

Chapter 6

Environmental Management Plan



NOONAMAH
RIDGE

INTRAPAC

6 ENVIRONMENTAL MANAGEMENT PLAN

6.1 BACKGROUND

This project is known as 'Noonamah Ridge'.

The project proposes a high quality, master-planned, rural community that provides a range of lot sizes and types, with an emphasis on retaining and enhancing the rural character and amenity of the area. It will comprise a maximum of 4,200 homes accommodating an estimated 11,000 people, and is envisaged to be delivered over a 30-year timeframe. It will consist of two villages that include local shops, services and community facilities. The development of one of these will occur during the first stage of the project. An enterprise area is also proposed to facilitate the generation of local employment opportunities.

The EIS Terms of Reference require that an Environmental Management Plan (EMP) be prepared and implemented to minimise or remedy environmental impacts identified in the EIS that result from either the construction or ongoing operations of the development. A risk assessment has been undertaken to identify the major risks to the project and thereby inform the EMP (see Chapter 6).

This EMP is a project-specific document that outlines the environmental management practices and principles to be followed for all phases of the project. It has been devised with reference to the *NTEPA Guideline for the Preparation of an Environmental Management Plan* (NTEPA 2015) and to *AS/NZS ISO 14001-2004 Environmental management systems – requirements with guidance for use* (Standards Australia & Standards New Zealand 2004). The EMP does not address any works that are required outside of the project area to connect Noonamah Ridge to existing services and roads networks. Such works will be the responsibility of NT Government agencies which have established processes for the assessment and management of potential environmental impacts relating to their activities.

Most design measures, and many management/mitigation measures that are not subdivision-specific, are described in detail in this EMP. For measures that are subdivision-specific, general management principles are given. The specifics will be provided in Construction EMP's prepared for each subdivision that will be required for the subdivision approvals' process – see Section 6.3.2 for detail.

6.1.1 Document structure

The aim of the EMP is to ensure that all project objectives and risks are identified, and that management actions, monitoring and reporting requirements are allocated in order to minimise the risks associated with the project. The EMP is based on knowledge of the proposed project activities and the existing environment, as presented in Chapters 2 and 3 of the EIS.

The EMP is divided into sections relating to particular aspects of the natural, cultural or social environment that will be affected by the development. Each section provides a summary of the general background information which informed the EMP – including legislation, environmental values relevant to the category, and potential impacts as identified through the risk assessment in the EIS. Management strategies and mitigation measures are then provided for each phase of the project – namely Design & Planning, Construction and Occupancy (i.e. the ongoing operational phase of development). For the Design & Planning phase, the general principles to be incorporated into the pre-development phase of the project are discussed. The Construction and Occupancy phases of the EMP are presented in tabular format. Each table includes the overall objective, and then the management strategies, monitoring requirements, performance indicators and corrective actions that will be adapted to achieve each objective.

Throughout this chapter, many mitigation measures have been labelled with a (P) to indicate an action that will be required and is typical within the planning process prior to subdivision approval being granted (see Section 1.6.5 for an explanation of the significance of this). The purpose of

attributing measures thus is to provide the reader with certainty that the measures will be implemented.

Reporting requirements and responsibilities are identified to demonstrate the structure that will be in place for implementation of the EMP. Monitoring has been designed to provide information on whether performance indicators are being achieved – allowing for continual improvement and review of management strategies. Corrective actions are included as potential amendments to the EMP in order to facilitate the feedback and revision process.

The EMP is designed to be an evolving document and, in some instances, to inform future management plans. Where the development of further plans is required, these have been highlighted. The EMP will be reviewed and updated annually to remain current with site activities.

Note: Reference is made in Construction sub-sections throughout to ‘contractor’. The development will require engagement of a civil and construction contractor who will be responsible for managing and undertaking all phases of the development, overseen by Intrapac. No company has yet been engaged. References to ‘contractor’ are therefore general, but are included to ensure future contractor requirements are identified.

6.1.2 Data supporting risk assessment

The sections and appendices of the EIS that contain contextual information that supports this EMP are displayed in Table 6-1.

Table 6-1. EIS references relevant to this chapter

Topic	Section in the EIS	Corresponding technical report in the EIS
Transport	Section 2.4	Appendix C1 – Traffic Impact Assessment
Electricity	Section 2.5	-
Biodiversity	Sections 3.7, 3.8 and 3.9	Appendix I – Flora and Fauna Assessment Report
Surface water	Section 3.6.1	Appendix F – Surface Water Quality Monitoring Report Appendix J – Aquatic Ecology Report
Groundwater	Section 3.6.2	Appendix E – Groundwater Report
Sewerage	Section 2.10	Appendix H – Land Capability Assessment Appendix G – Land Suitability Assessment
Noise	Section 3.16	-
Air quality	Section 3.15	-
Biting insects	Section 3.13	Appendix K – Biting Insects Assessment Report
Bushfires	Section 3.7.2	-
Cultural heritage	Section 3.14	Appendix L – Archaeological Survey Report

6.2 ACTIVITIES COVERED BY THE EMP

This EMP covers all three phases of the development – Design & Planning, Construction and Occupancy. The Design & Planning phase relates to that of the development as a whole, as well as each stage. This is the responsibility of Intrapac and, as such, is the phase over which Intrapac has the most influence. The Construction phase will have a Construction Environmental Management Plan (CEMP) for each stage as the over-arching management document. The development of the CEMP will be the responsibility of the construction contractor.

Most of the environmental management associated with the Occupancy phase – once the constructed works have been approved, undertaken and placed ‘off-maintenance’ – will be the responsibility of local or government authorities (as described in Section 2.3.7). Nevertheless, general management measures for that phase are presented as indications of likely measures that will be put in place.

6.3 IMPLEMENTATION THROUGH THE PLANNING PROCESS

6.3.1 Area Plan and Specific Use Zone

To ensure that the requirements of the EMP are followed through for the life of the project, the commitments described in Chapter 8 (which are the result of the management measures contained within this EMP) are included where feasible in the following documents that will be incorporated within the *NT Planning Scheme*:

- The Area Plan, which contains principles guiding high-level social and environmental objectives, and ensuring that areas requiring further environmental investigation are clearly identified (see Appendix O).
- The Specific Use Zone, which requires particular actions in relation to the lodgement of a subdivision plan, to achieve the requirements of the EMP within a particular stage application (see Appendix P).

The Specific Use zone will incorporate the environmental commitments within the EIS. This will require that all future subdivision applications address the commitments at the time of application, and places the requirement for the Development Consent Authority to take into account these requirements in their assessment of a subdivision application.

These documents will be submitted as part of Intrapac’s application to amend the *NT Planning Scheme*. This process will embed the EMP and associated commitments into the *NT Planning Scheme*, providing certainty that the measures will be implemented through the statutory development assessment and approvals’ process established by the *Planning Act*, as described in Section 2.1.

6.3.2 Subdivision

After rezoning approval is obtained – and before development can commence – a development application is required for subdivision of the site. Each development application is subject to comment by the public and relevant authorities (government departments, service providers etc.), and a technical assessment is provided to the Development Consent Authority (DCA). The DCA assesses the application and, if consenting, issues a permit. The permit usually contains conditions that incorporate the advice received during the comment period.

Examples of standard conditions for a subdivision development permit are:

Conditions precedent

- Prior to the commencement of works, an Erosion and Sediment Control Plan (ESCP) is to be submitted to, and approved by, the consent authority on the advice of the Department of Land Resource Management, and an endorsed copy of the plan will form part of the development permit. The ESCP should detail methods for minimising erosion and sediment loss from the site during the construction phase, with reference to the *IECA Best Practice Erosion and Sediment Control Guideline* (2008) and DLRM soil management resources.
- Prior to the commencement of works, the applicant is to prepare a schematic plan demonstrating the methods of onsite collect of stormwater and its discharge into the stormwater drainage system.

This plan shall be submitted to, and approved by, the Litchfield Council to the satisfaction of the consent authority.

- Prior to commencement of works, a Heritage Management Plan is to be submitted and approved by the consent authority.

General conditions

- The owner of the land must enter into agreements with the relevant authorities for the provision of water supply, sewage facilities, electricity supply and telecommunications to each lot.
- All existing and proposed easements and sites for existing and required utility services must be vested in the relevant authority and submitted for approval by the Surveyor General.
- Before the use starts, a Construction Environmental Management Plan must be submitted to, and approved by, the consent authority. The plan must include overall environmental objectives, procedures to minimise environmental impacts, monitoring programs and identification of risks relevant to the construction stage of the project.
- All road and intersections constructed for the development shall be to the standard of the Road Network Division.
- Stormwater is to be collected and discharged into the drainage network, which must incorporate Water Sensitive Urban Design (WSUD) techniques to manage stormwater within the site.
- The developer shall have carried out, in accordance with AS 3671-1989 *Acoustics – Road Traffic Noise Intrusion – Building Siting and Construction* (Standards Australia 1989), an assessment of the predicted noise levels, and noise attenuation works shall be carried out by the developer.
- There are statutory obligations under the *Weeds Management Act* to take all practical measures to manage weeds on the property.
- Before the issue of titles, firebreaks along boundaries or at temporary locations shall be slashed to the satisfaction of the consent authority on advice from Bushfires NT.
- A groundwater extraction licence is required under the *Water Act* for any bore equipped to supply over 15 litres per second.

Noonamah Ridge will be a staged development, comprising multiple unique subdivisions, each of which will require a separate subdivision application. These example conditions provided above are to indicate that, although an EMP has been devised for the EIS, each development application will necessitate further risk management and detailed mitigation work prior to development commencing.

Therefore, for some components of the development, instead of providing detailed management measures, this EMP contains overarching principles to guide the development of the specific management requirements that will arise from the particularities of each subdivision – e.g. erosion and sediment control, drainage and fire. For components of the development that are not influenced by differences between subdivisions – such as air quality and noise – specific management measures have been provided. Detail has also been provided in the instances where a particular component of the development requires tailored management measures – such as for certain threatened species.

6.4 MANAGEMENT STRUCTURE, ROLES AND RESPONSIBILITIES

Intrapac has overarching responsibility for the planning and delivery of each stage of the development. It is Intrapac's role to ensure that all of the commitments resulting from the EMP (as listed in Chapter 7) are contained within the Area Plan and Specific Use Zone amendments to the *NT Planning Scheme*. Intrapac will also be responsible for ensuring that the strategies for servicing the development comply with the EMP and that all conditions of development approvals are met.

A construction contractor will be engaged for each stage of the development. Compliance with the conditions of development approvals – including developing and implementing a Construction Environmental Management Plan (CEMP) – will be the responsibility of the contractor. Intrapac will be responsible for ensuring that approval conditions are communicated to the construction contractor, and for monitoring compliance.

Responsibility for ongoing management activities will lie with:

- Intrapac (or a contractor engaged by Intrapac) for sewage treatment and disposal
- Litchfield Council for the maintenance of public buildings, green space, roads and drainage works
- Power and Water Corporation for electrical, water and sewerage infrastructure
- Telstra and NBN Co for telecommunications infrastructure
- Department of Transport for public transport infrastructure.

6.5 TRANSPORT

Traffic in the local area will increase as the development proceeds and the number of residences and businesses grows. Consequently, a number of road upgrades will be required – including widening of existing roads, upgrades of intersections, extensions and new road links.

A stakeholder workshop held on 2 March 2015 identified the concerns of stakeholders and informed the management actions within this section.

Legislation, standards and guidelines

- *Planning Act*
- *NT Planning Scheme*
- *Waste Management and Pollution Control Act*
- *Water Act*
- *AS 2702-1984 Acoustics – methods for measurement of road traffic noise* (Standards Australia 1984)
- *AS 3671-1989 Acoustics – road traffic noise intrusion – building siting and construction* (Standards Australia 1989).

The *Litchfield Council Development Guidelines C – Road and Pathway Requirements* (2014c) stipulate how roads should be designed and constructed within subdivisions. The guidelines state that road designs must conform to the relevant current Australian Standards, AustRoads, Australian Road Research Board and all other relevant publications.

