the water will not be of a quality that will be detrimental, however attraction of fauna to ponds may increase interaction with humans. Whilst in general bats are susceptible to entanglement in fences, the Bare-rumped Sheath-tailed Bat is known to forage at high altitudes and be unlikely to interact with fencing. The risk of entrapment is low.

3.2.5 Significant Impact assessments

Significant Impact Assessments are determined using the DAWE Significant Impact Guidelines (DoE, 2013) for fauna listed as threatened or migratory under the EPBC Act, which are considered MNES. An assessment of impacts has been made on a species by species basis for the 13 threatened and 24 migratory species that are known to occur, likely to occur or possibly occur within Lot 1817 or areas that may be impacted by the Project. These assessments are provided in the Significant Fauna Impact Assessment (**Appendix J**).

The assessments identified that no significant impacts to MNES are expected to occur as a result of the Project.

3.2.6 Mitigation and Management

Table 3-28 lists the supplementary mitigation and management strategies for each impact source potentially arising from the Project for terrestrial ecosystems. These are complimentary to those proposed in the Draft EIS.

Table 3-28. Mitigation and management strategies for each impact source potentially arising from the Project.

Impact source	Mitigation Hierarchy	Mitigation and management strategy
Fragmentation	Minimise	Minimise the impact of fragmentation through rehabilitation of disturbed areas identified in the Rehabilitation Management Plan.
Inappropriate or ineffective rehabilitation	Avoid	Implementing a monitoring program, as detailed in the Rehabilitation Management Plan, to identify issues and management actions triggered by quantitative thresholds. Avoid the spread of weedy grasses by having an objective of eradication
Lightning and uncontrolled fire	Avoid	The Weed Management Procedure (EMP; Appendix M) and Fire Management Plan (FMP; Appendix N) have been updated to include the eradication of gamba grass
Ponds and fauna entrapment	Avoid	Avoid attracting fauna to settling ponds by engineering ponds to have steep raised embankments with no edges

The Commonwealth has prepared policy and guidance documents for a number of threatened species and threatening processes such as introduced fauna species. The policy and guidance documents relevant to the Terrestrial Ecosystems Factor are detailed in **Table 3-29**, which provides a discussion for how the Project is not in contravention of the stated objectives.

Table 3-29. Policy and Guidance

Guidance and Objectives	Discussion
Threat abatement plan for predation, habitat degradation, competition and disease transmission by feral pigs (<i>Sus scrofa</i>) (DoEE 2017b) • Prioritise key species, ecological communities, ecosystems and locations across Australia for strategic feral pig management • Encourage the integration of feral pig management into land management activities at regional, state and territory, and national levels • Record and monitor feral pig control programs, so their effectiveness can be evaluated • Build capacity for feral pig management and raise feral pig awareness amongst landholders and land managers • Improve public awareness about feral pigs and the environmental damage and problems they cause, and the need for the feral pig control.	The Project has identified Significant fauna and fauna habitats and Key features within the Site. The Project will record all introduced fauna at the Site and if they are increasing in number a control strategy will be developed in consultation with Key Stakeholders such as the DEPWS Flora and Fauna Division. Any opportunities for integration into existing programs will be identified and developed at that time. Any program for controlling feral pigs adopted by the Project will have a recording component. If a more suitable recording program is not nominated by the above consultation and integration, controls will be recorded on the Site fauna register as all fatalities and introduced fauna will be systematically recorded there. The Project will have roles for the management of Environmental aspects of the Project. The capacity to manage introduced fauna will be a component of the role. Suitable capacity will be sourced for the roles. Induction material for Project employees will contain material on introduced fauna. This will include the feral pig. Project personnel will be encouraged to report sightings and fatalities of the species, which will familiarise them with the species and the risks it poses. The Project is not in contravention of the objectives of the plan.
Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE 2018). • Contribute to long-term prevention of the incidence of marine debris • Understand the scale of impacts from marine plastic and microplastic on key species, ecological communities and locations • Remove existing marine debris • Monitor the quantities, origins, types and hazardous chemical contaminants of marine debris, and assess the effectiveness of management arrangements for reducing marine debris • Increase public understanding of the causes and impacts of harmful marine debris, including microplastic and hazardous chemical contaminants, to bring about behaviour change	Appropriate disposal activities and actions, including the collection, transport, treatment and disposal of non-process waste, are required to reduce adverse effects of waste on the marine environment. It is expected that handling of non-process waste can be effectively managed to prevent significant impact on marine fauna. The Project has committed to the following management that will reduce the risk of generating marine debris to Low. • Removal of existing waste from the site using accredited waste specialists • Recyclable materials, including cardboard, paper, glass, batteries, waste hydrocarbon drums and scrap metal, will be recycled wherever possible; • Housekeeping inspections of all work areas will be undertaken weekly; • Littering on site is prohibited and work and office sites are to be kept clean and tidy; • Rubbish containers are to be carried in all vehicles and provided at all work area; • Waste management will be addressed in the site induction and include a summary of biodiversity at the Project including threatened flora and fauna and details of construction and operations activities that could impact on flora and fauna including the potential generation of marine debris The Project is not in contravention of the objectives of the plan.

Guidance and Objectives	Discussion
Threat abatement plan for predation by the European red fox (DEWHA, 2008b). 1. Prevent foxes occupying new areas in Australia and eradicate foxes from high-conservation-value 'islands' 2. Promote the maintenance and recovery of native species and ecological communities that are affected by fox predation	No foxes are known to occur in the Greater Darwin Region or the Top End. The Project will record all introduced fauna and manage waste on site in a manner that does not attract introduced fauna. If Red Fox are recorded on site they will be recorded in the fauna register and immediately reported to the DEPWS Flora and Fauna Division. The Project will not be in contravention of the Threat abatement Plan for the Red Fox.
Threat abatement plan for predation by feral cats (DoE, 2015c). Effectively control feral cats in different landscapes.	The Project will record all introduced fauna and manage waste on site in a manner that does not attract introduced fauna. If cats are recorded to be increasing on Site a control strategy will be developed in consultation with Key Stakeholders such as the DEPWS Flora and Fauna Division. Any opportunities for integration into existing programs will be identified and developed at that time. Induction material for Project employees will contain material on introduced fauna. This will include the feral cat. Project personnel will be encouraged to report sightings and fatalities of the species, which will familiarise them with the species and the risks it poses. The Project is not in contravention of the objectives of the plan.
Conservation Advice <i>Calidris ferruginea</i> curlew sandpiper (DoE, 2015a) Conservation Advice <i>Numenius madagascariensis</i> eastern curlew (DoE, 2015b). Conservation Advice <i>Calidris canutus</i> Red knot (TSSC, 2016a). Conservation Advice <i>Charadrius mongolus</i> Lesser sand plover (TSSC, 2016) Conservation Advice <i>Charadrius leschenaultii</i> Greater sand plover (TSSC, 2016). Conservation and Management Actions: • Maintain and improve protection of roosting and feeding sites in Australia. • Incorporate requirements for curlew sandpiper into coastal planning and management. • Manage disturbance at important sites when curlew sandpipers are present – e.g. discourage or prohibit vehicle access, horse riding and dogs on beaches, implement temporary beach closures.	The Project will not reduce the protection of roosting and feeding sites for threatened migratory shorebird species. In line with Conservation Advices the Project has incorporated the requirements for the threatened migratory shorebird species into planning and proposed management to minimise the risk to any habitat suitable for these species, and thus not reduced the area of potentially suitable habitat threatened migratory shorebird species may occupy in the Darwin Harbour. The Project has incorporated the requirements for threatened migratory shorebird species into the planning and proposed management by minimising the impacts to suitable habitat through selection of alternative processes. The Project has been allocated on the Site in a way that minimises the impact to threatened migratory shorebird species habitats. As proposed in the Migratory Shorebird Guideline (CoA 2017) a vegetation buffer has been allocated between the Project and the suitable habitats. Where this buffer is currently in a degraded condition the Project will rehabilitate to a standard that will increase the buffering capacity from Project impacts. The Project will reduce current disturbance to the Site where domestic dogs, cars and motorbikes have unrestricted access and an existing threat of introduced species and fire are present. The Project is not in contravention of the objectives of the plans.

Guidance and Objectives	Discussion
EPBC Act referral guideline for the endangered northern quoll (CoA 2016) Mitigation Objective Northern Territory: Ensure appropriate land management (i.e. reducing high fuel loads through weed control and feral animal control). Threats and key impacts: Habitat clearing, modification or land use change Urbanisation Introduction and increases of invasive species Pastoralism Traffic Inappropriate fire regimes	The EPBC Act referral guideline for the endangered northern quoll CoA (2016) has Mitigation Objectives for the Northern Territory which are to: <i>Ensure appropriate land management (i.e. reducing high fuel loads through weed control and feral animal control).</i> The Project is not in contravention of these objectives. The Project has committed to the eradication of Gamba Grass from the site, a weedy grass that currently presents high fire risk. Cane Toads are a feral animal currently present at the Site that are a significant threat to the Northern Quoll. The Project will remove 95% of the existing breeding habitat for Cane Toad at the Site. All introduced fauna will be recorded and if found to be increasing control measures will be implemented. CoA (2016) lists Threats and key impacts to Northern Quoll as <i>Habitat clearing, modification or land use change, Urbanisation, Introduction and increases of invasive species, Pastoralism, Traffic and Inappropriate fire regimes.</i> The Project has minimised habitat clearing through the utilisation of land that is previously disturbed and currently in a degraded condition with a high level of introduced species and fire risk. The modification and land use change is planned in a way that minimises changes to aspects like hydrological processes. The Project will reduce the breeding habitat of Cane Toad by 95%. This introduced species poses a particular threat to Northern Quoll. Domestic dogs will also be reduced at the Site due to restriction of Public access. The risk of increased invasive species at the Project is Low. There is no pastoralism associated with the Project. At Construction and Operations respectively the Project is likely to comprise 4 and 14% respectively of the traffic on Channel Island Road. The use of busses is also considered to be an option for further reduction in traffic through Operations. It is expected that the majority of traffic movements will occur during the day when Northern Quoll are sleeping. The risk of vehicle strike as a result of the Project is Low. Management of weedy grasses including the eradication of Gamba Grass coupled with the restriction of Public access to the site will reduce the risk of fire at the Project. The Project does not substantially contribute to the key threats to Northern Quoll.
National Recovery Plan for the Northern Quoll <i>Dasyurus hallucatus</i> (Hill and Ward 2010) Objective: minimise the rate of decline of the northern quoll in Australia and ensure that viable populations remain in each of the major regions of distribution into the future. Specific objective 2: Foster the recovery of northern quoll sub-populations in	The Project will not cause the Northern Quoll to decline. No impact to the Quoll population or to significant habitat will occur as a result of the Project. The Project will not interfere in the recovery of Northern Quoll in the Greater Darwin Region, where individuals have survived alongside cane toads. Areas of degraded habitat will be rehabilitated to a quality suitable for Northern Quoll habitat. The project will reduce Cane Toad breeding habitat and reduce the presence of domestic dogs.

Guidance and Objectives	Discussion
areas where the species has survived alongside cane toads Specific objective 7: Reduce the impact of feral predators on northern quolls Specific objective 8: Raise public awareness of the plight of northern quolls	Induction material for Project employees will contain material on threatened fauna. This will include the Northern Quoll. Project personnel will be encouraged to report sightings and fatalities of the species, including road fatalities, which will familiarise them with the species and the risks it faces. The Project is not in contravention to the Objectives of the National Recovery Plan for Northern Quoll.
Conservation Advice <i>Mesembriomys gouldii</i> Black-footed tree-rat (TSSC, 2015) Primary Conservation objective: Stabilise or increase subpopulations across range, through amelioration of existing threats Conservation and Management Actions: • Develop or maintain regimes that reduce frequency and intensity of fire • Implement cost-effective control measures to reduce the abundance or impacts of feral cats • Maintain patch integrity and increase connectivity, especially in regions subject to clearing and intensification of land use • Implement integrated monitoring program linked to assessment of management effectiveness • Involve Indigenous ranger groups in survey, monitoring and management	The size of the local population of Black-footed Tree-rat will not be impacted by the Project. Translocation of animals prior to clearing will ensure no Black-footed Tree-rat are killed as a result of the Project. Whilst the release sites are yet to be determined in collaboration with DEPWS and DAWE, it is anticipated that animals will be moved to the intact habitat to the east and thus remain in the same sub-population. Remnant habitats will be retained in Lot 1817 outside of the Development Envelope. Existing threats are introduced predators, inappropriate fire regimes and habitat fragmentation. The Project will eradicate Gamba Grass and restrict access to the public. This will reduce the risk of fire and the frequency of domestic dogs at the Site. The Project will also control introduced predators if they are recorded to be increasing at the Site. TNG have committed to rehabilitation of land outside the Development Envelope in a Degraded and Completely Degraded condition. This will reduce the fragmentation of remnant habitats. The Project is not in contravention of the Conservation Advice. Indigenous ranger groups have not been involved in survey, monitoring and management strategy to date. TNG will, however, liaise with relevant groups such as the Larrakia Land Sea Ranger unit to foster good relationships and identify if synergies can be realised between both parties. This may be the case for shorebird monitoring, which has been conducted by the Larrakia Rangers in Darwin Harbour since 2013.

3.2.7 Monitoring and Reporting

Monitoring and reporting commitments made in the Draft EIS have been retained for the EIS Supplement. Additional monitoring and reporting commitments developed for the EIS Supplement are detailed in **Table 3-30**.

Table 3-30. Supplementary monitoring and reporting for Terrestrial Ecosystems

Relevant Plan	Monitoring	Reporting
Rehabilitation Management Plan	Twice per year for the first two years or until criteria are met then every two years until completion criteria are met	Annual Environmental Report

3.2.8 Statement of Residual Impact

Consistent with the outcomes from the Draft EIS, the following outcomes are predicted:

- No change to the conservation status of significant flora or fauna;
- Loss of vegetation and habitat is negligible at the regional scale; and
- No loss of important fauna populations at a regional scale.

Based on the assessed impacts and mitigating strategies proposed, including rehabilitation of existing disturbed areas, TNG expects the Project will achieve the NT EPA Objective for Terrestrial Ecosystems. No offsets are considered to be required.

TNG LIMITED

SUPPLEMENT TO THE
ENVIRONMENTAL IMPACT STATEMENT
DARWIN PROCESSING FACILITY

AIR QUALITY

3.3 AIR QUALITY

3.3.1 NT EPA Objective

The NT EPA objective for the environmental factor Air Quality (EPA 2021) is to:

Protect air quality and minimise emissions and their impact so that environmental values are maintained.

Whilst some aspects of the Project have been revised since completion of the Draft EIS, the Project will continue to achieve the above objective for Air Quality.

3.3.2 Technical Studies

To reflect amended Project design parameters, address comments raised through public submissions and inform a review of the impact assessment presented in the Draft EIS, the Project Air Quality Assessment has been updated. A Third Party Review of the draft Vipac Air Quality Assessment was undertaken by SRL. As a result of the review Vipac re-ran the model with due consideration of the findings and amended the Air Quality Assessment report accordingly.

The Air Quality Assessment report, and the third-party review of the assessment, is presented in full in **Appendix G**, with details listed below in **Table 3-31**.

The revised Air Quality Assessment report supersedes Appendix U in the Draft EIS.

Table 3-31. Air quality studies undertaken for the Supplement.

Date	Study Title	Consultant	Description	Report
25 January 2021	Darwin Magnetite Processing Facility EIS Noise & Air - APM for TNG Ltd - Air Quality Assessment	Vipac Engineers and Scientists	Air Quality Assessment	Appendix G
22 January 2021	Third Party Review	SRL		Appendix G

3.3.3 Background Information

3.3.3.1 Sensitive Receptors

A total of 14 sensitive receptors, representative of the closest residential and recreational areas that have the potential to be impacted by the Project, have been considered for the Project. An additional sensitive receptor, the future residential/urban area located in Weddell (R13), has been excluded from the assessment as this development is no longer planned to go ahead (pers. comm, NT EPA 2020). All sensitive receptors remain the same as the Draft EIS with the exception of the Elizabeth Boat Ramp, which has been included for the revised assessment.

Details of the sensitive receptors are listed below, with the locations shown in **Figure 3-11**:

- R1 to R7: Residential receivers located in the suburbs of Archer and Bellamack;
- R8 to R12: Residential receivers located in the suburb of Virginia;
- R13: Future residential/urban area at Weddell (excluded from further assessment)
- R14: Bladin Village (workers accommodation for the Bladin Point LNG Facility); and
- R15: Elizabeth River Boat Ramp.



Figure 3-11. Location of Air Quality sensitive receptors.

3.3.3.2 Background Air Quality

Data from the Palmerston Air Quality Monitoring Station is used as a conservative representation of background air quality levels at the Project site. The Palmerston station is used for this background assessment as it is located approximately four km north of the Project site and is sited to capture industrial emissions from Middle Harbour sources.

The Draft EIS used the 90th percentile concentrations as an estimate of background air quality however, in accordance with the guidelines set out by the Victorian EPA in the State Environmental Protection Policy (Air Quality Management), the 70th percentile measured concentrations are adopted for this study as a conservative estimate of background air quality for the Project area.

Table 3-32 summarises the assigned background concentrations for the Project and compares background levels with the relevant criteria.

Table 3-32. Assigned air quality background level for the Darwin Processing Facility

Parameter	Criteria (µg/m ³)		Period	Applied Background (µg/m ³)
PM₁₀	50		24 Hour	23.7
	25		Annual	19.9
PM_{2.5}	25		24 Hour	9.2
	8		Annual	7.6
SO₂	570		1 Hour	1.0
	230		24 Hour	1.0
	57		Annual	0.89
NO₂	250		1 Hour	5.5
	62		Annual	4.7
Dust Deposition	2 ^a	4 ^b	Annual	2

a maximum increase in deposited dust level in g/m²/month

b maximum total deposited dust level in g/m²/month

There are no significant sources of NH₃, HCl and Cl₂ in proximity to the Project site. Background levels of these pollutants are therefore estimated as negligible.

3.3.4 Potential Impacts and Risks

The source-pathway-receptor model (**Table 3-33**) used in the Draft EIS has been adopted to identify the additional impacts and risks to this factor, with further detail provided in the sections below. It is the Project's intention to maintain air quality and minimise emissions. For the Supplement, further technical studies have been produced to evaluate the potential impacts of air pollutants generated from the constructional and operational stages of the Project. With this information, it is then possible to determine the suitable mitigation and management actions that can be implemented and calculate the residual risk.

Table 3-33. Potential pathways for impact to air quality

Source	Pathway	Receptor
Particulate matter from point and fugitive emission sources	• Movement of vehicles on unsealed roads • Clearing of vegetation • Excavation activities • Wind erosion of exposed surfaces and stockpiles.	Air Quality
Stack emissions (NO ₂ , SO ₂ , NH ₃ , HCl and Cl ₂)	Gaseous emissions into the atmosphere from: • Vapour Scrubbers • Kiln Off-Gas • MEE Off-Gas • Power Generation	

3.3.4.1 Construction Impacts

The key atmospheric emission of concern during the construction phase of the Project is dust; however, the volume and duration of the emissions during construction will not be significant in comparison to emission levels during the operational phase. Furthermore, emissions will not be concentrated in a single location for an extended period of time.

Discharges to air during the constructional phase of the Project are primarily a management issue and can be minimised with good management practices (see **Section 3.3.5** for recommendations); as such, air dispersion modelling was not undertaken for the construction phase.

3.3.4.2 Operational Impacts

Particulate Impacts

The ground-level predictions of dust deposition, PM₁₀ and PM_{2.5} for the operation of the Processing Facility in isolation and including background (cumulative) at the sensitive receptors are presented in **Table 3-34**. Contour plots of the predicted maximum ground-level concentrations are presented in Appendix A of the Air Quality Assessment Report (**Appendix G**).

Results from the air quality modelling show:

- All predictions of dust deposition, PM₁₀ and PM_{2.5} at the modelled sensitive receptors for the operational phase of the Project in isolation are well below the relevant criteria;
- All predictions of dust deposition, PM₁₀ and PM_{2.5} at the modelled sensitive receptors for the operational phase of the Project including background (cumulative) are below the relevant criteria;
- The most affected of the modelled receptors is the Bladin Village – Workers Accommodation, which is in the westerly direction from the Project and downstream of the prevailing winds (from the east) which have the potential to carry air emissions to the receptor. It is also noted that the predictions are driven by the conservative approach adopted for the annual average and a total particulate matter emission rate assigned for PM_{2.5}.

Table 3-34. Maximum ground-level predictions of particle concentrations and dust deposition for the Project

Receptor	In Isolation					Cumulative				
	Annual Dust Deposition (g/m ² /month)	24 Hour PM ₁₀ (µg/m ³)	Annual PM ₁₀ (µg/m ³)	24 Hour PM _{2.5} (µg/m ³)	Annual PM _{2.5} (µg/m ³)	Annual Dust Deposition (g/m ² /month)	24 Hour PM ₁₀ (µg/m ³)	Annual PM ₁₀ (µg/m ³)	24 Hour PM _{2.5} (µg/m ³)	Annual PM _{2.5} (µg/m ³)
R1	0.00	0.67	0.02	0.58	0.02	2.00	24.37	19.92	9.78	7.62
R2	0.00	0.66	0.02	0.57	0.02	2.00	24.36	19.92	9.77	7.62
R3	0.00	0.67	0.02	0.54	0.02	2.00	24.37	19.92	9.74	7.62
R4	0.00	0.69	0.02	0.62	0.02	2.00	24.39	19.92	9.82	7.62
R5	0.00	0.88	0.02	0.84	0.02	2.00	24.58	19.92	10.04	7.62
R6	0.00	0.70	0.02	0.69	0.02	2.00	24.40	19.92	9.89	7.62
R7	0.00	0.47	0.02	0.46	0.01	2.00	24.17	19.92	9.66	7.61
R8	0.00	1.43	0.04	1.15	0.03	2.00	25.13	19.94	10.35	7.63
R9	0.00	1.88	0.04	1.82	0.04	2.00	25.58	19.94	11.02	7.64
R10	0.00	2.37	0.06	2.33	0.05	2.00	26.07	19.96	11.53	7.65
R11	0.00	5.14	0.16	5.06	0.14	2.00	28.84	20.06	14.26	7.74
R12	0.00	3.80	0.20	3.69	0.19	2.01	27.50	20.10	12.89	7.79
R14	0.01	5.21	0.42	5.19	0.38	2.01	28.91	20.32	14.39	7.98
R15	0.01	1.01	0.04	1.12	0.03	2.01	24.71	19.94	10.32	7.63
Criteria	2	50	25	25	8	4	50	25	25	8

Gaseous Impacts

The predicted ground-level concentrations of combustion gases (NO₂ and SO₂) and the other gases (NH₃, Cl₂ and HCl) for the operation of the Project at the sensitive receptors are presented in **Table 3-35** and **Table 3-36** respectively. Contour plots of the predicted maximum ground-level concentrations are presented in Appendix A of the Air Quality Assessment Report (**Appendix G**).

Results from the air quality model in relation to gaseous emissions show that the maximum predicted concentrations of NO₂ and SO₂ are below the adopted criteria for all sensitive receptors modelled for the Project operating both in isolation and including background (cumulative modelling). Furthermore, the maximum predicted concentrations of NH₃, Cl₂ and HCl are below the adopted criteria for all sensitive receptors modelled.

Table 3-35. Maximum predicted gaseous impacts for SO₂ and NO₂ (combustion).

Receptor	In Isolation					Cumulative				
	NO ₂		SO ₂			NO ₂		SO ₂		
	1 Hour	Annual	1 Hour	24 Hour	Annual	1 Hour	Annual	1 Hour	24 Hours	Annual
R1	12.79	0.02	73.76	4.32	0.13	18.29	4.72	74.76	5.32	1.02
R2	16.00	0.02	96.53	5.32	0.14	21.5	4.72	97.53	6.32	1.03
R3	18.17	0.02	115.07	5.97	0.14	23.67	4.72	116.07	6.97	1.03
R4	17.06	0.02	109.64	5.57	0.14	22.56	4.72	110.64	6.57	1.03
R5	12.02	0.02	81.65	5.92	0.14	17.52	4.72	82.65	6.92	1.03
R6	16.61	0.02	55.72	5.44	0.12	22.11	4.72	56.72	6.44	1.01
R7	6.14	0.01	34.69	1.92	0.09	11.64	4.71	35.69	2.92	0.98
R8	6.86	0.02	41.82	4.34	0.15	12.36	4.72	42.82	5.34	1.04
R9	10.04	0.02	54.83	5.60	0.18	15.54	4.72	55.83	6.60	1.07
R10	12.32	0.03	49.30	9.80	0.26	17.82	4.73	50.30	10.80	1.15
R11	10.55	0.08	64.71	17.70	0.77	16.05	4.78	65.71	18.70	1.66
R12	15.20	0.13	56.76	18.96	0.98	20.70	4.83	57.76	19.96	1.87
R14	32.99	0.47	208.05	35.80	3.04	38.49	5.17	135.73	23.15	3.30
R15	16.89	0.03	134.73	22.15	2.41	22.39	4.73	100.91	10.27	1.12
Criteria	250	62	570	230	57	250	62	570	230	57

Table 3-36. Maximum predicted gaseous impacts for Cl₂, HCl and NH₃.

Receiver	Maximum Predicted Concentration (µg/m ³)		
	1 Hour Cl ₂	1 Hour HCl	1 Hour NH ₃
R1	2.96	9.13	2.01
R2	3.44	8.27	2.53
R3	3.77	9.31	2.74
R4	3.34	8.90	1.81
R5	4.47	9.29	2.56
R6	3.02	8.98	1.85
R7	2.58	7.50	1.46
R8	4.33	12.35	3.13
R9	5.65	15.55	3.72
R10	8.09	18.52	3.95
R11	7.03	20.02	5.31
R12	6.35	18.31	4.40
R14	11.56	30.04	7.20
R15	4.13	13.27	8.44
Criteria	50	140	330

3.3.5 Mitigation and Management

An Air Quality Management Plan, included as Appendix B of the Air Quality Assessment report (**Appendix G**), has been developed to detail proposed measures to mitigate and manage the Project's air emissions throughout the construction and operation phases of the Project. In addition to the mitigation and monitoring activities outlined in the Draft EIS (section 7.10.7), further mitigation measures will be implemented during the operational phase of the Project and are detailed in **Table 3-37**.

For the full list of mitigation and management strategies for impacts to air quality (including the measures outlined in the Draft EIS) refer to the commitments register (**Section 1**).

Table 3-37: Additional Air quality mitigation measures

Pathway	Mitigation hierarchy	Mitigation measure
Fugitive dust	Avoid/minimise	- Active road surfaces will be either sealed, treated with a dust suppressant chemical or sprayed with water, as required to reduce dust generation; - All equipment utilised on site will be maintained in an efficient and effective manner; - Limit vegetation and soil clearing to reflect operational requirements; - For cleared vegetation, minimise burning activities by re-using vegetation during the rehabilitation phase or chipping it for use on site or to export chips off site. - Retention of sufficient moisture in the concentrate stream to maintain the concentrate at its Dust Extinction Moisture Level; - Use of water sprays or misting nozzles during stacking operations; - Water cannons/sprays on stockpiles;

Pathway	Mitigation hierarchy	Mitigation measure
		- Sprays on reclaim feeders and transfer points; - Physical enclosure of transfer points and operating equipment;
Stack emissions	Minimise	In order to reduce stack emissions TNG will: - Use scrubbers and/or filters for the control of atmospheric emissions from the Project stack sources, in accordance with the Air Quality Management Plan (Appendix B of Appendix G) - Comply with requirements of the Environmental Protection Licence, where applicable.

3.3.6 Monitoring and Reporting

The Air Quality Management Plan (Appendix B of **Appendix G**) incorporates a monitoring program as well as reporting requirements for the Project's air emissions throughout the operational phase.

Ongoing stack emissions (NO₂, SO₂, NH₃, HCl and Cl₂) monitoring will be carried out on the primary sources as identified in **Table 3-38**, in accordance with the relevant Australian/New Zealand Standards.

Whilst elevated predictions of PM_{2.5} concentrations are driven by the background levels and the conservative approach to modelling, an ongoing monitoring program for this pollutant will be undertaken at the most affected receptor location (the Bladin Village – Workers Accommodation). Continuous monitoring of PM_{2.5} will be carried out in the vicinity of the Bladin Village receptor in accordance with the relevant Australian/New Zealand Standards. PM_{2.5} will be monitored in accordance with the most recent version of either:

- AS/NZS 3580.9.12:2013 *Methods for Sampling and Analysis of Air. Method 9.12: Determination of Suspended Particulate Matter – PM2.5 Beta Attenuation Monitor*, or
- AS/NZS 3580.9.13:2013 *Methods for Sampling and Analysis of Air. Method 9.13: Determination of Suspended Particulate Matter – PM2.5 Continuous Direct Mass Method using a Tapered Element Oscillating Microbalance Monitor*.

In addition, in the event of a dust related complaint, campaign monitoring will be undertaken in the vicinity of the complaint as follows:

- PM₁₀ to be monitored in accordance with the most recent version of either:
 - Australian Standard AS 3580.9.6 – *Methods for sampling and analysis of ambient air – Determination of suspended particulate matter - PM10 high volume sampler with size-selective inlet – Gravimetric method*, or
 - Australian Standard AS 3580.9.6 – *Methods for sampling and analysis of ambient air – Determination of suspended particulate matter - PM10 low volume sampler – Gravimetric method*;
- PM_{2.5} to be monitored in accordance with the most recent version of AS/NZS 3580.9.10 – *Methods for sampling and analysis of ambient air – Determination of suspended particulate matter – PM2.5 low volume sampler – Gravimetric method*.

Table 3-38. Proposed stack emission sources, pollution controls and monitoring strategy.

Source ID*	Pollution Control Measure	Monitoring
PP200	Compact filter or filter house	-
PP300	Scrubber with packing and circulation	Annual emissions testing
PP310	Scrubber with packing and circulation	Annual emissions testing
PP320	Filter and scrubber with packing and circulation	Annual emissions testing
PP330	Scrubber with packing and circulation	Annual emissions testing
PP350	Scrubber with packing and circulation	Annual emissions testing
PP360	Venturi scrubber and scrubber with packing and circulation	Annual emissions testing
PP360	Filter	Annual emissions testing
PP370	Venturi scrubber and scrubber with packing and circulation	Annual emissions testing
PP370	Filter on bin	-
PP380	Scrubber with packing and circulation	-
PP400	Venturi scrubber and scrubber with packing and circulation	Annual emissions testing
PP500	Multiple scrubber system	Continuous emissions measurement
PP510	Dust filter scrubber	-
PP710	Dust filter scrubber	Continuous emissions measurement
PP780	Not yet determined	-

* Source ID correlates to location in Figure 2-36.

3.3.7 Statement of Residual Impacts

Based on outcomes of the EIA presented through the Draft EIS and this Supplement, TNG considers that the EPA's objective for air quality can be achieved through implementation of the Project. However, some residual impacts remain after the application of mitigating factors.

Residual impacts occur for:

- Stack emissions (NO₂, SO₂, NH₃, HCl and Cl₂).

As air quality at sensitive receptors is within criteria, and through implementation of management measures detailed above and in section 7.10.7 of the Draft EIS, the residual impact is not considered significant and no offsets are deemed to be required.

TNG LIMITED

SUPPLEMENT TO THE
ENVIRONMENTAL IMPACT STATEMENT
DARWIN PROCESSING FACILITY

**ATMOSPHERIC
PROCESSES**

3.4 ATMOSPHERIC PROCESSES

3.4.1 NT EPA Objective

The NT EPA established the environmental factor Atmospheric Processes in January 2021 with the objective to:

Minimise greenhouse gas emissions so as to contribute to the NT Government's goal of achieving net zero greenhouse gas emissions by 2050.

Greenhouse gas emissions were previously discussed in the Draft EIS under the environmental factor Air Quality; however, with the establishment of Atmospheric Processes as an environmental factor, information pertaining to GHG have been included under this factor for the Supplement.

3.4.2 Technical Studies

Greenhouse gas contribution in the form of CO₂eq has been reassessed, based on updated Project information. Furthermore, a GHG Discussion Paper has been developed and potential offsets approaches considered.

Details of the technical studies are listed below in **Table 3-39**.

Table 3-39. Greenhouse gas emission studies undertaken for the Supplement.

Date	Study Title	Consultant	Description	Report
January 2021	Discussion Paper – Greenhouse Gas Emissions: Management plan and offsets	Aurora Environmental	Discusses the current framework and options for TNG's approach to preparation of a GGMP and potential approaches to offsets.	Appendix I

The above study supplements and updates, where appropriate, the GHG report presented in the Draft EIS Appendix V.