Other applicable Department of Transport (2014a) policies include:

- Access to Properties During Roadworks
- Performance and Design Standards for Northern Territory Government Roads
- Road Traffic Noise on NT Government Controlled Roads
- Road Safety Audits
- Stormwater and Drainage
- Street Lighting.

Existing environment

There is an existing road network within the local area but only a few rough tracks within the project area. Figure 2-11 shows the existing road hierarchy and overall road network within the local area. The Stuart Highway – a key road within the study area – is a National Highway and only 3.5 km (closest point) from the project area. Both Stuart Highway (north of Cox Peninsula Road) and Arnhem Highway (west of Humpty Doo) have moderate traffic volumes (i.e. numbers of cars) with more than 3,000 vehicles per day per direction. Traffic volumes are otherwise generally quite low within the local area due to the rural setting.

The main future road scheme proposed in the vicinity of the study area is a high-capacity road link between Stuart Highway and Palmerston via Channel Island Road, providing an alternative route to the Stuart Highway – see Figure 2-14. The NT Government timeframes for delivery of this scheme are not known, but it is not expected for some time.

Two bus routes currently provide services from Palmerston to the project area – see Figure 2-9. Services are provided for both routes Monday to Saturday, with neither having timetabled services on Sundays or public holidays. There are no footpaths or shared use paths in vicinity of the site due to the existing rural conditions and lack of development.

Potential impacts

- Increased traffic and possible congestion on surrounding roads
- Increased road noise
- Increased safety risks due to road and intersection traffic
- Strain on existing public transport and limited accessibility for non-car users within and to the site
- Increased pedestrian and cyclist traffic, and associated safety risks
- Increased congestion increasing local emergency service response times.

6.5.1 Design and planning

A *Traffic Impact Assessment* (TIA) completed for the EIS (see Appendix C1) provides comprehensive modelling of predicted traffic impacts and details required works for each stage of the development. All roads within Noonamah Ridge will be constructed by Intrapac, with ongoing maintenance by Litchfield Council. External road upgrades are the responsibility of DoI. Intrapac will collaborate with road authorities to ensure that the external road upgrades required are undertaken as the development progresses.

Noonamah Ridge is being designed to be relatively self-contained in the provision of residents' daily needs; thereby reducing the number of vehicle trips required (leaving Noonamah Ridge). To support this, a network of footpaths and bike paths will service residential areas and provide pedestrian access to the villages.

The proposed street network within the development is highly interconnected and allows for direct access to neighbourhoods, reducing the need for traffic on local collector roads. It is proposed to have the main access to the town centre either as an extension of Elizabeth Valley Road or an access road 800m north of Elizabeth Valley Road.

Two roads will soon be extended by the DoI – Goode Road and Alverly Road – as part of road upgrades to service the existing rural residential areas. These works will double the number of secondary roads between the site and the Stuart Highway.

C Intrapac will use the Strategic Traffic Model (currently being developed by the DoT) to validate the findings of the TIA. A Conceptual Road and Traffic Management Plan (and associated monitoring) has also been developed (see Appendices C2 and C3). Intrapac will collaborate with road and transport authorities as the project proceeds to ensure that:

- Staged upgrades and new road developments minimise congestion and ensure accessibility is maintained to the project area and surrounding regions, including access for emergency services.

- Staged upgrades to junctions address potential road safety issues at key intersections (e.g. Redcliffe Road/Freds Pass Roads)
- Interim 'park and ride' facilities within the site become a bus interchange servicing local and regional areas
- Final development design allows for 90 % of the dwellings to be within 600 m of a bus stop.

6.5.2 Construction

External roadworks

External roads are the responsibility of DoT and DoI. Intrapac will collaborate with these departments to ensure that the external road and junction upgrades required for each stage are undertaken as the development progresses. The environmental management of external road upgrades are not considered within the scope of this risk assessment because the responsible NT Government agencies have established processes for the assessment and management of potential environmental impacts relating to their activities.

Internal roadworks

C Under the *Litchfield Council Development Guidelines A* (2014a) an approved Traffic Management Plan (TMP) is required in accordance with *AS 1742.3-2009 Manual of uniform traffic control devices – traffic control for works on roads* (Standards Australia 2009a) prior to the commencement of any works in an existing road or road reserve. Where relevant, a *Permit To Work Within A Road Reserve* is required from Litchfield Council.

A TMP will be devised in consultation with, and submitted for approval to, both Litchfield Council and DoT for the construction of each stage of the subdivision. Each TMP will clearly outline all road works and traffic controls required at the subdivision stage, as well as monitoring and reporting requirements. The TMP's will provide opportunity for feedback of traffic monitoring data and consequent amendment (if required) to ensure that management measures are effective. General principles and standard measures are outlined below, and the TIA (see Appendix C1) should be referred to for more detail on planned future works.

Social and safety impacts

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
Impacts on existing road users and residents as a result of road works is limited to short-term inconvenience	Obtain all required permits and approvals from relevant authorities prior to works commencing	Internal audits of compliance with TMP Complaints log	Compliance with TMP audits No complaints to external agencies No reported pedestrian or vehicle safety incidents	Investigate complaint/non-compliance/incident Implement required remedial actions, e.g.: • Stakeholder consultation • Altered work hours • Improved traffic control
	C Devise and implement a TMP for each subdivision construction phase (using, as a base, the preliminary <i>Conceptual Road and Traffic Management Plan</i> – and associated monitoring – in Appendices C2 and C3). The TMP will include: • Use of traffic controls (signage etc.) for safety and to provide continued resident and public access to surrounding areas • Planning construction traffic routes, programs for deliveries, and dedicated waiting and parking areas to minimise impacts on local road users (i.e. avoid construction traffic during peak hours) • Re-routing pedestrian and cycle paths temporarily to minimise			

	nuisance and safety impacts			
Recording and reporting	Internal inspections and records Traffic Management Plan reporting All required documentation and permits for compliance with DoT policies			
Responsibility	Contractor			

Infrastructure

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
Impacts to existing road infrastructure avoided	C Pre-development survey of existing road conditions undertaken to enable monitoring of construction-related damage to roads	Routine monitoring of road conditions during construction	Existing roads in as good or better condition following completion of works	Repairs as required
Recording and reporting	Internal monitoring reports Reporting to DoT and/or DoI as required			
Responsibility	Contractor			

6.5.3 Occupancy

Infrastructure

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
All new road infrastructure to be accessible and operational	New road network included in Litchfield Council maintenance schedule and budget	None	Maintenance schedule and budget includes Noonamah Ridge	None
	Maintenance of roads and associated infrastructure (drains, lights etc.) undertaken regularly to remain functional	General infrastructure monitoring and/or condition reports	All infrastructure is in working order and accessible to users	Implement maintenance and repairs as required
	Maintenance of footpaths, bike paths and pedestrian infrastructure undertaken regularly to remain functional	Monitoring associated with the Conceptual Road and Traffic Management Plan		
Recording and reporting	Condition reports Maintenance and works records			
Responsibility	Litchfield Council for maintenance Intrapac for monitoring associated with the Conceptual Road and Traffic Management Plan			

6.6 WATER

This EMP has categorised water management according to quality and quantity.

Potable water for this development may come from two sources. It is anticipated that for Stage 1 the majority of the lots will receive potable water piped from bore-fields located within the project area. The remaining lots will be larger and will be located in an area within the project area in which it is possible for each lot to have its own bore (or else share with a few adjoining properties).

Concurrently with Stage 1, Intrapac intends to investigate the viability of the Koolpinyah Aquifer as an ongoing water supply for the remainder of the project. This aquifer is located on a pastoral lease that has the same owner as the project area. Water would be piped to the project area, pumped up to a water tank on an elevated site and then reticulated through the developed area. If the Koolpinyah Aquifer does not present as a feasible water supply for the project, Intrapac proposes to enter into a cost-sharing agreement with PWC to connect Noonamah Ridge to mains water supply.

Legislation, standards and guidelines

- *Waste Management and Pollution Control Act*
- *Water Act*
- *Water Supply and Sewage Services Act*
- *Public and Environmental Health Act and Regulations*
- *AS 1547-2012 – Onsite domestic wastewater management* (Standards Australia 2012)
- *Guidelines for Land Capability Assessment for Onsite Wastewater Management* (DoH 2014c)
- *Guidelines for Wastewater Works Design Approval of Recycled Water Systems* (DoH 2014a)
- *Litchfield Council Development Guidelines B – Stormwater Drainage* (2014b)

Existing environment

The key features of groundwater regionally, locally and within the project area are summarised below:

- The project area is situated within the Pine Creek Complex – a complex geological area with complex hydro-geology.
- There are numerous local users of groundwater in existing rural subdivisions concentrated to the west and north of the project area.
- Groundwater occurrence within the project area is variable in terms of yields, with at least one porous, high-yielding sandstone aquifer occurring adjacent to a major fault zone.
- The Koolpinyah Aquifer to the east and north-east of the project area provides high yields in areas where karstic development has occurred, although there has been an apparent overuse of the aquifer in some areas (Fell-Smith and Sumner 2011).
- Aquifer recharge is variable across the project area, depending on the occurrence of fracture zones (i.e. high recharge) or saprolitic clays in the low-lying areas (i.e. low recharge).
- Groundwater quality meets relevant drinking water quality guidelines.
- Two potential groundwater-dependent ecosystems (GDE's) have been identified on and adjacent to the project area – one in the central-eastern section and one just outside the project area to the south-east. The latter is also an Aboriginal sacred site – see Figure 3-22.

The characteristics of the surface water within and downstream of the project area are summarised below:

- The project area lies within two surface water catchments, with the majority being in the upper Elizabeth River catchment (major tributary of the Darwin Harbour catchment) and the remainder located within the Adelaide River catchment.
- Drainage within the project area involves narrow, rapidly-draining gullies and upland drainage lines (first-order) in the ridges and upper slopes, which capture and divert run-off toward the broad drainage floors and seasonal creek lines (second-order).
- The tributaries of Elizabeth River that flow from the project area are ephemeral, flowing only during the wet season and ceasing to flow early in the dry season (either drying completely or contracting to occasional pools).
- There are no known downstream consumptive users of surface water (i.e. extraction for water supply) from the project area, but there are likely to be significant recreational (e.g. fishing) and aesthetic values held by both the general public and local land-owners along the Elizabeth River and its tributaries.
- Land within the project area that may be susceptible to flooding is minimised by the relatively steep topography and rapid-draining upland areas. Modelling of the 1 % AEP undertaken for the largest catchment within the project area indicates that flooding may occur within 50 – 100 m of drainage lines.
- During the community consultation sessions held for this development, a number of residents of properties to the west of the project area indicated that since roadworks and drainage easement works were undertaken on Redcliffe Road approximately seven years ago, their properties have experienced seasonal flooding.
- The existing quality of water on the site is generally very good, with low turbidity and low concentrations of suspended solids, dissolved ions and heavy metals, but occasional elevated nutrient concentrations associated with seasonal flow conditions.
- Previous monitoring of water quality in the Elizabeth River indicates that some pollutants – mainly nutrients and suspended sediments – are often slightly elevated above guideline values; however, reporting by the NT Government has consistently assigned this system an 'excellent' water quality rating (DLRM 2014).

Potential impacts

- Inadequate supply of potable water due to insufficient groundwater available onsite or accessible from the Koolpinyah aquifer.
- Over-extraction of aquifers and reduced quantity of groundwater for residents, other existing users and the environment.
- Reduced quality of groundwater due to contaminants (such as from sewerage treatment systems and/or hazardous chemicals) impacting residents and surrounding users.
- Decreased recharge of aquifers and altered surface hydrology due to an increase in impervious surfaces, impacting users and GDE's.
- Altered surface hydrology (flow pathways and quantity of flows) impacting ecosystems, residents and downstream users.
- Reduced surface water quality – particularly during first flush rainfall events – associated with run-off from construction activities and from urbanisation of the catchment.

6.6.1 Design and planning

C Intrapac is committed to no significant changes to pre-development surface water quantity, quality and flows, and groundwater quality (as compared to baseline data). With this goal in mind, and mindful of the above-mentioned approval requirements, the development has been designed and planned to minimise the impact on surface water and groundwater in the following ways:

Potable water

- **C** A Groundwater Sustainability Study – including pump testing of groundwater bores – will be undertaken to verify the existence of a sustainable water supply for Stage 1 of the development, and to understand and predict the response of the aquifer to extraction.
- **C** The number of lots using bore water will be limited to that which can be supported by the available groundwater resources as discussed in Section 2.8.4.
- **C** Further investigations of the viability of the Koolpinyah aquifer as a long-term water supply for the project will be undertaken.
- **C** If further groundwater investigations reveal Koolpinyah aquifer to be an insufficient resource for stages of the development beyond Stage 1, the option for connecting to mains water remains available.
- **C** The potential for active recharge of aquifers using excess stormwater will be investigated.
- **C** Ways to manage and monitor water extraction by individual lots will be investigated, including the possibility of having multiple lots connected to a single bore (i.e. five lots to a bore).

Stormwater

- The *Litchfield Council Development Guidelines B – Stormwater Drainage* (2014b) stipulate how stormwater drainage should be designed and constructed within subdivisions. During the detailed design phase, approval from Litchfield Council will be required for the construction of all civil works, including drainage features.
- **C** Prior to each stage of development, hydrological modelling will be undertaken to predict potential changes in run-off characteristics (in each instance taking into account cumulative impact from any existing development). The results will be incorporated into a Stormwater Management Plan that will be developed for each stage of the subdivision. It will include details of the stormwater drainage design, aspects of water-sensitive urban design (WSUD), engineering of stormwater controls to maintain off-site discharges to pre-development flow rates, and drainage designs that do not pool to create mosquito-breeding habitat.
- **C** Design of each subdivision will retain riparian vegetation as buffers and filters for stormwater run-off in accordance with the buffering requirements specified in the *NT Planning Scheme*.
- **C** All stormwater infrastructure will be designed and engineered to the 1 % AEP (1 in 100-year event).
- In cases where major drainage infrastructure is proposed (such as detention pond with a > 3.0 m embankment) approval from the Department of Land Resources Management will be required.

Note: Some downstream residents experience seasonal flooding. Intrapac has committed to there being no significant changes to pre-development surface water quantity, quality and flows (as compared to baseline data). Consequently, the project design neither exacerbates nor improves flooding to these residents.

Sewerage

- **C** Land Capability Assessments (see, e.g., Appendix H) will be undertaken to inform the specific location of wastewater treatment facilities for all lots proposing to install individual wastewater systems, and to inform the specific location of all proposed community-scale wastewater treatment systems.
- Intrapac will gain the approval of DLRM, DoH and the NTEPA with respect to wastewater management for the development.
- **C** Wastewater treatment and land application systems – both individual lots and community-scale systems – will be sited and designed according to relevant standards and guidelines. These will dictate the relevant setbacks, buffers and design principles for minimising potential pollution events and impacts on groundwater and surface water resources (see Standards Australia 2012, DoH 2014b and THS 1996).
- For the community-scale sewerage treatment systems, wet weather retention will be accomplished through the use of an appropriately-sized sub-surface storage tank, rather than holding ponds, which minimises the infiltration of groundwater and stormwater into the system.

Effluent storage will be sized by considering the relevant climate data (historic rainfall for at least 50 years) for each site and optimised using MEDLI modelling. Historical flood event and climate data will also be used when determining the design and location of the wastewater treatment facilities. The programming of the system is designed to have a 100 % buffer capacity above the normal operating range to allow for unusual flows. To date, there have been no over-topping events in any of the operating IT systems, despite these systems having experienced some extreme events, including a record daily rainfall at an Amity Point facility near Brisbane.

- Irrigation of treated wastewater will be designed and operated in accordance with the *Guidelines for Wastewater Works Design Approval of Recycled Water Systems* (DoH 2014b) including development of an Irrigation Management Plan, obtaining a Wastewater Works Design Approval prior to installation of the systems, and obtaining Waste Discharge Licences.

6.6.2 Construction

Stage-specific management actions relating to both stormwater and contaminants will be outlined in the CEMP's required for each stage of the subdivision; however, general principles and standard measures are provided below for guidance. In addition to the CEMP's, it is standard for an ESCP developed by a suitably-qualified professional to be requested for approval by DLRM prior to commencement of works as a condition of development approval. Both the CEMP's and ESCP's for each subdivision stage will be reviewed and approved by DLRM prior to commencement of works.

Note: A Water Monitoring Plan (WMP) is mentioned in some of the monitoring sections that follow – this is detailed in Section 6.6.4.

Groundwater and surface water quality

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
No pollution of groundwater or surface water bodies as a result of construction	C Implement approved stage-specific CEMP for each subdivision that specifies storage and handling requirements for hazardous materials during construction	C Water monitoring to be implemented as per WMP	No significant change in ground and surface water quality from baseline data	Investigate causes of altered water quality
	C Implement ESCP as per Section 6.7, including temporary drainage and erosion and sediment controls	Visual inspections as per ESCP (see Section 6.7)		Improve ESC Remediate contaminated soil

	for each stage of development			
Recording and reporting	Water quality monitoring database Incident register maintained by construction contractor			
Responsibility	Construction Contractor for the CEMP's, ESCP's and spill response procedures, and for visual assessments of the ESC Intrapac for water quality monitoring and reporting, and follow-up investigation of exceedances			

6.6.3 Occupancy

Groundwater – quantity

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
No change in groundwater quantity and/or quality as a result of extraction for potable water sources	C Gauge bore-fields to ensure that extraction from individual bore and/or bore-fields is limited to < 20 % of the available resource per year (as determined by annual rainfall and specified by DLRM)	C Routine water monitoring as per WMP (particularly standing water levels in bores) Monitoring of aquifer water levels – as undertaken by DLRM	Extraction rates are limited to < 20 % resource	Access alternative options for water sources via PWC
	Investigate ways to manage and monitor water extraction by individual lots, including the possibility of having multiple lots connected to a single bore (i.e. five lots to a bore)		Standing water levels data do not indicate pattern of ongoing drop in water levels (excluding natural seasonal fluctuations)	Investigate options for active recharge of aquifers
	Minimise water use through community education and recycling programs			
Recording and reporting	Water monitoring database (particularly water level data) DLRM water data portal			
Responsibility	Intrapac			

Surface water – quantity

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
No change in surface water quantity and flows as a result of the development	Maintain stormwater infrastructure to ensure flows are not impeded, drainage is adequate and pre-development flows are maintained off-site	C Routine water monitoring as per WMP (specifically flows)	No significant difference between measured and modelled flows	Investigate causes of altered water quantity Modify drainage infrastructure
Reporting	Water quantity monitoring database			
Responsibility	Litchfield Council for stormwater infrastructure maintenance Intrapac for water quantity monitoring			

Groundwater and surface water quality

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
No significant change in groundwater and surface water quality from pre-development conditions	Maintain WSUD features, detention basins and drainage outlets	C Routine water monitoring as per the WMP	No exceedance of site-specific trigger values *	Investigate causes of altered water quality Adapt water management infrastructure, maintain/repair wastewater management systems, or update Irrigation Management Plan
	C Design, operate and maintain all wastewater management systems in accordance with standards and guidelines, and obtain required approvals from DoH and other departments			
	C Implement an Irrigation Management Plan for the community-scale wastewater treatment systems – including modular, rotational irrigation and wet season contingencies			
Recording and reporting	Stormwater infrastructure inspection and maintenance records Water quality monitoring database			
Responsibility	Intrapac for stormwater infrastructure design and water quality monitoring Wastewater treatment plant operator for wastewater measures Litchfield Council for fertiliser use and stormwater infrastructure maintenance			

* Water quality data will be compared to the Darwin Harbour Water Quality Objectives for freshwater rivers and streams (DNRETAS 2010a) and the ANZECC (2000) guidelines for 95 % species protection (slightly-to-moderately disturbed ecosystems) of aquatic ecosystems until sufficient baseline data is available for the development of site specific trigger values, as per the ANZECC guidelines format for development of site specific trigger values.

6.6.4 Water Monitoring Plan

The proposed Water Monitoring Plan (WMP) for the development is outlined in Table 6-2 and Table 6-3. In addition to routine water quality monitoring, treated effluent from the community-scale wastewater treatment systems will be monitored on an ongoing basis to confirm the effectiveness of the system. Data loggers will be installed to provide real-time water quality data. It will be the responsibility of the future operator of the system to implement monitoring procedures and training as required.

Water quality data will be compared to the Darwin Harbour Water Quality Objectives (WQO's) for freshwater rivers and streams (DNRETAS 2010a). Parameters that are not provided in the WQO's will be compared to the default ANZECC (2000) guidelines for 95 % species protection (slightly-to-moderately disturbed ecosystems) of aquatic ecosystems. Site-specific trigger values will be developed in future once sufficient baseline data is available, in accordance with the framework provided in the ANZECC guidelines. Refer to the *Surface Water Quality Monitoring Report* in Appendix F for an example of how the trigger values are applied to water quality data.

Creek flows will be monitored using auto-loggers at stream gauging stations located at monitoring sites NRSW02 and 03. The data will be compared with the flows expected from the hydrological modelling and any significant deviations will trigger the management actions mentioned above.