3.4.3 Background Information

The NT Government issued a *Climate Change Discussion Paper* in September 2019, which was intended to promote discussion about emission targets. Consultation occurred over the period from October to December 2019. Subsequently, the NT developed a *Draft Offset Environmental Policy* dated December 2019. This policy, while not specifically dealing with GHG emissions, outlines principles in relation to offsets.

In July 2020, the NT Government released the *Northern Territory Climate Change Response: Towards 2050* framework document, with a target of net zero emissions by 2050. This long-term objective sets expectations about future emissions constraints and aligns the Territory with all other States and Territories across Australia.

The NT Government has stated an objective to transition the Territory's economy to a low carbon economy. This objective is reflected in the *Climate Change Response: Towards 2050* document, which indicates to industry that the Territory expects all reasonable and practical steps to be taken when designing and implementing projects, to ensure GHG emissions are kept as low as reasonably possible.

3.4.4 Potential Impacts

The source-pathway-receptor model (**Table 3-40**) used in the Draft EIS has been adopted to identify the additional impacts and risks to this factor, with further detail provided below. It is the Project's intention to implement measures wherever possible to minimise emissions into the atmosphere.

Table 3-40. Potential pathways for impact to atmospheric processes

Source	Pathway	Receptor
CO ₂ emissions	- Combustion of fossil fuels to produce electricity either on-site or off-site; - Combustion of fossil fuels to produce heat as an input to facility processes; - Production of CO₂ as a by-product of the processing facility metallurgical and chemical processes (e.g. from using coke); and - Operation of mobile plant and equipment.	Atmospheric processes

Based on the current design and operating assumptions of the Darwin Processing Facility, direct GHG emissions will equate to approximately 944,020 tpa of CO₂eq based on 7000 hours of operation.

Indirect emissions have been calculated based on all electricity for the Project being sourced from the Darwin-Katherine Interconnected System, with an emission factor of 0.56 kg CO₂eq per kilowatt hour (kWh). Approximately 1597 TJ of grid electricity will be consumed by the Project each year, resulting in annual emissions of 248,383 t CO₂eq. Accordingly, the updated annual total emissions for the Project equates to 1,152,464 t CO₂eq.

The calculated increase in emissions due to the operation of the Darwin Processing Facility represents an increase of around 7.1% for the NT contribution, based on the NT's total annual GHG emissions from the 2017 *State and Territories Greenhouse Gas Inventories* (DoEE 2019) and a 0.22% increase in the overall Australian emissions.

3.4.5 Mitigation and Management

TNG will commit to developing a detailed GGMP prior to the commencement of operations. The GGMP will include an updated GHG emission estimate forecast and will consolidate TNG's plan for technical abatement as well as including an appropriate offset package.

In the absence of specific requirements regarding management and offsetting GHG in the NT, TNG will adopt the Western Australian *Environmental Factor Guideline for Greenhouse Gas Emissions* (WA EPA, 2020). These guidelines require proponents to develop a GGMP that demonstrates their contribution towards the aspiration of net zero emissions by 2050. In light of this, TNG will develop a comprehensive GGMP that will:

- Review the final facility design in relation to GHG intensity/efficiency
- Commit to 5 yearly reviews of energy efficiency and renewables use over the life of the project, with a view of reducing direct greenhouse emissions on a year on year basis over the life of the project. Noting that even a small annual emission decrease compounded over a 40-year project life represents a substantial emissions reduction over the life of the project. Such reductions could be focussed in the

later years of the project where it is likely that new technologies will allow for substantial reductions of greenhouse gases in a more cost effective manner

- Utilise strategies that are unique to the Project's specific circumstances
- Account for and align with Commonwealth and NT targets.
- Prepare an offset package

An offset package is yet to be defined; however, options may include:

- Buying carbon credits on the market;
- Rehabilitating degraded pastoral station land; or
- Like some other major NT Projects, offering to assist with savannah fire management. This is an attractive target as the NT's discussion paper suggests that 58% of the Territory's GHG emission come from savannah grasslands and agriculture (i.e. land use, land-use change and forestry).

TNG will continue to liaise with the NT EPA and other relevant Agencies to determine the most appropriate approach to GHG management.

3.4.6 Statement of Residual Impacts

Development of the Darwin Processing Facility will result in an additional GHG contribution. To address this residual impact, TNG are proposing development of a GGMP and an offset package to reduce impacts from GHG emission and progress towards the NT EPA objective of contributing to the goal of achieving a net zero emissions by 2050.

Following implementation of these strategies, TNG believes that the NT EPA objective for atmospheric emissions will be achieved.

TNG LIMITED

SUPPLEMENT TO THE
ENVIRONMENTAL IMPACT STATEMENT
DARWIN PROCESSING FACILITY

**COMMUNITY AND
ECONOMY**

3.5 COMMUNITY AND ECONOMY

3.5.1 NT EPA Objective

The NT EPA objective for the environmental factor Community and Economy (EPA 2021) is to:

Enhance communities and the economy for the welfare, amenity and benefit of current and future generations of Territorians.

Community and Economy were previously discussed in the Draft EIS under the environmental factor Social, Economic and Cultural Surroundings; however, with the amendment of the environmental objectives, information pertaining to social, economic and cultural aspects of the Project have been included under this new factor for the Supplement.

Whilst some aspects of the Project have been revised since completion of the Draft EIS, the Project will continue to achieve the above objective for Community and Economy.

3.5.2 Technical Studies

Further technical studies were undertaken for the Supplement to better inform assessment of potential impacts on the Community and Economy due to Project updates Stakeholder submissions on the Draft EIS. Details of the technical studies are listed below in **Table 3-41**.

Table 3-41. Community and Economy studies undertaken for the Supplement.

Date	Study Title	Consultant	Description	Report
December 2020	Darwin Magnetite Processing Facility EIS Noise & Air - APM for TNG Ltd – Noise Impact Assessment	Vipac Engineers and Scientists	Noise Impact Assessment	Appendix H
January 2021	Proposed Magnetite Processing Facility – Traffic Impact Assessment	Tonkin	Traffic Impact Assessment	Appendix D
January 2021	Darwin TIVAN® Processing Facility – EIS Stakeholder and Community Engagement Plan	Elton Consulting	Stakeholder Consultation Plan	Appendix O

3.5.3 Background Information

This section is informed by the technical studies listed in **Table 3-41**, which detail further information for the existing environment to take into account any Project changes described in **Section 1**.

3.5.3.1 Noise

The Noise Impact Assessment has been updated to reflect the current Project design and address comments from the NT EPA relating to additional background noise levels and noise outputs from rail operations. The revised Noise Impact Assessment report is presented in full in **Appendix H**. Potential noise and vibration impacts from the construction and operation of the Project were assessed against applicable criteria based on the NT EPA Noise Management Framework Guideline.

Sensitive receptors

The number of sensitive receptors identified as having potential to be impacted by the Project has been reduced from four (as presented in the Draft EIS) to three receptors:

- The suburb of Bellamack – approximately 2.7 km from the nearest site boundary;
- The suburb of Virginia – approximately 4.8 km from the nearest site boundary; and
- Bladin Village (workers accommodation for the Bladin Point LNG Facility – approximately 4.3 km from the nearest site boundary).

The Weddell Urban Area has been removed as a sensitive receptor, as the Weddell development is no longer proposed. Based on the assessment, it was predicted that the Project would potentially impact the Weddell Urban area only during the construction phase of the Project. If the Weddell development recommences prior to, or during construction, TNG will revisit the impacts of noise to this receptor and introduce appropriate mitigation strategies.

The location of these sensitive receptors is shown in **Figure 3-12**.



Figure 3-12. Location of the sensitive noise receptor surrounding the Project.

Baseline noise monitoring

Baseline noise monitoring was carried out by Vipac between the 23rd and 30th August 2020 (**Appendix H**) at two of the three sensitive receptors (Bellamack and Virginia). Bladin Village is not currently operational and any baseline monitoring conducted would not be reflective of background noise levels when occupied. As such, it was determined that Bellamack and Virginia provided a more accurate representation of current background

levels for the Project and would better reflect anticipated noise levels at Bladin Village when accommodation services recommence.

The baseline monitoring presented in the Supplement was conducted over a longer time period (seven days) compared to the previous assessment (three days) presented in the Draft EIS. The longer period of noise monitoring has provided the assessment with a more robust baseline for the Project. Noise monitoring was carried out in accordance with Australian Standard AS1055:2018 Acoustics – *Description and Measurement of Environmental Noise*.

The existing noise environment in the vicinity of the Project can be characterised as ‘very rural’, with only mild sources of activity noise, mostly light wind through vegetation, distant traffic noise and insect/bird noise. Channel Island Road and the Adelaide to Darwin Rail Line run along the eastern boundary of the Project site, however traffic is intermittent on both road and rail. Vibration from existing rail movements was not detectable at the monitoring locations.

A summary of the noise monitoring results is presented in **Table 3-42**.

Table 3-42. Summary of Noise Monitoring Results at the Bellamack and Virginia Receptors from the 23rd to 30th August 2020

Noise Descriptor	Time Period for All Days	Overall Noise Levels dB(A) During Monitoring Period	
		Bellamack Receptor	Virginia Receptor
L _{Aeq} , adj 15 mins	Day (7am to 6pm)	51	44
	Evening (6pm to 10pm)	46	45
	Night (10pm to 7am)	43	37
L _{A10} , adj 15 mins	Day (7am to 6pm)	51	47
	Evening (6pm to 10pm)	44	36
	Night (10pm to 7am)	43	38
L _{A90} , adj 15 mins	Day (7am to 6pm)	42	37
	Evening (6pm to 10pm)	36	28
	Night (10pm to 7am)	35	27
Rating Background Level (RBL)	Day (7am to 6pm)	37	30
	Evening (6pm to 10pm)	32	24
	Night (10pm to 7am)	28	20

It is evident that noise levels in the vicinity of the Project are relatively quiet, especially during the night-time period, when the Rating Background Levels (**RBL**) are 20-28 db(A) during the full monitoring period.

3.5.3.2 Traffic

No changes have been made to the transport infrastructure required for the Project, which is:

- Road connection to the site from Channel Island Road.
- A rail siding running parallel to the Adelaide-Darwin rail line.

TNG did, however, engage Tonkin to revise the Traffic Impact Assessment (**TIA**) for the Project in December 2020 following liaison with Department of Infrastructure, Planning and Logistics (**DIPL**) to include:

- Recent background traffic data
- Assessment of traffic impacts for both the construction and operational phases of the Project
- Analysis of the combined traffic impact from the proposed development and adjacent developments (including the future Kittyhawk Estate)
- Review of potential traffic delays as a result of rail operations associated with the Project.

The full report is included as **Appendix H**. This assessment supersedes Draft EIS Appendix X.

Existing Traffic Volumes

Based on 2019 traffic data, Channel Island Road has an annual average daily traffic volume of approximately 1,895 vpd with a commercial vehicle percentage of 12.33% (data from DIPL Annual Traffic Report, 2019). The vpd on Channel Island Road from 2008-2019 are shown in **Table 3-43**.

Table 3-43. Channel Island Road Traffic Counts (NTG 2019)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Inbound (vpd)	339	371	454	502	872	1,514	2,199	1,548	1,358	1,520	1,821	950
Outbound (vpd)	339	372	439	496	674	1,442	2,388	1,812	1,566	1,535	1,810	944
Two-way (vpd)	678	743	893	998	1,546	2,956	4,587	3,360	2,924	3,055	3,631	1,894

It is noted that Channel Island Road had significantly higher traffic volumes (approximately 250 % higher than the observed 2019 volumes) in the proceeding years when the construction of the INPEX project was underway.

Existing Rail Delays

There are two level crossings near the Kittyhawk Estate junction - Channel Island Road and Jenkins Road (**Figure 3-13**). Both level crossings currently have advance warning signage on the approaches to the level crossings.

The current clearance time at these crossings for trains when departing Darwin is approximately 2.5 minutes if the train is travelling at 50 km/h and 1.85 minutes if the train is travelling at 70 km/hr.

The extent of current delays at each level crossing have been estimated by Tonkin based on current (Channel Island Road) and estimated (Jenkins Road) traffic and are shown in **Table 3-44**.

Table 3-44. Estimated current extent of delays at level crossings

Train speed (km/hr)	Clearance time required (mins)	Assumed peak flow within clearance time (%)	Channel Island Road Level Crossing			Jenkins Road Level Crossing		
			Number of light vehicles	Number of heavy vehicles	Queue length (m)	Number of light vehicles	Number of heavy vehicles	Queue length (m)
50 (train departing)	2.5	10%	8	1	124	6	1	91
70 (train departing)	1.85	7.5%	6	1	93	5	1	68

Site Access

A junction has recently been constructed on Channel Island Road for the Kittyhawk Development and is shown in **Figure 3-13**. To access Lot 1817, the Project will connect to the internal road network of the Kittyhawk Estate, situated immediately west of the TNG site, rather than providing direct access to and from Channel Island Road. This plan has been developed in collaboration with the Land Development Corporation (LDC).

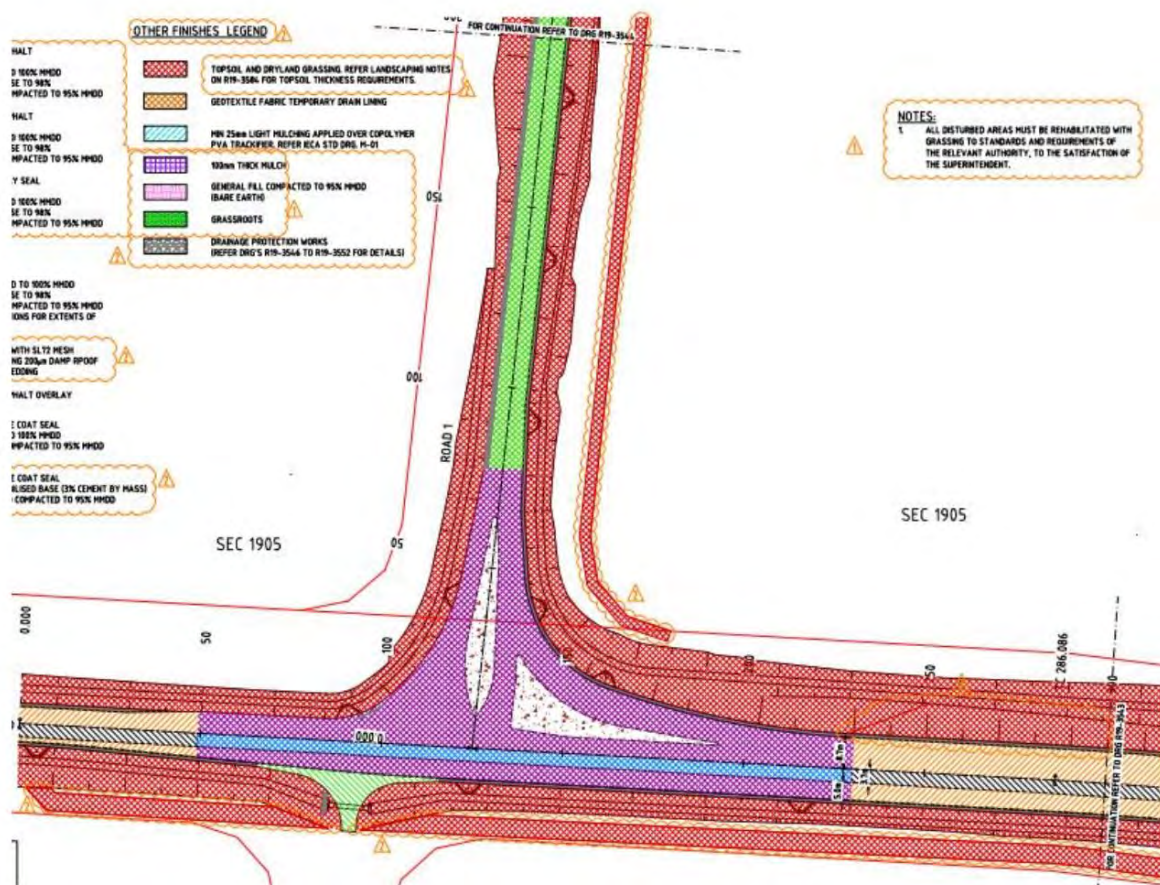


Figure 3-13. Kittyhawk Estate junction with Channel Island Road (Byrne Consulting)

3.5.3.3 Community

Stakeholder Consultation and Engagement

Stakeholder engagement has continued in preparation for the Supplement. A key focus for this consultation has been liaison with Government Departments and stakeholders who submitted a response to the Draft EIS or have indicated an interest in the Project.

Whilst every effort has been made to undertake comprehensive engagement since provision of Draft EIS comments, restrictions arising from the Coronavirus (COVID-19) pandemic and from TNG's continuous disclosure obligations with the Australian Securities Exchange as a result of various ongoing corporate matters, has resulted in a diversion from the proposed engagement plan for 2020.

Table 3-45 provides details of the stakeholder consultation undertaken as part of the Supplement development.

Table 3-45. Stakeholder consultation undertaken to support Supplement development

Date	Stakeholder	Communication Type	Points of Discussion
21 April 2020	Mandy Trueman – NT EPA Sharon Arena - APM	Phone Conversation	- Discussion regarding implications of the new <i>Environmental Protection Act 2019</i> and the transitional arrangements that are in place. - The TNG Supplement will be assessed under the new Act, which includes an additional public comment period of three weeks.
24 April 2020	Mandy Trueman – NT EPA Sharon Arena - APM	Phone Conversation	- Discussion relating to EIS comments and the proposed process to move it forward. - Discussions were held regarding wastewater discharge to the harbour. NT EPA suggested that alternative options may be available and provided details of Peter Rogers at the Department of Health as a contact for additional advice on wastewater treatment.
24 April 2020	Peter Rogers – Department of Health Sharon Arena - APM	Phone Conversation	- Discussion was held with Department of Health regarding alternative options for wastewater treatment. - A number of systems effectively working within the NT environment at a relatively large scale were discussed and contact details of system providers were given as an option to follow up. - APM informed Department of Health that TNG were committed to investigating options for reducing or eliminating wastewater discharge and would follow up on the suggested systems.
5 May 2020	Mandy Trueman – NT EPA Sharon Arena - APM	Phone Conversation Email	- Discussion held on the comments received for the Draft EIS. - TNG indicated that clarification from other Agencies would be useful to ensure comments are appropriately addressed. - NT EPA to liaise with other Agencies to organise meetings.

Date	Stakeholder	Communication Type	Points of Discussion
12 May 2020	Mandy Trueman - NT EPA Multiple Staff - DAWE Mitchell Ladyman – APM Sharon Arena - APM	Video Conference	- Discussion held relating to terrestrial flora and fauna requirements for the Supplement. - APM provided an overview of the work completed to date and a proposal for addressing the comments on the EIS. - It was agreed in the meeting that the comments could be addressed through a desktop assessment and no additional fieldwork was required to inform the Supplement.
12 May 2020	Dr Sam Buchanan - Paspaley Group	Phone Conversation	- Communicated that TNG have received the comments and are working through them for inclusion in the Supplement. - Paspaley indicated that the key issues related to water discharge into the harbour and water use volumes. - A key concern raised was the impact of discharge water quality on hatchery areas within the harbour. - Paspaley indicated that if wastewater discharge was occurring into the harbour they would expect rigorous monitoring regimes. - Paspaley would be very supportive of options that avoid discharge into the harbour or reduce water volumes being input into the process. - Discussions were also held regarding the approval process. Paspaley would like to have an opportunity to comment on the Supplement. It was advised that under the new Act the Supplement will be available for comment for a 3 week period. - TNG will continue to liaise with Paspaley as development of the Supplement progresses, which was well received.
12 May 2020	Mandy Trueman – NT EPA	Email	Further detail provided on transitional arrangements for the TNG EIS assessment process.
12 May 2020	David Ciaravolo - CEO AFANT	Phone Conversation	Phone call and email sent. Unable to reach David Ciaravolo.
13 May 2020	Mandy Trueman – NT EPA Jane Orr – DEPWS (Operations Branch) Brendon Nicol – TNG Sharon Arena - APM	Video Conference	- Discussion held relating to materials characterisation; specifically comments #1, #3 and #8 were addressed. - APM/TNG queried what tests were appropriate to satisfy requirements of the Supplement. NT EPA informed that no specific guidelines exist for testing requirements. Testing will be dependent on the composition and pathways of impact from material and a geochemical expert would be best to advise on testing. - APM/TNG queried what guidelines and criteria are utilised by NT EPA for materials characterisation, particularly waste materials. NT EPA informed that the NT does not have specific guidelines, however, there have been a number of

Date	Stakeholder	Communication Type	Points of Discussion
			instances where NSW guidelines have been considered.
13 May 2020	Greg Greeley – ENVIRA Sharon Arena – APM	Phone Conversation	- Discussion held regarding the ENVIRA Holdings wastewater treatment system. The system had been noted by Peter Rogers at Dept of Health as being effectively operational in the Darwin area. - The ENVIRA system has achieved good results at a relatively large scale (approx. 4.5 GL/yr sewage and grey water) within a housing estate in Darwin. - The system appears to have more application to sewage than processing wastewater and therefore is likely not suitable for process water. It does have good application for sewage and may be worthwhile considering as a sewage treatment system.
18 May 2020	Mandy Trueman – NT EPA Sharon Arena – APM	Email	Additional information on materials characterisation provided by NT EPA.
21 May 2020	Shar Molloy – Director ECNT	Phone Conversation	- Communicated that TNG have received the comments and are working through them for inclusion in the Supplement. - Key issue for ECNT is wastewater discharge into the harbour and water use volumes. - Indicated that TNG were investigating options to reduce or eliminate wastewater discharge. The decision by TNG to look into other options was commended by ECNT. - ECNT indicated that the concerns associated with the Darwin Processing Facility Project would be significantly lower if wastewater discharge is eliminated. - Discussion was held regarding stakeholder engagement. ECNT indicated that the Larrakia Nation may be interested, especially impacts to the harbour. An invitation has been extended to them to engage with TNG. ECNT will also provide contact details for appropriate people within Larrakia Nation. - TNG will continue to liaise with Paspaley as development of the Supplement progresses, which was well received.
26 May 2020	David Ciaravolo - CEO AFANT	Phone Conversation	- Key concern is the volume of water being used for the Project. - Issues raised around supply sources for water and infrastructure upgrades that would be required to supply the high volume of water. - AFANT mentioned that Manton Dam is one of the only recreational swimming, skiing facility available in Darwin and supplying water to the TNG project would cut public access to this site. - Question raised about why this Project would be supported if it consumes 25 % of Darwin's water to the detriment of other users and the environment.

Date	Stakeholder	Communication Type	Points of Discussion
			- APM mentioned that PWC had indicated that the water could be supplied to TNG and any new dam or water supply infrastructure required would undergo due environmental assessment processes through PWC. - Wastewater discharge and harbour water quality was also raised as a concern. - Renewable energy was raised. The point was made that Darwin community are wanting innovative, 'green' companies to occupy the land adjacent to the harbour on Middle Arm. - It was mentioned by APM that TNG are looking at a range of options for efficiency, particularly around water reuse, minimising or eliminating wastewater discharge etc. This was met favourably by AFANT. - Overall, potential project changes such as elimination of wastewater discharge and reduction in water volumes was seen as positive steps forward for the Project.
7 July 2020	Paul Burton – TNG David Ciaravolo – CEO AFANT Shar Molloy – Director ECNT Dr Sam Buchanan – Paspaley Group	Email	Letter providing an update on the status of the EIS Supplement.
9 July 2020	Mandy Trueman – NT EPA Sharon Arena – APM	Phone Conversation Email	- Requirement #23 from the Draft EIS comments requests additional baseline groundwater monitoring to provide wet season information to augment the May – September 2019 monitoring data. As comments on the Draft EIS were not received until April 2020 and TNG intend to submit the Supplement prior to the completion of the 2020/2021 wet season, obtaining additional groundwater data for inclusion in the Supplement is not practical. - TNG will commence monitoring in September 2020 and will ensure that updated groundwater data is available during final pond design and engineering. - NT EPA understood the constraints and were supportive of not delaying Supplement submission as a result of the timing of the groundwater monitoring program.
22 July 2020	Mandy Trueman – NT EPA Kate Quinn – NT EPA Martin Klopper – Elton Sharon Arena – APM Mitch Ladyman – APM	Video Conference	- TNG provided an overview of stakeholder consultation undertaken to date. - Elton detailed the proposed approach for the Stakeholder Engagement Strategy, which would provide a high level summary of the long term approach to stakeholder consultation throughout the life of the operation. - NT EPA agreed with this approach and indicated that the <i>Draft Guideline for</i>

Date	Stakeholder	Communication Type	Points of Discussion
			<i>Proponents – Stakeholder Engagement</i> may provide some useful information. It was acknowledged that these guidelines mainly relate to the EIS process rather than longer term stakeholder engagement, however, the broader principles will apply.
23 July 2029	Mandy Trueman – NT EPA Sharon Arena – APM	Email	Details provided on the public submission period for the Supplement under the transitional arrangement.
5 August 2020	Mandy Trueman – NT EPA Sharon Arena – APM	Phone Conversation Email	NT EPA provided advice received from Jonathon Burcher at DENR that the NSW Noise Policy for Industry provides relevant guidance for the noise assessment and would be an applicable policy to use for the Supplement.
14 September 2020	Mandy Trueman – NT EPA Sharon Arena - APM	Phone Conversation	Project update provided to NT EPA on progress of the Supplement development, including indicative timing for submission.
13 October 2020	Kushan Gunarathne – DIPL Bryden Smith – Tonkin Kim Grey – TNG Sharon Arena – APM	Video Conference	- Meeting with DIPL to discuss requirements of the updated Traffic Impact Assessment. - DIPL indicated the Traffic Impact Assessment should be informed by the most current background traffic data and include an analysis of the cumulative impacts for Project traffic and known or anticipated traffic volumes from other developments in the area.
10 November 2020	Mandy Trueman – NT EPA Lisa Bradley – NT EPA Sharon Arena – APM	Phone Conversation Email	- Project update provided. - Further detail on the application of the transitional arrangements for Supplement submission discussed.
10 November 2020	Mandy Trueman – NT EPA Sharon Arena - APM	Phone Conversation Email	It was agreed between TNG and the NT EPA that, should TNG amend the Project scope to not include wastewater discharge to the Elizabeth River, requirements #27 to #39 from Draft EIS comments will not be addressed in the Supplement document.
17 November 2020	Daniel Cameron – LDC Paul Kreppold - TNG	Email	Confirmation received from LDC supporting TNG site access through the Kittyhawk development access road.
26 November 2020	Lisa Bradley – NT EPA Paul Burton – TNG	Phone Conversation Email	- Project overview provided by Paul Burton, including a summary of Project amendments since Draft EIS submission. - Stakeholder engagement requirements discussed.
2 December 2020	NT EPA Board Paul Purdon – NT EPA Lisa Bradley – NT EPA Paul Burton – TNG Paul Kreppold – TNG Paula Raffo – TNG Dan Foo – TNG Sharon Arena – APM	Video Conference	- Project overview provided by TNG to the NT EPA Board members - Discussion held on Project, with Board members provided an opportunity to ask questions of TNG on the Project.
7 December 2020	Paul Burton – TNG David Ciaravolo – CEO, AFANT Shar Molloy – Director ECNT	Email	Letter providing an update on the status of the EIS Supplement regarding: - water usage and discharge, and - further stakeholder engagement

Date	Stakeholder	Communication Type	Points of Discussion
	Dr Sam Buchanan – CEO, Paspaley Group		
14 December 2020	Paul Burton – TNG Nigel Browne – CEO of the Larrakia Development Corporation	Email	Letter providing an update on the status of the EIS Supplement regarding: - water usage and discharge, and - further stakeholder engagement
15 December 2020	Steve Tatzenko – Department of Industry, Tourism and Trade (DITT) Terry Stark - TNG	Phone Conversation	- Initial discussion to determine the possibility of disposing Project solids wastes within disused mine sites in closer proximity to Darwin than Mount Peake. - Steve Tatzenko indicated he would look into it and provide feedback on potential options in due course.
16 December 2020	Steve Tatzenko – DITT Terry Stark – TNG	Email	Email providing details of waste types and volumes to be disposed of as part of the TNG Project.
16 December 2020	David Ciaravolo – AFANT Sharon Arena - APM	Email	- Email indicating that there had been some significant Project changes and extending an invitation to meet to discuss. - Auto-reply received to indicate David Ciaravolo is on leave until 11 January 2021.
16 December 2020	Sam Buchanan – Paspaley Sharon Arena - APM	Email	- Email indicating that there had been some significant Project changes and extending an invitation to meet to discuss. - A brief over-view of Project changes was provided. - Agreement was made to make contact early in 2021.
17 December 2020	Shar Molloy – ECNT Sharon Arena - APM	Phone Conversation	- Provided an update on the Project changes. - APM informed ECNT that a water recycling plant will be incorporated into the Project, resulting in no discharge to the Elizabeth River and a significant reduction in water demand from Darwin water supply. - ECNT indicated that the Project amendments are positive for the Project and will significantly reduce the concerns relating to the Project impacts on the environment.
13 January 2021	Steve Tatzenko – DITT Terry Stark – TNG	Email	- Follow up email to Steve Tatzenko requesting an update on progress for potential waste disposal options. - Awaiting response.
15 January 2021	Sam Buchanan – Paspaley Sharon Arena - APM	Email	- Sam Buchanan raised some questions in relation to the proposed water recycling plant, including wastes generated proposed management of wastes and whether any wastewater discharge were required. - APM provided information on wastes and management, as well as confirming that no wastewater will be discharged from the Project following the Project changes.
14 January 2021	Kylie Fitzpatrick – NT EPA Sharon Arena – APM	Phone Conversation	The logistics of the Supplement submission were discussed.

Date	Stakeholder	Communication Type	Points of Discussion
			Under the transitional arrangement, the NT EPA will have 21 business days following completion of the public comment period to request additional information. If no information is requested, the Assessment Report will be prepared within 35 business days of completion of the public comment period.
22 January 2021	David Ciaravolo – AFANT Sharon Arena – APM	Phone Conversation	- Project update provides, with particular emphasis on the amendments following submission of the Draft EIS. - AFANT were supportive of the removal of wastewater discharge from the Project Scope and responded positively to the reduced water demand.
3 February 2021	Kate Finch – Larrakia Development Corporation Paul Burton – TNG Paula Raffo – TNG Martin Elton – Elton Sharon Arena - APM	Video Conference	- Project overview and changes were discussed. It was noted that Nigel Browne’s key concern regarding wastewater discharge to the Darwin Harbour has been addressed with the inclusion of the WRP. - Undertaking to continue engagement, cementing long term relationships with the Larrakia Development Corporation and Larrakia Nation.

The Supplement will also be released for a three-week public comment period, which will allow a broader range of stakeholders to provide comment on the Project.

Visual Amenity

From a visual perspective, the built environment of the Project remains consistent with the Draft EIS, with the exception of one ventilation stack. The updated Project design includes the addition of multiple ventilation stacks and the height of these stacks remain consistent with those proposed in the Draft EIS (between 9 m to 40 m); the ventilation stack proposed for the sulphate plant, however, measures 100 m in height. The proposed location of the sulphate plant stack is on the southern peninsula of Lot 1817.

Beyond the addition of the sulphate plant stack, there is no change to the built environment of the Project.

3.5.4 Potential Impacts and Risks

The source-pathway-receptor model (**Table 3-46**) used in the Draft EIS has been adopted to identify the additional impacts and risks to this factor.

It is the Project’s intention to enhance the community and economy of the NT. Further technical studies have been produced as part of the Supplement to evaluate potential impacts on the community and economy, with information relating to these impacts provided in the following sections.

Table 3-46. Predicted pathways for impact to Community and Economy.

Source	Pathway	Receptor
Use of plant and equipment during construction	Noise and vibration generation from construction activities	Nearby residents, workers at nearby locations
Operation of Processing Plant equipment	Noise generated from operation of processing equipment	Nearby residents, workers at nearby locations
Traffic movements on Channel Island Road	Traffic delays, congestion and increased road safety risk due to increase traffic movements	Vehicle operators in the vicinity of the Project
Rail movements	Traffic delays and congestion at rail crossing due to rail movements	
	Noise from rail operations	Nearby residents, workers at nearby locations
Stakeholder consultation	Consultation methods employed for liaison with stakeholders	Key Stakeholders
Community resources	Use of resources such as water and power for Project operations	Darwin community
Sulphate plant stack	Visual amenity impacts from sulphate plant stack	Nearby residents, workers at nearby locations, river and harbour users

3.5.4.1 Noise

Noise levels during construction and operations were re-assessed by Vipac (2020; **Appendix H**) to account for Project changes occurring through progression of the design stage. The SoundPLAN noise modelling software was utilised along with CONCAWE algorithm noise prediction methodology to project noise impacts during both neutral and worst case climatic conditions.

Model inputs include meteorological data and noise source information – proposed equipment, location of equipment and associated sound power level. The model has been run with the following conservative assumptions:

- All equipment is operational 100% during standard and non-standard hours
- All equipment is being utilised concurrently
- All construction equipment is located on the eastern boundary of both the northern and southern peninsulas
- All operations equipment is located in the eastern half of the southern peninsula
- Noise emissions from freight locomotives is continuous over 24-hours
- Noise emissions for reach stackers, front end loaders and haul trucks at the rail interface are modelled as operating 100% of the time.

In reality;

- Equipment will not be continuously operated
- Not all equipment will be used concurrently; particularly during construction where, for example, site preparation and bulk earthworks are completed prior to commencement of structural, mechanical and platework erection.
- Equipment will be dispersed throughout the site, not all located on the eastern boundary
- Locomotive operation will not be continuous
- Equipment at the rail interface will not operate concurrently 100 % of the time.

This conservative approach to the noise modelling does, however, allow for a degree of amendment to be accommodated during the final design stage.

Predicted noise level results during the construction phase of the Project for neutral and worst-case climatic conditions are presented in **Table 3-47**. Construction noise is predicted to comply with the standard hours criteria during all climatic conditions. During non-standard hours, construction noise is predicted to exceed criteria during worst case climatic conditions.

Table 3-47. Predicted Construction Noise Levels for both Neutral and Worst-Case Climatic Conditions.

Receptor	Predicted Noise Levels L _{Aeq} dB(A)	Recommended Assigned Noise Affected Level L _{Aeq} dB(A)		Complies with Criteria?	
	Neutral Climatic	7am-7pm	7pm-7am	7am-7pm	7pm-7am
Bellamack	30	47	33	✓	✓
Virginia	24	40	25	✓	✓
Bladin Village	24			✓	✓
Worst Climatic		7am-7pm	7pm-7am	7am-7pm	7pm-7am
Bellamack	36	47	33	✓	+3
Virginia	30	40	25	✓	+5
Bladin Village	32			✓	+7

Predicted noise level results during the operation phase of the Project for neutral and worst-case climatic conditions are presented in **Table 3-48**. Operation noise, including process plant and rail operations, is predicted to comply with the day, evening and night-time criteria at all receivers during neutral and worst-case climatic conditions without the need for site specific noise mitigation.

Table 3-48. Predicted Operation Noise Levels for both Neutral and Worst-Case Climatic Conditions.

Receptor	Predicted Noise Levels L _{Aeq} dB(A)		Recommended Assigned Noise Affected Level L _{Aeq} dB(A)			Complies with Criteria?		
	Neutral Climatic	Worst Climatic	Day	Evening	Night	Day	Evening	Night
Bellamack	16	21	42	37	35	✓	✓	✓
Virginia	15	20	35	35	35	✓	✓	✓
Bladin Village	15	23				✓	✓	✓

Given the conservative approach to noise modelling, compliance of the Project with criteria for all but the worst-case climatic condition for non-standard hours during construction and the short duration of the construction period, the impact of the Project on the surrounding community from noise generation is not predicted to be significant.

3.5.4.2 Traffic

Expected Project traffic increases and distribution

In summary, the predicted change to traffic conditions as a result of the Project are anticipated to be a total of 195 vehicle movements per day during construction (assuming the use of buses) and up to 636 vehicle movements per day during operations (assuming no use of buses).

Based on the yearly traffic counts undertaken on Channel Island Road by DIPL (DIPL Annual Traffic Report, 2019), the current daily traffic volume is approximately 1,895 vpd.

Adding the maximum traffic anticipated to be generated by the site at any time (636 vpd), to the existing traffic, a total daily traffic of 2530 vpd may result. This is less than the traffic volumes experienced in 2014 and therefore could reasonably be accommodated by the existing road network.

The Lot neighbouring Lot 1817 to the west is the proposed site for the Kittyhawk development. The identified traffic from Kittyhawk development is 1,920 vpd (i3 consultants updated TIA). To estimate the cumulative impact, vehicle movements from the Kittyhawk development have been added to the 2019 daily traffic volume and the expected daily traffic volumes for the TNG Project during construction and operations.

During construction, a total daily traffic volume of approximately 4,010 vpd could be expected on Channel Island Road. Taking into account the cumulative impact of the traffic for the Kittyhawk development, the traffic distribution during construction on the Channel Island Road junction has been modelled by Tonkin for the TNG Project. Tonkin have combined the anticipated traffic flow to be generated by both developments as well as the background traffic volumes along Channel Island Road (data from DIPL Annual Traffic Report, 2019).

As the predicted traffic volumes are less than what has been experienced at the peak road usage in 2014, the existing road network can accommodate the proposed increase in traffic from the construction phase of the Darwin Processing Facility and the Kittyhawk development.

During operations, using the maximum number of vpd for the Project, the cumulative total daily traffic movements would be 4,725, 3% (138 vpd) higher than the maximum experienced in 2014. This scenario is based

on all Staff movements occurring in individual private vehicles (worst case scenario), whereas TNG will encourage alternative commuting options, such as buses, to reduce this.

The cumulative traffic volumes during operations under the worst case scenario are expected to be similar to peak movements experienced in 2014. As such, it is considered that the Project will not adversely impact safety or capacity of the existing road network. It is, however, noted that if sustained cumulative traffic growth is experienced, the Chung Wah Terrace and Elrundie Avenue junction may require upgrading in the future.

The inclusion of buses for the operational phase will significantly reduce vehicle movements associated with Processing Facility staff, which will further reduce impacts from the operations.

Expected delays to road traffic due to rail movements

Tonkin has assessed traffic flows at the Channel Island Road and Jenkins Road level crossings in order to understand the extent of delays and queues. This assessment has been carried out by adopting the DIPL traffic data from Channel Island Road (DIPL Annual Traffic Report, 2019) and assumed traffic volumes along Jenkins Road.

The total clearance time at level crossings would be approximately nine minutes if the train was travelling at 10 km/h and 17 minutes if the train was travelling at 5 km/hr. It is anticipated that trains will arrive and depart the Project as per the timetables in **Section 2.2.7**. It is expected that the trains arriving on Thursdays and trains departing on Tuesdays will have the biggest impact on the local network as they arrive/depart within the peak hours.

The expected maximum extent of delays and length of queues at both level crossings is presented in **Table 3-49**. This represents a significant delay to traffic along both Channel Island Road and Jenkins Road.

Table 3-49. Estimated extent of delays at level crossings as a result of the Project

Train speed (km/hr)	Clearance time required (mins)	Assumed peak flow within clearance time (%)	Channel Island Road Level Crossing			Jenkins Road Level Crossing		
			Number of light vehicles	Number of heavy vehicles	Queue length (m)	Number of light vehicles	Number of heavy vehicles	Queue length (m)
5 (train arriving)	17	75	62	9	928	46	7	684
10 (train departing)	9	50	41	6	618	30	5	456

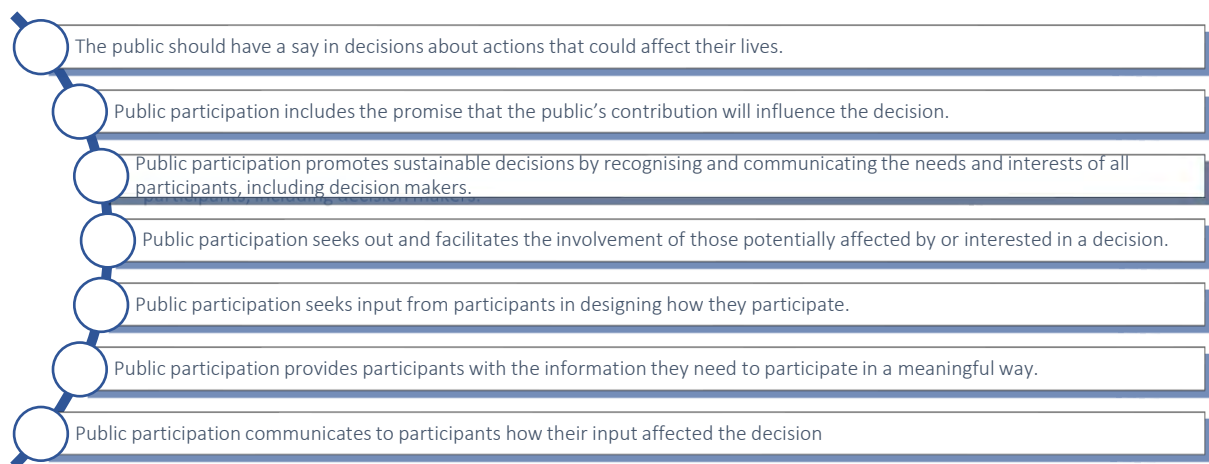
TNG has limited control over the timing of trains as this is coordinated by the train operator (to fit with other demands on the train line); however, both parties will continue to work together to minimise potential delay on the road network wherever possible.

3.5.4.3 Community

Stakeholder Consultation and Engagement

Engagement with the community and key stakeholders is an essential process for the TNG Project, providing a mechanism to demonstrate to stakeholders that environmental risks have been identified and appropriate mitigating measures implemented to reduce risks to an acceptable level. Inadequate consultation can result in the Company not achieving established targets and goals for community and stakeholder engagement.

TNG recognise the importance of building long term relationships with stakeholders and the community. To formalise this TNG, in conjunction with Elton, have developed a Community and Stakeholder Engagement Strategy consistent with the International Association for Public Participation (IAP2) Core Values illustrated in Figure 3-14.



Source: International Association for Public Participation – www.iap2.org

Figure 3-14: International Association of Public Participation (IAP2) Core Values

The Community and Stakeholder Engagement Strategy is provided as **Appendix O**. Implementation of the Strategy will ensure that enduring consultation throughout the life of the Project will be appropriate and inclusive, whilst also maintaining conformance with NT EPA objectives for stakeholder engagement. This Strategy is a dynamic document which will be revised at each Project Phase to ensure it remains current with Project aspects and cognisant of stakeholder expectations at the time of implementation.

Community Resources, Fairness and Equity of the Project

The revised Project detailed in this Supplement has resulted in a significant increase in fairness and equity with regards to consumption of community resources when compared to the Project scope presented in the Draft EIS.

A noted concern through submissions on the Draft EIS was the high volume of water required for the operation (equivalent to 26 % of Darwin's current water demand). Based on Project amendments, particularly the inclusion of the WRP, the water requirement has reduced to 9.1 % of current water demand for the Darwin region. This represents a positive improvement in the Project outcomes.

Similarly, the benefit on the community from the revised Project is apparent through the removal of the wastewater discharge component, which ensures that water quality in the harbour, aesthetics, engagement in recreational pursuits and business ventures are not affected by operation of the Darwin Processing Facility.

When considering the costs and benefits of a Project on the community, an assessment of the fairness and equity can vary depending on the parties involved. For example, the use of materials for construction may affect short term supply chains for some parties, however, the increase in demand provides opportunities for others to expand local businesses and economies.

Project costs, such as use of community resources, traffic delays through intermittent rail operations, GHG emissions and clearing of native vegetation known to support listed species, are expected to be outweighed by the economic and social benefits of the Processing Facility to the Darwin community, particularly through employment opportunities, support for local businesses, implementation of the Mount Peake Project Community Benefit Fund across the TNG operations.

In addition, an environmental benefit will result from the rehabilitation program, which will restore a significant portion of the currently degraded areas of the Project site to native vegetation.

Visual Amenity

The addition of the 100 m sulphate plant stack will slightly change the visual impact of the Project from an off-site perspective. In an effort to reduce the visual impact of the Project, particularly from the Elizabeth River Boat Ramp, TNG have positioned the stack on the southern peninsula of the site.

With retention of the mangrove belt, this amendment will result in only the top of the stack being visible at the Jetty. The stack will be visible from the Elizabeth River Bridge and when travelling along parts of Channel Island Road; this is not expected to reduce the amenity of the area, however, as it is a designated industrial precinct.

3.5.5 Mitigation and Management

Mitigation measures for noise and community impacts are listed in **Table 3-50** and are supplementary to those in the Draft EIS. The mitigation measures described in the Draft EIS for traffic impacts are sufficient and do not require updating.

A full list of the mitigation commitments, including the traffic mitigation commitments made in the Draft EIS can be found in the Consolidated Commitments Register (**Appendix R**). More detail can be found in the Traffic Management Plan (Draft EIS Appendix Y) and the Noise Management Procedure in the Environmental Management Plan (**Appendix M**). A Stakeholder Engagement Plan has also been prepared and is included as **Appendix O**.

Table 3-50. Additional Community and Economy mitigation measures

Pathway	Mitigation hierarchy	Mitigation measure
Noise impacts at sensitive receivers during non-standard hours (7pm to 7am)	Avoid	- Avoid noise generating construction activities in non-standard hours and recommend construction activities occur during standard hours (7am to 7pm) where possible. - If out of hours construction is required, avoid operating particularly noisy machinery before 7am and after 7pm.
	Minimise	- Implement mitigation strategies detailed in the Noise Management EP-19 from the EMP (Appendix M); - Provide an induction to construction personnel (including sub-contractors) addressing responsibilities regarding noise management outlined in the EMP (Appendix M); - Ensure truck drivers are informed of designated vehicle routes, parking locations, delivery hours and minimising engine braking and idling;

		• Provide education of supervisors, operators and sub-contractors on the need to minimise noise through toolbox meetings; • Avoid noisy plant working simultaneously where possible; • Ensure all plant and equipment is equipped with appropriate noise control (<i>e.g.</i> mufflers, silenced exhausts, acoustic enclosures flashing lights as an alternative to reversing beepers), and equipment is shut down and not left idling when not in use; • Consider the use of temporary solid screens for noise mitigation of noisy stationary equipment; and • Establish a Complaints and Grievance Protocol to address noise complaints
Traffic impacts	N/A	See Draft EIS (Section 7.11.7)
Reduced visual amenity due to sulphate plant stack	Minimise	• Facility infrastructure contained mainly to southern peninsula of Lot 1817 • Install the sulphate stack located in area aimed at minimising visual impacts as much as practicable.
Community impacts		• Implement the Community and Stakeholder Engagement Strategy to guide the long-term consultation outcomes for the Project. • Implement efficiency measures into the final design phase to reduce use of community resources as much as practicable. • Implement a Complaints and Grievance Protocol for community members, incorporating an investigation and corrective action process, as appropriate.

3.5.6 Monitoring and Reporting

In addition to the monitoring and reporting for Community and Economy proposed in the Draft EIS, the supplementary monitoring and reporting required is listed in **Table 3-51**.

The Traffic monitoring strategy proposed in the Draft EIS is adequate, therefore no further information is required as part of the Supplement. If a complaint is received, a traffic survey will be conducted using recognised traffic monitoring practices. The Traffic Management Plan (Draft EIS Appendix Y) details monitoring programs that will be enacted under specific activities and their associated management procedures.

Table 3-51. Supplementary monitoring and reporting for Community and Economy

Relevant Plan	Monitoring	Reporting
Noise Procedure	Noise levels at affected location following complaint	Corrective actions will be reported to the affected persons and recorded in the complaints register seven days after complaint is received.
Stakeholder Engagement Plan	Maintain records of all stakeholder consultation. Monitor consultation and complaints records to identify trends	Report outcomes from stakeholder consultation through annual reporting to relevant Agencies and to the wider community.
Traffic Management Plan	Details Provided in Appendix Y of Draft EIS	

3.5.7 Statement of Residual Impacts

Amendments made to the Project have resulted in a reduction in the impact on community and economic factors. This is particularly the case following removal of wastewater discharge and reduction in water use requirements, which were identified through submissions to the Draft EIS as the main concerns raised.

As a result of this, and through confirmation from additional noise and traffic assessments that the impacts are acceptable, the Project is not expected to have a significant negative impact on the wider community and will be consistent with the NT EPA objective for Community and Economy.

TNG LIMITED

SUPPLEMENT TO THE
ENVIRONMENTAL IMPACT STATEMENT
DARWIN PROCESSING FACILITY

OTHER ENVIRONMENTAL INFORMATION

4. OTHER ENVIRONMENTAL INFORMATION

This chapter contains information pertaining to the Environmental Factors: Marine Environmental Quality and Marine Ecosystems. These two factors are not considered key environmental factors in Supplement as the Project will no longer have a direct impact on Marine Environmental Quality or Marine Ecosystems. Despite this, indirect impacts to sensitive receptors within the marine environment have been considered, and are discussed below, due to the close proximity of the Project to the Darwin Harbour and the Elizabeth River.

The influence of the Project on MNES is also detailed below in this Chapter, including an assessment of alternatives on MNES.

4.1 MARINE ENVIRONMENTAL QUALITY

The Project Site is adjacent to the Upper Estuary of the Elizabeth River which is highly connected to the marine environment of the Darwin Harbour. Advisian (2021b) prepared a Marine and Coastal Assessment (**Appendix P**) to identify potential sensitive receptors within the marine environment and to assess the possibility for these receptors to be indirectly impacted by the Project. The assessment includes a conceptual site model that illustrates existing pollutant sources and additional potential environmental risks associated with indirect proposal activities.

4.1.1 Location Characteristics

4.1.1.1 Darwin Harbour

The Darwin Harbour region covers the tributaries, catchment and estuarine areas of Cox Peninsula, Woods Inlet, West Arm, Middle Arm, East Arm and the Howard River. The Harbour is an estuarine system with semi-diurnal tides (two high tides and two low tides) characterised by strong tidal currents, within which water from the Timor Sea mixes with runoff from the northern Australian land surface (Wilson, Padovan & Townsend, 2004).

Unlike the estuaries of other large Australian cities (e.g. Perth, Brisbane), which receive most of their catchment inflow from one large river, Darwin Harbour receives inflow from several major rivers (Howard, Elizabeth and Blackmore) and numerous small streams. Darwin Harbour is also distinguished by the small area of its land catchment relative to its estuarine area, particularly in comparison to other major Australian waterways. This means the area that can potentially generate polluted runoff into the Harbour is relatively small (Moritz-Zimmermann, Comley & Lewis, 2002). Water quality in Darwin Harbour and its catchment is generally good to excellent (Fortune, 2016).

The Darwin Harbour supports 20,400 hectares of mangrove communities, representing approximately 5% of the mangrove areas of the NT and 0.1% of remaining world mangrove regions. These mangrove communities are diverse, accounting for 36 of the (approximately) 50 recognised mangrove species throughout the world (Brocklehurst & Edmeades, 1996).

4.1.1.2 Elizabeth River

The Elizabeth River is immediately adjacent to the Project. The habitat of the nearshore environment surrounding the Project site consists of medium-low density filter feeders (corals, algae, sponges and soft corals), bare sand (mud flats or bars) and mangroves. River flows reflect the region's wet and dry seasonal rainfall, with flows typically commencing during December and January, and reaching maximum levels between January and March. By June, most rivers have ceased to flow (Drewry, Fortune & Browne, 2010). The aquatic environment immediately surrounding the proposed project site is considered as Upper Estuary and is described as the most

upstream reaches of the estuary, where hypersaline conditions may persist for short periods during the dry season and significant freshwater pulses prevail during the wet season. This zone experiences limited flushing from freshwater inflows or tidal exchange and water here typically has a long residence time in comparison to other parts of the Harbour. The Upper Estuary indirectly receives licensed wastewater discharge from Myrmidon Creek, and sediment and nutrient loads from diffuse sources during the wet season (Fortune, 2010).

4.1.2 Conceptual Site Model

Figure 4-1 presents a conceptual site model of the Elizabeth River Estuary that illustrates the major point and diffuse pollutant sources. As shown in **Figure 4-1**, the Elizabeth Estuary receives pollutant loads from both point and diffuse sources. Point sources include the Palmerston wastewater treatment plant and INPEX Ichthys Gas Field Development project.

4.1.2.1 Diffuse Sources

The dramatic seasonal variation in rainfall in Darwin has water quality impacts on the region, particularly in terms of runoff, discharge and freshwater inflows from the major rivers. Diffuse discharge is negligible in the dry season as flows to many of the seasonal creeks which enter the Elizabeth River estuary cease to flow by June most years. As a result, diffuse discharge in the estuary is associated with wet season flows and is typically accompanied by a series of intense pulses of freshwater together with the contaminants it carries (Drewry, Fortune & Browne, 2010). Consequently, diffuse (or non-point) sources such as urban and rural storm-water, leaching through soil, river bank erosion, and roads mainly enter Darwin Harbour during the wet season.

Urban development such as the city of Palmerston approximately doubles the volume of runoff into Darwin Harbour in any given wet season. In addition, pollutant loads increase with rainfall due to the increased runoff volume across all catchment land-uses; hence more runoff results in more pollutant transport (Skinner, Townsend & Fortune 2009). Stormwater is a natural part of the hydrological system; however, it can act as a pathway for pollutants to be transferred from terrestrial settings into the marine environment.

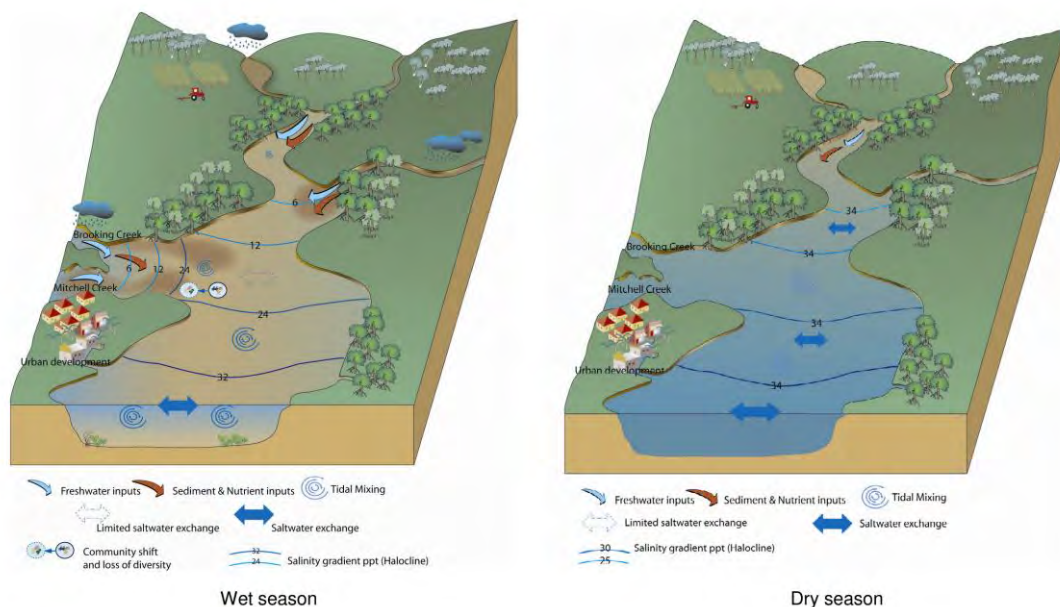


Figure 4-1. Elizabeth River estuary pollution sources, processes and ecology in the wet and dry seasons.
Source: Drewry, Fortune & Browne (2010).

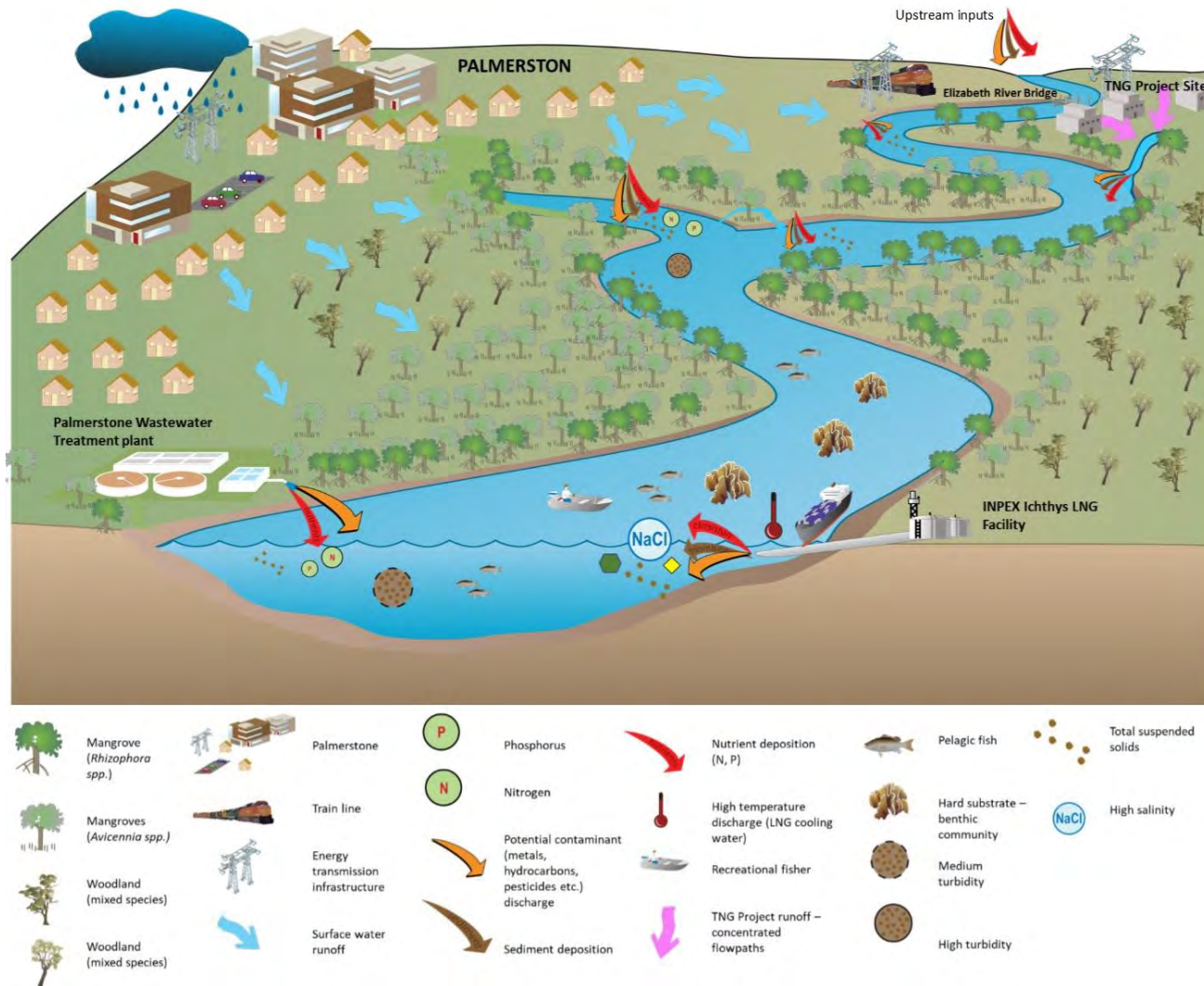
4.1.2.2 Point Sources

There are two main point sources within the estuary; the Palmerston waste water treatment plant and INPEX's Bladin Point project (**Figure 4-2**).

The Palmerston wastewater treatment facility is located on the southern side on Myrmidon Creek, close to the river bank on the coastal side of Palmerston. The discharge point is approximately 850 m from the mouth of the creek, where it is around 100 m wide and 6 m deep at high tide.

There is a distinct green sewage plume which enters the creek at the discharge point. The plume, typically restricted to the surface layer, is low in dissolved oxygen and enriched in nutrients, suspended matter and chlorophyll-a. The plume gradually disperses during the ebb tide and is rapidly diluted and mixed, becoming undetectable within a few hours. Discharges from this wastewater treatment plant are associated with increased nutrient, toxicant and pollutant loads, which can result in increased algal growth, accumulation of pollutants in sediments. The effects of this discharge are localised and temporary.

INPEX's Ichthys gas field development Bladin Point project is the closest major project to the TNG Project site, located near to the mouth of the Elizabeth River. Liquid discharges associated with this project include production water, cooling water, sewage and grey water, desalination reject water, deck drainage and ballast water (INPEX, 2010). Most of these discharges are associated with increased salinity and turbidity.



The TNG project site will not discharge into Darwin Harbour. Any surface water discharge from the site will be associated with managed stormwater runoff.

Figure 4-2. Conceptual site model of the Elizabeth River Estuary major point and diffuse pollutant sources. (Courtesy of the Integration and Application Network, University of Maryland Centre for Environmental Science [ian.umces.edu/symbols/]).

4.1.2.3 Risks to Sensitive Environmental Receptors

Figure 4-3 presents a conceptual site model of the ecological characteristics of the Elizabeth River Estuary and general risks associated with major point and diffuse pollutant sources. The Darwin Processing Facility Project will not contribute directly to the Elizabeth River system, however, has the potential to impact the environmental receptors through increases in concentration of total suspended solids (TSS) from sedimentation and contaminants such as hydrocarbons and metals from stormwater.

The risk of sedimentation is concentrated in the Construction phase and is discussed in **Section 2.2.3**. The risk of sedimentation to sensitive environmental receptors is low and short term in nature.

During operations, the project will adopt a holistic water sensitive urban design (WSUD) approach that aims to minimise the impacts of the development on the natural water cycle and downstream environmental systems. The design of the stormwater minor and major conveyance systems, minor diversion systems and other stormwater management features (such as SQUIDs, bioretention basins etc) are expected to be undertaken during the detailed design phases of the project once site layouts and design constraints are finalised. As such, any pollutant loads in surface water runoff from the project are expected to be minor and the impacts on the nearshore marine environment minimal and localised. The risk to sensitive environmental receptors of contaminants transported in surface water is low.

Further information on risks to marine biota are provided in Marine Ecosystems (**Section 4.2**).

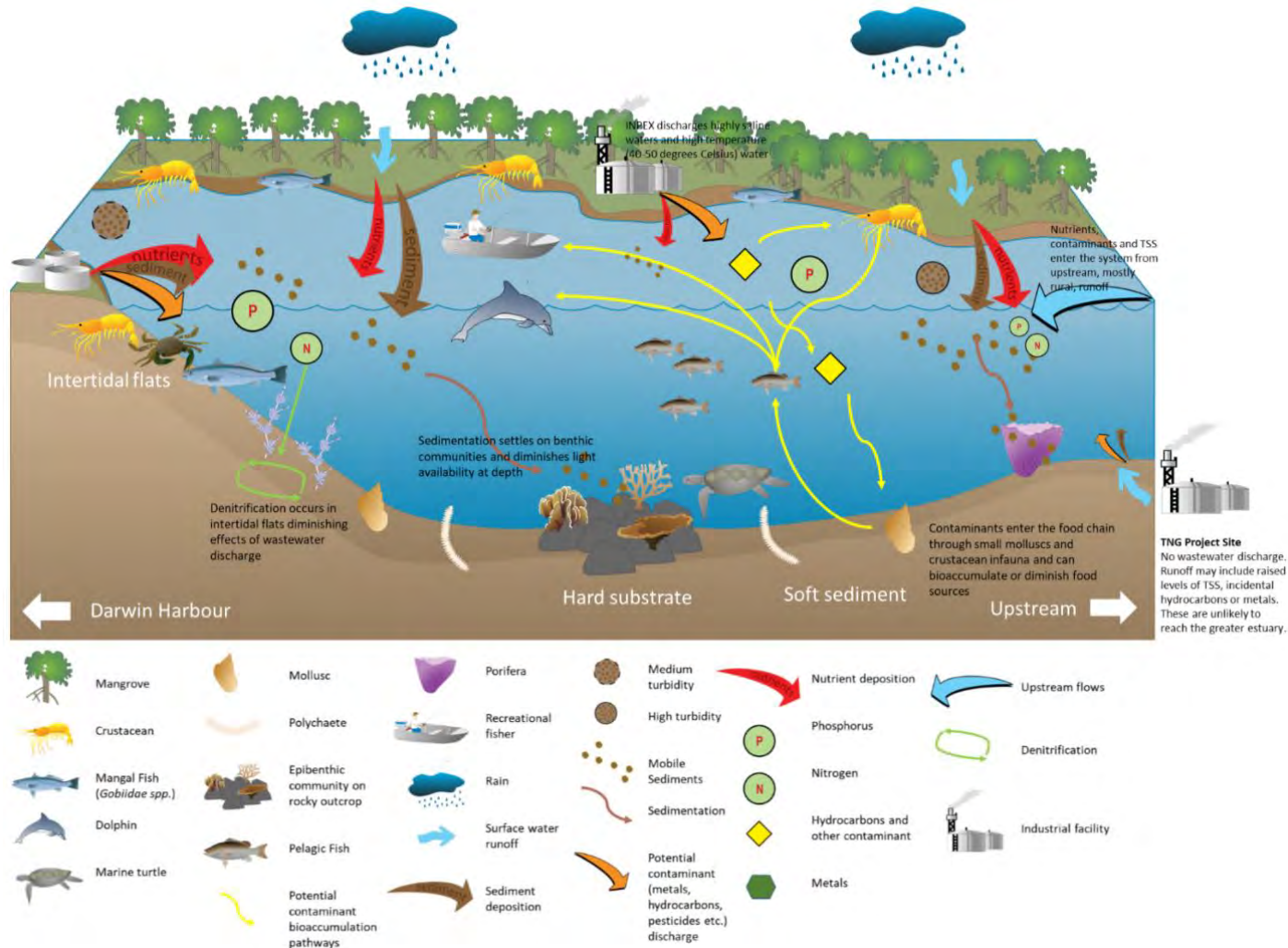


Figure 4-3. Conceptual site model of the Elizabeth River Estuary and general risks associated with major point and diffuse pollutant sources. (Courtesy of the Integration and Application Network, University of Maryland Centre for Environmental Science [ian.umces.edu/symbols/])

4.1.2.4 Potential to contaminate surface water

The addition of reagents, mineral concentrates, sediments, litter, nutrients, hydrocarbons, ASS and other pollutants to stormwater runoff may decrease environmental values of downstream receiving environments. Setting water quality objectives in line with guidelines as detailed in **Section 2.3.5** provides the appropriate management framework, and two levels of containment have been designed to avoid this risk.