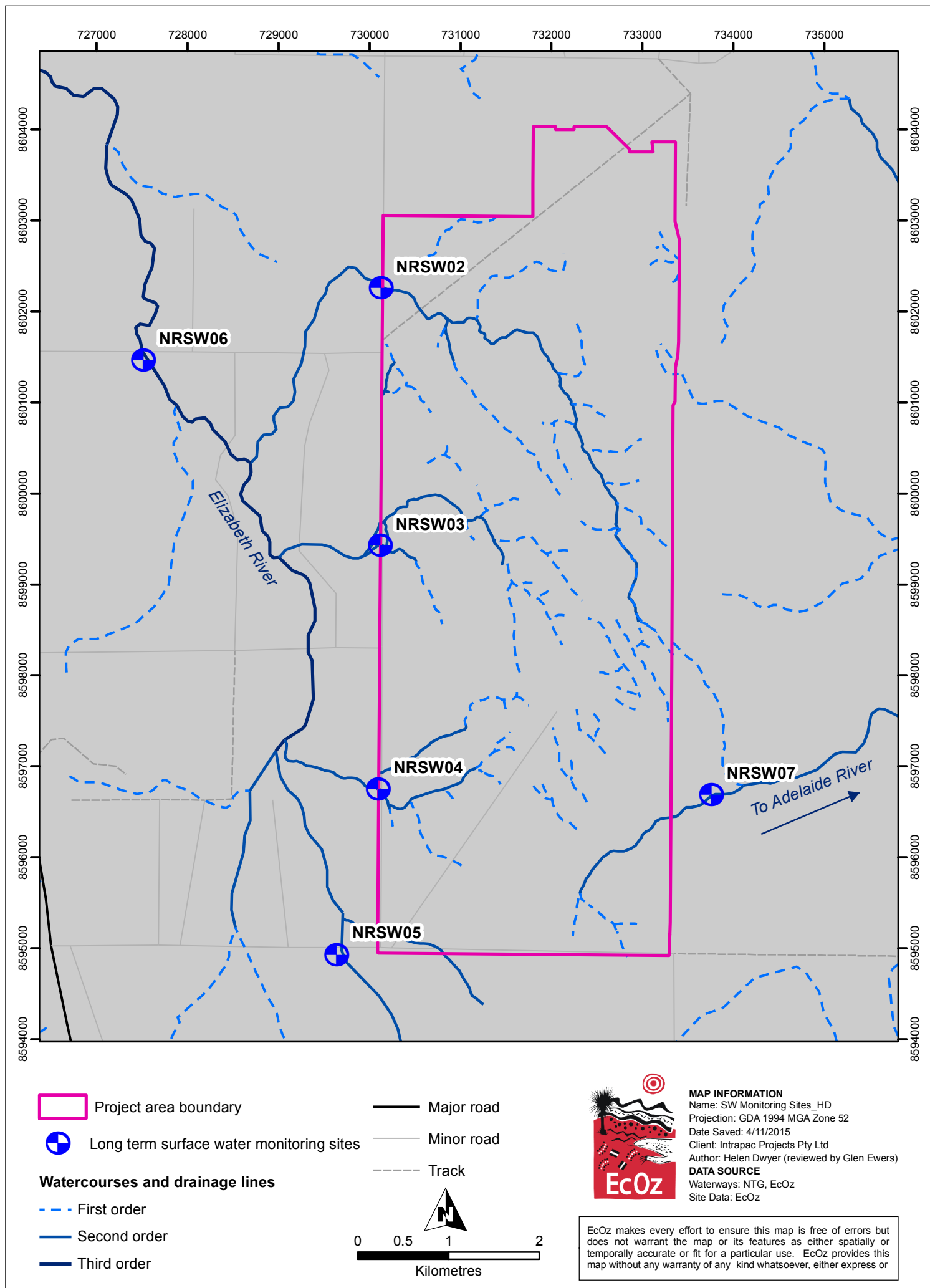


Table 6-2. Stormwater monitoring plan

Monitoring sites	Frequency	Measurements/Analytes
Stream monitoring sites: NRSW02 – NRSW07 (see Figure 6-1)	Construction periods: <u>Downstream:</u> Monthly NRSW02–NRSW04 (whichever are downstream of active construction) and NRSW06 <u>Upstream (Control):</u> Monthly NRSW05 and NRSW07 Ongoing: Annually at all sites during the late wet season recessional flow period	Field measurements: Stream flows (i.e. readings from gauge boards installed at each monitoring site, relating to stream flows). Records should reflect whether flowing or standing water is sampled. Temperature, pH, oxidation-reduction potential (ORP), electrical conductivity (EC), total dissolved solids (TDS), dissolved oxygen (DO) and turbidity. Laboratory analyses: • Total suspended solids (TSS) • Major anions (Cl, SO₄, CO₃/HCO₃, and NO₃) and cations (Ca, Mg, Na and K) • Dissolved metals (Al, As, Cd, Co, Cr, Cu, Mn, Ni, Pb, Zn and Fe) • Ammonia and nutrients (NO₂, NO₃, TKN, Total N and Total P) • <i>E. coli</i> and <i>Enterococci</i>

Table 6-3. Groundwater monitoring plan

Monitoring sites	Frequency	Measurements/Analytes
Monitoring bores: Specific locations to be determined but based on the following: 1) <i>Water supply extraction</i> For each community supply bore, two monitoring bores to be installed/sampled – one in immediate vicinity (e.g. < 100 m) and one downstream (e.g. 500 – 1000 m). 2) <i>Community wastewater disposal areas</i> For each community wastewater disposal irrigation area, two monitoring bores to be installed/sampled – one in immediate vicinity (e.g. < 100 m) and one downstream (e.g. 500 – 1000 m).	Ongoing: Bi-annually (i.e. late wet season and late dry season) at all sites	Field measurements: Standing water levels Temperature, pH, oxidation-reduction potential (ORP), electrical conductivity (EC), total dissolved solids (TDS), dissolved oxygen (DO) and turbidity. Laboratory analyses: • Major anions (Cl, SO₄, CO₃/HCO₃ and NO₃) and cations (Ca, Mg, Na and K) • Dissolved metals (Al, As, Cd, Co, Cr, Cu, Mn, Ni, Pb, Zn and Fe) • Ammonia and nutrients (NO₂, NO₃, TKN, Total N and Total P)



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ14400 - Noonamah Ridge Estates EIS\01 Project Files\EMP\Long term SW monitoring locations.mxd

Figure 6-1. Map of surface water monitoring sites

6.7 EROSION AND SEDIMENT CONTROL

Erosion of soil, and subsequent sedimentation, is a natural process that is often exacerbated by construction works involving disturbance of ground cover and soil, removal of vegetation, and excavation and stockpiling of soils – particularly when these occur in areas of steep slope or erosive soils.

The Noonamah Ridge development is still in the preliminary design and planning phase, and so the detail required to create an ESCP for any stage (let alone the whole development) does not yet exist. Instead, this section provides overarching principles – in accordance with industry best practice and relevant guidelines (see below) – for incorporation into future ESCP's. It should be read in conjunction with the Water Management Plan (Section 6.6) which discusses drainage management for the project area.

Legislation, standards and guidelines

- *Soil Conservation and Land Utilisation Act*
- *Water Act*
- *Waste Management and Pollution Control Act*
- *IECA Best Practice Erosion and Sediment Control (2008)* and associated guideline documents – see example standard drawings for controls in Addendum
- *Land Suitability Assessment Guidelines (DLPE 2013)*

Also, the following guidelines from the DLRM website:

- *Erosion and Sediment Control for Residential Building Sites*
- *Road Drainage*
- *Water Movement and Drainage*
- *Model Erosion and Sediment Control Plans (ESCP) for Rural Development Fact Sheets:*
 - *ESCP for Rural Development*
 - *ESCP Overview Map*
 - *ESCP Map for Improved Pasture and Development*
 - *ESCP Map for Orchard Development*

Existing environment

The project area is naturally vegetated with the exception of some tracks and small disturbance footprints throughout. The key features of the project area that will influence erosion and sediment control requirements are:

- **Slope:** The *Land Suitability Assessment Guidelines (DLPE 2013)* stipulate that areas of moderate slope (0.75 – 5 %) to steep slope (> 5 %) are of moderate to high risk respectively for erosion and sediment issues, and so an ESCP and ongoing land management are required. For the project area, mapping based on contour data and field surveys indicates that 1,505 ha of the project area has a slope range of 0.75 – 5 % and 249 ha of the project area has a slope range of > 5 %.
- **Soil:** Generally, soils with higher silt and/or clay content have greater erosivity (compared to sandy or loamy soils). Detailed soil analysis has not been undertaken for most of the site.
- **Exposure:** Surface cover, either in the form of vegetation or gravel reduces the exposure of soils to erosive forces such as wind and rain. Removal of natural cover during land clearing will therefore increase the risk of erosion throughout the project area.

Potential impacts

- Reduced amenity values (e.g. access to areas, visual amenity) due to erosion of topsoil and creation of erosion gullies or sheet erosion.
- Damage to habitat and ecosystems due to erosion.
- Damage to habitat and ecosystems due to sedimentation, particularly significant habitat in areas that are at risk of sedimentation due to the drainage and deposition patterns (e.g. plains and sandsheet heath).
- Compromised ecosystem health and habitat smothering due to sedimentation of riparian habitat and creek lines.
- Reduced visual amenity and recreational (swimming and fishing) usage due to sedimentation in waterways within and downstream of the project area.
- Increased or decreased creek flows from altered drainage pathways due to erosion and sediment deposition.
- Creation of mosquito breeding habitat in eroded areas or sediment depositional zones that impede free drainage and create pooling water (refer to Biting Insects Management Plan).

6.7.1 Design and planning

A *Land Suitability Assessment* (LSA) is a requirement for all developments that are subject to Clause 11.4.1 (Site Characteristics of Subdivisions of Rural and Unzoned Land) of the *NT Planning Scheme*. The *NT Land Suitability Guidelines* (DLPE 2013) stipulate how to assess rural subdivisions to demonstrate that the proposed development has sufficient unconstrained land to support planned uses. Such an assessment has been undertaken for the entire site – see Appendix G. The development will be guided by the LSA to ensure that each subdivision is designed and planned to minimise erosion and sedimentation. This may be achieved in the following ways:

- **C** Contour maps and high-risk erosion areas (as identified in the LSA) will be referred to when planning and designing subdivision to apply adequate controls when working in these areas, and/or avoid disturbance.
- **C** The infrastructure (such as roads and stormwater drainage) for each subdivision will be designed to accommodate existing topography and landforms, and minimise creating erosion-prone infrastructure (e.g. not creating concentrated flow, minimising crossing drainage areas and creeks).
- Each subdivision will be designed such that minimal clearing is undertaken, particularly in steep areas. There will also be private land clearing restrictions – see Section 2.2.3.

6.7.2 Construction

C Construction works for Noonamah Ridge will require a specific Erosion and Sediment Control Plan (ESCP) developed by a suitably-qualified professional for each stage of the development, to be assessed and approved by DLRM prior to commencement of works as condition of development approval under the *Planning Act*. Stormwater management will also play a large role in minimising erosion and sedimentation through diverting and managing drainage around the site, particularly during the construction phases when exposed surfaces and soil disturbance will occur. General principles and standard measures are outlined in this sub-section to guide the development of stage-specific ESCP's.

Erosion

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
No significant erosion of disturbed areas will occur as a result of construction activities	Plan, design and manage work areas in accordance with IECA guidelines* for construction	Weekly inspections of disturbance areas, relevant waterways and erosion controls Inspections of controls and drainage outlets immediately following rainfall events	No visible erosion in work area No unauthorised clearing or earthworks 80 % cover achieved on disturbed areas from Oct to Apr	Review and revise ESCP Maintain/repair ESC devices Cease high risk works in the wet season (Oct to Apr) if erosion is cannot be controlled
	Plan, map, survey and flag cleared areas to minimise unauthorised clearing			
	Progressively stabilise (either through temporary cover or permanent revegetation) disturbed areas as soon as practicable			
	Maintain all erosion and sediment controls in working order			
	Install temporary cover (e.g. mulch or geotextile) to maximise ground cover during wet season (Oct to Apr)**			
Recording and reporting	Internal inspection records Incident register Additional reporting requirements of development permits (if applicable)			
Responsibility	Intrapac to develop ESCP Contractor to implement and monitor ESCP			

* Refer to standard drawings in Addendum, which comply with IECA standards.

** Rainfall is a key driver of erosion in the Top End and at least 80 % cover of exposed surfaces is required. Cover includes mulch, grass, gravel and geotextiles (refer to IECA guidelines).

Drainage

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
Stage-specific drainage will be designed and installed to minimise erosion and sediment control	Install temporary or permanent (as appropriate) drainage structures and culverts to direct clean run-off around disturbance areas and to capture all 'dirty' run-off*	Weekly inspections of drainage and disturbed areas	No increase in turbidity and/or total suspended solids in downstream waterways	Investigate cause of drainage issues
	Design drainage to avoid creating concentrated flow, unless directing captured stormwater to a sediment basin or designed capture point			Maintain/repair ESC devices
	Avoid earthworks between Oct and Apr where possible (highest chance of rainfall and increased erosion risk)	Monitoring for turbidity and total suspended solids (refer to Water Monitoring Plan)		Review and update ESCP
	Ensure any run-off from within disturbance areas is captured by sediment controls in accordance with the ESCP			Install larger, alternative or more drainage controls
Recording and reporting	Internal inspection records Additional reporting requirements of development permits (if applicable)			
Responsibility	Contractor to develop, implement and monitor ESCP			

* Refer to standard drawings in Addendum, which comply with IECA standards, and to IECA guidelines for other examples including catch drains, diversion channels and compost berms that divert clean run-off around and away from disturbance area.

Sedimentation

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
Avoidance of sediment moving off-site	Maximise sediment retention onsite with stage-specific controls; e.g. install sediment fences downslope of disturbed areas*	Weekly inspection of controls and areas downstream	No increase in total suspended solids and/or turbidity in downstream waterways	Investigate cause of sedimentation issue
	Stockpile and cover soils (fine silty or clay soils may be stockpiled separately and covered) in accordance with IECA guidelines	Weekly inspections of stockpiles to monitor for erosion		Maintain/repair ESC devices
	Maintain controls to maximise effectiveness (i.e. repair silt fences, clear out captured sediment)	Additional inspections of all areas immediately following rainfall events	No visual sediment loss from stockpiles	Review ESCP and amend as required
	Plan sediment management around site constraints (e.g. do not stockpile on steep slopes, install sediment traps where required)		All sediment controls in working order and have sufficient capacity	Install more, larger, alternative or more controls Cover or relocate stockpiles
Recording and reporting	Internal inspection records Additional reporting requirements of development permits (if applicable)			
Responsibility	Contractor to develop, implement and monitor ESCP			

* Refer to standard drawings in Addendum, which comply with IECA standards.