Primary management and containment for process chemicals are achieved by placement of potential COIs above the 1:1,000 year storm surge elevation, within suitable vessels and housings with the appropriate linings and bunding. All processing areas will have a formal drainage network where potential pollutants will be contained within controlled bunded areas and collected in sumps. The discharge quality shall be assessed and if of suitable quality it will be released into the internal stormwater system. Any potentially pollutant discharge will be diverted to wastewater treatment plants for processing. These measures are described in **Sections 2.3.2, 2.3.3, 2.3.4 and 2.3.5**. Primary management techniques are supported by a regular schedule of monitoring and reporting to ensure infrastructure is functioning as designed and any required maintenance has been identified and delivered.

Rainwater is diverted away from areas where sources of potential COIs are stored, transported or used. Rain will be intercepted on the roof spaces and redirected to a rainwater pond for harvest, avoiding the generation of contaminated surface water in these areas.

A secondary system for process chemicals is available in the event that primary management and containment infrastructure was to fail. This may be in the event of an emergency or an action that is unforeseen and thus unavoidable. In this circumstance, impacts can be minimised through the stormwater management measures described in **Section 2.3.5**. (e.g. SQUIDS, bioretention pods and basins etc.). The stormwater management system will also effectively manage the treatment of sediment, gross pollutants, nutrients and incidental hydrocarbons within the stormwater runoff from the non-process areas of the site. Water within this system can be tested and if found to be of unsuitable quality it can be redirected to the WRP for further treatment.

ASS will be managed through implementation of the ASS Management Plan (Appendix L), whilst the CCESCP has been prepared to ensure the risk of impacts from erosion and sedimentation during construction is managed with consideration for Chapter 5.2 of Best Practice Erosion and Sediment Control (IECA 2008).

Implementation of these management approaches are expected to result in impacts that are limited or local in scale, with a duration that ceases at the completion of the Project (medium term) and of very low intensity.

4.1.2.5 Potential to contaminate groundwater

The Project, as a source of COIs, has the potential to impact surface water quality and contaminate groundwater through surface water seepage pathways.

Measures taken to prevent the generation of contaminated surface waters and thus reduce the risk of seepage to groundwater are discussed above. Additional to those is the use of uncontaminated water for use as dust suppression water. Dust suppression will be conducted for the stockpiles and transfer points as described in **Sections 2.3.2**. Water will be sourced from the Raw Water Pond. Water in the Raw Water Pond is obtained from the Darwin Water Supply and will be free of COIs. Ponds will also incorporate impervious liners into the design to mitigate seepage impacts.

The likelihood of contamination of groundwater from dust suppression or pond seepage water is rare, the consequence insignificant and the risk is low.

Measures taken to prevent the seepage of surface water into the groundwater include the allocation of concrete floors in storage locations for sources of potential COIs as detailed in **Section 1**. Concrete floors will prevent seepage and control the flow of surface waters into the purpose built drainage systems that will collect contaminated water separate from the general stormwater system.

Further technical assessment has been made for the Supplement to determine the potential of COIs to migrate to the receiving environment if the controls preventing contamination and seepage of surface water were to fail. Advisian (2021a) conducted an analysis of the Project risk to groundwater including the development of a simple seepage model to estimate the infiltration of dust suppression and irrigation water, the subsequent mobilisation of COI's and assess the potential of COI's to migrate into groundwaters and receiving waters in Darwin Harbour and Elizabeth River. The full Memorandum is included in **Appendix K**.

The site is underlain by a thin layer of shallow lateritic soil, underlain by 19 m of clay. There is a groundwater layer associated with each of these soil layers. In the upper lateritic soil, a wet season perched aquifer occurs. There is also groundwater in the clay aquifer. The two aquifers are connected; however, the clay serves as a natural barrier to groundwater flow and vertical seepage is very limited with the deep clay separating deeper groundwater zones from the site. Due to the clay aquifer's characteristics of low permeability and hydraulic conductivity, flow/movement of groundwater through this layer is likely to be very low. Thus, the risk of contaminants migrating into these groundwater layers is very minimal.

The groundwater seepage model found horizontal flow will dominate due to the higher conductivity of the near surface lateritic soils. During the wet season, groundwater flow is both to the west and north, following the defined drainage paths into the mangrove and estuarine areas.

A time series of 100 years indicated the transportation of potential COI's show only a small number of pathways reaching the receiving waters (**Figure 3-8**). This is due to most of the seepage evaporating. The model finds that a combination of evapotranspiration, dilution due to recharge and natural attenuation provide effective measure against any COIs at concentrations exceeding regulatory thresholds reaching the receiving waters.

In conclusion the analysis finds that seepage into groundwaters from ore concentrate, product or waste stockpiles will be unlikely due to the storage and handling procedures and methods adopted by TNG. Seepage into groundwaters from the irrigated grassy areas and unsealed roads/laydown areas will be typically seasonal and is unlikely to pose a material risk to environmental values and receptors, given the measures proposed for containing potential contaminants and the target quality of water leaving the WRP. Chemical and reagent storage areas will also be designed in accordance with *AS1940:2017* to minimise the risk of release to the adjacent environment.

No mitigation measures, beyond material storage procedures, are recommended or necessary.

Based on the review of the existing information, site hydrogeological conditions and proposed management practices, the potential for site activities to pose a material risk to groundwater is minimal. The likelihood of contamination of groundwater is unlikely. In the event that COIs are not prevented from seeping into groundwater by the primary control measures (such as containerising, bunding, hardstands, concrete floors, internal drainage systems reporting to the WRP) the consequence of seepage, given the results of the model, suggest the contaminants would be retained on the site and not transported into the Elizabeth River in concentrations that exceed water quality standards. This indicates a moderate consequence, and a medium risk.

4.1.2.6 Acid Sulfate Soils

Baseline soil assessments undertaken for the Draft EIS identified the presence of actual and potential ASS within certain areas of the Site, however there is a high potential for ASS to be encountered more broadly across the site during the proposed construction works for the project. An ASS Management Plan was prepared for the Draft EIS, and a commitment to perform a detailed study to identify actual and potential ASS during the detailed design phase for the Project was made.

For the Supplement, a Stormwater Management Plan and Groundwater study were commissioned to provide further detail on the surface and groundwater aspects of the site.

The ASS Management Plan (**Appendix L**) has been updated for the Supplement to reflect the increased knowledge gained by the supplementary studies.

4.2 MARINE ECOSYSTEMS

The Darwin Processing Facility falls within the North Marine Region which is made up of numerous habitats, biological communities and ecosystems and is characterised by high species-richness but relatively low endemism. Due to the updated Project design, the marine ecosystem is not expected to incur any direct impacts as a result of the Project. Despite this, the marine ecosystems of the adjacent Elizabeth River and the Darwin Harbour have been considered as part of the Supplement and a Marine and Coastal Assessment (**Appendix P**) was prepared to identify potential sensitive receptors within the marine environment and the possibility of these receptors being indirectly impacted by the Project.

Whilst no direct impacts are likely to occur from Project activities, the Elizabeth River represents the key sensitive receptor for the site, given its proximity. As such, an overview of the marine environment is provided below.

4.2.1 Marine Biota

The Elizabeth River estuary supports a wide variety of marine ecosystems, as well as resident and transient marine organisms which are described in detail below. The Estuary is characterised by dense mangrove zones, intertidal mudflats and a seasonal difference in turbidity and salinity. As expected, the harbour end of the river is more saline than upstream, while the turbidity increases in the opposite direction excluding some marine organisms. The entrance to the estuary is characterized by coral and sponge gardens, for example surrounding South Shell Island, which has high biodiversity.

4.2.1.1 Invertebrates

Elizabeth River's invertebrate fauna is largely representative of the greater Darwin Harbour region. A significant sampling effort conducted in 2012 found Elizabeth River to have higher species richness for both molluscs and fish (discussed below) than Middle Arm and Blackmore River. During this survey, crustaceans were most abundant (92.5 % of all individual organisms recorded).

No marine invertebrates identified in the harbour are listed as threatened or of conservation significance. However, the marine invertebrates in the harbour region are essential for functional ecosystems which support a wide variety of species and provide ecosystem services to the Darwin community, including recreational fisheries.

The major taxonomic invertebrate groups in Darwin Harbour are described in the following sections.

Sponges

Extremely biodiverse in the Northern Territory, however Darwin Harbour represents around 10 % of the known diversity of the greater region. Sponges are found on hard substrates as a transition between reef and subtidal mudflats, as well as on soft-bottom substrates. Sponge gardens play an integral role in the productivity of the ecosystem and provide essential habitat for small fish and many invertebrates.

Corals

Darwin Harbour has generally low diversity of soft corals, thought to be associated with the higher turbidity in parts of the Harbour. Hard corals are highly biodiverse but restricted to areas with hard substrates and strong currents. Around Elizabeth River, hard corals are restricted in depth (between mean sea-level and 10 m deep) by light availability due to the increased turbidity.

Hydroids

At least 72 species of hydroids have been identified in Darwin Harbour, with seven species found only in this region. They require hard substrate to attach to so are found mostly in these areas of the harbour.

Marine worms

Polychaetes worms are most diverse and abundant where subtidal reefs are followed by subtidal mud flats and intertidal mud flats. Polychaetes are found over a wide variety of habitats.

Echinoderms

Several species, many of which are endemic, are found in Darwin Harbour but are potentially at risk of increased human activity including redistribution of sediment or increased river silt from human development.

Molluscs

Compared to other nearby regions, Darwin Harbour is not as biodiverse for molluscs, however in terms of abundance they are one of the most dominant taxa in the harbour.

Crustaceans

There are an estimated 1000 crustacean species in the harbour region, with a high abundance of decapods (crabs, prawns, shrimps, lobsters) associated with the harbour's mangrove environments. The Harbour crustacean diversity is dominated by two shrimp species, *Acetes siboga* and *Caridea spp.*

Crustaceans play an important role in the trophic structure in marine ecosystems. Many decapods graze on the substrate for algae and detritus; copepods are an important component of the marine plankton and provide a major food source for many small and juvenile fish; shrimps, prawns and crabs are an important food source for many species of fish; isopods feed in great numbers on dead fish. Consequently, any changes in the marine environment which impact on crustacean abundance will affect those species that use crustaceans as a food source. Conversely, if the fish composition is modified this may have an impact on decapod fauna, with a cascading effect on habitat structure and ecosystem function.

4.2.1.2 Fish

Elizabeth River estuary is home to a number of resident and transient pelagic fish species. While commercial fishing is not allowed within Darwin Harbour, many species are the target of recreational fishers. Indigenous fishers most commonly aim for fishes with mangrove habitat as juveniles, such as trevallies (*Caranx spp.*), mackerel (*Scomberomorus spp.*), threadfin salmon, (*Eleutheronema tetradactylum* and *Polydactus macrochir*),

Spotted Javelinfinch (*Pomadasys kaakan*) and barramundi (*Lates calcarifer*). A 2012 hook and line survey of the Elizabeth River (in Smit, Penny & Griffiths, 2012) found 22 different fish species in the river, with 72% of the total catch consisting of Moses' Snapper (*Lutjanus russellii*), Seabream (*Acanthopagrus berda*), Golden Snapper (*Lutjanus johnii*), Spotted Javelinfinch (*Pomadadys kaakan*) and Grass Emperor (*Lethrinus laticaudis*). Most of these species are target species for recreational fishers.

This hook and line survey very likely under-represents fish diversity and abundance in the Elizabeth River Estuary, as the method does not account for mangrove fish assemblages. Further grab and beam trawl surveys (Smit, Penny & Griffiths, 2012) represented 61 species, mostly small bottom-dwelling species due to the nature of the sampling method. The most abundant (40 %) were Gobies (family *Gobiidae*), followed by gudgeons (family *Eliotridae*).

Estuaries have an important role as the nursery for many species of marine fish. Coastal wetlands, such as mangrove forests, are important nursery sites for juvenile fish and crustaceans. For example Moses' Snapper - an important commercial and recreational fish - spend their early life stages in estuarine waters.

4.2.1.3 Seabirds

Darwin Harbour offers habitat, particularly mangroves, for a number of resident and migratory seabird species. Frigatebirds, boobies, terns, noddies, tropicbirds, petrels, shearwaters and gulls all found in the Elizabeth River Estuary. Of these, several migratory species are listed under the EPBC Act, such as the streaked shearwater (*Calonectris leucomelas*), masked booby (*Sula dactylatra*), lesser frigatebird (*Fregata ariel*), lesser crested tern (*Thalasseus bengalensis*) and little tern (*Sternula albifrons*).

4.2.1.4 Marine mammals & other vertebrates

Darwin Harbour provides resident or transient habitat for dolphins, dugongs, marine turtles, marine snakes and saltwater crocodiles.

Dolphins and Dugongs

Three species of coastal dolphin, Australian snubfin (*Orcaella heinsohni*), Indo-Pacific humpback (*Sousa chinensis*) and Indo-Pacific bottlenose (*Tursiops aduncus*), are resident in the harbour and one offshore false killer whale (*Pseudorca crassidens*) is an irregular visitor. Dugongs are also known to occur in the harbour, mostly associated with seagrass meadows.

The most commonly sighted is the Indo-Pacific humpback, then the Indo-Pacific bottlenose. All three resident species use the area for breeding. Bottlenose dolphins are rarely seen on the western side of the harbour, or in turbid, muddy waters. East Arm is important foraging habitat.

Dolphins have been found to travel long distances (20 to 50km) upstream in other locations, however monitoring shows that sightings of all three species further up the Elizabeth Estuary than Bladin Point are rare. It is also rare for dugongs to be seen past Bladin Point, although potential foraging habitat can be found almost throughout the estuary. Dugongs could be found anywhere that supports seagrass or algae, which is all areas with hard-substrate bottom less than 10 m in depth, and areas of rocky reef such as South Shell Island.

Marine Turtles

Of the six species of marine turtles found in the Northern Territory, the green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*) and flatback (*Natator depressus*) turtles regularly utilize Darwin Harbour.

Turtle occurrence in the harbour is likely to be associated with foraging, as the harbour is largely fringed with mangrove forests, there is little habitat for nesting within the harbour. All three of these species have been observed on the reefs around the islands in the Elizabeth River (Catalina Island). While all three travel upstream in the estuary the herbivorous Green Turtle is observed most frequently upstream, likely due to its ability to feed on mangroves. All three species are listed as vulnerable under Commonwealth legislation.

Marine Snakes

The harbour is home to several marine snake species, including species of file snake (*Acrochordidae*), mud snakes (*Homalopsinae*) and true sea snakes (*Hydrophiidae*). While marine snake monitoring is difficult, and largely opportunistic, there have been several recorded observations in the Elizabeth River, as far as the Elizabeth River Bridge. There is suitable habitat throughout the Elizabeth River Estuary so marine snake occurrence upstream is likely.

4.2.1.5 Benthic Communities

The majority of the Elizabeth River consists of soft-bottom habitat, characterized by mobile sediments. These sediments are typically inhabited by molluscs, polychaetes and crustaceans. Epibenthic communities are generally associated with hard substrates. Generally, these areas are found in seafloor depressions within the Elizabeth River or rocky outcrops at the mouth of the river. The deeper depressions are characterised by soft sediments and may have large amounts of organic matter.

Only 9% of the hard substrates found in Elizabeth River were found to be bare (Smit, Penny & Griffiths, 2012). Hard substrate communities within the phototrophic zone (below mean sea-level height), such as the northern part of Elizabeth River, are best described as mixed communities with varying degrees of cover of corals, alga, sponges, gorgonians, hydroids, with no species group having more than 40 % cover.

4.2.1.6 Mangrove Habitats

Mangroves in Darwin Harbour constitute one of the largest tracts of mangrove forest throughout the Northern Territory and Australia and are largely regarded as pristine and intact (Moritz-Zimmermann, Comley & Lewis, 2002). Darwin Harbour's mangrove forests cover around 20,400 hectares, constituting around 5% of the Northern Territory's entire mangrove area (Brocklehurst & Edmeades, 1996). In addition to being one of the largest discrete blocks, Darwin Harbour is recognised for its diversity, containing 36 mangrove species, 6 of which are most common, *Rhizophora stylosa*, *Ceriops tagal*, *Sonneratia alba*, *Bruguiera exaristata*, *Avicennia marina* and *Camptostemon schultzei* (Brocklehurst & Edmeades, 1996).

Mangrove communities are sensitive to additional risks as illustrated in **Figure 4-4**.

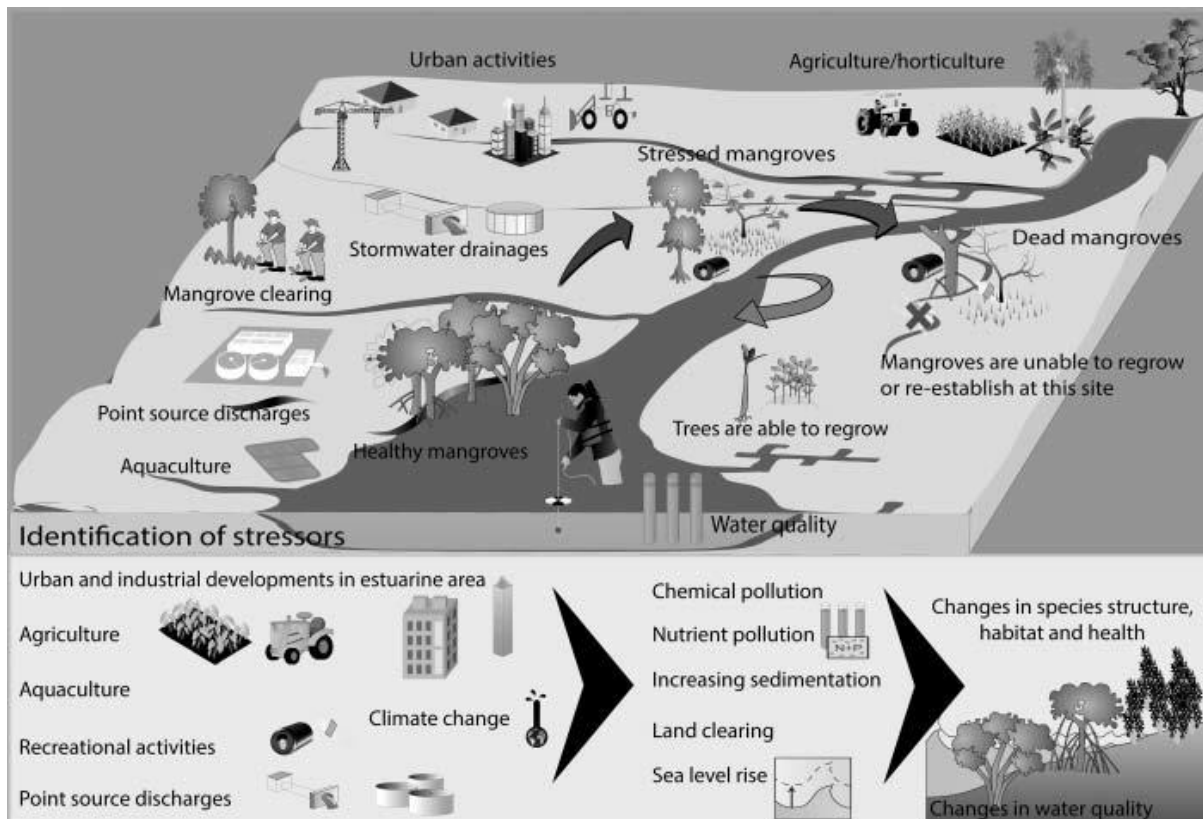


Figure 4-4. A conceptual diagram showing estuarine activities and their effect on mangroves

The Draft EIS proposed clearing of 2 ha of mangroves to accommodate the ocean outfall pipeline. This clearing is no longer required due to changes to the Project described in **Section 1**, and for the EIS Supplement no mangroves will be cleared.

Mangrove species distribution and the complexity and composition of mangrove communities, particularly on the landward edge, is influenced by the freshwater regime. It is the Project's intention to maintain natural groundwater seepage and stormwater runoff flows into the adjacent intertidal zone from outside the development envelope. However, the Project will require the minor alteration of surface water flows and may impact the groundwater regime through reduced infiltration of stormwater.

These risks were described in the Draft EIS and the residual risk to downstream receiving waterways resulting from surface and groundwater quantity changes were determined to be low. The supplementary information on the existing environment and the Project changes described in **Section 1** have not resulted in any increased risk and no management are changes proposed.

4.2.2 Potential Impacts to Marine Biota

The proposed TNG Project will not directly interact with the marine environment, disturb benthic habitats or result in clearing of mangrove communities. Whilst no direct impacts are likely to occur from Project activities, there may be some indirect impacts from increases in concentration of TSS from sedimentation and contaminants such as hydrocarbons and metals from stormwater, if primary containment measures fail.

Table 4-1 lists the sensitive receptors in the Elizabeth River and indicates the specific sensitivities in relation to those with the potential to arise indirectly from the Project. The risk of sedimentation to sensitive environmental receptors is low and most impacts will be temporary during the construction phase. Detailed discussion of potential impacts due to sedimentation is provided in **Section 3.2.4.2**.

Table 4-1. Sensitive environmental receptors and known sensitivities

Sensitive Environmental Receptors	Known sensitivities
Molluscs and Crustaceans	Contaminants enter the food chain through small molluscs and crustacean infauna and can bioaccumulate or diminish food sources
Hydroids, Marine Worms, Echinoderms	Loss of habitat for many invertebrates if sponges are diminished due to sedimentation. Echinoderms are sensitive to redistribution of sediments or increased sedimentation.
Fish	Sensitive to bioaccumulation of contaminants in food sources and/or diminished food sources Possible disruption to breeding cycles if estuary becomes unsuitable habitat for early life stages for species that require estuary as nursery habitat.
Seabirds	Bioaccumulation of contaminants in food sources and/or diminished food sources Sensitive to loss of specific habitats required for feeding or roosting such as mudflats, salt pans and mangroves.
Marine mammals and other vertebrates	Bioaccumulation of contaminants in food sources and/or diminished food sources Dugongs are sensitive to loss of seagrass and algae from sedimentation Bottlenose dolphins are sensitive to turbidity
Turtles	Diminished food sources from effects of sedimentation
Benthic Communities (including sponges and corals)	Sedimentation settles on benthic communities and diminishes light availability at depth. Corals are sensitive to turbidity. Benthic communities require hard substrates that may be buried by sediments.
Mangrove Communities	Complex physico-chemical and biological interaction influence the distribution of mangrove assemblages in the Darwin Harbour. Assemblages are likely to also be influenced by seasonality of climate and tidal regimes, freshwater inflows from point and diffuse sources, topography and substrate type. Landward mangrove habitats are likely to be more influenced by terrestrial, rather than marine, processes including freshwater seepage, seasonal deposition of terrestrial sediments, infrequent tidal inundation and desiccation (Metcalf, 2007).

As no direct impacts will occur from the Project and given the proposed mitigation measures to address indirect impacts from sedimentation or contamination, the Project is not anticipated to result in an increase in the sensitive processes described in **Table 4-1**. As such, the impacts from the Project on the marine environment are expected to be low.

4.3 IMPACTS OF THE PROJECT ON MNES

4.3.1 Policy and Guidance

Submissions received on the Draft EIS requested further assessment of the threatened MNES species known to occur within the Elizabeth River adjacent to Lot 1817 against the requirements of relevant policies and guidance. The species recognised as MNES within the Elizabeth River are Green Turtle, Hawksbill Turtle, Flatback Turtle, Olive Ridley Turtle, Dwarf Sawfish, Largetooth Sawfish and Green Sawfish.

The relevant policy and guidance for these MNES are:

- Approved Conservation Advice for *Pristis clavata* (Dwarf Sawfish; DEWHA 2009)
- Approved Conservation Advice for *Pristis pristis* (largetooth sawfish; DoE 2014)
- Approved Conservation Advice for Green Sawfish (DEWHA 2008)
- Sawfish and River Sharks Multispecies Recovery Plan (DoE 2015)
- Recovery Plan for Marine Turtles in Australia (DEE 2017)
- Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DEE 2018)

Table 4-2 summarises the Objectives within each of these policy and guidance statements and discusses how the Project, as proposed in the Draft EIS and Supplement, is consistent with these objectives.

Table 4-2. Policy and guidance for marine fauna in relation to the Project

Guidance	Objective	Discussion
Approved Conservation Advice for <i>Pristis clavata</i> (Dwarf Sawfish) (DEWHA (2009)).	Priority Actions: • Raise awareness of the Dwarf Sawfish, including species identification and handling techniques for bycatch specimens. • Identify populations and areas of high conservation priority • Maintain liaison with Indigenous ranger groups and other appropriate groups patrolling waters in which the population occurs	The EMP (Appendix M) provides a framework for inductions and training. Through a regularly updated Biodiversity Management Plan (BMP) the induction and training for personnel will ensure employee and local contractor awareness of local fauna and encourage reporting of sightings through the fauna register, including for Dwarf Sawfish. There are no significant habitats (i.e. nesting, nursery, foraging or breeding areas), for any marine fauna species listed under the EPBC Act or TPWC Act within the Project area, including for the Dwarf Sawfish. The Draft EIS (Table 7-84) commits to engagement with relevant Indigenous stakeholders to ensure traditional activities in nearby areas are understood and not impacted. This commitment is retained for the EIS Supplement. The Project is consistent with the objectives of the conservation advice.
Approved Conservation Advice for <i>Pristis pristis</i> (largetooth sawfish) (DoE (2014)).	Priority Actions: • Encourage and educate recreational fishers to identify largetooth sawfish species to species level and report any interactions. • Implement measures to reduce adverse impacts of habitat degradation and/or modification • In collaboration with Indigenous communities promote largetooth sawfish conservation.	The EMP provides a framework for inductions and training. Through a regularly updated BMP the induction and training for personnel will ensure employee and local contractor awareness of local fauna and encourage reporting of sightings through the fauna register, including for Largetooth Sawfish. EIS Supplement Section 1 outlines changes to the processing methodology to remove the requirement for the disposal of liquid wastes to the Darwin Harbour. The risk of exposure to ASS and sedimentation/erosion as a result of the outfall pipeline construction is no longer relevant as the outfall pipeline will not be constructed; therefore, soil disturbance will not occur within the marine and intertidal habitats. After the risks associated with these have been avoided, the residual risk of pollution of the Elizabeth River and Darwin Harbour is Low. The Draft EIS Section 7.7.5.2 proposes implementation of effective controls, such as good housekeeping and waste handling practices. These are anticipated to result in negligible risk to the environmental quality of the marine environment from Project operations due to litter. The Draft EIS Section 7.7.5.3 notes the proposed design of the Facility, incorporating significant hardstand and bunded areas, stormwater containment infrastructure and designated chemical storage and handling facilities, as well as an ability to detect and address spills promptly within the terrestrial environment, it is considered that the likelihood of chemicals entering groundwater or stormwater pathways and directing to the marine environment is low. Further detail for how this will be implemented is presented in the EIS Supplement and the residual risk of contamination of surface and groundwater as a result of the Project is low.

Guidance	Objective	Discussion
		The Draft EIS (Table 7-84) commits to engagement with relevant Indigenous stakeholders to ensure traditional activities in nearby areas are understood and not impacted. This commitment is retained for the EIS Supplement. The Project is consistent with the objectives of the conservation advice.
Approved Conservation Advice for Green Sawfish. DEHWA (2008).	Priority Actions: • Identify known sites of high conservation priority. • Raise awareness of the species, including species identification and handling techniques for bycatch specimens. • Improve reporting of interactions with fishers	There are no significant habitats (i.e. nesting, nursery, foraging or breeding areas), for any marine fauna species listed under the EPBC Act or TPWC Act within the Project area, including for the Green Sawfish. The EMP provides a framework for inductions and training. Through a regularly updated BMP the induction and training for personnel will ensure employee and local contractor awareness of local fauna and encourage reporting of sightings through the fauna register, including for Green Sawfish. The Project is consistent with the objectives of the conservation advice.
Sawfish and River Sharks Multispecies Recovery Plan (DoE 2015).	The primary objective of this recovery plan is to assist the recovery of sawfish and river sharks in Australian waters with a view to: • improving the population status leading to the removal of the sawfish and river shark species from the threatened species list of the EPBC Act • ensuring that anthropogenic activities do not hinder recovery in the near future, or impact on the conservation status of the species in the future. The specific applicable objectives of the recovery plan are to: • Reduce and, where possible, eliminate adverse impacts of fishing on sawfish and river shark species • Reduce and, where possible, eliminate adverse impacts of habitat degradation and modification on sawfish and river shark species. • Reduce and, where possible, eliminate any adverse impacts of marine debris on sawfish and river shark species noting the linkages with the Threat	The Project is not considered to pose any significant residual risks to the protection of marine fauna and therefore biological diversity and ecological integrity can be maintained. The Project will not impact the capacity for the population status to be improved and the species to be delisted. The Project will not hinder recovery in the near future, or impact on the conservation status of these species in the future EIS Supplement Section 1 outlines changes to the processing methodology to remove the requirement for the disposal of liquid wastes to the Darwin Harbour. The risk of exposure to ASS and sedimentation/erosion as a result of the outfall pipeline construction is no longer relevant as the outfall pipeline will not be constructed; therefore, soil disturbance will not occur within the marine and intertidal habitats. The risks associated with these have been avoided. The residual risk of pollution of the Elizabeth River and Darwin Harbour is Low. The Draft EIS Section 7.7.5.2 proposes implementation of effective controls, such as good housekeeping and waste handling practices. These are anticipated to result in negligible risk to the environmental quality of the marine environment from Project operations due to litter. As a result, the Project is not expected to be a source of marine debris. The Draft EIS Section 7.7.5.3 notes the proposed design of the Facility, incorporating significant hardstand and bunded areas, stormwater containment infrastructure and designated chemical storage and handling facilities, as well as an ability to detect and address spills promptly within the terrestrial environment, it is considered that the likelihood of chemicals entering groundwater or stormwater pathways and directing to the marine environment is low. Further detail for how this will be implemented is presented in the EIS Supplement and the residual risk of contamination of surface and groundwater as a result of the Project is low.

Guidance	Objective	Discussion
	Abatement Plan for the Impact of Marine Debris on Vertebrate Marine Life. • Reduce and, where possible, eliminate any adverse impacts of collection for public aquaria on sawfish and river shark species. • Improve community understanding and awareness in relation to sawfish and river shark conservation and management.	The EMP provides a framework for inductions and training. Through a regularly updated BMP the induction and training for personnel will ensure employee and local contractor awareness of local fauna and encourage reporting of sightings through the fauna register. Inductions will identify where the Project has the potential to impact fauna or fauna habitats and the importance of the management strategies in mitigating impacts. The Project is consistent with the objectives of the recovery plan.
Recovery Plan for Marine Turtles in Australia (DoEE 2017a).	The long-term recovery objective for marine turtles is to minimise anthropogenic threats to allow for the conservation status of marine turtles to improve so that they can be removed from the EPBC Act threatened species list. Interim applicable recovery objectives: • Current levels of legal and management protection for marine turtles are maintained or improved both domestically and throughout the migratory range of Australia's marine turtles. • The management of marine turtles is supported. • Anthropogenic threats are demonstrably minimised	Draft EIS Section 7.9.4.4 identified the risk for loss of Benthic Habitat and Communities (BHC) for marine turtles as a result of the Project. The project activities proposed in the Draft EIS which could potentially impact BHC are listed below with their status for the EIS Supplement: • Direct removal or smothering of intertidal and subtidal BHC for the discharge pipeline installation - eliminated, no longer a risk. • Sub-lethal impacts to BHC from the discharge of process water within the small mixing zone of the outfall - eliminated, no longer a risk • Pollution of the marine environment altering water quality and potentially impacting subtidal BHC, resulting in different community structures or a decrease in density leading to a reduction in associated primary productivity outputs - eliminated, no longer a risk • Altered groundwater and stormwater runoff regimes causing intertidal erosion or changing the salinity of sediment pore waters in mangrove communities - continued risk, see below. The EIS Supplement Section 1 outlines changes to the processing methodology to remove the requirement for the disposal of liquid wastes to the Darwin Harbour. The risk of exposure to ASS and sedimentation/erosion as a result of the outfall pipeline construction is no longer relevant as the outfall pipeline will not be constructed; therefore, soil disturbance will not occur within the marine and intertidal habitats. The risks associated with these have been avoided. the residual risk of pollution of the Elizabeth River and Darwin Harbour is Low. A Stormwater Management Plan has been prepared for the EIS Supplement. The Plan identifies that by following policy and guideline recommendations the risk of sedimentation is low and the impact to marine habitats is expected to be limited in scale and short term in duration.