Standard drawings are provided in the Addendum below for proposed erosion, drainage and sediment controls.

6.7.3 Occupancy

Erosion

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
Erosion is absent from established subdivision areas	Design and maintain all permanent structures (e.g. WSUD features, drainage outlets and roads) in accordance with IECA guidelines* to minimise inadvertent erosion issues	Visual inspections	No visible or ongoing erosion issues in final landforms	Investigate cause of erosion issues
	C Minimise clearing on individual lots through the use of building envelopes <i>Note: Clearing in excess of 1 ha requires an approval.</i>		80 % cover established and maintained on all final landforms	Amend landforms, revegetate, and undertake maintenance works (weeding, slashing etc.)
	Landscape and maintain final landforms** to maximise ground cover, and align with surrounding topography to avoid creating preferential flow paths			
	Slash (rather than grade) fire breaks to maintain ground cover	Not applicable	No erosion along fire breaks	Not applicable
Recording and reporting	Future maintenance records from Litchfield Council			
Responsibility	Individual rural lot owners for lot management, clearing and erosion control Contractor for construction and installation according to guidelines			

	Intrapac for design Litchfield Council and/or PWC for public open space and infrastructure
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* Refer to standard drawings in Addendum, which comply with IECA standards.

** Final landforms are those that, during development, had their existing vegetation cover disturbed/cleared and therefore require landscaping.

Drainage

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
Permanent drainage structures will not create erosion or sedimentation issues within the project area or downstream waterways	Maintain and/or repair drainage structures as required to ensure effectiveness and function in accordance with design specifications	Ongoing water quality monitoring (turbidity and total suspended solids) – refer to Water Monitoring Plan	No increase in turbidity or total suspended solids in waterways within or downstream of project area	Investigate cause of erosion or sedimentation
		Visual inspections	No visible erosion of drains, waterways or structures/no complaints received	Maintain infrastructure (e.g. slashing grass, sediment removal, repairs)
Recording and reporting	Water quality monitoring database and reporting Future maintenance records from Litchfield Council			
Responsibility	Intrapac for design and monitoring Litchfield Council and/or PWC for maintenance of public open space and infrastructure			

Addendum - Examples of ESCP measures

GENERAL NOTES:

1. TIMEFRAME FOR CONSTRUCTION/ESC WORKS, START 9TH OF JUNE, END 1ST OF AUGUST.
2. MULCH BERM CAN BE USED IN LIEU OF SEDIMENT FENCE.
3. CLEAR 4.0m WIDE FIRE BREAKS ALONG ALL BOUNDARIES THAT DO NOT FRONT A ROAD BY REMOVING VEGETATION. A RAISED BLADED MACHINE IS TO BE USED AS PREFERRED METHOD. ENSURE SOIL IS NOT DISTURBED. WINDROWS ARE NOT PERMITTED. DRAG BACK OVER TO REMOVE.
4. MAX 1 IN 4 BATTERS FOR ALL EARTHWORKS UNLESS NOTED OTHERWISE.
5. ALL OPEN DRAINS SHALL BE TRAPEZOIDAL IN SHAPE WITH 2.5m BASE & 1 IN 4 MAX BATTERS UNLESS NOTED OTHERWISE.
6. VEHICLE & CONSTRUCTION PLANT ACCESS IS RESTRICTED TO THE PROPOSED ROAD AREA & CLEARED FIRE BREAKS. NO ACCESS OR DISTURBANCE ACROSS THE LOTS IS PERMITTED.
7. THE CONTRACTOR SHALL COMPLY WITH THE CURRENT VERSION OF LITCHFIELD COUNCIL PLANNING - DEVELOPMENT GUIDELINES NOTES FOR LANDSCAPE.

LITCHFIELD COUNCIL

1. GIVE A MINIMUM 48 HOURS NOTICE TO THE LITCHFIELD COUNCIL OF INTENDED COMMENCEMENT DATE AND PROGRAMME OF WORKS. ALL NOTIFICATIONS SHALL BE IN WRITING.
2. CONTACT LITCHFIELD COUNCIL & OBTAIN A PERMIT TO WORK WITHIN A ROAD RESERVE PRIOR TO THE COMMENCEMENT OF ANY WORK WITHIN THE ROAD RESERVE.
3. "AS CONSTRUCTED DRAWINGS" FOR ROADWORKS AND STORMWATER DRAINAGE SIGNED BY THE DEVELOPERS CONSULTANT SHALL BE LODGED WITH LITCHFIELD COUNCIL BY THE CONSULTANT PRIOR TO HANDOVER.
4. ALL WORKS TO BE CARRIED OUT TO LITCHFIELD COUNCIL REQUIREMENTS.
5. GIVE A MINIMUM OF 48 HOURS NOTICE TO LITCHFIELD COUNCIL TO ATTEND HOLD POINTS IN ACCORDANCE WITH THE CURRENT VERSION OF THE LITCHFIELD COUNCIL PLANNING - DEVELOPMENT GUIDELINES. ALL NOTIFICATION SHALL BE IN WRITING.

EROSION CONTROL

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE CONTROL OF ALL TRAFFIC INTO AND OUT OF THE SITE, INCLUDING THE MOVEMENT OF CONSTRUCTION TRAFFIC WITHIN THE SITE AND SHALL MAINTAIN DUST SUPPRESSION MEASURES TO THE SATISFACTION OF THE SUPERINTENDENT.
2. BEFORE CLEARING COMMENCES AREAS OF VEGETATION NOMINATED FOR PROTECTION SHALL BE FLAGGED OR FENCED AND INSPECTED BY THE SUPERINTENDENT. CLEARING OF VEGETATION SHALL BE RESTRICTED TO THE NOMINATED AREAS.
3. SILT FENCING SHALL BE INSTALLED BEFORE COMMENCING EARTHWORKS.
4. SILT FENCING AND MULCH BERMS SHALL BE PLACED ON CONTOUR WHEN POSSIBLE. WHEN NOT POSSIBLE INSTALL RETURN PANELS AT REGULAR INTERVALS OF 20m MAX.
5. ALL DISTURBED AND UNSEALED AREAS SHALL BE DAMPENED AND ROLLED TO SEAL THE SURFACE TO MINIMISE DUST.
6. ALL TEMPORARY EARTH BERMS AND DIVERSION EMBANKMENTS SHALL BE MACHINE COMPACTED AND MAINTAINED.
7. INSTALL ALL EROSION AND SEDIMENT CONTROL MEASURES PRIOR TO THE COMMENCEMENT OF CONSTRUCTION ACTIVITIES.
8. INSPECT SEDIMENT CONTROL STRUCTURES WEEKLY AND AFTER STORMS FOR STRUCTURAL DAMAGE OR CLOGGING. REMOVE ALL TRAPPED SILT TO MAINTAIN STORAGE CAPACITY. REPAIR ANY DAMAGE AND MAKE GOOD TO THE SATISFACTION OF THE SUPERINTENDENT.
9. SILT REMOVED FROM SILT TRAPS SHALL BE DUMPED AT A LOCATION THAT PREVENTS SILT RE-ENTERING THE SYSTEM. LOCATION SHALL BE TO THE APPROVAL OF THE SUPERINTENDENT.
10. DIVERT ALL STORMWATER RUNOFF AWAY FROM DISTURBED GROUND AND INTO INTACT NATIVE VEGETATION OR THE STORMWATER DRAINAGE SYSTEM.
11. COMPLETE ALL FINAL EROSION PREVENTION MEASURES PRIOR TO FINAL HANDOVER INSPECTION. MAINTAIN ALL CONTROL DEVICES UNTIL THE END OF THE DEFECTS LIABILITY PERIOD.
12. ADDITIONAL EROSION CONTROLS MAY BE REQUIRED DURING CONSTRUCTION AS DETERMINED BY THE SUPERINTENDENT IN CONSULTATION WITH THE DEPARTMENT OF LAND RESOURCE MANAGEMENT (DLRM).
13. ANY CHANGES TO THE EROSION AND SEDIMENT CONTROL PLAN SHALL BE SUBMITTED BY THE CONTRACTOR TO SUPERINTENDENT FOR APPROVAL PRIOR TO COMMENCEMENT.
14. ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE UNDERTAKEN TO THE SATISFACTION OF THE SUPERINTENDENT AND DLRM.
15. WATER QUALITY MONITORING SHOULD BE CARRIED OUT FOR ANY CONTROLLED DISCHARGE. IT IS RECOMMENDED THAT DEWATERING ACTIVITIES SHOULD TAKE ALL REASONABLE AND PRACTICABLE MEASURES TO ACHIEVE A MAXIMUM 75 NEPHELOMETRIC TURBIDITY UNITS (NTU).
16. REMOVE TEMPORARY ESC DEVICES AT THE END OF THE DEFECTS LIABILITY PERIOD. SURFACES TO BE MADE GOOD TO MATCH SURROUNDING AREAS.

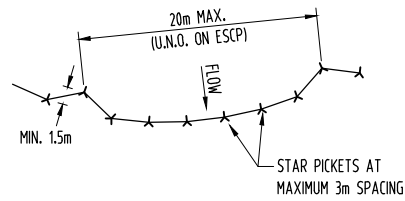
TOPSOIL AND GRASSING

1. RE-SPREADING OF STRIPPED TOPSOIL OR SPREADING OF IMPORTED TOPSOIL AND GRASSING SHALL BE UNDERTAKEN BY 30TH SEPTEMBER TO ALLOW THE BEST OPPORTUNITY FOR GERMINATION OF SEEDS.
2. THE RESPONSIBILITY LIES WITH THE DEVELOPER TO ENSURE THAT COUNCIL'S REQUIREMENT OF 60% COVERAGE OF GRASS IS PERFORMED PRIOR THE DEVELOPER SEEKS THE ON MAINTENANCE CERTIFICATE FROM COUNCIL (PLEASE REFER TO THE DOCUMENT PART A: GENERAL PLANNING REQUIREMENTS, SECTION ON MAINTENANCE REQUEST).
3. IF 60% GRASS COVERAGE IS NOT ACHIEVED BY THE TIME OF THE ON MAINTENANCE INSPECTION REQUEST, THE DEVELOPER SHALL INSTALL THE REQUIRED EROSION AND SILT CONTROL MEASURES IN ACCORDANCE WITH THE APPROVED ESCP, AND SUBMIT AN APPLICATION TO BOND THE VALUE OF THE RE-ESTABLISHMENT OF GRASS (PLEASE REFER TO THE DOCUMENT PART A: GENERAL PLANNING REQUIREMENTS, SECTION BOND - OUTSTANDING WORKS).
4. THE DEVELOPER IS ENCOURAGED TO MONITOR THE GROWTH OF GRASS OVER THE DEFECTS PERIOD OF LIABILITY TO ENSURE SPECIFIED COVERAGE IS ACHIEVED.
5. GRASS COVERAGE IS TO BE NOMINALLY 60% AT THE COMPLETION OF THE LITCHFIELD COUNCIL DEFECTS PERIOD OF LIABILITY. SHOULD THE COVERAGE OF GRASS DOES NOT COMPLY WITH THE SPECIFICATION PROVIDED ON THESE GUIDELINES, COUNCIL MAY UTILISE THE BOND AMOUNT TO ACHIEVE THE REQUIRED RE-ESTABLISHMENT OF GRASS IN CASE THE DEVELOPER TAKES NO APPROPRIATE ACTION.
6. STRIP EXISTING TOPSOIL AND STOCKPILE AT THE LOCATION NOMINATED IN THE ESCP OR WINDROW BESIDE THE ROAD FORMATION. TO THE MAXIMUM DEGREE PRACTICABLE, TOPSOIL SHOULD NOT BE MIXED WITH SUBSOIL DURING THE STRIPPING AND STOCKPILING PROCEDURE.
7. THE TOP 50MM OF SOIL SHOULD BE STOCKPILED SEPARATELY AND RE-SPREAD AS THE TOP LAYER. HOWEVER, IF THE SOIL CONTAINS EXCESSIVE WEED SEED THEN THE TOP 50MM LAYER MAY NEED TO BE BURIED OR OTHERWISE TREATED TO PREVENT THE SPREAD OF WEEDS.
8. AS IT IS DESIRABLE TO RETAIN THE VIABLE SEED CONTENT OF THE SOIL, STOCKPILING SHOULD CONSIST OF LONG LOW MOUNDS NO GREATER THAN 1 TO 1.5M IN HEIGHT. STRIPPED TOPSOIL SHOULD BE USED AS SOON AS POSSIBLE (FOR SEED VIABILITY), AND PREFERABLY NOT STOCKPILED FOR MORE THAN 12 MONTHS. LONG-TERM STOCKPILES MAY NEED TO BE MULCHED OR TEMPORARILY VEGETATED TO PREVENT WEED INFESTATION AND LOSS OF MATERIAL.
9. SOILS MAY NEED ADJUSTMENT WITH A COMBINATION OF FERTILISERS AND AMELIORANTS TO IMPROVE BOTH THE SHORT AND LONG TERM SUCCESS OF VEGETATION ESTABLISHMENT. FERTILISERS MUST BE APPLIED IN ACCORDANCE WITH MANUFACTURER'S GUIDELINES, OR SITE-SPECIFIC SPECIALIST ADVICE.
10. PRIOR TO THE APPLICATION OF THE TOPSOIL, LIGHTLY RIP THE FINISHED EARTHWORKS TO A DEPTH OF 50-100MM ENSURING RIPPING OPERATIONS OCCUR ALONG THE CONTOUR.
11. SPREAD TOPSOIL TO A LIGHTLY COMPACTED (I. E. FIRM) DEPTH OF ABOUT 40 TO 60MM WHERE THE SLOPE EXCEEDS 6:1(H:V) AND 75 MM ELSEWHERE. WHERE IT IS DESIRABLE TO RE-ESTABLISH THE ENTRAPPED SEED CONTENT OF THE SOIL, THE TOPSOIL SHOULD BE RE-SPREAD IN THE REVERSE SEQUENCE TO ITS REMOVAL SO THAT THE ORIGINAL UPPER 50MM SOIL LAYER IS RETURNED TO THE SURFACE.
12. IF EXISTING STRIPPED TOPSOIL LIMITED, IMPORT CLEAN, WEED FREE TOPSOIL AS REQUIRED.
13. UTILISING A PAD FOOT ROLLER (NOT VIBRATING) COMPLETE ONE PASS OVER THE TOPSOIL AREA TO INTRODUCE SURFACE ROUGHNESS.
14. APPLIED GRASS MUST BE SOWN WITH A MIX AND RATE APPROVED BY THE LITCHFIELD COUNCIL.

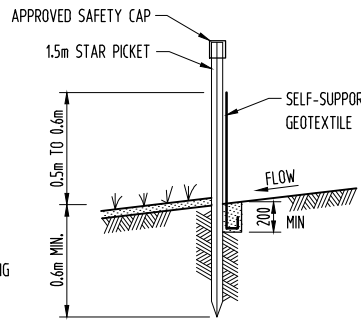
15. THE DEVELOPER MUST ENSURE THAT AN EVEN STRIKE OF GRASS GROWS AT AN ACCEPTABLE RATE. THE DEVELOPER IS ADVISED TO UNDERTAKE SOIL TESTING TO IDENTIFY PROPERTIES OF TOPSOIL AND SUBSOIL AND ANY SUBSEQUENT DEFICIENCIES FOR THE INTENDED GRASS SPECIES. SOILS SHOULD BE ADJUSTED WITH A COMBINATION OF FERTILISERS AND AMELIORANTS TO IMPROVE BOTH SHORT AND LONG TERM SUCCESS OF THEIR RE-VEGETATION.
16. THE DEVELOPER MUST ESTABLISH AND MAINTAIN ALL GRASSSED AREAS FOR A MINIMUM OF 13 WEEKS OR UNTIL THE END OF THE LITCHFIELD COUNCIL DEFECTS LIABILITY PERIOD, DEPENDING ON THE GRASS COVERAGE. AREAS OF UNSATISFACTORY GRASS STRIKE OR SCOURED/DAMAGED AREAS MUST BE REPAIRED AND RE-SOWN AS SOON AS THE PROBLEM BECOMES APPARENT.
17. THE DEVELOPER MUST MAINTAIN AND MOW THE GRASS TO A MAXIMUM HEIGHT OF 150MM IN RURAL AREAS AND 70MM ON URBAN AREAS.
18. THE DEVELOPER MUST APPLY A MIX OF THE TOPSOIL REMOVED FROM THE CONSTRUCTION SITE & FERTILISER FREE FROM SAND, STONES, TIMBER, TURF CLUMPS & ANY OTHER FOREIGN MATERIALS TO ALL ROAD VERGES, TABLE DRAINS, PAVEMENT SHOULDER AREAS, & / OR ANY OTHER DISTURBED AREA WITH POTENTIAL TO SCOUR.
19. DEVELOPER MUST PLACE THE TOPSOIL AT APPROPRIATE TIME OF YEAR CONSIDERING THE NT WEATHER CONDITIONS. NEVERTHELESS, COUNCIL WILL ONLY ACCEPT THE WORKS IF THEY HAVE ACHIEVED THE RE-ESTABLISHMENT ADDRESSED IN THIS DOCUMENT.
20. TOPSOIL & GRASSING SHALL BE APPLIED TO ALL AREAS AS SHOWN ON THE TYPICAL SECTION. TOPSOIL & GRASSING SHALL ALSO BE APPLIED TO OTHER DISTURBED AREAS PLUS 500mm PAST THE EFFECTED AREA, OR AS REQUESTED BY THE COUNCIL OFFICER.

PRELIMINARY

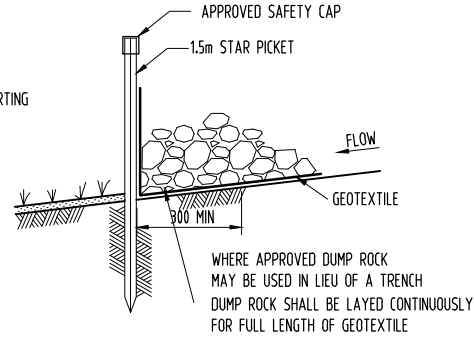
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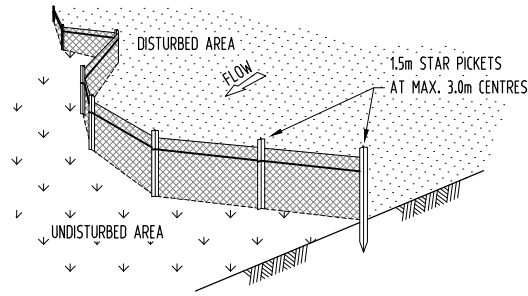
DETAIL - 2



STANDARD FENCE INSTALLATION & ANCHOR DETAIL



ALTERNATIVE FENCE INSTALLATION AND ANCHOR DETAIL



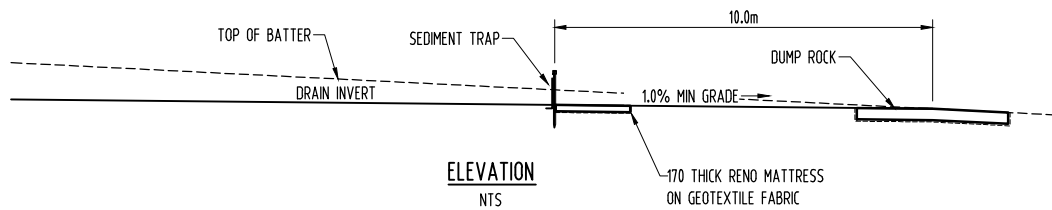
DETAIL - 1

SEDIMENT FENCE INSTALLATION DETAILS

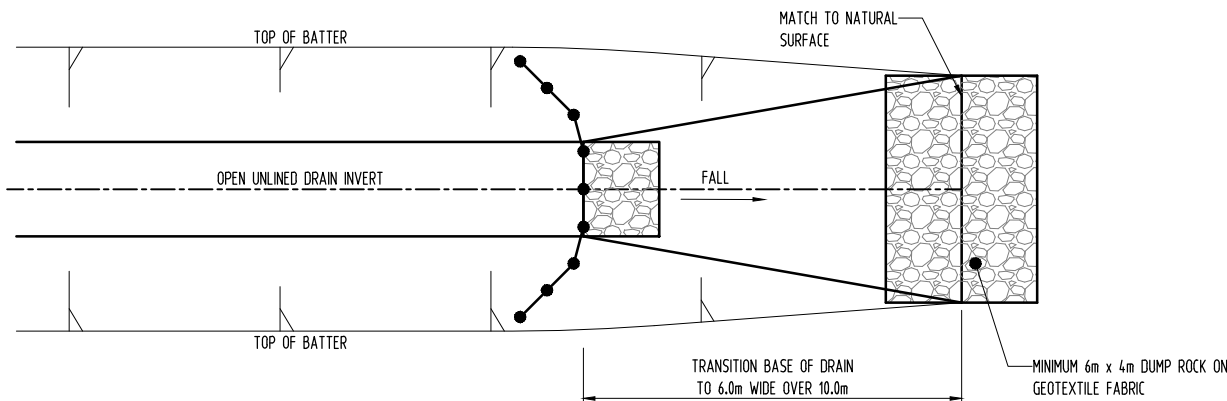
N.T.S.

SEDIMENT FENCE CONSTRUCTION NOTES:

1. CONSTRUCT ALL SEDIMENT CONTROL FENCES ALONG THE CONTOUR WHERE POSSIBLE.
2. WHERE SEDIMENT CONTROL FENCES ARE NOT CONSTRUCTED ALONG THE CONTOUR INCORPORATE RETURN PANELS AT REGULAR INTERVALS NOT EXCEEDING 20m.
3. ALL STAR PICKETS SHALL INCORPORATE APPROVED SAFETY CAPS
4. DIG A 150mm DEEP TRENCH ALONG THE UPSLOPE LINE OF THE FENCE FOR THE BOTTOM OF THE FABRIC TO BE ENTRENCHED. BACKFILL TRENCH OVER BASE FABRIC. FIX SELF-SUPPORTING GEOTEXTILE TO UPSLOPE SIDE OF POSTS WITH WIRE TIES OR AS RECOMMENDED BY GEOTEXTILE MANUFACTURER. JOIN SECTIONS OF FABRIC AT A SUPPORT POST WITH A 150mm OVERLAP.
5. WHERE APPROVED BY THE SUPERINTENDENT IN CONSULTATION WITH DLRM DUMP ROCK MAY BE USED TO ANCHOR THE GEOTEXTILE IN LIEU OF A TRENCH.

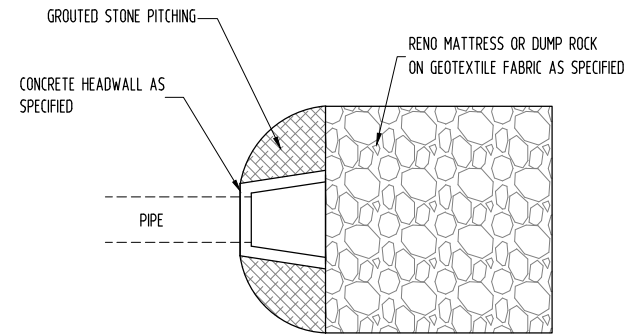


ELEVATION
N.T.S.