Guidance	Objective	Discussion
		The Draft EIS Section 7.9.4.1 identified that Marine turtles are particularly vulnerable to the ingestion of marine debris and entanglement (CoA 2017). Appropriate disposal activities and actions, including the collection, transport, treatment and disposal of non-process waste, are required to reduce adverse effects of waste on the marine environment. It is expected that handling of non-process waste can be effectively managed to prevent significant impact on marine fauna. The Draft EIS Section 7.7.5.2 proposes implementation of effective controls, such as good housekeeping and waste handling practices. These are anticipated to result in negligible risk to the environmental quality of the marine environment from Project operations due to litter. As a result, the Project is not expected to be a source of marine debris. The Project is consistent with the objectives of the recovery plan.
Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE 2018).	• Contribute to long-term prevention of the incidence of marine debris • Understand the scale of impacts from marine plastic and microplastic on key species, ecological communities and locations • Remove existing marine debris • Monitor the quantities, origins, types and hazardous chemical contaminants of marine debris, and assess the effectiveness of management arrangements for reducing marine debris • Increase public understanding of the causes and impacts of harmful marine debris, including microplastic and hazardous chemical contaminants, to bring about behaviour change	The existing environment at the site is identified in the Draft EIS Section 7.2.3 to have a high level of illegal and unregulated rubbish dumping, including hazardous chemical contaminants. The Draft EIS section 7.2.6, Table 7-6 identifies that TNG will ensure the removal of fly-tipped waste from the site using accredited waste specialists, including Inspection of disturbed areas and fly-tipped waste for the presence of asbestos; removal, transport and disposal of asbestos using licensed specialists. The project will reduce the generation of marine debris from this source. A Domestic and Industrial Waste Management Procedure (EP14), within the EMP (Appendix M) will be implemented for the Site. This includes the implementation of effective controls, such as good housekeeping and waste handling practices. These are anticipated to result in negligible risk to the environmental quality of the marine environment from Project operations due to litter. As a result, the Project is not expected to be a source of marine debris. The EMP provides a framework for inductions and training that will ensure employee and local contractor awareness of potential impacts to local fauna that may occur as a result of the Project and the importance of the management strategies that have been proposed to mitigate these impacts. The Project is consistent with the objectives of the threat abatement plan.

Given the Project scope described in **Section 1** and the mitigating measures described through the Draft EIS and Supplement, it is considered that the Darwin Processing Facility will be constructed and operationed in accordance with the objectives of all relevant policies and plans associated with MNES.

4.3.2 Impact of Project Alternatives on MNES

This section provides a comparative description of the impacts of the Proposal alternatives on MNES, including how it complies with the principles and objectives of ecologically sustainable development (ESDSC 1992).

Alternatives considered include:

- not proceeding with the Project
- alternative locations for components of the Project
- alternative processing methods
- alternative infrastructure designs
- alternative environmental management techniques
- alternative energy sources
- alternative decommissioning and rehabilitation methods.

The expected impacts of the Project to MNES are summarised in **Table 4-3**.

Section 4.3 of the Draft EIS detailed a range of Alternatives that were considered for the Project. Further alternatives in relation to development envelope, energy and water are described in **Sections 2.7** above.

This section details how the Alternatives differ in their impact to MNES and provide justification in relation to the Core Objectives and Guiding Principles of the National Strategy for Ecologically Sustainable Development.

Table 4-3. Expected impacts to MNES as a result of the Project.

MNES	Expected Significant Impact	Description
Listed Threatened Species	No	From terrestrial field survey work (Draft EIS Appendix J Table 5-2) it was determined that no flora listed under the EPBC Act are present in Lot 1817. The Protected Matters Search Tool (PMST) does not identify any threatened flora listed under the EPBC Act that are likely to be present in Lot 1817. The Significant Fauna Impact Assessment (Appendix J) performs Significant Impact Assessments using the DAWE Significant Impact Guidelines (DoE, 2013) for MNES known to occur, likely to occur or possibly occurring within areas likely to be impacted by the Project. The assessments concluded there is no significant impact to listed threatened fauna species as a result of the Project. From the Marine study undertaken for the Draft EIS (Appendix T) it was identified that 7 fauna species listed as threatened under the EPBC Act were found to occur in the Study area or were assessed as likely to occur due to the presence of suitable habitat and the known proximity of the species to the Study area. The Supplement Section 1 outlines the changes to the Processing methodology proposed since the Draft EIS. Significant changes to the Project waste streams have been made to avoid the risk to marine fauna. TNG commissioned Advisian to develop a Marine and Coastal Assessment for the Supplement that identified sensitive marine and coastal receptors in relation to the expected impacts from the revised Project. The assessment finds

MNES	Expected Significant Impact	Description
		impacts to the marine and coastal environment as a result of the Project are likely to be short in duration and of limited to localised scale and intensity. There will be no significant impact to marine fauna listed as Threatened under the EPBC Act.
Listed Threatened Ecological Communities	No	From terrestrial field survey work (Draft EIS Appendix J Table 5-2) it was determined that no ecological communities listed under the EPBC Act are present in Lot 1817. The PMST does not identify any ecological communities listed under the EPBC Act that are likely to be present in Lot 1817.
Migratory Protected Species under International Agreements	No	From terrestrial field survey work (Draft EIS Appendix J Table 5-2) it was identified that 14 fauna species listed as migratory under the EPBC Act were found to occur in the Study area or were assessed as likely to occur due to the presence of suitable habitat and the known proximity of the species to the Study area. From the Marine study undertaken for the Draft EIS (Appendix T) it was identified that 11 fauna species listed as migratory under the EPBC Act were found to occur in the Study area or were assessed as likely to occur due to the presence of suitable habitat and the known proximity of the species to the Study area. The Saltwater crocodile was considered in both assessments leading to a total of 24 migratory species considered to be potentially impacted by the Project. Detailed assessment of the potential impacts to migratory avifauna has been undertaken in the Significant Fauna Impact Assessment (Appendix J). The Significant Impact Assessment was undertaken using the DAWE Significant Impact Guidelines (DoE, 2013). No significant impact is expected to affect migratory avifauna species as a result of the Project. The Supplement Section 1 outlines the changes to the Processing methodology proposed since the Draft EIS. Significant changes to the Project waste streams have been made to avoid the risk to marine fauna. TNG commissioned Advisian to develop a Marine and Coastal Assessment for the Supplement (Appendix Q) that identified sensitive marine and coastal receptors in relation to the expected impacts from the revised Project. The assessment finds impacts to the marine and coastal environment as a result of the Project are likely to be short in duration and of limited to localised scale and intensity. There will be no significant impact to marine fauna listed as Migratory under the EPBC Act.
Wetlands of International Importance	No	The PMST did not identify any RAMSAR Wetlands of International importance in or near Lot 1817.
Commonwealth Marine Areas	No	The PMST did not identify any Commonwealth Marine Areas in or near Lot 1817.

MNES	Expected Significant Impact	Description
World Heritage Properties	No	The PMST did not identify any World Heritage Properties in or near Lot 1817.
National Heritage Places	No	The PMST did not identify any National Heritage Places in or near Lot 1817.
The Great Barrier Reef Marine Park	No	Lot 1817 is not located near to, adjacent to, or in any catchment that reports to the Great Barrier Reef Marine Park.
Nuclear Actions	No	No nuclear actions are associated with the Project
A water resource, in relation to coal seam gas development and large coal mining development	No	The Project is not a coal seam gas or coal mining development.

4.3.2.1 Alternative Action: Not proceeding with the project

There are no significant impacts to MNES as a result of the Project (**Table 4-3**).

Not proceeding with the Project would see the retention of 92.5 ha of Eucalypt woodland which is known to support the MNES terrestrial species Black-footed Tree-rat. Loss of 92.5 ha of habitat will be a 0.01% reduction of the total available habitat in the Darwin region, and an estimated 4% reduction in the habitat occupied by the species in the Middle Arm area (**Section 3.2.3.2**).

It is not expected that the habitat loss arising from the Project will cause habitat degradation for Black-footed Tree-rat that would result in species decline. The proposed mitigation is the rehabilitation of the 64 ha of currently disturbed land that lies outside of the Development Envelope in a degraded condition. This is detailed in the Rehabilitation Management Plan (**Appendix B**). The residual impact is the loss of 28.5 ha of Black-footed Tree-rat habitat. Not proceeding with the Project would remove this residual loss of habitat.

Not proceeding with the Project would see the removal of the potential for project impacts to reduce habitat quality on Black-footed Tree-rat and Far Eastern Curlew. Project impacts that may reduce habitat quality have a residual risk of low to medium.

The Project has already, and will continue to, contribute to knowledge about the ecological integrity of threatened species populations in the local area. The implementation of a BMP containing conservation activities including monitoring surveys for MNES species, complementary to those conducted by DEPWS, will aid this knowledge base. Additionally, TNG will continue to review and be guided by the current threat abatement and recovery plans for listed species that are relevant to the project.

Table 4-4 lists the core objectives for the National Strategy for Ecologically Sustainable Development in the context of not proceeding with the Project

Table 4-4. The core objectives for the National Strategy for Ecologically Sustainable Development in the context of not proceeding with the Project

Core Objectives	
Objective	Compliance
To enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations	Not proceeding with the Project removes the opportunity to develop a path of economic development that safeguards the welfare of future generations. The environmental impact of the project has been considered at every stage of Project development and continues to be central to the ongoing planning of the Project. Reduction of environmental risk originating from the Project has been an ongoing process developed in consultation with the community to deliver an outcome that is satisfactory for current and future generations.
To provide for equity within and between generations	The land at Lot 1817 where the Project is proposed is largely degraded by past sand mining activity. Whilst there has been some attempt at rehabilitation for some parts of the land, large areas are in a degraded or completely degraded condition, contain the weedy Gamba Grass (<i>Andropogon gayanus</i>) species and are subject to recreational motorbiking and rally driving, fires and illegal rubbish dumping including of toxic components such as asbestos, car batteries and motor oil. TNG have committed to restricting access to the remnant habitats in Lot 1817, removing all dumped rubbish in a manner consistent with NT Government policy and utilising as much of the previously disturbed areas as possible.
To protect biological diversity and maintain essential ecological processes and life-support systems	The former extractive industries changed the site hydrology such that rainfall is no longer infiltrated into the shallow lateritic aquifer in the previously disturbed areas and instead is available as shallow open water during the wet season. These areas are suitable cane toad breeding environments. TNG has allocated the Project layout into these highly disturbed areas and the cane toad breeding habitats will be reduced by 95 %. The large areas of Gamba Grass and the frequent intentional and unintentional fires currently occurring on the land pose a significant threat to terrestrial and marine MNES fauna of the locality. Inappropriate fire regime is a Threatening Process for Fawn Antechinus, Northern Quoll, Black-footed Tree-rat, Pale Field Rat and Bare-rumped Sheath-tail Bat. Gamba Grass is a highly invasive weed that creates high fuel loads. This can cause uncontrollable, hot and intense fires that affects people, properties and communities. Gamba is a greater risk to the environment than native grass fires and destroys vegetation, large trees and animal shelters (NTG 2020). Large uncontrolled fires can cause significant water quality issues when ash and soil are transported into waterways (WQA 2020). TNG have committed to the eradication of weedy grasses on Lot 1817 through a FMP (Appendix N) and will actively manage the land to reduce the risk of fire on and around Lot 1817. TNG will actively manage invasive predators currently known to occur in Lot 1817. Not proceeding with the project will negatively impact MNES by preserving the status quo at Lot 1817 which is:

- maintaining the threat of contamination of habitats from the illegal dumping of toxic rubbish and products of hot fires
- maintaining the threat of ignition source for uncontrollable hot and intense fires that reduce habitat for terrestrial MNES species and are a threatening process for Fawn Antechinus, Northern Quoll, Black-footed Tree-rat, and Bare-rumped Sheath-tail Bat. Uncontrolled fire originating from Lot 1817 may spread into large intact undisturbed habitats in Middle Arm Peninsula known to host significant populations of threatened fauna
- maintaining the poorly or not rehabilitated areas and their reduced capacity to support MNES terrestrial fauna
- maintenance of the approximate 10 ha of cane toad breeding habitat. Cane toads are a threatening process to Northern Quoll, Mertens' Water Monitor and Yellow Spotted Monitor – all expected to be present in the Middle Arm Peninsula habitats outside of Lot 1817
- maintenance of the invasive predator population using Lot 1817
- lack of knowledge of the MNES fauna population dynamics and distributions in the locality

In addition to the direct impacts of not proceeding with the Project described above, there are some indirect impacts to MNES on a Territory, National and Global scale. The Project benefits were described in the Draft EIS Section 4.2.2, including significant Tax benefits to the NT and Australian Governments. Contribution to the Tax pool helps to support the work of Governments in the protection and promotion of MNES which is of vital importance to the sustainability of the threatened and migratory species in the Darwin region, in Australia and globally as Australia advocates for sustainable development.

Vanadium pentoxide is one of the products of the Darwin Processing Facility. Vanadium is a metal used as an alloying agent, catalyst and ingredient in the manufacture of vanadium redox batteries. Vanadium redox batteries can switch between charge and discharge instantaneously and can cycle often and deeply, differentiating them from solid state, lithium-based batteries. It can also be left completely discharged for long periods of time with no ill effects. The vanadium in the batteries can also be recycled. This has significant advantages in the move towards a higher renewable energy targets (IISD 2019), reducing the impact of climate change on MNES on a global scale. The Project, with a design production output of 6,00 tonnes per annum of Vanadium pentoxide, will provide a valuable addition to global output of this important commodity.

4.3.2.2 Alternative Project Component Locations

As discussed in **Section 1**, the location for the Darwin Processing Facility has been nominated as Lot 1817, Hundred of Ayers, Middle Arm Peninsula of Darwin Harbour.

After the completion of the multi-year and multi-season Biological Survey work, an analysis was conducted to inform the project layout in regards to the distribution of conservation significant biological features present in or adjacent to Lot 1817. As the Lot is divided in the centre by the incursion of riparian vegetation, the analysis compared the values of the northern peninsula to the southern peninsula.

The number of recordings of MNES fauna recorded during field surveys in 2018 and 2019 from within or adjacent to the north or south peninsulas were compared. For the species that are listed under the EPBC Act as Threatened or Migratory that have records in or immediately adjacent to Lot 1817, there are 40 records for the southern zone and 111 records for the northern peninsula. The locations of these records are shown in **Figure 4-5**.

As a result of the analysis, it was determined that placing the industrial processing components of the project on the southern peninsula was advantageous in reducing the potential for noise to impact the MNES species that use the waterway adjacent to the northern peninsula and limiting the infrastructure on the northern peninsula to quieter components such as carparks and support infrastructure.

Allocation of the Development Envelope utilised as much as possible of the lower quality vegetation cover and preserves as much as possible of the higher quality vegetation.

The former extractive industries changed the site hydrology such that rainfall is no longer infiltrated into the shallow lateritic aquifer in the previously disturbed areas and instead is available as shallow open water during the wet season. These areas are suitable cane toad breeding environments. TNG has allocated the Project layout into these highly disturbed areas and the cane toad breeding habitats will be reduced by 95 %. Cane toads are a threatening process for the threatened species Northern Quoll, Mertens Water Monitor and the Yellow-spotted Monitor.

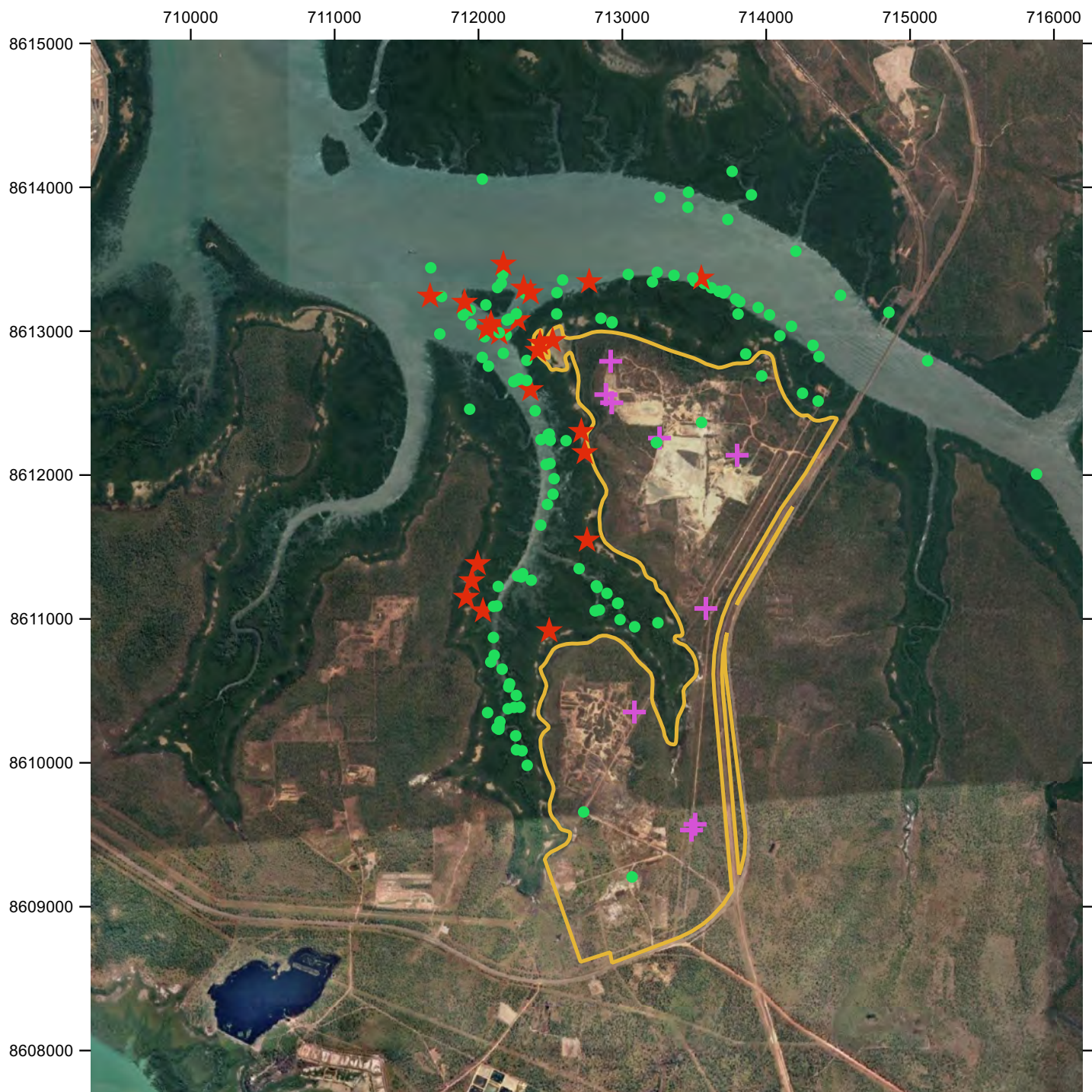


Figure 4-5. MNES fauna field survey records

Legend

MNES Category

★ CR, Mi

✚ EN

● Mi

□ Lot 1817 boundary



0 750 1500 m



Author: eleanor@animalplantmineral.com.au
 Date: 23/06/2020
 Coordinate Reference System: GDA94/MGA
 Zone 52

4.3.2.3 Alternative Processing Methods

The Draft EIS details a Processing waste stream that has process waters disposed through an ocean outfall pipeline (Draft EIS Section 4.6.16.1).

Stakeholder engagement following the Draft EIS has prompted a refinement of the proposed Processing waste streams as outlined in **Section 2.6** of the Supplement. The liquid waste stream will no longer be disposed through an ocean outfall, instead water coming from the Processing Facility will be recycled in the WRP.

This risk identified from the ocean outfall has been avoided. Simultaneously, the revised processing waste stream methods have reduced the overall water demand for the Project by 65% of that proposed in the Draft EIS. This has been achieved through recycling of process water.

There are two factors to consider when comparing the potential impacts of the alternative processing waste streams on MNES. These are described below.

1. Changes to Development Envelope resulting from changes to processing waste streams

In the Draft EIS the ocean outfall pipeline required the clearing of 2 ha of Mangrove vegetation. This vegetation was considered to be suitable habitat for a number of MNES species. The species are listed in **Table 4-5**. The change to the processing waste streams has reduced the required clearing of Mangroves to zero and this impact has been removed. There is now no impact of vegetation clearing to the Far Eastern Curlew or any of the species listed in **Table 4-5** as a result of the proposed project.

Table 4-5. Avoided loss of habitat for MNES fauna as a result of clearing for the ocean outfall pipeline

Species	EPBC Act Conservation Code	Habitat Type	Area in Draft EIS Development Envelope (ha)
Eastern Curlew	CR/Mi	Mangroves	2
Curlew Sandpiper	CR/Mi		
Lesser Sand Plover	EN/Mi		
Whimbrel	Mi		
Common Sandpiper	Mi		
Oriental Cuckoo	Mi		

The changes to the processing waste streams will require additional space in the Development Envelope to accommodate the WRP and associated water harvesting infrastructure. This has resulted in a small increase to native vegetation clearing.

Section 0 assesses the impact from the additional vegetation that will be cleared as a result of the changes to the Development Envelope relative to the habitat value for MNES fauna. No significant impact occurs as a result of the increased clearing.

2. Changes to the risk of contamination resulting from changes to processing waste streams

In the Draft EIS the products to be disposed of through the ocean outfall pipeline had the associated risks of degradation of marine water quality and contamination of marine sediments within the Darwin Harbour system. The water quality and sediment habitats of the Darwin Harbour are currently considered to be in pristine condition.

Species listed as Threatened and Migratory under the EPBC Act that use the marine environment in the Darwin Harbour that had the potential to be exposed to these risks. These species are listed in **Table 4-6**. In addition, 26 species of migratory shorebird have been regularly recorded across the Darwin Harbour region, of which 7 are listed threatened species under the EPBC Act. These species are detailed in **Section 3.2.3.1**.

Table 4-6. MNES marine species assessed as likely to occur in the Elizabeth River

Group	Conservation Category
Turtles	
Green Turtle	VU/Mi
Hawksbill Turtle	VU/Mi
Flatback Turtle	VU/Mi
Olive Ridley	EN/Mi
Crocodiles	
Salt-water Crocodile	Mi
Mammals	
Dugong	
Australian Humpback Dolphin	Mi
Indo-Pacific Bottlenose Dolphin	Mi
Australian Snubfin Dolphin	Mi
Elasmobranch species	
Dwarf Sawfish	VU
Green Sawfish	VU/Mi
Large-toothed Sawfish	VU/Mi

Removing the ocean outfall from the processing waste stream has reduced the risk of impact to these MNES species. The Project Risk Assessment (Draft EIS Appendix G) determined that the risk of discharge of treated wastewater to the marine environment was very high. Mitigation strategies reduced the risk to medium, however as the process is novel the certainty was determined to be Low. This risk has now been avoided.

4.3.2.4 Alternative Infrastructure Designs

The Draft EIS proposed a Wastewater Treatment Plant (**WWTP**) to facilitate wastewater discharge that has been replaced by the WRP for the Supplement. The WRP receives the liquid products leaving the processing facility, removes the waste products and allows for the recycling of process water back into the processing plant.

Preliminary infrastructure design for the WWTP contained open settling ponds to receive the wastewater for the primary removal of contaminants for disposal. The liquid waste product leaving the processing facility would potentially contain the toxic substances such as heavy metals. Fauna may be attracted to the ponds and ponds present a risk of contamination to the Elizabeth River and Darwin Harbour in an exceptionally high rainfall event (e.g. 1:10,000 year event or maximum possible event).

The alternative infrastructure design adopted is to pass the liquid waste from the processing plant through enclosed tanks to remove the waste. Water reporting to open ponds after the final stages of the treatment process is non-toxic (**Section 2.3.8**). This will reduce the risk of death of MNES fauna, particularly migratory shore birds, that may be attracted to open water.

Whilst the water in the open settling ponds will be non-toxic to bird species, if MNES birds are attracted to the Processing Facility area they are more likely to interact with humans, vehicles and are at greater risk of harm. Alternative infrastructure design has incorporated ideas that prevent the establishment of suitable habitat for MNES species – particularly shorebirds that might find suitable habitat in muddy slopes and gently sloping banks of settling pond areas. As the Ponds now required for the project are for clean water storage and not for settling, design can be adaptable to reducing the habitat suitability for MNES species.

4.3.2.5 Alternative Environmental Management Techniques

The Environmental Management Techniques developed through the Draft EIS resulted in seven Management Plans available as Appendices to the Draft EIS:

1. Environmental Management Plan
2. Acid Sulfate Soils Management Plan
3. Fire Management Plan
4. Biodiversity Management Plan
5. Marine Environmental Quality Monitoring and Management Plan
6. Emergency Response Plan Management Plan
7. Biting Insects Management Plan

Through the Draft EIS stakeholder engagement process the limitations of these plans have been acknowledged and new or revised plans have been prepared for the EIS Supplement. Changes to these plans or additional plans are summarised in **Table 4-7**.

Table 4-7. Changes to environmental management techniques as proposed in environmental management plans and sub plans for the Supplement

Plan	Changes to environmental management techniques
Environmental Management Plan	Updated to Version 2 for the Supplement. A minor hazard and minor impact have been defined. A table of the type, quantity and quality of vegetation to be cleared has been added.
Biodiversity Management Plan	Has been revised to Version 1.1 with updated Project aspects and to incorporate the Rehabilitation Management Plan.
Rehabilitation Management Plan	A Rehabilitation Management Plan has been developed to guide the rehabilitation of land during the construction phase. The rehabilitation will benefit the MNES terrestrial fauna by increasing available habitat outside of the Development Envelope, providing a buffer against the impact of noise and light, and increasing the hydrological function by improving the quality of currently degraded land.
Weed Procedure	Revision of the treatment of weedy grasses such as Gamba grass from control to eradicate. This will benefit MNES fauna by reducing the risk of uncontrolled fire in the remnant and rehabilitated habitats within Lot 1817 and the Middle Arm area generally.
Fire Management Plan	Revised to recognise the eradication of Gamba and other weedy grasses as a key risk reduction measure.
Acid Sulfate Soils Management Plan	Updated to ensure currency with supplementary information generated in the EIS Supplement.

Environmental Management techniques will continue to evolve throughout the Project lifespan, in collaboration with stakeholders, as further information becomes available that indicates alternative methods that better protect MNES.

4.3.2.6 Alternative Energy Sources

Alternative energy sources were discussed in **Section 2.7**. This section identifies the impacts to MNES associated with the alternatives.

From the perspective of MNES, a solar array capable of supplying the required power would require up to 600 ha of space for the panels. It is assumed other support infrastructure would be required in addition to this such as roads and buildings. The array would need to be close to the Facility for power efficiency reasons. There is not sufficient land available in Lot 1817 to support this array. Land would need to be secured near the Project. Most of the land adjacent to Lot 1817 to the east is undisturbed Eucalypt Woodland known to be habitat to a number of significant populations of MNES fauna. Clearing of large areas to support a solar farm would likely constitute a significant impact to these species in this area. To the west is the Elizabeth River which is unsuitable. To the north and south are sections similar to Lot 1817 where the Eucalypt Woodland transitions to the riparian vegetation adjacent to the Elizabeth River. The requirement to place infrastructure above the 1 in a 1,000 year storm surge elevation reduces the available land and securing sufficient space would require the clearing of up to 600 ha of remnant Eucalypt Woodland and reduce the available habitat for MNES species. The Darwin Processing Facility proposes to clear 92.5 ha of remnant Eucalypt Woodland vegetation, which has been assessed not to have a significant impact on MNES. It is likely that clearing for a solar array would be a significant impact on a number of MNES (**Section 3.2.3.2**).

Wind turbines would have an unacceptable impact on the Migratory Birds (Loss *et al.* 2013). Darwin Harbour and the Greater Darwin Area provides habitat to 26 Migratory shorebirds, seven of which are listed as Threatened under the EPBC Act (**Section 3.2.3.1**)

4.3.2.7 Alternative Decommissioning and Rehabilitation Methods

Options for eventual decommissioning and site rehabilitation include subsequent industrial use, as the Site is located within an area earmarked for medium to long term industrial use. Alternatively, depending on future local development patterns and surrounding land uses, it may be considered more desirable to rehabilitate and repurpose the Site for other land uses, such as conservation, recreation and/ or residential use.

The significant impact assessments for MNES in the Significant Fauna Impact Assessment (**Appendix J**) do not rely on the future rehabilitation of the land within the Development Envelope. It is assumed that following the planned 42 years of occupation by the TNG Darwin Processing Facility the site will be rejuvenated for further industrial use or repurposed. No significant impact was determined for MNES species under the scenario where the Development Envelope is not rehabilitated to native vegetation. A significant proportion of the Development Envelope (180 ha or 68%) is previously disturbed and does not currently provide high quality habitat to species that are MNES.

Plans for the Rehabilitation of the land that is currently in a Degraded or Completely Degraded condition outside of the Development Envelope are detailed in the Rehabilitation Management Plan (**Appendix B**). The plan outlines a method of best practice rehabilitation through the following initiatives:

- Eradication of weedy grasses
- Rehabilitation soil materials consist of fresh topsoil and subsoil recovered from the remnant vegetation within the Development Envelope to the rehabilitation areas
- Rehabilitation surface materials consist of recovered hollow bearing trees and chipped canopies from the remnant vegetation within the Development Envelope to the rehabilitation areas
- Target quantities for flora species known to provide habitat for the MNES fauna Black-footed Tree-rat to ensure high habitat quality
- Clear objectives for delivering MNES fauna habitat linked to monitoring outcomes that trigger further action when not met within specific timeframes.

The alternative is to not rehabilitate the existing degraded and completely degraded land within Lot 1817. This would retain the status quo which is high weedy grass load that presents significant fire risk when coupled with the frequent human ignition sources; high level of fragmentation between habitat patches, high levels of human and introduced fauna disturbance; and high levels of rubbish dumping leading to unregulated pollution.

TNG LIMITED

SUPPLEMENT TO THE
ENVIRONMENTAL IMPACT STATEMENT
DARWIN PROCESSING FACILITY

**PRINCIPLES OF
ECOLOGICALLY
SUSTAINABLE
DEVELOPMENT**

5. PRINCIPLES OF ECOLOGICALLY SUSTAINABLE DEVELOPMENT

Part 2 Division 1 of the EP Act sets out the Principles of Ecologically Sustainable Development (**ESD**) that must be considered and applied in making a decision under the Act. **Table 5-1** lists the Principles of ESD and discusses how the Project is in keeping with these principles.

Table 5-1. The Principles of Ecologically Sustainable Development

Principle	Discussion
Decision-making principle	
(1) Decision-making processes should effectively integrate both long-term and short-term environmental and equitable considerations.	The risk assessment methodology detailed in Appendix Q incorporates the duration of impact into the assessment of the severity of consequence. This gives consideration to the long term and short term nature of impacts. This is effectively integrated into the decision making process as the risk level is tied to a mitigation response, identifying the appropriate level of corporate governance over which the impact must be managed.
2) Decision-making processes should provide for community involvement in relation to decisions and actions that affect the community.	Community involvement is an integral part of the Environmental Impact Assessment process. The draft EIS itself is a vehicle for detailed and informed Stakeholder Engagement and the outcomes of that process have been used to refine the Proposal, as presented in the Supplement, to the point where the concerns of the broad community are sufficiently addressed. The Draft EIS detailed a community consultation and stakeholder engagement process and an Economic and Social Impact Management Plan (Appendix H of the Draft EIS) to provide a framework for community views to be addressed over the course of the Project. The Draft EIS had a 12 week period for public comment where all members of the community were invited to participate in the decision making process for the Project. Three public submission were received. Community consultation and stakeholder engagement has also occurred throughout the development phase of the Supplement and is detailed in Section 3.5.3.3. The Supplement has been prepared to address the public and government submissions on the Draft EIS. Significant changes to the proposal have been detailed in Section 1, many of which have been driven by community concern. TNG have demonstrated a willingness to adapt the Project based on community concern and the involvement of the community has led to decision making processes implemented in the Supplement. The Supplement will be available for public comment for a period of 3 weeks in early 2021. A Stakeholder and Community Engagement Plan has been developed for the Supplement (Appendix O) that identifies the strategy and framework for ongoing community involvement in the Project planning and delivery phases.