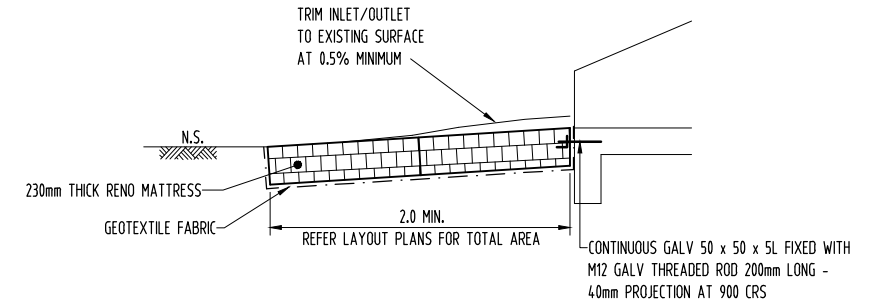
PLAN
N.T.S.

TYPICAL TYPE BU SEDIMENT TRAP DETAIL



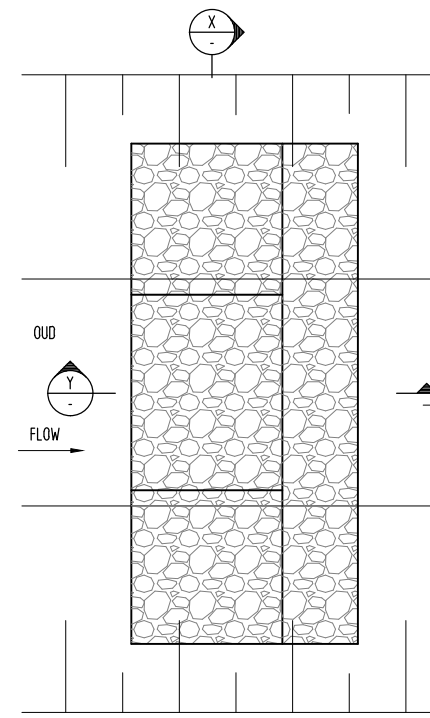
TYPICAL HEADWALL & OUTLET PROTECTION

N.T.S.



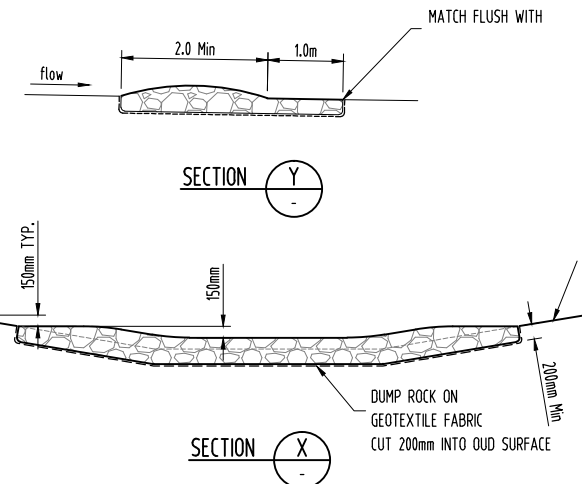
TYPICAL OUTLET PROTECTION ATTACHMENT

N.T.S.



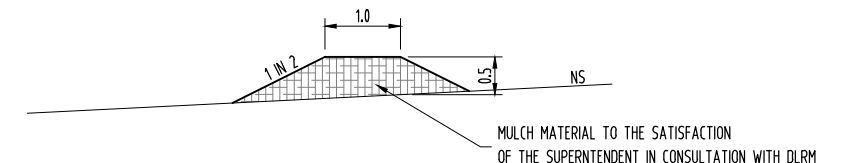
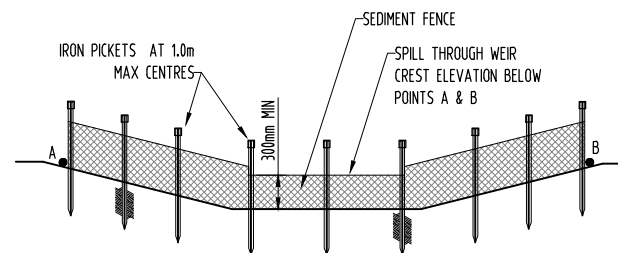
ROCK CHECK DAM DETAIL

N.T.S.



ROCK CHECK DAM CONSTRUCTION NOTES

1. TRENCH STRUCTURE 200mm INTO GROUND SURFACE WHEREVER THE STRUCTURE CONTACTS THE OUD BASE. FILL TRENCHES TO 100mm ABOVE GROUND SURFACE TO REDUCE RISK OF UNDERCUTTING.
2. ENSURE HEIGHT OF SPILLWAY IS LESS THAN 1m ABOVE THE GULLY FLOOR.
3. DUMPED ROCK PROTECTION WORKS WHERE SPECIFIED SHALL BE NOM. 500mm THICK ON GEOTEXTILE FABRIC. ROCK SHALL BE 75mm MIN TO 300mm MAX IN SIZE AND BE HARD AND DURABLE.



TYPICAL MULCH BERM

PRELIMINARY

B	25/05/15	KF	ISSUED FOR REPORT		
No	DATE	INITIAL	AMENDMENT		

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CLIENT



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PROJECT MANAGER	NAS	TITLE	NOONAMAH RIDGE		
DRAWN	MDW	CHECKED	SPB	EROSION & SEDIMENT CONTROL DETAILS	
DESIGNED	NAS	CHECKED	SPB	SCALE	AS SHOWN
				PROJECT No	14055
				DRAWING No	14055-SK122
				AMDT	B

6.8 BIODIVERSITY

This section of the EMP presents management actions for avoiding and/or reducing impacts to biodiversity values in general, as well as important threatened species populations that occur in the project area.

Legislation, standards and guidelines

- *Bushfires Act*
- *Territory Parks and Wildlife Conservation Act*
- *Weeds Management Act*
- *Environment Protection and Biodiversity Conservation Act (Commonwealth)*
- *Land Clearing Guidelines* (DNRETAS 2010).

There is a statutory Weed Management Plan for *Andropogon gayanus* (Gamba Grass) which applies to the whole of the NT and specifies the minimum requirements for managing Gamba Grass. The project area is within the zone in which land managers are required to control the growth and spread of Gamba Grass. Relevant management requirements within the plan are to:

- Implement early detection, monitoring and management programs by undertaking a property survey early in each calendar year – prior to flowering and seeding times – to identify any infestations and to allow for any necessary control work to be undertaken prior to seeding.
- Eradicate isolated plants and outbreaks through the design and implementation of an annual control and containment program, having first determined the areas of priority and established the most appropriate control methods. Appropriate buffer zones should be implemented.
- Design and implement a seed spread prevention program to ensure that Gamba Grass seed is not moved on machinery or equipment.

The plan contains strategies for implementing each of these requirements. These will be referred to in the development of the stage-specific Weed Management Plans that will accompany every CEMP.

Existing environment

The project area is characterised by largely intact native vegetation that occurs contiguous with sparsely developed land to the south and east. Land areas to the north and west are either already developed or contain substantially modified habitat because of land-use. The project area has endured widespread fires occurring 13 times over the past 14 years, the frequency of which is likely to have had some negative impacts on the biodiversity of the area.

The type and abundance of non-threatened flora and fauna species within the project area are typical of tropical savannah woodland. The woodland habitats found within the project area – predominately Eucalyptus woodland – are common across the area and the region more broadly. Four sensitive vegetation types were identified within the project area. Of these, the following are considered to be of conservation significance (see Figure 4-15 and Figure 4-16):

- One area of sandsheet heath in the north-west
- All areas of riparian vegetation
- The only patch of dry monsoon forest (in the north-east)
- All the wetlands.

Parts of the project area are considered Priority Environmental Management Areas within the Municipality of Litchfield. Development proposals of land identified as Priority Environmental Management Areas must demonstrate consideration of the environmental significance of natural vegetation and other landscape features, and the retention and protection of those areas identified by this evaluation to be significant (DIPE 2002). The Priority Environmental Management Areas within the project area largely align with the second order waterways along the western boundary.

'Important populations' of threatened species have been identified within the project area. The following threatened species' populations that occur within the project area satisfy the criteria for being an 'important population':

- Spiderflower (*Cleome insolata*) – the sole population
- *Typhonium praetermissum* – the populations shown in Figure 6-2 and Figure 6-3
- Howard River Toadlet (*Uperoleia daviesae*) – the populations shown in Figure 6-2 and Figure 6-3
- Black-footed Tree-rat (*Mesembriomys gouldii*) – the entire population
- Partridge Pigeon (*Geophaps smithii smithii*) – the entire population.

These threatened species' populations are considered to be of conservation significance and can be divided into two categories – those that have a restricted habitat (and hence a small area of occupancy) within the project area, and the Partridge Pigeon which occurs more across within the project area.

Potential impacts

Direct mortality of flora and fauna will occur during land clearing activities. In addition, there are a number of activities associated with the development that may affect habitat condition and quality resulting in a reduction in biodiversity. These are:

- Reduction in habitat due to land clearing.
- Altered hydrology due to stormwater infrastructure and/or use of groundwater.
- Altered surface and/or groundwater quality because of sedimentation or pollution.
- Introduction or proliferation of weed species (particularly during construction).
- Introduction or proliferation of feral fauna species due to residential occupancy (e.g. cats and rodents).
- Disturbance from dust or noise (particularly during construction).
- Disturbance and/or injury from human activities (e.g. traffic and usage of green spaces).
- Altered fire regimes (e.g. more frequent or later fires).

With regards to the first of the potential impacts listed above – reduction in habitat due to land clearing – it is considered that habitat loss associated with the development of Noonamah Ridge will not have a significant impact on regional biodiversity. The reasons are listed below:

- The habitats found within the project area – predominately Eucalyptus woodland – are common across the area and across the region.
- The project area is contiguous with large tracts of very sparsely developed land to the east associated with the Adelaide River floodplain
- The riparian habitats within the project area that provide wildlife corridors that link with the habitats to the west will be buffered from development.
- The project area sits to the south and east of areas that either are developed or have had substantially modified habitat; thus, continuity from the eastern areas across this development will not be substantially affected.

Whilst regional biodiversity will not be significantly affected, habitat loss that will occur through land clearing could have an impact on conservation-significant populations of threatened species and sensitive vegetation types that occur within the project area. Therefore, this EMP focuses on the specific measures that will be implemented to avoid or reduce impacts on these values.

6.8.1 Design and planning

Green spaces

The concept master plan (Figure 2-2) contains a network of green spaces throughout the development. The indicative location of these coincides either with community requirements (e.g. parks and sporting venues) or with significant conservation values (e.g. sensitive vegetation and threatened species' habitats identified through field-based assessments). Additionally, three areas are depicted on the concept master plan as 'environmental investigation areas'. They have been labelled as such because there are uncertainties associated with them that will require further ecological investigations prior to the development of a master plan for those locations (see Section 2.3.4 for more detail). Intrapac has made commitments in the EIS to address these information gaps prior to submitting subdivision applications for the affected areas.

C All conservation-significant habitats and 'important populations' of threatened species are contained and buffered within the green space network that will be master-planned for the project – see Figure 6-2 and Figure 6-3 – with the exception of Partridge Pigeon. This includes the areas of sandsheet heath that harbour threatened species, the monsoon forest patch, and all riparian vegetation and wetlands. Once the uncertainties surrounding the 'environmental investigation areas' have been resolved, the location and extent of the green spaces that buffer the conservation values within them will be established. These will be designed to provide for the preservation and maintenance of existing hydrology to the habitats.

The green space network will also benefit the maintenance of biodiversity values more broadly by providing remnant habitat areas that many species will continue to utilise, and by maintaining connectivity to the undeveloped land areas to the east. This includes other listed species that are not deemed to occur in populations of conservation significance – Mertens' Water Monitor will be buffered within protected riparian areas, the *Utricularia hamiltonii* population lies within the north-western Howard River Toadlet population's calling boundary, and some medium-density areas of Darwin Cycad are within green spaces.