Principle	Discussion
Precautionary principle	
(1) If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.	The application of the Precautionary Principle is triggered by two conditions: the threat of serious or irreversible environmental damage and scientific uncertainty as to the environmental damage. By its very nature, the EIS is precautionary action in that it assesses the potential for serious or irreversible change and uses technical reports to reduce scientific uncertainty regarding the likelihood of such damage. TNG has taken the following actions to fulfil the requirements of the precautionary principle: • A significance-based approach was used to assess the potential impacts of the Project, informed by technical studies and stakeholder engagement. Such an approach assumes that identified impacts will occur and that the proposed mitigation measures will be implemented effectively. • A risk-based approach was used to determine key risks that incorporate uncertain threats to the environment. This approach includes an assessment of the likelihood of harm and the measures taken to avoid, mitigate or manage the risk. • A compliance assessment method was applied to protect relevant environmental values. Such an approach relies on statutory guidelines based on both scientific knowledge and community values. Modelled emissions and discharges from infrastructure and operations are incorporated into the planning of the Project in order to achieve compliance with statutory limits. • Measures to avoid, mitigate or manage the threat of damage to the environment or social development will be implemented at all stages of construction, operation and closure. The risk assessment methodology detailed in Appendix Q incorporates an assessment of certainty. This allows impacts to be assessed based upon the level of knowledge available. As an example of how this has been applied to the Project, discharge of wastewater as proposed in the Draft EIS was determined to have low residual risk but low certainty. This was identified as requiring further mitigation. As a result, the Processing circuit has been re-engineered to remove the requirement for this low certainty process.
(2) Decision-making should be guided by:(a) a careful evaluation to avoid serious or irreversible damage to the environment wherever practicable; and (b) an assessment of the risk-weighted consequences of various options.	The risk assessment methodology detailed in Appendix Q incorporates an assessment of certainty. This allows impacts to be evaluated based upon the level of knowledge available. An alternatives section has been included in the Supplement. The section identifies where options have been decided against for the project as the consequences and or risk, as assessed in the Draft EIS, was determined to be unfavourable. Alternatives are proposed in the Supplement that reduce the consequence and/or risk as provided in the Project Risk Assessment (Appendix Q).

Principle	Discussion
Principle of evidence-based decision-making	
Decisions should be based on the best available evidence in the circumstances that is relevant and reliable.	TNG have commissioned a large number of technical studies to support the EIA process for the Project. These studies are listed in the Factor sections for both the Draft EIS and Supplement. These technical studies have been performed where TNG have identified that additional technical expertise was required to provide relevant and reliable evidence to support the decision making process. Technical studies have been performed by suitably qualified experts in their field.
Principle of intergenerational and intragenerational equity	
The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of present and future generations.	The risk assessment methodology detailed in Appendix Q incorporates the duration of impact into the assessment of the severity of consequence. This results in impacts that are permanent or long term in nature being more likely to attract a very high or high risk rating. Very High risk is defined as being unacceptable. Specific action plans required to reduce risk to an acceptable level. High risk is generally unacceptable without action. In this way impacts to future generations are avoided, managed and mitigated. Careful management of the environmental impacts of the Project will ensure that the integrity of the environment is maintained for future generations. The Project will use a range of avoidance, mitigation and management measures to achieve this. All potential impacts have been modelled for the full life of the project, resulting in future generations receiving no additional environmental or social impacts than current generations. Domestic production of vanadium pentoxide will increase the viability of domestic manufacturing of vanadium redox batteries, which would in turn improve Australia's ability to provide renewable energy. Provision of renewable energy aligns with the NTG's commitment of net zero emissions by 2050, helping to reduce global GHG emissions and allowing the health of the environment to be maintained for future generations. The Project has a planned life of 40 years, resulting in a suite of jobs being provided for the Darwin community for many years. In addition, the Project will provide opportunities for apprenticeships, up-skilling of workers and on the job training, contributing to the skill base present in the Darwin community. Throughout the life of the Project, measures will be investigated and implemented to reduce resource requirements for the Facility; ensuring it operates as efficiently as possible to protect long term resource availability for future generations. The Project will develop a GGMP that will perform five-yearly reviews of energy efficiency and renewable use over the life of the project with a view of reducing Scope 1 emission by an average of 1 % a year over 20 years.

Principle	Discussion
Principle of sustainable use	
Natural resources should be used in a manner that is sustainable, prudent, rational, wise and appropriate	For the Supplement, the Project has proposed to reduce demand for water by 65%. Recycling of water is proposed for the Project to increase the sustainability. Vanadium pentoxide is one of the products of the Darwin Processing Facility. Vanadium is a metal used as an alloying agent, catalyst and ingredient in the manufacture of vanadium redox batteries. Vanadium redox batteries can switch between charge and discharge instantaneously and can cycle often and deeply, differentiating them from solid state, lithium-based batteries. It can also be left completely discharged for long periods of time with no ill effects. The vanadium in the batteries can also be recycled. This has significant advantages in the move towards a higher renewable energy targets (IISD 2019), reducing the impact of climate change on MNES on a global scale. The Project, with a design production output of 6,000 tpa of Vanadium pentoxide, will provide a valuable addition to global output of this important commodity. Use of natural resources for this purpose is consistent with NT, Commonwealth and global aspirations for sustainability.
Principle of conservation of biological diversity and ecological integrity	
Biological diversity and ecological integrity should be conserved and maintained.	Biological diversity is comprised of genetic diversity (within taxa), species diversity and ecosystem diversity. The planning and design of the project has been informed by in-depth multi season biodiversity studies. The Project has been planned to maintain biological diversity at the site by minimising land clearing where practicable and maintaining habitat connectivity with surrounding vegetation. In addition, impacts to the highly diverse and sensitive mangrove habitat will be avoided during construction and operations. The specific measures used to maintain biological diversity and ecological integrity are outlined in relevant chapters of the EIS. There are no significant impacts to communities, flora and fauna as a result of the Project.
Principle of improved valuation, pricing and incentive mechanisms	
(1) Environmental factors should be included in the valuation of assets and services.	The cost of products sold by TNG will incorporate the costs associated with delivering the product in a way that meets the NT Government and Commonwealth Government high environmental standards. The alternative to producing these Products under NT and Australian standards is to purchase them from overseas. Products purchased from overseas have a lower certainty over the environmental sustainability of processes used and whether environmental factors have been included in the valuation of assets and services.
(2) Persons who generate pollution and waste should bear the cost of containment, avoidance and abatement.	TNG proposes to bear the cost of containment, avoidance and abatement of pollution and waste from the Project. In addition, TNG propose to bear the cost of the inspection, containment and disposal of pre-existing waste materials at Lot 1817 from the former extractive

Principle	Discussion
	industries and illegal rubbish dumping that has occurred at the site over many years. The Project is likely to have an impact to the Atmospheric Processes Factor as discussed in Section 1.1. TNG have made preparations to bear the cost of abatement for this factor.
(3) Users of goods and services should pay prices based on the full life cycle costs of providing the goods and services, including costs relating to the use of natural resources and the ultimate disposal of wastes.	The cost of products sold by TNG will incorporate the costs relating to the disposal of wastes and the costs associated with the abatement of impacts to atmospheric processes.
(4) Established environmental goals should be pursued in the most cost-effective way by establishing incentive structures, including market mechanisms, which enable persons best placed to maximise benefits or minimise costs to develop solutions and responses to environmental problems	The Valuation Principle that endeavours to reduce environmental cost externalities by applying a 'polluter pays' framework and establishing incentive structures, including market mechanisms, is largely the responsibility of the government, by implementing policies that develop pricing and incentive mechanisms. However, the content of the EIS and all subsequent environmental reporting, will inform governments and contribute to the development of such policies.

TNG LIMITED

SUPPLEMENT TO THE
ENVIRONMENTAL IMPACT STATEMENT
DARWIN PROCESSING FACILITY

**SUMMARY OF
SUBMISSIONS
RECEIVED**

6. SUMMARY OF SUBMISSIONS RECEIVED

A total of four submissions were received in response to the Draft EIS. The submissions received were from the NT Government and three non-government organisations. The complete, un-edited submissions are provided in **Appendix A**.

Each submission contains multiple comments relating to various topics. A total of 11 main topics were raised across the submissions. **Table 6-1** provides details of each submitter and the topics raised in each submission.

The topic raised most frequently was marine environmental quality, particularly in regards to impacts associated with the discharge of waste water streams into the Darwin Harbour. Other topics raised in multiple submissions included the level of certainty in water balance requirements for processing, the lack of alternatives investigated (both topics fall under proposal description) and the lack of non-government stakeholder consultation.

Submissions from the NT Government are addressed separately to the remaining submissions in this section. **Section 0** addresses the submission from the NT Government and **Section 6.2** addresses the remaining submissions from non-government organisations.

Table 6-1. Summary of topics raised in each submission.

Stakeholder	Proposal Description	Environmental Management Plan	Approvals and Regulatory Framework	Consultation	Terrestrial Flora and Fauna	Inland Water Quality	Marine Environmental Quality	Benthic Habitat and Communities	Marine Flora and Fauna	Air Quality and Greenhouse Gases	Social, Cultural and Economic Surroundings
NT Government	X	X	X	X	X	X	X	X	X	X	X
Environment Centre NT	X		X	X	X	X	X				
Amateur Fishermen's Association NT	X			X			X				
Paspaley Pearling Company	X		X	X			X				X
Total	4	1	3	4	2	2	4	1	1	1	2

6.1 NORTHERN TERRITORY GOVERNMENT

The Northern Territory Government comments on the Draft Environmental Impact Statement for the Darwin Processing Facility are provided in **Table 6-2**.

Table 6-2. Northern Territory Government comments on the Draft Environmental Impact Statement for the Darwin Processing Facility

ID # 1	Topic: Proposal Description - Management of Stockpiles	EIS section:	Section 2.3.2
Comment	Information requested by NT EPA		
The Draft EIS does not provide details on the stockpiles of concentrate and solid waste streams. There is potential for these to cause impacts on terrestrial environmental quality or inland water environmental quality (which could have flow-on impacts to marine environmental quality).	Provide information on the management of stockpiles of magnetite concentrate, neutralised digest residue and dry magnetic separation non-magnetics, including: • volume to be stored on site at any time, the surface area required to store this volume, and the location of the stockpiles; and • material characterisation relating to the potential for contaminated runoff or leachate (solubility, reactivity, etc.).		

TNG Response

Three materials will be stockpiled at the site; magnetite concentrate, iron oxide and petcoke. Stockpiles are described in **Section 2.3.2** including dimensions and specifications of storage areas. **Figure 2-16** displays the locations of stockpiled materials. Material characterisation details are provided through attached SDSs.

Neutralised digest residue and dry magnetic separation non-magnetics are not included in the Stockpiles Section. These products were listed in the Draft EIS as waste products from the Processing circuit. Further waste identification and characterisation has occurred for the Supplement and these waste products are no longer specifically identified as they have been differentiated into lower order individual products.

All waste materials will be immediately transferred to containers, requiring no stockpiling. Containers will be sealed for storage prior to removal from site. Operational phase waste streams are described in **Section 2.5**, including details on the volume, handling and storage. **Section 2.5** also summarises the material characterisation relating to the potential for contaminated runoff or leachate (solubility, reactivity, etc.). This is described in more detail in the Waste Characterisation Report in **Appendix F**.

ID # 2	Topic: Proposal Description - Ponds	EIS section:	Section 2.3.3
Comment	Information requested by NT EPA		
The Draft EIS includes ponds on some maps but does not provide details about these ponds. There is potential for infiltration or runoff from these ponds to cause impacts on inland water environmental quality and potential for impacts on wildlife that may be attracted to the ponds.	Provide a map, design and description of each pond proposed on the site, including: • composition of material to be stored • the type and infiltration parameters of any proposed lining • intended freeboard for high rainfall events, and the ARI rainfall event that would be retained (e.g. 100-year).		

TNG Response

Ponds for Processing are described in **Section 2.3.3**. These are the Raw Water Pond and the Rainwater Pond. They have not yet been subject to detailed design, however, design parameters relating to liner and freeboard have been nominated as a HDPE liner and freeboard sufficient to accommodate a 1:100 ARI event. The water quality is not expected to pose any environmental risk as it is sourced from rainwater, the Darwin Water Supply, WRP and Bioretention basins. Water quality parameters for water exiting the WRP and Bioretention basins are listed in Sections **2.3.9.1** and **2.3.9.2** respectively.

Other open water structures required for the Project are the Sediment Basins in the Construction phase and the Bioretention Basins in the Operations phase. These are described in detail in **Sections 2.2.3** and **2.3.7.5** respectively. These structures will contain stormwater from non-process areas within the development envelope and will be lined with geo-synthetic impermeable clay liners. The capacity has been designed in accordance with the relevant guidance.

ID # 3	Topic: Proposal Description - Waste Stream Constituents	EIS section:	Section
Comment	Information requested by NT EPA		
The Draft EIS outlines the waste streams but does not give sufficient detail to give confidence in the following: - that all potential waste discharges and emissions have been identified, and the likely parameters of these wastes (including contents) - the ability of real-time monitoring to detect conditions that may affect waste parameters so that operational controls can be implemented to ensure compliance with relevant criteria.	Provide (a) detailed site layout diagram/s and (b) detailed process block/flow diagram/s showing: - location of all emissions and discharges of contaminants to air, water or land, including potential fugitive emissions, with a unique identifier for each emission/discharge source (to be carried through all environmental assessment documentation) - a description of all equipment to be used to emit/discharge waste - location of all proposed internal and external monitoring of the quality and quantity of process and waste streams - detailed description of the source, quantity and composition of all emissions and discharges of contaminants to air, water or to land from the whole Proposal, including for the construction phase, standard operations, shutdowns, and any other variation to standard operations (normal operating conditions and likely worst case upset conditions). Quantities of contaminants of concern in emissions and discharges are to be based on the composition of all inputs (including, but not limited to, ore, coke and reagents).		

TNG Response

A process block/flow diagram is presented as **Figure 2-11**. Discharges and emissions are described in **Section 2.6**. A detailed site layout diagram is presented as **Figure 2-37** with all locations of emissions and discharges, including potential fugitive emissions, identified with a unique identifier. The unique identifier codes for discharges used in **Figure 2-37** are corresponding to the descriptions of the discharge sources in the Stormwater Management Plan (**Appendix C**). The unique identifier codes for emissions used in **Figure 2-37** are corresponding to the descriptions of the emission sources in **Table 2-25, Table 2-26, Table 2-27**. These are consistent with the Air Quality technical report included in **Appendix G**.

Equipment that discharges emissions to land are listed in **Section 2.6.1**, with monitoring detailed in **Table 3-11** in **Section 3.1.6** and discharge quality to land described in **Section 2.3.7.4**. Equipment that discharges emissions to the atmosphere are listed in **Section 2.6.2**. Monitoring of air emissions is detailed in **Table 3-38**, **Section 3.3.6**, with contaminants in emissions to air listed in **Table 2-25**, **Table 2-26**, **Table 2-27**.

ID # 4	Topic: Proposal Description - Power Generation and Greenhouse Gas Emissions	EIS section:	Section 2.7 and Section 4.3.2.6
Comment	Information requested by NT EPA		
The Draft EIS considered solar superior for renewable energy generation given its efficiency and low cost over the project life. However, the Draft EIS states solar will only be considered for implementation once the Project is established. The NT EPA may consider that the Proposal’s predicted 6.2 % increase in the NT’s GHG emissions (over predicted 2019 levels) is a significant impact.	Provide information on the extent of land required for a potential solar electricity generation source for the Proposal. Identify where this may be located on site or off site. Discuss potential options for offsets for GHG emissions from the Proposal.		
TNG Response			

Alternative energy sources are described in **Section 2.7** and **Section 4.3.2.6**. Solar electricity generation at a scale required for the site would require up to 600 ha of panels, plus additional area for support infrastructure. There is insufficient space at the Site to accommodate this and any solar electricity generation on that scale would need to be accommodated off-site. Potential options for offsets of GHG emissions for the Project are discussed in the technical paper produced for the EIS Supplement - *Discussion Paper – Greenhouse Gas Emissions: Management Plan and Offsets* (**Appendix I**) and **Section 3.4.5**.

ID # 5	Topic: Proposal Description - Alternatives for Wastewater/ Reduction of Water Requirements	EIS section:	Section 2.7.2
Comment	Information requested by NT EPA		
The Proposal includes the use of a high volume of water, equivalent to approximately 25 % of Darwin's current total annual water consumption. The proposed volume of wastewater discharge (12 GL) would be the single largest contributor to point source inputs to Darwin Harbour, equivalent to about 70 % of the volume of all current inputs.	Demonstrate application of the waste management hierarchy of avoidance, re-use and reduction to the use of water and the proposed controlled discharge of wastewater to Darwin Harbour by investigating, reporting on and considering alternatives to the use of water and the proposed discharge presented in the Draft EIS. Describe and justify why the adopted option has been chosen.		
The Draft EIS did not address the ToR item (in Section 4.3.2) requesting the assessment of the risk of unsustainable use and/or wastage of water resources.	Examples of potential options include increased re-use of water, off-site use of wastewater by a third party, or off-site discharge of wastewater or sludge from evaporative treatment (potentially using the return-rail movement to Mount Peake).		
The Draft EIS has not proposed alternatives that would reduce water requirements and wastewater discharges to the Darwin Harbour.			

TNG Response

Alternative water sources are proposed in the Supplement that are consistent with the waste management hierarchy and are presented in summary in **Section 2.7.2 Table 2-29**.

The adopted alternatives reduce the demand from the Darwin water supply from 11 GL/a to 3.85 GL/a, with the potential for further reduction through the harvest of stormwater. The Supplement also proposes to avoid the discharge of wastewater to Darwin Harbour. Through the adoption of a WRP process wastewater, contaminated stormwater and sewage and greywater will be recycled back into the process.

Through the detail design phase of the Project, it is expected that further alternatives may become available. Alternatives will be preferentially adopted where the outcome complies with the hierarchy of approaches in accordance with Part 2 Section 27 of the EP Act.

ID # 6	Topic: Proposal Description - Water Balance	EIS section:	Section 2.3.9.2
Comment	Information requested by NT EPA		
The water balance provided in the Draft EIS (Figure 4-6) was too general to demonstrate that process wastewater can be successfully managed within the site to prevent the discharge of any contaminated water (including contaminated stormwater) from the site.	Provide a more detailed water balance that illustrates the volume of all water entering and leaving the site, including the volume to be used for at least all of the following components: • processing components • dust suppression • water treatment plant • staff use Include the source of water entering the site (including in magnetite concentrate, reagents, rainfall) and the fate of water leaving the site (in products, vapour [off-gas], infiltration, surface runoff or controlled discharge offsite).		

TNG Response

A detailed water balance has been prepared for the Supplement however, it is commercial in confidence and will be provided separately, in due course. **Section 2.3.9.2, Table 2-18** does, however, provides a summary of the water balance.

ID # 7	Topic: Proposal Description - Volume of wastewater for controlled discharge	EIS section:	Section 2.3.5
Comment	Information requested by NT EPA		
References in the Draft EIS to the volume of wastewater for discharge varied such that it was unclear how much water is proposed to be discharged. The hydrodynamic modelling used 34.6 ML/d with a discharge velocity of 8 m/s. Elsewhere in the Draft EIS, discharge volume is stated to be 12 GL per year (average 26 ML wastewater per day; peak discharge of 32 ML/d).	State the expected volume of wastewater to be discharged annually into Darwin Harbour from the wastewater treatment plant. Provide the expected annual and daily volume of the discharge (average and maximum). Explain what conditions would require daily discharges higher or lower than average, including tidal timing. Ensure that technical reports refer to the same volume, or if not, provide an explanation for the difference and the technical implications of the difference (e.g. how would modelled predictions differ?).		

TNG Response

Alternative waste management methods have been developed for the Project as described in the Supplement, such that there is no wastewater to be discharged from a WWTP into the Darwin Harbour. For the Supplement, a WRP has been proposed that negates the wastewater discharge described in the Draft EIS. The WRP is described in **Section 2.3.4.2**. The design basis (**Section 2.3.4.2**) stipulates Zero liquid discharge. Liquid is instead recycled for use in the Processing circuit.

ID # 8	Topic: Proposal Description - Wastewater Treatment Plant	EIS section:	Section 2.3.5
Comment	Information requested by NT EPA		
The Draft EIS does not identify the proposed wastewater treatment methodology. It is unclear from the information provided in the Draft EIS whether the proposed wastewater treatment plant is capable of achieving the proposed wastewater quality criteria. This lack of detail has the potential to invalidate portions of the management and monitoring program, as it has been developed without a full understanding of the technology to be employed.	Provide information on: - the water treatment methodology / technology and evidence that it is able to achieve the discharge water quality criteria for the intended volume of wastewater - how the treated wastewater will be discharged in real time to coincide with the outgoing tide - how/where treated wastewater will be stored on site in between discharge times - how often and under what circumstances the water treatment plant may need to shut down due to not having enough storage capacity for treated wastewater (or any other reason), and in such cases, where/how untreated wastewater would be stored - the waste product/s from the wastewater treatment plant, including state (liquid, solid), nature (physical and chemical parameters) volume, handling, storage and disposal.		

TNG Response

The WWTP, as described in the Draft EIS and applicable to the comments and requested information in ID #8, is no longer a feature of the proposal. The changes to the Project described in **Section 1** of the Supplement no longer require the discharge of wastewater via the ocean outfall pipeline. Wastewater will instead be recycled through a WRP.

The WRP is summarised in **Section 2.3.4**. The WRP has been designed with sufficient redundancy for routine maintenance and emergency maintenance work while remaining operational at high or full capacity. Details on the quality of recycled water products are described in **Section 2.3.9.1**. Details on the solid products from the WRP are described in **Section 2.4** and **2.5**, including the state, nature, volume, handling, storage and disposal.

ID # 9	Topic: Proposal Description - Wastewater discharge pipeline	EIS section:	Section: 2.1
Comment	Information requested by NT EPA		
The Draft EIS provides only an indicative location of the pipeline. This does not enable adequate assessment of potential impacts on the seafloor and other users of Darwin Harbour.	Provide an updated map of the discharge pipeline encompassing the whole pipeline route from the Proposal site to the outfall location in Darwin Harbour. Include the location of other existing or proposed infrastructure in the vicinity of the pipeline (e.g. other pipelines or dredged areas). Describe the methods that will be used to construct the pipeline. Include a consideration of how the laying and maintenance of the pipeline will impact other users, including seafloor dredging conducted to navigable access for INPEX and Darwin Port, and how it will be protected from damage by other Harbour users.		

TNG Response

The pipeline described in the Draft EIS has been removed from the proposal. **Figure 2-1** shows the Project Layout and Development Envelope for the EIS Supplement. The indicative location of the pipeline as presented in the Draft EIS has been removed.

ID # 10	Topic: Proposal Description - Domestic wastewater	EIS section:	Section 2.3.8

Comment	Information requested by NT EPA
The Draft EIS (section 4.6.16.3) mentions a sewage treatment plant onsite, and usage of greywater from this plant to irrigate the surrounding landscape, but details are insufficient to enable assessment of potential impacts from this.	Consider and discuss the proposed management of domestic wastewater in accordance with codes and guidelines for wastewater management published by the Department of Health. Provide details on the management of domestic wastewater (sewage and greywater) during both construction and operations phases, including: - location of the sewage treatment plant - details on the type of treatment to be used, the capacity of the plant where 'greywater' irrigation would occur.

TNG Response

Further detail on the Sewerage Treatment Plant for the Operations phase is provided in **Section 2.3.8** of the Supplement, including the type of treatment to be used and the capacity of the plant. Use of grey water for irrigation is no longer a feature of the proposal. As indicated in **Section 2.3.8** and **2.3.4.3** liquid from the Sewerage Treatment Plant will be recycled through the WRP.

Figure 2-32 identifies the location of the Sewerage Treatment Plant.

ID # 11	Topic: Environmental Management Plan - Definitions	EIS section:	Appendix Q

Comment	Information requested by NT EPA
The meaning of minor environmental impact and hazard is unclear.	Define 'minor environmental impact' and 'some minor actual or potential hazard to the environment'.

TNG Response

The definitions of risk ratings are described and discussed in **Appendix Q** of the Supplement. The wording in the EMP (**Appendix M**) has been adjusted to be in line with the definitions as detailed in **Appendix Q**.

An impact can be considered "minor" if it has two or more of the following characteristics:

- Limited - Impact limited to the Site
- Very Low - Impact does not significantly alter the quality, distribution or abundance of environmental values
- Short term - Impact that is experienced to completion of construction

ID # 12	Topic: Environmental Management Plan – Land Clearing	EIS section:	2.2.1, Table 2-5
Comment	Information requested by NT EPA		

It is unclear how much vegetation will be cleared in the disturbance area of 264 ha.

Clarify the type, quality and extent of native vegetation to be cleared.

TNG Response

The Draft EIS proposed a Development Envelope of 264 ha. For the Supplement, the Development Envelope has been slightly increased to 270.5 ha, which includes clearing of 75.2 ha of existing disturbed land, 88 ha of degraded vegetation and 107.3 ha of good to excellent quality vegetation. **Figure 2-7** shows the Development Envelope in relation to the types of vegetation that are present. All of the vegetation within the Development Envelope will be cleared. **Table 2-5** in **Section 2.2.4** lists the type, condition and extent of vegetation that will be cleared.

This information has also been updated in the EMP (Section 5-1, Table 5-1).

ID # 13	Topic: Approvals and Regulatory Framework – Environmental Approval	EIS section:	Section 1.2 Section 3, 3.4.5, 3.5.5 Section 1
Comment	Information requested by NT EPA		

It is anticipated that the new 2019 **EP Act** will commence in mid - 2020. If assessment of the Proposal is completed after commencement of the EP Act, once the assessment process (under the *Environmental Assessment Act 1983*) is completed, an environmental approval for the Proposal will be required in accordance with sections 301 and Part 5 of the EP Act.

The purpose of the environmental approval is to manage the potentially significant environmental impacts of the Proposal. The decision on whether to grant environmental approval is made by the Minister, based on advice from the NT EPA including a draft environmental approval or draft statements of unacceptable impact.

The Minister is required to take certain matters into account when making the decision. To inform the Minister in making a decision on an environmental approval for the Proposal the EIS should demonstrate how the matters at section 73 of the EP Act have been taken into account.

Provide information relating to the Minister's decision on an environmental approval. Matters that are additional to those addressed elsewhere in the EIS, and that require attention in the Supplement, include:

- principles of ecologically sustainable development and management hierarchies, as outlined in Part 2 of the EP Act
- the objects of the EP Act (section 3), including object 3(e) to recognise the role that Aboriginal people have as stewards of their country as conferred under their traditions and recognised in law, and the importance of participation by Aboriginal people and communities in environmental decision-making processes. It is considered that other objects of the EP Act (**Section 1**) are or will be addressed elsewhere in the EIS
- that any proposed environmental offsets that form part of this Proposal and/or the EIS can be provided in accordance with the EP Act
- a signed declaration that the Proponent is a fit and proper person to hold an

environmental approval in accordance with section 62 of the EP Act.

TNG Response

Section 1.2 of the Supplement describes the transition of the Project to the EP Act.

Section 1 of the Supplement has been developed in recognition of the EP Act. The Mitigation and Management sections within each of the Factors apply the management hierarchies, as outlined in Part 2 of the EP Act.

Section 1 of the Supplement discusses how the Principles of Ecologically Sustainable Development have been applied.

Section 3.5.5 presents the Stakeholder engagement process undertaken for the Project. The Aboriginal people and communities are considered stakeholders in the Project approvals process.

Participation in the Project approvals process by Aboriginal people and communities is described in Section 3.5.5.

Section 3.4.5 indicates that an environmental offset may be required for the risk to Atmospheric Processes. A discussion paper has been prepared that identifies some of the options available for an offset to this impact that would be satisfactory under the EP Act and Commonwealth legislation. The Discussion Paper is included in full in **Appendix I** and summarised in **Section 3.4.5**. TNG will continue to liaise with the NT EPA to determine an acceptable environmental offsets package.

The Proponent will provide a signed declaration that the Proponent is a fit and proper person to hold an environmental approval in accordance with section 62 of the EP Act.

ID # 14	Topic: Consultation – Community and Stakeholder Consultation	EIS section:	Section 3.5.3.3 Appendix O
Comment	Information requested by NT EPA		
Community engagement and consultation undertaken for the Draft EIS does not appear to have addressed the full range of potential environmental impacts and risks associated with the Proposal, particularly in relation to water usage (see Social, Economic and Cultural Surroundings below) and wastewater discharge to Darwin Harbour (see Marine Environmental Quality below). Also, while many stakeholders were identified, not all of these were actively engaged in consultation in relation to the Draft EIS.	Provide details of further community engagement and consultation on the Proposal in accordance with the NT EPA's Guidance for Proponents – Stakeholder Engagement (NT EPA 2019). Specifically, demonstrate that information has been provided to stakeholders on the Proponent's response to items 5, 7, 26-32, 34-35, 50-52 of this document, and provide details (in accordance with section 2.4 of the NT EPA's General Guidance for Proponents Preparing an Environmental Impact Statement (NT EPA 2019)) of the engagement and consultation undertaken on this.		
	Provide a Community and Stakeholder Engagement Plan (as proposed in Section 6.5 of the Draft EIS) that includes transparent reporting of monitoring results to all stakeholders.		

TNG Response

Community engagement and consultation conducted since the Draft EIS is summarised in Section 3.5.3.3 **Table 3-45**, which includes liaison with parties providing submissions on the Draft EIS.

A Community and Stakeholder Engagement Plan has been prepared and is included as **Appendix O**. TNG will continue to liaise with stakeholders throughout the life of the Project.

ID # 15	Topic: Terrestrial Flora and Fauna - Shorebirds	EIS section:	Section 2.3.3
Comment	Information requested by NT EPA		

There is a potential risk that new exposed areas of freshwater are attractive to shorebirds particularly during the dry season when they move into the Darwin area.

Should the settling ponds contain compounds toxic to waterbirds there would be potential for impacts on waterbirds.

Relevant reference:

Lilleyman A. and Garnett S. (2019). Shorebird values and knowledge gaps in Darwin Harbour. *Unpublished report of Department of Environment and Natural Resources*, RIEL Charles Darwin University

If ponds may contain materials that could be toxic to waterbirds, provide an assessment of the potential impacts and risks to waterbirds that may be attracted to the ponds especially during the dry season. As appropriate, describe any mitigation measures to address potential impacts.

TNG Response

Ponds are described in **Section 2.3.3**. There are two kinds of ponds described, a Raw Water Pond and a Rainwater Pond. Ponds will have water of a quality that is not toxic to waterbirds. Pond design is yet to be finalised; however, will incorporate measures to reduce suitability and attractiveness to shorebirds such as steep slope embankments.

ID # 16	Topic: Terrestrial Flora and Fauna – Matters of National Environmental Significance (MNES)	EIS section:	Section 3.2.3.2 Appendix J
Comment	Information requested by NT EPA		

Further information is required to adequately meet assessment requirements for MNES in accordance with the EPBC Act, as specified in section 3.1 of the ToR.

For the MNES species listed below, clearly provide the following:

- an assessment of the presence or likely presence of the species in the Proposal area and in any areas that may be impacted
- the size and distribution of the local population, including at different life cycle stages, for example, when breeding, foraging, resting and/or migrating
- The importance of the local population in a local, regional, NT, national and international context.

- The identification of suitable habitat for the species (for breeding, foraging, aggregation or roosting), and the quality of this habitat, and how this may be disturbed or altered by the Proposal
- The relevant terrestrial MNES species are the curlew sandpiper, eastern curlew, greater sand plover, red knot, lesser sand plover, black-footed tree-rat, and northern quoll.

TNG Response

A Significant Fauna Impact Assessment has been prepared for the Supplement and is included as **Appendix J**. The requested information is provided in detail in the Significant Fauna Impact Assessment and summarised in **Section 3.2.3.2**.

ID # 17	Topic: Terrestrial Flora and Fauna – Environmental Assessment Guidelines	EIS section:	Section 3.2.6 Section 4.3.1
Comment	Information requested by NT EPA		
Policy and guidance material referred to in the EIS did not include some documents which were requested to be included in the EIS for assessing the Proposal under the EPBC Act:	Discuss how the following DAWE policy and guidance documents have been considered (including those already identified within the Draft EIS). That is, provide a brief discussion on the objectives of the documents and whether the Proposal is consistent with them. For example, the <i>Recovery Plan for marine turtles in Australia</i> states a Recovery Objective of: “<i>The long-term recovery objectives for marine turtles is to minimise anthropogenic threats to allow for the conservation status of marine turtles to improve so that they can be removed from the EPBC Act threatened species list</i>”. Provide a discussion on how the Proposal is consistent with this objective or alternatively, how the proposed avoidance, mitigation / management and offsetting will compensate for any residual significant impact, thereby ensuring consistency with the objective for relevant MNES.		

TNG Response

The policy and guidance for terrestrial fauna has been discussed in **Section 3.2.6** and **Table 3-29**.
The policy and guidance for marine fauna has been discussed in **Section 4.3.1**.

ID # 18		Topic: Terrestrial Flora and Fauna - Mitigation of impacts to listed migratory species	EIS section:	Section 3.2.3.1 Appendix J

Comment	Information requested by NT EPA
The Draft EIS does not appear to identify and discuss nationally significant aggregations of water birds sufficiently.	Identify and discuss nationally significant aggregations of waterbirds. Refer to relevant DAWE policy and guidance documents with respect to listed migratory species, and discuss the correlation between the Proposal and important habitat. Refer to the assessment of risk outlined in Section 4.2.1.3 of the ToR on a species case-by-case basis.

TNG Response

A Significant Fauna Impact Assessment has been prepared for the EIS Supplement and is included as **Appendix J**. Nationally Significant Aggregations of waterbirds are discussed in relation to the Project in detail in the Significant Fauna Impact Assessment and summarised in **Section 3.2.3.1**. The risk to each of the listed migratory species is assessed in the Significant Fauna Impact Assessment, including a Significant Impact Assessment using the DAWE Significant Impact Guidelines (DoE, 2013). The Assessments determined there is no significant impact from the Project on migratory shorebirds.

ID # 19		Topic: Terrestrial Flora and Fauna – Mitigation and Monitoring Programs	EIS section:	Section 3.2.4 Section 3.2.6 Section 3.2.7 Appendix J Appendix R

Comment	Information requested by NT EPA
The Draft EIS does not provide sufficient information to meet the requirements of section 4.2.3 of the ToR.	Provide further discussion regarding the mitigation and monitoring programs for terrestrial species, including but not limited to: • Eastern curlew (<i>Numenius madagascariensis</i>) • Curlew sandpiper (<i>Calidris ferruginea</i>) • Great knot (<i>Calidris tenuirostris</i>) • Northern quoll (<i>Dasyurus hallucatus</i>) • Red knot (<i>Calidris canutus</i>) • Lesser sand plover (<i>Charadrius mongolus</i>) • Black-footed tree-rat (<i>Mesembriomys gouldii gouldii</i>) • Greater sand plover (<i>Charadrius leschenaultii</i>). For example, address potential impacts to these species at or near the site as a result of impacts of the Proposal, for example, noise and light.

TNG Response

A Significant Fauna Impact Assessment has been prepared for the EIS Supplement and is included as **Appendix J**. A detailed description of the Project impacts to habitats, habitat features and species is provided. This is summarised in **Section 3.2.4**.

Mitigation and management of impacts are listed in the Draft EIS Section 7.4.5 Table 7-22 with supplementary mitigation proposed in the Supplement, **Section 3.2.6, Table 3-28**. These measures are consolidated in the Commitments Register (Section 7 – **Appendix R**) and the Significant Fauna Impact Assessment.

Monitoring programs are listed in the Draft EIS Section 7.4.6 Table 7-23 with supplementary monitoring proposed in the Supplement, **Section 3.2.7, Table 3-30**.

ID # 20	Terrestrial Flora and Fauna – Proposal Alternatives	EIS section:	Section 4.3
Comment	Information requested by NT EPA		
The ToR (section 2.5) requested discussion of proposal alternatives on MNES but this was not provided in the Draft EIS.	Provide a comparative description of the impacts of Proposal alternatives on MNES as requested in Section 2.5 of the TOR.		

TNG Response

A comparative description of the impacts of Proposal alternatives on MNES is provided in **Section 4.3**

ID # 21	Topic: Inland Water Environmental Quality – Stormwater Management Plan	EIS section:	Appendix J Section 2.2.3 Section 2.3.7 Section 2.6.1 Section 2.3.7.4
Comment	Information requested by NT EPA		
The Draft EIS does not provide sufficient detail on the management of stormwater to demonstrate that potential impacts to inland water environmental quality will be effectively mitigated.	Provide a stormwater management plan (include the infrastructure design parameters) for the site to demonstrate that the volume of contaminated stormwater will be minimised, and uncontaminated stormwater will be diverted away from areas where it could become contaminated. Provide details on the storage and treatment of contaminated stormwater, and where the treated water would be released.		

TNG Response

A Stormwater Management Plan has been prepared for the Supplement, included in full as **Appendix J**. The Plan includes measures for the Construction and Operations phases. The Construction phase is summarised in **Section 2.2.3**. The Operations phase is summarised in **Section 2.3.7**.

The Plan includes infrastructure design parameters, the storage and treatment of Stormwater for each phase.

The volume of contaminated stormwater will be minimised, and all contaminated stormwater will be diverted to the WRP for recycling. Uncontaminated stormwater will be diverted away from operational areas where contamination could occur.

The discharge locations of stormwater in both the Construction and Operations phases are shown in **Figure 2-37 Section 2.6.1**

The Stormwater quality targets in the Operations phase are discussed in **Section 2.3.7.4**.

ID # 22	Topic: Inland Water Environmental Quality – Dust Management	EIS section:	Section 2.3.2, 2.3.3, 2.3.4
Comment	Information requested by NT EPA		
The Draft EIS does not address the potential contamination of surface water or groundwater from water applied to stockpiles or other working areas for dust suppression.	Demonstrate that water used for dust management will not transport contaminants to groundwater or to surface flows leaving the site.		

TNG Response

The Supplement proposes to use water as a dust suppressant in the stockpile areas and at takeover points on the Iron Oxide conveyor (**Section 2.3.2**). Any runoff water from the dust suppression systems will be collected in sumps and directed to the PWTP, which then discharges to the Water Recycling Plant (**Section 2.3.4**). Concrete hardstands will be used as a barrier to seepage and contaminated water is effectively directed to the sumps.

A number of design features have been proposed to divert stormwater from potentially contaminated areas; contaminated water is prohibited from entering surface water flows. As described in **Section 2.3.2**, all stockpiles will be protected from rainfall by being placed in designated storage and handling areas that are covered, three sided structures, with the internal drainage systems separated from the Stormwater system. Rain falling on roofed surfaces will be intercepted and directed to the rainwater pond as described in **Section 2.3.3**, avoiding contact with potentially contaminated areas.

ID # 23	Topic: Inland Water Environmental Quality - Potential contamination of groundwater	EIS section:	Section 3.1.3.2 Section 2.3.3
Comment	Information requested by NT EPA		
The Draft EIS does not address the potential for pond storages to contaminate groundwater.	Demonstrate that ponds will be constructed above the groundwater table to avoid any interaction between groundwater and the base of pond liners and pond contents and thereby prevent contamination of groundwater. This will require additional baseline groundwater level monitoring		

to ascertain the seasonal maximum groundwater level at the sites where ponds will be located. The groundwater levels that were measured in May and September 2019 do not reflect groundwater condition at the site that will occur during periods of extended wet weather. Provide a statement from a registered professional engineer stating that design and construction of all relevant containment structures is feasible within constraints of the site and specify the manner of construction that will be required to ensure that:

- a) groundwater is protected from impacts of the contents of storages of materials and wastes on site
- b) the liners for structures that contain waste / waste water must be designed and constructed to achieve permeability of not greater than 1×10^{-9} m/s
- c) the cell liners are resistant to chemical and physical erosion
- d) the cell liners are able to withstand the weight of waste and any equipment used in the ponds (e.g. to remove sludge).

TNG Response

For the Supplement, an additional technical study on groundwater at Lot 1817 was commissioned (**Appendix K**). As submissions on the Draft EIS were received after the wet season, additional groundwater monitoring data for the 2020/2021 wet season is not yet available. Loggers were, however, installed in August 2020 and will be retained until after the wet season to capture the additional information required on wet season groundwater levels. Loggers currently in place for groundwater monitoring are described in **Section 3.1.3.2**

Process Ponds are described in **Section 2.3.3**, including the source of water that will be stored in the ponds. The quality of water in Process Ponds is not expected to pose any risk to the environment. Despite the high quality of water, ponds will be lined with HDEP liners and be placed above the water table. The ponds will have sufficient freeboard to accommodate a 100 Year ARI major storm event and locations have been allocated such that if the extreme Year 2100 – 1 in 1,000 year AEP) storm tide event occurred, inundation would not occur. Process Ponds have not yet been designed in detail. Detailed design and the signed statement from an engineer will be progressed during the final Project design phase and will be informed by the wet season groundwater levels established from the installed loggers.

ID # 24	Topic: Inland Water Environmental Quality – Sewage treatment and irrigation	EIS section:	Section 2.3.8 Section 2.3.4
Comment	Information requested by NT EPA		
The Draft EIS did not assess the potential impacts and risks to inland water environmental quality from the proposed onsite sewage treatment and irrigation.	Clarify the intended treatment of sewage effluent and greywater generated on site, and the intended discharge or use of this wastewater. Assess the potential impacts and risks to inland water environmental quality (surface water and groundwater) from any irrigation using treated effluent		

from sewage treatment onsite. Outline the measures that will be implemented to avoid or mitigate potential impacts, and how these matters would be monitored and reported.

TNG Response

Further detail on the Sewerage Treatment Plant for the Operations phase is provided in **Section 2.3.8** of the Supplement. Use of grey water for irrigation is no longer a feature of the proposal. As detailed in **Section 2.3.8** and **Section 2.3.4**, liquid from the Sewerage Treatment Plant will be recycled through the WRP. The recycled water will be used in the Processing circuit.

ID # 25	Topic: Inland Water Environmental Quality – Water Quality	EIS section:	3.1
Comment	Information requested by NT EPA		
The Draft EIS did not adequately demonstrate that any impacts to groundwater would not influence receiving waters in Darwin Harbour	Demonstrate that any impact to groundwater quality will not influence receiving waters in Darwin Harbour, upholding relevant Water Quality Objectives or Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2008).		

TNG Response

For the Supplement, an additional technical study on groundwater at Lot 1817 was commissioned (**Appendix K**), including a simple seepage model. A number of design, mitigation and management measures are proposed in **Section 3.1.5**, **Table 3-10** to prevent potential COIs arriving into surface waters and thus being available to seep into groundwater. A summary of the model outcomes are presented in **Section 4.1.2.5**.

However, the seepage model ran the hypothetical scenario where the measures above had failed to prevent contamination of surface water and these were present in areas where seepage was possible to occur into groundwater. The model found that the likelihood of contaminated groundwater reaching the receiving waters in Darwin Harbour in concentrations that would exceed guideline values were low.

ID # 26	Topic: Marine Environmental Quality – Conceptual Model	EIS section:	4.1.2
Comment	Information requested by NT EPA		
It is unclear from the Draft EIS if all sensitive receptors and ecosystem processes have been taken	Provide a conceptual site model of appropriate scale and complexity to illustrate potential		

into account in the identification of potential impacts from controlled and uncontrolled water discharges to Darwin Harbour.

The ToR requested a conceptual site model for discharges, wastes or contaminants, but this was not provided for discharges to Darwin Harbour.

environmental risks to sensitive receptors in the marine environment from controlled and uncontrolled discharges and other Proposal activities that may influence marine environmental quality (including via groundwater and/or surface water flows from the site).

TNG Response

Whilst discharge to Darwin Harbour is no longer a component of the Project, TNG recognise the proximity of Elizabeth River to the site; therefore, a Marine and Coastal Assessment was conducted for the Supplement, which incorporates a conceptual site model. The conceptual site model is presented within the technical report (**Appendix P**) and summarised in **Section 4.1.2**. Sensitive Environmental Receptors are identified, and specific sensitivities are discussed in relation to those expected from the Project. The Project is likely to have a low residual risk of impact on the identified Sensitive Environmental Receptors.

ID # 27	Topic: Marine Environmental Quality – Pollutant Outfall Model	EIS section:	N/A
Comment	Information requested by NT EPA		
The pollutant outfall modelling indicated an increase in background concentrations of contaminants in Darwin Harbour approaching equilibrium within six months. The six month modelling period does not cover seasonal or interannual variability in conditions in Darwin Harbour.	Provide updated pollutant outfall modelling based on the final Proposal specifications (i.e. taking into account any update to the discharge location and/or discharge regime, including rate) and based on a period suitable for understanding variability in Darwin Harbour within and between years (i.e. longer than six months).		

TNG Response

There will be no discharge of wastewater into the Darwin Harbour or the marine environment. TNG applied the mitigation hierarchy against the environmental objective of marine environmental quality, choosing to avoid any impact to the marine environment and no longer be discharging wastewater or pollutants into Darwin Harbour. Wastewater from the Project will instead be processed by the WRP and water will be treated and recycled into the processing circuit as described in **Section 2.3.4**.

The change of Project scope has resulted in this factor being removed as a key factor of the Project and no direct impacts will occur.

ID # 28	Topic: Marine Environmental Quality – Assess potential impacts to identified values in Darwin Harbour	EIS section:	N/A
Comment	Information requested by NT EPA		
Darwin Harbour is home to a multitude of environmental values that depend on high quality sea water (for example, it is an important nursery area for many fish species and is host to a significant recreational fishery). These could all be influenced by controlled or uncontrolled discharges from the	Provide an updated assessment of the potential impacts and risks to marine environmental quality and dependent environmental values in Darwin Harbour, based on a detailed whole- of-environment analysis of risks to Darwin Harbour, taking into account ecosystem processes/functions. This analysis		

Proposal site.

There is uncertainty around the impact of the outfall discharge to these values, beyond water and sediment quality, particularly for aquatic biota, ecosystem processes and biogeochemical processes. The long term impacts of a warm buoyant plume are unknown.

The draft EIS is general about the nature of pollutants expected to be released from the waste water discharge point in East Arm (e.g. page 56; Appendix P page 6; and Table 7-46 – it's unclear if this is a complete list of toxicants and chemicals that may be present in the wastewater discharge).

The Draft EIS does not appear to have fully assessed all of the potential impacts that could arise from this discharge, taking into account wastewater composition and parameters; biodegradation, and bioaccumulation of chemical constituents; environmental fate and transport; toxicity; and more.

must consider the following (at a minimum) for all proposed controlled and potential uncontrolled discharges from the Proposal:

- chemical composition (for controlled discharge, this is to be determined by analysis of the chemical component flows through the processing circuit and wastewater treatment plant)
 - chemical-physical properties (e.g. pH, electrical conductivity, ionic composition, Redox, temperature)
 - speciation of toxicant chemicals (as metal hydroxides can be as toxic as metal ions) after entry to Darwin Harbour where they may transform, precipitate or react in response to varying estuarine conditions (tidal, seasonal, etc.).
 - environmental fate and transport (e.g. biogeochemical transformations; incorporation of chemicals into biota or sediment; temperature effects on dissolved oxygen, redox potential, rates of remineralisation and microbiological processes)
 - consideration of contaminant loads entering the Harbour
 - ecotoxicity (including chronic and acute) and bioaccumulation
 - whole effluent toxicity (WET) as outlined in section 4.3.4 of Appendix Q, and comparison to default guideline values for at least 95% species protection (ANZG, 2018)
-
- biodegradation (under anaerobic and aerobic conditions – because the hot discharge will be low in oxygen and it is possible that anoxic conditions could be generated in bottom waters and sediment porewater in the vicinity of the outfall) and consideration of the risk of any metabolites
 - potential pathway to sensitive receptors and the receiving environment
 - potential scouring, erosion, suspension or deposition of sediments around the proposed discharge location on the sea floor, taking into account the discharge rate and existing hydrodynamics.

TNG Response

There will be no discharge of wastewater into the Darwin Harbour or the marine environment. TNG applied the mitigation hierarchy against the environmental objective of marine environmental quality, choosing to avoid any impact to the marine environment and no longer be discharging wastewater or pollutants into Darwin Harbour. Wastewater from the Project will instead be processed by the WRP and water will be treated and recycled into the processing circuit as described in **Section 2.3.4**.

The change of Project scope has resulted in this factor being removed as a key factor of the Project and no direct impacts will occur.

ID # 29	Topic: Marine Environmental Quality – Cumulative Impact Assessment	EIS section:	N/A
Comment	Information requested by NT EPA		
The Draft EIS (Appendix G part 2) does not adequately assess cumulative impacts and risks to Darwin Harbour as requested in the ToR. A number of other operators are active in the East Arm domain. The proposed discharge of wastewater to Darwin Harbour is larger than the cumulative discharge of all other current point sources (wastewater treatment and other industry).	Provide assessment of the potential impacts of the Proposal to marine environmental quality that may contribute to cumulative impacts in Darwin Harbour, taking into consideration other existing human activities in East Arm and upstream. Address the following: • consideration (and a map) of other sources of discharge and sediment-disturbing activities (e.g. dredging) in East Arm and the Elizabeth River including, but not limited to: LNG facilities (INPEX and Conoco Philips), Darwin Port, wastewater treatment plants (Berrimah and Palmerston), stormwater and other diffuse sources • comparison with the discharge volumes and types of contained contaminants (e.g. nutrients, sediments) that enter Darwin Harbour from other sources (this could be obtained from online sources such as waste discharge or environment protection licences) • how any impacts of the Proposal would be discerned from other cumulative impacts in the East Arm domain (noting that proposed monitoring site Ref2 (Draft EIS Figure 7-28) is a former discharge zone for the nearby INPEX operation) • how maintenance dredging in the East Arm area may influence the proposed discharge regime (including any contaminant plume) and monitoring results.		
TNG Response			

There will be no discharge of wastewater into the Darwin Harbour or the marine environment. TNG applied the mitigation hierarchy against the environmental objective of marine environmental quality, choosing to avoid any impact to the marine environment and no longer be discharging wastewater or pollutants into Darwin Harbour. Wastewater from the Project will instead be processed by the WRP and water will be treated and recycled into the processing circuit as described in **Section 2.3.4**.

The change of Project scope has resulted in this factor being removed as a key factor of the Project and no direct impacts will occur.

ID # 30	Topic: Marine Environmental Quality - Water quality criteria for controlled discharge to Darwin Harbour	EIS section:	N/A
Comment	Information requested by NT EPA		
The proposed mixing zone may not be considered acceptable.	Based on the assessment of impacts and risks requested above, reconsider appropriate water quality criteria for the intended discharge to Darwin Harbour. To prevent significant impacts and environmental harm, the NT Government considers the appropriate level of protection for the proposed discharge location is for slightly disturbed aquatic ecosystems (95 % level of species protection). It also considers that toxicant concentrations should be below the 10th percentile (with 95 % confidence) of chronic effects concentration as determined by the WET assessment. Include reconsideration of the size of the mixing zone, with reference to the NT EPA Guidelines on Mixing Zones (NT EPA 2013), and demonstrate that the proposed mixing zone is as small as possible and is unlikely to result in any significant environmental impacts identified in the risk assessment. Include reconsideration of the diffuser type and discharge regime for minimising contaminant loads to Darwin Harbour (e.g. discharge only above certain tidal flow velocity, and/or cease discharge some minutes or hours prior to low tide to enable flushing of the plume to the outer Harbour). Demonstrate how compliance with the discharge regime will be verified using real-time monitoring of tidal parameters.		
TNG Response			
There will be no discharge of wastewater into the Darwin Harbour or the marine environment. TNG applied the mitigation hierarchy against the environmental objective of marine environmental quality, choosing to avoid any impact to the marine environment and no longer be discharging wastewater or pollutants into Darwin Harbour. Wastewater from the Project will instead be processed by the WRP and water will be treated and recycled into the processing circuit as described in Section 2.3.4. The change of Project scope has resulted in this factor being removed as a key factor of the Project and no direct impacts will occur.			

ID # 31	Topic: Marine Environmental Quality – Baseline Water Quality	EIS section:	N/A
Comment	Information requested by NT EPA		
The baseline water quality study is limited by the sampling duration (two days in March and one day in May).	Update the baseline water quality assessment, to the extent required to account for the final Proposal specifications and the assessment of potential impacts requested above. This should cover all water quality measures that might be altered by the Proposal. Sampling should be appropriate to account for natural variability, both spatial (considering the zone of influence) and temporal.		

TNG Response

Expansion of the baseline water quality study is no longer necessary as there will be no discharge of wastewater into the Darwin Harbour or the marine environment. TNG applied the mitigation hierarchy against the environmental objective of marine environmental quality, choosing to avoid any impact to the marine environment and no longer be discharging wastewater or pollutants into Darwin Harbour. Wastewater from the Project will instead be processed by the WRP and water will be treated and recycled into the processing circuit as described in **Section 2.3.4**. The change of Project scope has resulted in this factor being removed as a key factor of the Project and no direct impacts will occur.

ID # 32	Topic: Marine Environmental Quality - Marine Environmental Quality Monitoring and Management Plan (MEQMMP)	EIS section: N/A
Comment	Information requested by NT EPA	
Analysis for total metals in discharge process wastewater is not proposed in the monitoring plan. Analysis of total metals is an important parameter with which to understand if the treatment process has been able to retain contaminants on site rather than discharged to the environment. A change in state of a contaminant from dissolved to a total concentration may reduce its bioavailability, however various conditions in the receiving environment have the potential to remobilise contaminants. As such, understanding of total concentrations should be included in the monitoring and management plan along with an annual assessment of loads discharged into the harbour.	Provide an updated MEQMMP that takes into account the final Proposal specifications and the impact assessment requested above. Include a commitment for further review and update following commissioning of the water treatment plant and following any changes to the Proposal that would alter the quality or discharge regime of any controlled or uncontrolled wastewater discharge. The following additional updates to the MEQMMP are required: • updates associated with changes to the proposed wastewater characteristics or discharge regime • updated figures of the final pipeline route • provide for analysis of total metals in discharge process wastewater • include annual assessment of contaminant loads discharged into the harbour • incorporate continuous data logging of key parameters; including pH, temperature, electrical conductivity, turbidity, pE (redox) and surrogates for key toxicants; of: ○ the treated wastewater, prior to its the release to the outfall pipe ○ receiving waters at locations within and outside the mixing zone including adjacent to the sea floor and both upstream and downstream of the discharge site • consideration of tide and seasonality, including whether any standardisation is required for the reporting of monitoring results • update Table 3-3 to include increased waterway sedimentation in the Potential Environmental Impact column • update Table 3-4 to include environmental quality indicators for increase waterway sedimentation, and updated for the remainder of the MEQMMP as appropriate • clarify what is meant by the term 'large scale deaths' • update terminology used in MEQMMP to be more specific i.e. from "should" to "will"	

- include intertidal infauna and consideration of community composition in the marine monitoring program.

TNG Response

A MEQMMP is no longer required as there will be no discharge of wastewater into the Darwin Harbour or the marine environment. TNG applied the mitigation hierarchy against the environmental objective of marine environmental quality, choosing to avoid any impact to the marine environment and no longer be discharging wastewater or pollutants into Darwin Harbour. Wastewater from the Project will instead be processed by the WRP and water will be treated and recycled into the processing circuit as described in **Section 2.3.4**.

The change of Project scope has resulted in this factor being removed as a key factor of the Project and no direct impacts will occur.

ID # 33	Topic: Benthic Habitat and Communities - Benthic habitat modelling, assessment of sensitive receptors, and pipeline placement	EIS section:	N/A
Comment	Information requested by NT EPA		
The desktop review presented in the Draft EIS main report and Appendix S used data from 2012 or earlier and relied heavily on GeoOceans (2010) and Smit, Penny & Griffiths (2012) for describing benthic habitats and communities. Although new data was collected using side scan sonar and towed underwater video, no new data appears to be presented in the benthic habitats and communities maps presented in the EIS and Appendix S (e.g. Figure 7-32 (EIS main report) or Figure 14 (Appendix S)). The reports by GeoOceans (2010) and Smit et al (2012) attempted a modelling approach to predict the spatial distribution of benthic habitats and communities, predominantly in subtidal habitats. However, due to the lack of full spatial coverage of important environmental parameters (e.g. substrate type, sediment grainsize and mobility, current strength at the seafloor, salinity, temperature, wave characteristics), the presented maps were at best inferred from predominantly depth and expert knowledge. Since 2012, a number of reports and associated data sets have been publicly released that allow for a more comprehensive overview of the environmental settings for inner Darwin Harbour, including Elizabeth River. DENR holds spatial benthic habitat and community data sets from towed video and still imagery (epibenthic biota, including a seagrass site in Slack Creek). In addition, all data from the Darwin-Bynoe region habitat mapping program, which contains three detailed reports and over 90 spatial data layers, are now publicly available as a data package at the Geoscience Australia data portal: http://pid.geoscience.gov.au/dataset/ga/127494 Relevant references:	Provide a description of benthic communities and habitats for the entire zone of influence of the Proposal, encompassing the proposed pipeline route and area that could potentially be influenced by the discharge (with an appropriate buffer). This is to be based on modelling using a full suite of existing data. The updated modelling should be used inform site selection and further survey for the proposed pipeline alignment. Demonstrate that the placement and alignment of the pipeline will not cause significant impacts to benthic habitat and communities during construction or in the long term. Address all potential significant impacts including, but not limited to, those that could arise from disturbance of sediments, erosion or accretion of sediments, or interference with existing or proposed dredging activities in Darwin Harbour.		

iXSurvey. 2011. Bathymetric survey of Darwin Harbour. Hydrographic Survey Report D11-0219. iXSurvey Australia Pty Ltd: Brisbane. <https://ecat.ga.gov.au/geonetwork/srv/eng/catalog.search#/metadata/83182>
Siwabessy, J. 2015. p-rock (probability of rock) grids from the Darwin Harbour 2011 Marine Survey (GA0333).

Geoscience Australia, Canberra. <http://pid.geoscience.gov.au/dataset/ga/83950> Siwabessy J, Tran M, Huang Z, Nichol S, Atkinson I. 2015. Mapping and classification of Darwin Harbour seabed. Geoscience Australia Record 2015/18. Geoscience Australia, Canberra, ACT, Australia. 58 pages

TNG Response

A detailed description of the benthic habitat and communities is no longer required as there will be no disturbance from pipeline construction or discharge of wastewater into the Darwin Harbour or the marine environment. TNG applied the mitigation hierarchy against the environmental objective of marine environmental quality, choosing to avoid any impact to the marine environment and no longer be discharging wastewater or pollutants into Darwin Harbour. Wastewater from the Project will instead be processed by the WRP and water will be treated and recycled into the processing circuit as described in **Section 2.3.4**.

The change of Project scope has resulted in this factor being removed as a key factor of the Project and no direct impacts will occur.

ID # 34	Topic: Benthic Habitat and Communities – Wastewater Discharge	EIS section:	N/A
Comment	Information requested by NT EPA		
The EIS did not discuss the long-term impact from waste water discharge on benthic communities, in particular the fate of the elevated temperature and contaminants and decrease in salinity within the mixing zone and how this affects water quality, phyto-/zooplankton, sediment health and the fauna that live within the sediment (infauna). Infauna are an important factor for trophic structures and ecosystem processes within the marine ecosystem, including nutrient cycling, and locking up pollutants and contaminants. Contaminants can remain soluble with some becoming toxic to bacterial and micro-algae within the water column. Certain contaminants can also be often absorbed by organic matter and enter the trophic pathways through feeding zooplankton on contaminated organic matter; or contaminated organic matter can settle out of the water column and be deposited and accumulate on the seafloor after which it enters the nutrient recycling pathways within benthic environment.	Referring to the updated marine environmental quality assessment, consider and assess the potential long-term impacts from altered marine environmental quality, particularly in the proposed mixing zone, on phyto-/zooplankton, sediment health and sediment infauna.		

ID # 34	Topic: Benthic Habitat and Communities – Wastewater Discharge	EIS section:	N/A

TNG Response

An assessment of the long-term impacts from wastewater discharge on benthic communities is no longer required as there will be no discharge of wastewater into the Darwin Harbour or the marine environment. TNG applied the mitigation hierarchy against the environmental objective of marine environmental quality, choosing to avoid any impact to the marine environment and no longer be discharging wastewater or pollutants into Darwin Harbour. Wastewater from the Project will instead be processed by the WRP and water will be treated and recycled into the processing circuit as described in **Section 2.3.4**.

The change of Project scope has resulted in this factor being removed as a key factor of the Project and no direct impacts will occur.

ID # 35	Topic: Marine Flora and Fauna – Factor Assessment	EIS section:	N/A

Comment

Information requested by NT EPA

Discharge outflows into the marine environment during operations have the potential to impact on marine fauna through physical changes to light in the water column relating to food availability, hunting and habitat degradation/community shifts; chemical alterations resulting in physical damage to gills, skin or eyes and toxic accumulation throughout the marine fauna food chain affecting the health and survival of fauna populations.

Referring to the updated marine environmental quality assessment, consider and assess the potential long-term impacts from altered marine environmental quality, particularly in the proposed mixing zone, on marine flora and fauna and the broader ecosystem processes within Darwin Harbour. Include assessment of the potential impacts and risks to sensitive receptors in Darwin Harbour including Darwin Aquaculture Centre (production of marine animals and microalgae).

TNG Response

An assessment of the long-term impacts from wastewater discharge on marine flora and fauna is no longer required as there will be no discharge of wastewater into the Darwin Harbour or the marine environment. TNG applied the mitigation hierarchy against the environmental objective of marine environmental quality, choosing to avoid any impact to the marine environment and no longer be discharging wastewater or pollutants into Darwin Harbour. Wastewater from the Project will instead be processed by the WRP and water will be treated and recycled into the processing circuit as described in **Section 2.3.4**.

The change of Project scope has resulted in this factor being removed as a key factor of the Project and no direct impacts will occur.

ID # 36	Topic: Marine Flora and Fauna – Environmental Quality Criteria		EIS section:	N/A
Comment	Information requested by NT EPA			
The proposed mixing zone has been positioned with a buffer of 250 m to the nearest sensitive receptors, however the classification of sensitive receptors is not clear other than ‘hard substrate benthic habitat and communities’. The outflow point is within 1-2 km of the INPEX mixing zone. The EIS states that the presence of marine fauna within the mixing zone is transitory and fauna will be able to actively vacate and evade the mixing zone. This assumes that mobile fauna are able to detect a broad range of toxicants potentially hazardous to their health at fairly low concentrations. The proposed position of the outflow pipe channel species evading the mixing zone either towards the East Arm wharf or towards to INPEX outflow in order to access the Elizabeth River, or alternatively it may result in the entire area being avoided, effectively resulting in significant habitat loss. Alternatively, animals may continue to use the area and be exposed to potential impacts from substances discharged through the outflow. The draft EIS outlines a process for developing local Environmental Quality Criteria (EQC) based on whole effluent toxicity testing on a small number of local marine invertebrate species. However, clarity should be provided on how these EQC apply to vertebrate marine fauna. There is also the risk of bioaccumulation of toxicants up the food chain through consumption of contaminated prey, resulting in adverse health effects on in-shore dolphins and potentially other fish species. The EIS only considers bioaccumulation in response to a significant event (i.e. fish kill or oil spill), but there is also potential for longer-term impacts on vertebrate marine fauna due to bioaccumulation of toxicants from the proposed discharge outflow.	Provide information on the applicability of the proposed local EQC to avoiding or mitigating potential impacts on vertebrate marine fauna, given that the EQC will be based on WET testing on local marine invertebrate species.			
TNG Response				
Development of EQC is no longer necessary for marine flora and fauna as the quality of the marine environment will remain unchanged due to the removal of wastewater discharge into Darwin Harbour from the Project scope. TNG applied the mitigation hierarchy against the environmental objective of marine environmental quality, choosing to avoid any impact to the marine environment and no longer discharge wastewater or pollutants into the marine environment. Wastewater from the Project will instead be processed by the WRP and water will be treated and recycled into the processing circuit as described in Section 2.3.4. The change of Project scope has resulted in this factor being removed as a key factor of the Project and no direct impacts will occur.				

ID # 37	Topic: Marine Flora and Fauna - Noise and Vibration	EIS section:	N/A
Comment	Information requested by NT EPA		
The EIS has not considered the risks and potential impacts of noise and vibration associated with underwater construction for the outflow pipe. Sub-trauma levels of sound can affect the fitness of marine megafauna individuals. These affects can take the form of masking of important signals, including echolocation signals, intra- species communication, and predator-prey cues; disrupting important behaviours through startle and repellence, or of acting as attractive nuisances, all of which may alter or result in abandonment of important habitats.	Provide an assessment of potential impacts on marine megafauna from noise and vibration associated with construction of the wastewater discharge pipeline, and associated measures that will be implemented to mitigate any potential impact.		
TNG Response			
A noise and vibration impact assessment is no longer necessary for marine megafauna, as the wastewater discharge pipeline will not be constructed. TNG applied the mitigation hierarchy against the environmental objective of marine flora and fauna and has chosen to avoid any impact to the marine environment as a whole. Wastewater will no longer be discharged into the Darwin Harbour or marine environment. Wastewater from the Project will instead be processed by the WRP and water will be treated and recycled into the processing circuit as described in Section 2.3.4 . The change of Project scope has resulted in this factor being removed as a key factor of the Project and no direct impacts will occur.			

ID # 38	Topic: Marine Flora and Fauna - Likelihood of occurrence of sea turtles and dolphins	EIS section:	4.2.1.4
Comment	Information requested by NT EPA		
The EPBC Act Protected Matters Report identified the Loggerhead Turtle (<i>Caretta caretta</i>) as " <i>Foraging, feeding or related behaviour known to occur within the area</i> " and Irrawaddy Dolphin (<i>Orcaella bfevostris</i>) as " <i>Species or species habitat known to occur within area</i> ".	If discounting the presence of the Loggerhead Turtle (<i>Caretta caretta</i>) and Irrawaddy Dolphin (<i>Orcaella bfevostris</i>), provide a discussion on the rationale for this conclusion.		
The Draft EIS did not identify these species as likely to be present but did not justify why they are considered not present.	If these species are considered to be present in the Proposal area or area of impact, provide an assessment consistent with the item below.		
TNG Response			
TNG applied the mitigation hierarchy against the environmental objective of marine flora and fauna and has chosen to avoid any impact to the marine environment as a whole. Wastewater will no longer be discharged into the Darwin Harbour or marine environment. Wastewater from the Project will instead be processed by the WRP and water will be treated and recycled into the processing circuit as described in Section 2.3.4 .			
The change of Project scope has resulted in this factor being removed as a key factor of the Project and no direct impacts will occur.			

ID # 39	Topic: Marine Flora and Fauna - MNES	EIS section:	4.3
Comment	Information requested by NT EPA		

Further information is required to adequately meet assessment requirements for matters of national environmental significance (MNES) in accordance with the EPBC Act, as specified in section 3.1 of the ToR.

For the MNES species listed below, clearly provide the following:

- an assessment of the presence or likely presence of the species in the Proposal area and in any areas that may be impacted
- the size and distribution of the local population, including at different life cycle stages, for example, when breeding, foraging, resting and/or migrating
- The importance of the local population in a local, regional, NT, national and international context.
- The identification of suitable habitat for the species (for breeding, foraging, aggregation or roosting), and the quality of this habitat, and how this may be disturbed or altered by the Proposal

The relevant marine MNES species are turtles (green, hawksbill, flatback and Olive-Ridley) and sawfish (dwarf, largetooth and green).

TNG Response

TNG applied the mitigation hierarchy against the environmental objective of marine flora and fauna and has chosen to avoid any impact to the marine environment as a whole. Wastewater will no longer be discharged into the Darwin Harbour or marine environment. Wastewater from the Project will instead be processed by the WRP and water will be treated and recycled into the processing circuit as described in **Section 2.3.4**.

The change of Project scope has resulted in this factor being removed as a key factor of the Project and no direct impacts will occur.

ID # 40	Topic: Air Quality and Greenhouse Gases - Elizabeth River Boat Ramp	EIS section:	3.3.3
Comment	Information requested by NT EPA		

The Elizabeth River boat ramp is considered to be a sensitive receptor but was not included as such in the Draft EIS (including Appendix U).

Provide maximum predicted gaseous impacts (ground level concentrations; as per Appendix U Tables 6-2 and 6-3) of combustion gases and other gases at the Elizabeth River boat ramp.

ID # 40	Topic: Air Quality and Greenhouse Gases - Elizabeth River Boat Ramp	EIS section:	3.3.3

TNG Response

An updated Air Quality Assessment was conducted for the Supplement and is included as **Appendix G**. The Elizabeth River Boat Ramp was included as a Sensitive Receptor and assessed for impact. Sensitive Receptors for the Factor Air Quality are summarised in **Section 3.3.3.1**. Results from the air quality model show that the maximum predicted concentrations of dust deposition, particulate matter and gaseous emissions are below the adopted criteria for the Elizabeth River Boat Ramp modelled for the Project during construction and operating both in isolation and including background (cumulative modelling). Further information on the predicted impacts are presented in **Section 3.3.4**.

ID # 41	Topic: Air Quality and Greenhouse Gases – Pollution Prediction Contours	EIS section:	3.3.4.2

Comment

Information requested by NT EPA

The stated air quality goals for chloride (Cl₂ - 50 micrograms/m³) and hydrochloric acid (HCl - 140 micrograms/m³) (Table 3-1 of Appendix U) are incorrectly indicated for an averaging time of annual. The averaging time for these criteria, as prescribed in the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales, is one hour.

Provide an update of the pollution prediction contours (**Appendix G**) and maximum predicted gaseous impacts (Table 6-3) for chloride (Cl₂) and hydrochloric acid (HCl), based on an averaging time of 1 hour, as prescribed in the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales.

TNG Response

An updated Air Quality Assessment was conducted for the Supplement and is included as **Appendix G**. Pollution prediction contours have been updated based on an averaging time of 1 hour. The results are listed in **Section 3.3.4.2 Table 3-34**.

ID # 42	Topic: Air Quality and Greenhouse Gases – Air Quality Assessment	EIS section:	3.3.2

Comment

Information requested by NT EPA

It is unclear from the Draft EIS if air quality goals are suitable for avoiding impacts to air quality and if the air quality modelling and derived predictions are sufficiently robust to enable the incorporation of design features for mitigating significant impacts.

Not all data required for the modelling of air emissions from the operation of the Project was available.

Present a third-party qualified person review of the Proposals Air Quality Assessment to:

- assess the suitability of the input data used for the model and the suitability of the air quality goals
- assess confidence in the model and its predictions
- provide recommendations for an air emissions monitoring program to regulate operational emissions from the Proposal

- d) provide recommendations on contingency options for reducing emissions if necessary after commissioning or start-up of operations

TNG Response

An updated Air Quality Assessment was conducted for the Supplement. The Air Quality Assessment report, as well as a third party review of the assessment, is presented in full in **Appendix G**. The revised Air Quality Assessment report supersedes Appendix U in the Draft EIS.

ID # 43	Topic: Air Quality and Greenhouse Gases - Odours	EIS section:	3.4.4
Comment	Information requested by NT EPA		
Organic matter in the ore concentrate, or other sources, may have potential to generate odours. This has not been addressed in the Draft EIS.	Consider whether odorous compounds may be emitted during the roasting process or if thickeners containing hot liquor are open to the atmosphere, or if people may experience odours from undiluted sulfur dioxide emissions coming to ground. If appropriate, provide an impact assessment for individual odorous air pollutants or for complex mixtures of odours (where appropriate) as per <i>Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales</i> . Provide justification if an impact assessment is not considered necessary.		

TNG Response

An updated Air Quality Assessment was conducted for the Supplement and is included as **Appendix G**. The technical report found that given the sources and compositions of emissions to the atmosphere (described in **Section 2.6.2**) there are no significant sources of odour and as a consequence, impacts on odour in the surrounding air environment from the Project are expected to be negligible.

ID # 44	Topic: Air Quality and Greenhouse Gases – Mitigation and Monitoring	EIS section:	3.4.5
Comment	Information requested by NT EPA		
The Draft EIS does not include an Air Quality Management and Monitoring Plan as requested in the ToR (section 4.6.3). There is inadequate information about air emissions and mitigation measures to enable assessment of potential impacts.	Provide an Air Quality Management and Monitoring Plan that includes the following: A map showing all sources of emissions to air (including potential fugitive emissions).		

ID # 44	Topic: Air Quality and Greenhouse Gases – Mitigation and Monitoring	EIS section:	3.4.5
	• Details on all of the emissions reduction equipment to be used for mitigating air emission to demonstrate that emissions will be reduced to the maximum extent possible in accordance with the waste management hierarchy and consistent with the design criteria prescribed by <i>Protection of the Environment Operations (Clean Air) Regulation 2010</i> for Group 6 items of equipment. It is noted that the predicted maximum cumulative impacts of NO₂ and SO₂ at some receptors are close to their 1-hour impact assessment criteria values (Appendix U); more efficient emission reduction equipment may be required than what is currently proposed. • Contingency options for reducing emissions after the facility has been built and operations have commenced, if emissions exceed the air quality goals. • Measures that will be implemented to mitigate the generation and release of dust and fugitive gaseous emissions. • A commitment to install continuous emissions monitoring equipment and sampling ports for manual sampling in all stationary source emission stacks. • Outline of a monitoring program for air emissions (dust and gases; from point-sources and fugitive emissions), including ○ a map showing all sampling sites (onsite and offsite) and sensitive receptors ○ the frequency of sampling, and the parameters to be monitored, including the establishment of baseline conditions ○ indication of the equipment (e.g. high volume air samplers) to be used to establish baseline conditions and monitor particulates in air and gaseous emissions in ambient air, onsite and offsite, and a demonstration that this equipment is appropriate for detecting potential contaminants ○ the analyses to be undertaken to compare with the air quality goals.		
TNG Response			

An updated Air Quality Assessment was conducted for the Supplement and is included as **Appendix G**. The Air Quality Management Plan (Appendix B of the Air Quality Assessment) incorporates a monitoring program as well as reporting requirements for the Project's air emissions throughout the operational phase. This is summarised in **Section 3.3.6**

ID # 45	Topic: Social, Cultural and Economic Surroundings - Noise and Vibration	EIS section:	3.5.3.13.5.3.1 3.5.3.2
Comment	Information requested by NT EPA		
The Noise Impact Assessment (NIA) in the Draft EIS did not adequately consider baseline background noise levels or the potential impacts from operation of the rail siding. Baseline noise monitoring was conducted at two of the four sensitive receptors from 26 - 28 August 2019 during times that did not adequately cover the 24-hour 7-days a week operating period, which is required for obtaining baseline information. The predicted rail noise was compared against noise criteria for rail infrastructure projects (Appendix X; Tables 4-5 and 7-4), however this is not considered sufficiently protective. As nearby sensitive receptors include residential areas, there is potential for noise from the Proposal to significantly impact amenity values (noting that widespread complaints could be a material environmental harm offence under the WMPC Act – see Table 2).	Conduct an assessment of the NIA (including noise modelling) for compliance with the <i>Northern Territory Environment Protection Authority - Northern Territory Noise Management Framework Guideline</i> ; section 3.2 Commercial and Industrial noise. Provide an updated version of the NIA to address any issues identified in the revision, and to include (at a minimum): a) background noise monitored in accordance with the guideline b) noise assessment at all nearby sensitive receptors, including rail noise assessed against the industrial/commercial criteria c) noise mitigation measures where it is established that there is actual, or the potential for, excessive noise, to reduce the level of noise to acceptable levels.		

TNG Response

An updated NIA was conducted for the Supplement and is included as **Appendix H**. Additional background noise monitoring was conducted, with background noise levels presented in **Section 3.5.3.1**. Potential impacts to sensitive receptors were modelled and are summarised in **Section 3.5.4.1**. Mitigation measures are presented in the Draft EIS Section 7.11.7 Table 7-84, with supplementary measures proposed in **Section 3.5.5, Table 3-50**. Residual risk of noise impacting on sensitive receptors was determined to be a Low risk.

ID # 46	Topic: Social, Cultural and Economic Surroundings - Aboriginal Areas Protection Authority (AAPA) certificate		EIS section:	2
Comment		Information requested by NT EPA		
On 31 July 2019, the Aboriginal Areas Protection Authority (AAPA) issued an Authority Certificate to Enigma Mining Limited in respect of the Proposal. It is understood that Enigma Mining is a wholly owned subsidiary of TNG. However, the Authority Certificate only provides an indemnity to prosecution under the <i>Northern Territory Aboriginal Sacred Sites Act 1989</i> to its holder, Enigma Mining (if compliant with terms and conditions), not TNG.		Clarify whether Enigma Mining or TNG is the operating entity.		
TNG Response				
Enigma Mining is a wholly owned subsidiary of TNG Limited. The Darwin Processing Facility will be operated by Enigma Mining.				

ID # 47	Topic: Social, Cultural and Economic Surroundings – AAPA Certificate		EIS section:	Figure 6-1
Comment		Information requested by NT EPA		
There is a discrepancy in the Proposal area given in the Draft EIS (outlined in white) and the area covered by the Authority Certificate (shaded in red), so it is unclear if the Authority Certificate issued to Enigma Mining covers all of the proposed activities and the Project site.		Clarify whether the Authority Certificate issued to Enigma Mining covers all of the proposed activities and the entire site.		
TNG Response				

The EIS Supplement Development Envelope replaces that proposed in the Draft EIS. The EIS Supplement Development Envelope is entirely within the Authority Certificate area as shown in Figure 6-1.

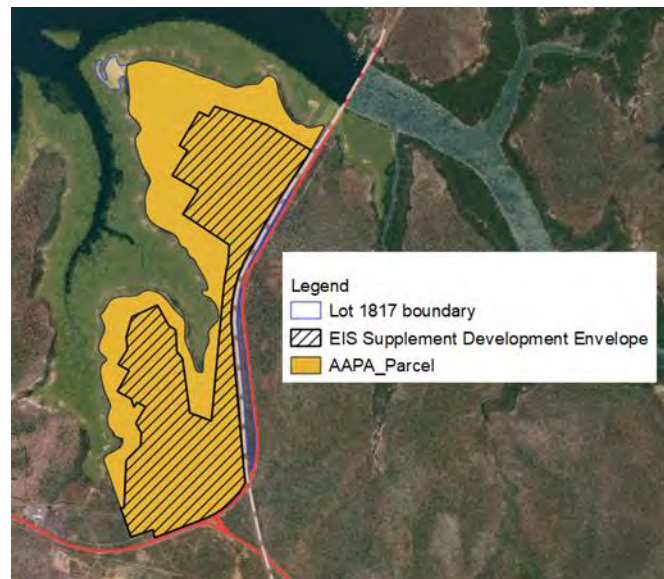


Figure 6-1. AAPA Certificate area and the EIS Supplement Development Envelope.

ID # 48	Topic: Social, Cultural and Economic Surroundings – Traffic Impact Assessment	EIS section:	2.3.12

Comment	Information requested by NT EPA
The Traffic Impact Assessment provided in the Draft EIS did not adequately consider potential transport impacts including consideration of wider transport network conditions and development proposals in the vicinity. The relevant contact is DevRoads.ntg@nt.gov.au	Provide an updated Draft Traffic Impact Assessment that includes consideration of the wider transport network conditions and development proposals in the vicinity of the Proposal, and demonstrates that impacts can be appropriately avoided or mitigated. This update is to be informed by communication with the Department of Infrastructure, Planning and Logistics (DIPL) Transport Civil Services Division on the identification and avoidance or mitigation of traffic-related impacts of the Proposal.

TNG Response

An updated Traffic Impact Assessment was conducted for the Supplement and is included as **Appendix D**. The scope and objectives of the TIA were developed in consultation with DIPL, as listed in the Stakeholder engagement and consultation register summarised in **Section 3.5.3.3, Table 3-45**. Supplementary information on the existing environment for traffic is presented in **Section 3.5.3.2**. An update of the impacts from traffic arising from the Project is presented in **Section 3.5.4.2**. Strategies proposed for the mitigation and management of traffic impacts are listed in the Draft EIS Section 7.11.7 Table 7-84. No supplementary mitigations are proposed for the Supplement.

ID # 49	Topic: Social, Cultural and Economic Surroundings – Commitments Register	EIS section:	7.1

Comment	Information requested by NT EPA
The Draft EIS includes four separate tables containing commitments and mitigation measures relating to this factor (Draft EIS Table 7-84, Appendix W section 4.1 and Table 4-1, and Appendix E pages 14-17). This confuses the identification and realisation of benefits and the mitigation of potential negative impacts.	Include in the Supplement a single commitments register that clearly defines commitments relating to social, economic and cultural aspects of the Proposal and how potential impacts will be addressed.

TNG Response

A consolidated commitments register has been prepared for the Supplement and is included as **Appendix R**. This register incorporates commitments from the Draft EIS that remain applicable to the amended Project scope, as well as all commitments detailed in the Supplement. This register supersedes commitment tables presented in the Draft EIS.

ID # 50	Topic: Social, Cultural and Economic Surroundings – Water Use	EIS section:	2.7
Comment	Information requested by NT EPA		
The Draft EIS did not address the ToR item (in section 4.3.2) requesting the assessment of the risk of unsustainable use and/or wastage of water resources. There is current community concern regarding low water levels in Darwin River Dam. This concern could be compounded by the significant amount of potable water required for this project relative to Darwin’s current consumption.	Provide a discussion on the efficient and appropriate use of water in the context of competing strategic water use requirements (current and future) for community, cultural and industry purposes, and in the context of current community concern regarding low water levels in Darwin River Dam. Discuss fairness and equity associated with the use of a high volume of water that is equivalent to approximately 25 % of Darwin’s current total annual water consumption.		
TNG Response			
For the Supplement, TNG have reduced the demand from the Darwin water supply by 65% of that proposed in the Draft EIS, equating to approximately 9.1% of Darwin’s current annual water consumption. TNG have achieved this by recycling water from the process circuit, increasing the water use efficiency. Section 3.5.4.3 provides a discussion on the fairness and equity of the project demands in relation to the Darwin Water Supply.			

ID # 51	Topic: Social, Cultural and Economic Surroundings – Discharge of Toxicants into the Darwin Harbour	EIS section:	4.3.2.3
Comment	Information requested by NT EPA		
Toxicants discharged into Darwin Harbour could accumulate to a level that approaches carrying capacity for the Harbour. This would limit the potential for further development within Darwin Harbour catchment.	Discuss the fairness and equity issues around discharging toxicants to Darwin Harbour.		
TNG Response			
Following community consultation and Stakeholder engagement, discharge to the Darwin Harbour proposed in the Draft EIS has been removed from the Project.			

ID # 52	Topic: Social, Cultural and Economic Surroundings – Stakeholder engagement regarding water use and wastewater discharge		EIS section:	4.3.2.3
Comment		Information requested by NT EPA		
The Draft EIS does not report on any consultation undertaken on the issues of water use. The NT Government considers this is a matter for community consultation, as is concern around potential impacts from discharging wastewater into Darwin Harbour.		Provide an updated Community and Stakeholder Engagement Plan that specifically address water use and wastewater discharge to Darwin Harbour (and associated impacts). Demonstrate that Proposal information will be proactively disseminated and that community concerns will be managed.		
TNG Response				

A Stakeholder and Community Engagement Plan has been prepared for the Supplement consistent with the International Association for Public Participation (IAP2) Core Values (**Appendix O**). For the Supplement, TNG have proposed to reduce the water demand from the Darwin Water supply by 65 % and remove the discharge to the Darwin Harbour from the Project. These changes have been driven by community concern identified through community consultation and the stakeholder engagement process. Through the development of the Supplement stakeholders and community members that have raised concerns have been actively consulted, as identified in the engagement register (**Section 3.5.3.3**). Using the Supplement as a tool to support the conveyance of information to the broader community, TNG will actively disseminate information to the community regarding these key changes in accordance with the Stakeholder and Community Engagement Plan.

6.2 PUBLIC COMMENTS

Three non-government submissions were received by the NT EPA in response to the Draft EIS. These were submitted by:

- Environment Centre Northern Territory (ECNT),
- Amateur Fishermen's Association of the Northern Territory (AFANT)
- Paspaley Pearling Company.

Summaries of the public submissions received in response to the EIS are provided in **Table 6-3**. For the full un-edited submissions please refer to **Appendix A**.

Table 6-3. Public comments on the Draft Environmental Impact Statement for the Darwin Processing Facility

ID # 53	Topic: Project Description - Alternatives for Processing Methods	EIS section:	2.7
Comment		Concerned groups	
The EIS does not identify feasible alternatives to processing methods particularly regarding the use of alternative sources and re-use opportunities for water.		ECNT, AFANT	
TNG Response			
Project Alternatives are discussed in Section 2.7 . Alternative Water Sources are discussed in Section 2.7.2 . For the Supplement the Project proposes to recycle process water in a WRP, reducing the demand from the Darwin Water Supply by 65 %.			

ID # 54	Topic: Project Description - Waste water management and discharge	EIS section:	2.7
Comment		Concerned groups	
The EIS has not identified alternatives to discharging the contaminated waste stream into the Darwin Harbour.		ECNT, AFANT, Paspaley Pearling Company	
The EIS has not adequately demonstrated how the chemicals in the wastewater will interact with the environment, their cumulative effect and what the impact of the collective mixture will be.			
The EIS has not adequately identified the risks for discharging the waste water into the Darwin harbour and the insufficient data provided renders the hydrodynamic modelling of the discharge and pollutant outfall unreliable.			
The Proposal requires a high volume of water and it does not seem attainable from the current Darwin water supply. As such, the project would require the construction of a new dam to supply the water and the construction of a new dam should form part of the assessment.			

TNG Response

Project Alternatives are discussed in **Section 2.7**. Alternative Water Sources are discussed in **Section 2.7.2**. For the Supplement the Project proposes to recycle process water in a WRP, reducing the demand from the Darwin Water Supply by 65 % and removing the requirement for the discharge of liquid waste to the Darwin Harbour.

ID # 55	Topic: Project Description – Terms of Reference	EIS section:	0
Comment		Concerned groups	
TNG did not adequately address the ToR imposed by the NT EPA.		ECNT, Paspaley Pearling Company	

TNG Response

Consolidated comments from the NT Government provided by the NT EPA in **Table 6-1** identify specific areas where the Draft EIS inadequately addressed the ToR. The Supplement has been prepared to address these inadequacies and provide sufficient information to satisfy the ToR.

ID # 56	Topic: Consultation	EIS section:	3.5
Comment		Concerned groups	
Consultation has been minimal for this project. A significant number of community and industry stakeholders identified have not been directly or adequately consulted even when requested.		ECNT, AFANT	

TNG Response

Through the preparation of the Supplement, community consultation and Stakeholder engagement have continued with specific activities listed in the Stakeholder engagement and community consultation register summarised in **Section 3.5.3.3, Table 3-45**. A Stakeholder and Community Engagement Plan to guide long term consultation processes has been prepared for the Supplement consistent with the International Association for Public Participation (IAP2) Core Values (**Appendix O**). Using the EIS Supplement as a tool to support the conveyance of information, TNG will continue to actively disseminate information to the community regarding key changes in the proposed Project in accordance with the Stakeholder and Community Engagement Plan.

ID # 57	Topic: Inland Water Quality – Acid Sulfate Solis	EIS section:	3.1.4
Comment		Concerned groups	
Mitigation and management of ASS does not appear to address short-term impacts on groundwater quality resulting from storm surge activity.		ECNT	
Management measures to capture the sediment/drainage must be adequately designed to reduce the impact mangroves and waterways.			

TNG Response

The development envelope is situated outside of the 1000-year storm surge boundary; no disturbance of soils will occur outside of the development envelope, resulting in no ASS being encountered within the 1000-year storm surge area.

The ASS Management Plan has been updated for the Supplement to recognise the additional information obtained through further technical studies on surface water and groundwater (**Section 3.1.2, Table 3-2**). The mitigation and management of ASS as proposed in the Draft EIS has been reviewed to ensure appropriateness in light of additional information obtained. No additional mitigation or management strategies have been proposed for the Supplement.

A Stormwater Management Plan has been developed for the Supplement (**Appendix C**). The proposed treatment of Stormwater in the construction phase is presented in **Section 2.2.3** and for operations in **Section 2.3.7**. The risk of sedimentation is discussed in **Section 3.1.4.2**. Mitigation and management of the risk of sedimentation is proposed in the Draft EIS Section 7.6.5 Table 7-39, with supplementary measures in the Supplement **Section 3.1.5, Table 3-10**.

ID # 58	Topic: Terrestrial Flora and Fauna	EIS section:	3.2
Comment	Concerned groups		

EIS identifies suitable habitat for the *Typhonium praetermissum* (recognised under the Territory Parks and Wildlife Conservation Act (TPWC Act) as vulnerable) on the Project site but failed to locate these species in the Study area. Further onsite studies need to occur using different methods such as survey of leaf material and genetic analysis.

TNG Response

Potentially suitable habitat for *Typhonium praetermissum* (TPWC Act VU) has been mapped by the NT Government (DLRM 2019) as occurring within Lot 1817. Targeted searches at the appropriate survey period were reported in Appendix J of the Draft EIS, including a description of the survey methodology, survey effort and a map of the spatial distribution of area searched in relation to the predicted suitable habitat provided (Figure 4-8 Draft EIS Appendix J). No *Typhonium* spp. were recorded in the search areas, no leaf material was available for collection for genetic analysis. Suitable habitat for *T. praetermissum* was found to be present (using the description in DLRM, 2016) but no individuals were recorded. The likelihood of an important population being present is considered to be low. It is possible that the survey failed to detect a small number of individuals, however it is unlikely the survey failed to detect a large number of individuals. Therefore, any impact to this species as a result of clearing will not be significant.

ID # 59	Topic: Marine Environmental Quality	EIS section:	4.1
Comment	Concerned groups		
Technical report for the hydrodynamic modelling of discharge has insufficient data and makes false assumptions: • The reliability of the model is reduced by the use of only one years’ worth of data, undertaken in only two seasons. The model does not capture inter-annual variability. • The method of model validation is very poor. • The report incorrectly states that the waste discharged will be adequately diluted by the tidal processes however the Darwin Harbour is poorly flushed, especially in the dry season. • The pollutant outfall modelling is based on the hydrodynamic report and has inherited the same problems outlined above. Baseline studies need to be undertaken for known chemicals that form a component of the waste water discharge. The EIS needs to identify the existing water quality of the marine environment and propose management practices that ensure the Project will stay within an acceptable range of that. The EIS has interpreted “no change to natural values” as being the same as “within the limits of natural variation” and this is highly problematic. The full impacts of the how the chemicals in the waste water will interact in the environment and how the chemicals interact with each other needs to be investigated prior to the Project being commissioned.	ECNT, AFANT, Paspaley Pearling Company		
TNG Response			
Discharge of wastewater to the Darwin Harbour has been removed from the Project. For the Supplement TNG propose to recycle waste water through a WRP, reducing water demand for the Project by 65% and removing the need to discharge. For the Supplement TNG prepared a Marine and Coastal Assessment (Appendix P) that identified sensitive receptors in the marine environment in relation to the revised Project with no discharge. The assessment found there is low risk to the marine environment from the updated Project scope.			
ID # 60	Topic: Social, Cultural and Economic Surroundings – Human Health Impacts	EIS section:	3.5.4
Comment	Concerned groups		
Health impacts to those consuming food from the harbour, either recreationally, customarily or commercially gathered.	Paspaley Pearling Company		

TNG Response

Discharge of wastewater to the Darwin Harbour has been removed from the Project. For the Supplement TNG propose to recycle waste water through a WRP, reducing water demand for the Project by 65 % and removing the need to discharge. As a result, health impacts from consuming food from the harbour will not be affected by operations of the Project.

ID # 61	Social, Cultural and Economic Surroundings – Social and Cultural Impacts	EIS section:	3.5.4, 5
Comment		Concerned groups	
Impacts to tourism, recreational and customary use.		Paspaley Pearling Company	
Reputational impact to Darwin and the Darwin community and government.			

TNG Response

A discussion on Community resources, fairness and equity of the Project in light of the significant changes to the Project proposed in the Supplement is provided in **Section 3.5.4.3**. How the Project complies with the guiding principles for the National Strategy for Ecologically Sustainable Development (ESDSC 1992) are discussed in **Section 9 of the Draft EIS**. How the Project complies with the Northern Territory Principles of Ecologically Sustainable Development as listed in the EP Act are discussed in **Section 1**.

TNG LIMITED

SUPPLEMENT TO THE
ENVIRONMENTAL IMPACT STATEMENT
DARWIN PROCESSING FACILITY

**UPDATED
COMMITMENTS
REGISTER AND
PROJECT RISK
ASSESSMENT**

7. UPDATED COMMITMENTS REGISTER AND PROJECT RISK ASSESSMENT

7.1 COMMITMENTS REGISTER

Environmental commitments were developed for the Project as described within the Draft EIS. Whilst many commitments have been retained, some commitments have become redundant due to Project changes detailed within this document. All environmental commitments retained from the Draft EIS and developed for the Supplement are combined into the Consolidated Commitments Register attached as **Appendix R**. This supersedes the commitments register included in the Draft EIS as Appendix E.

7.2 RISK ASSESSMENT

The Project Risk Assessment provided within **Appendix Q** of the Supplement consolidates all applicable risks and impacts presented in the Draft EIS, in addition to the risks and impacts identified in the Supplement. The risk assessment presented as part of the Supplement supersedes the risk assessment presented in the Draft EIS Appendix G. Due to Project changes, some of the Project risks have been amended or completely removed due to a change in the risk rating or elimination of this risk as a result of further mitigation measures or changes in Project design.

The updated Risk Assessment broadly determines that the proposed Project changes have resulted in an overall reduction of impacts on the Environmental Factors, with the majority of residual impacts posing a low to moderate risk to all of the NT EPA's environmental objectives. This is particularly the case following removal of wastewater discharge to the Darwin Harbour and a reduction in water use requirements, which were identified through submissions to the Draft EIS as the main concerns raised. Impacts to the marine environment have been significantly reduced, or completely negated in some circumstances, as a result of the amended wastewater management strategy to treat and recycle all wastewater at the WRP rather than discharge into the Darwin Harbour.

Whilst the overall impact of the Project on the Environmental Factors has been reduced, new impacts have also arisen as a result of Project changes. Further advances in FEED and the inclusion of the WRP has resulted in additional waste streams being identified, which has created new risk pathways; however, through the development of appropriate mitigation measures and good management practices these risks are not likely to have a negative impact on the Environmental Factors and will be consistent with the NT EPA Environmental Objectives.

There is only one high residual risks associated with the following:

- Contamination of surface water and marine ecosystems by hazardous chemicals with known risk to aquatic ecosystems due to breaching of primary and secondary containment during a 1 in 10,000 AEP storm surge event

This risk is not expected to be unacceptable, but rather the high risk rating indicates that this would be a catastrophic event that can be mitigated to some extent by management and design, however it cannot be fully controlled or the risk eliminated. The likelihood of occurrence of this event is identified as rare.

TNG LIMITED

SUPPLEMENT TO THE
ENVIRONMENTAL IMPACT STATEMENT
DARWIN PROCESSING FACILITY

REFERENCES

8. REFERENCES

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SUPPLEMENT TO THE
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DARWIN PROCESSING FACILITY

APPENDICES

9. APPENDICES

APPENDIX A: DRAFT EIS SUBMISSIONS

APPENDIX B: REHABILITATION MANAGEMENT PLAN (APM 2020)

APPENDIX C: STORMWATER MANAGEMENT PLAN (ADVISIAN 2020)

APPENDIX D: TRAFFIC IMPACT ASSESSMENT (TONKIN 2021)

APPENDIX E: SAFETY DATA SHEETS

APPENDIX F: WASTE CHARACTERISATION (ENVIRONMENTAL GEOCHEMISTRY INTERNATIONAL 2021)

APPENDIX G: AIR QUALITY ASSESSMENT (VIPAC 2021)

APPENDIX H: NOISE IMPACT ASSESSMENT (VIPAC 2020)

APPENDIX I: GREENHOUSE GAS DISCUSSION PAPER (AURORA ENVIRONMENTAL 2021)

APPENDIX J: SIGNIFICANT FAUNA IMPACT ASSESSMENT (APM 2021)

APPENDIX K: GROUNDWATER IMPACT EVALUATION (ADVISIAN 2021A)

APPENDIX L: ACID SULFATE SOILS MANAGEMENT PLAN

APPENDIX M: ENVIRONMENTAL MANAGEMENT PLAN

APPENDIX N: FIRE MANAGEMENT PLAN

APPENDIX O: STAKEHOLDER AND COMMUNITY ENGAGEMENT PLAN (ELTON CONSULTING 2021)

APPENDIX P: MARINE AND COASTAL ASSESSMENT (ADVISIAN 2021B)

APPENDIX Q: PROJECT RISK ASSESSMENT

APPENDIX R: CONSOLIDATED COMMITMENTS REGISTER