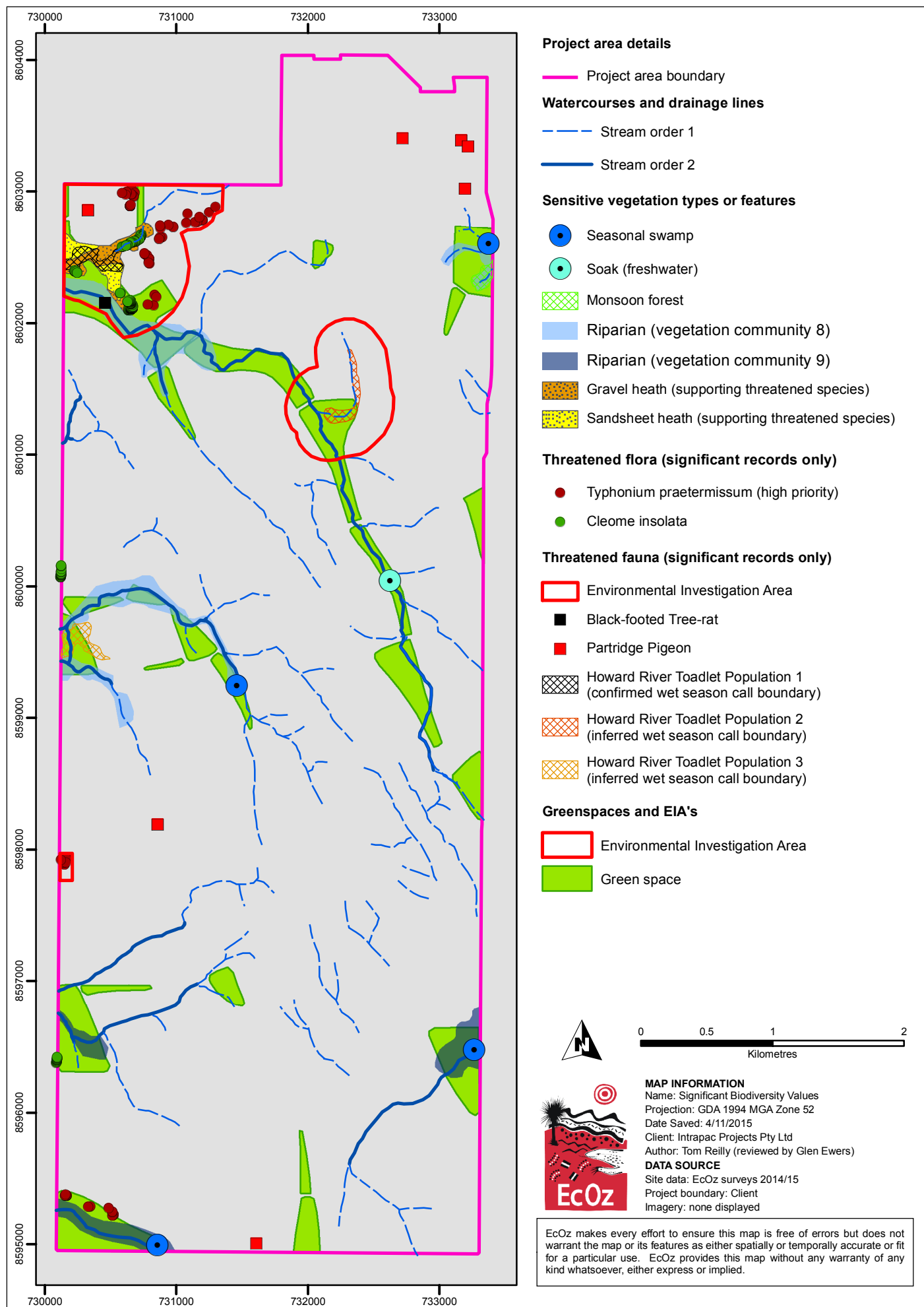
Off-site impacts

As described in Section 2.9.4, a range of mitigation measures will be included within the design of the stormwater management system to ensure that there are no changes in the quantity or the quality of surface water leaving the project area. Detailed designs will be developed in the Stormwater Management Plan for each stage of the subdivision, which will incorporate appropriate aspects of WSUD and engineering of stormwater controls to maintain off-site discharges to pre-development flow rates. Each plan will be assessed and approved as part of the subdivision applications submitted pursuant to the *Planning Act*. Therefore, it is not expected that there will be any impact on ecology downstream of the project area.

Land clearing on individual lots

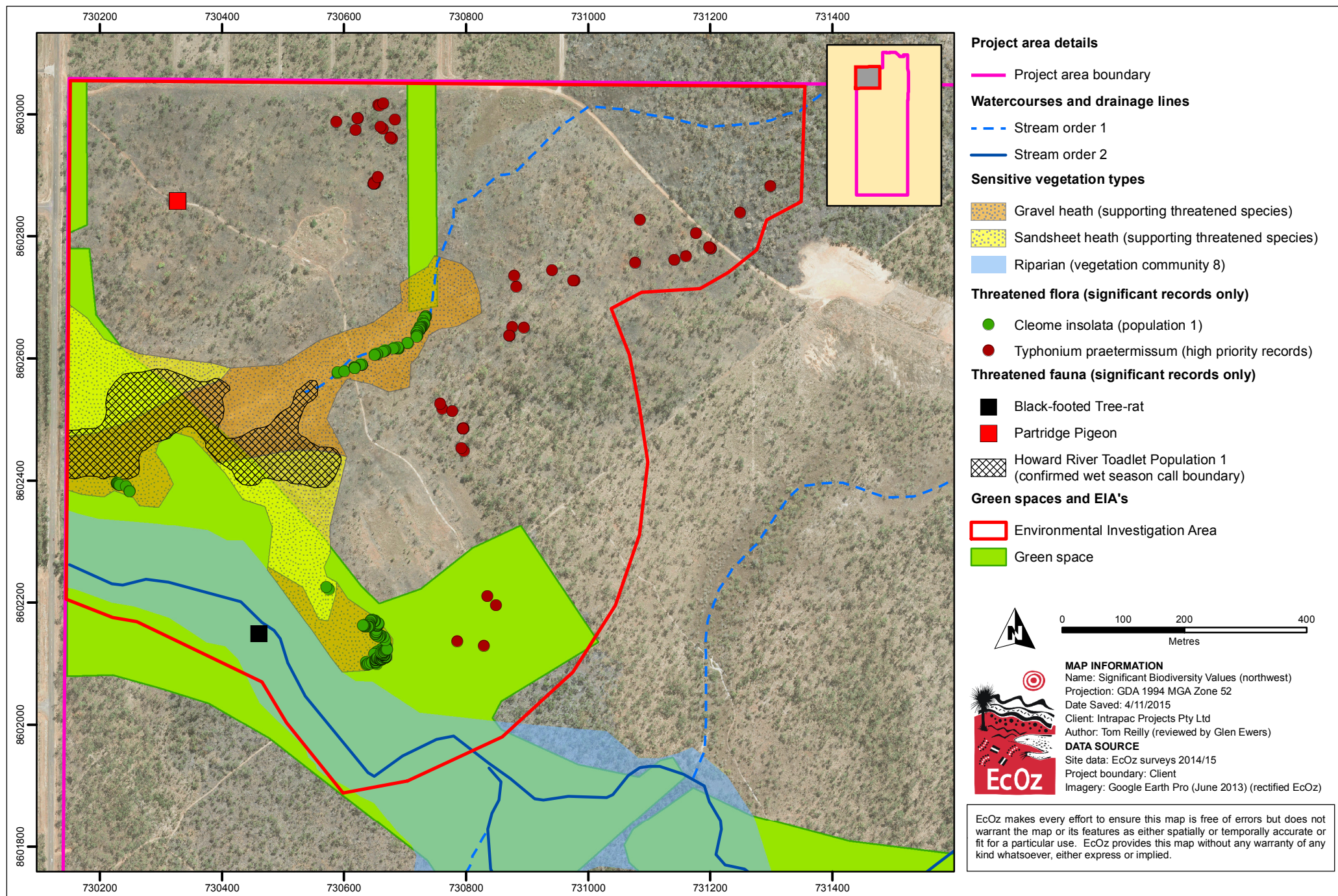
C Land clearing on individual lots will be governed in accordance with the *NT Planning Scheme*. Landowners will be required – through the combined use of the building envelopes and land clearing permit requirements – to retain as much natural vegetation as possible on their lots. This will reduce the impact on biodiversity and may be of benefit to threatened species such as the Bare-rumped Sheath-tail Bat (which roosts in hollow-bearing trees) and the Darwin Cycad that is abundant onsite.

There are standard land clearing requirements contained in the *NT Planning Scheme* for lots 2 ha and larger that will apply – Clauses 10.2 and 10.3, as well as the *Land Clearing Guidelines* (DNRETAS 2010). These exist to minimise unnecessary clearing. For lots smaller than 2 ha, a new clause will be incorporated into the *NT Planning Scheme* (through a Planning Scheme Amendment specifically for the Noonamah Ridge area), requiring land-holders to obtain a permit to clear more than 1,000 m² of native vegetation (exclusive of the assigned building envelope).



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Figure 6-2. Map of the conservation-significant values and the green space network within the project area



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ14400 - Noonamah Ridge Estates EIS\01 Project Files\Flora and Fauna Baseline\Significant Biodiversity Values (northwest).mxd

Figure 6-3. Map of the conservation-significant values and the green space network (north-west corner of the project area)

6.8.2 Construction

C The CEMP's required for each stage of the subdivision will include the following to minimise impacts on important populations of threatened species and sensitive vegetation types:

- Vegetation Clearing Management Procedure (including the engagement of a fauna spotter-catcher to monitor land clearing and a Wildlife Rescue Procedure) – see Addendum at the end of this section.
- Fire Management and Emergency Response Plan (incorporating Section 6.10).
- Water Management Plan (incorporating Section 6.6 for surface and groundwater, and Section 6.7 for ESCP).
- Noise Management Plan (incorporating Section 6.12).
- Air Quality Management Plan (incorporating Section 6.13).
- Weed Management Plan – see general principles below.

All of these measures will also benefit other threatened species – such as Bare-rumped Sheath-tail Bat, Fawn Antechinus and Pale Field-rat – which may occur within the project area despite not being recorded during surveys.

Note: Vegetation clearing will be undertaken stage-by-stage, and only where required.

Weed management

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
No introduction of new weeds, or spread of existing weeds	Prior to each subdivision, map existing weed infestations and develop a subdivision-specific Weed Management Plan for approval and implementation	Pre- and post-construction weed surveys	Approved Weed Management Plan in place	Investigate cause of weed spread or introduction
	Implement vehicle and machinery hygiene measures (inspections and wash-downs) prior to entering and leaving work areas			
	Include within Weed Management Plan how works will be staged so that they are undertaken in weed-free areas prior to moving to infested areas			
	Avoid driving machinery through weed-infested areas.			
	Source all fill or mulch brought to site from a declared weed-free source	Monthly weed management inspections during construction	No spread of existing weeds	Review and update Weed Management Plan as required
	Implement weed treatment (e.g. spraying, removal and burial) as required, particularly in disturbed areas and stockpile areas. Avoid stockpiling material from weed-infested areas in 'clean' areas.			
	Inform staff through inductions and signage of known and/or potential weeds onsite			
	Progressively revegetate and			
		Monitoring of treated areas	No introduction of new weeds	Implement appropriate treatment (refer to NT Weed Management Handbook (WMB 2014)).
		Induction records	All staff are trained in weed hygiene and have access to weed information	Update inductions and develop weed information signage
		Mapping of	All disturbed	Seed and close



	landscape disturbed areas no longer required to minimise exposed topsoil susceptible to weed invasion	disturbed and revegetated areas	areas no longer required have been seeded	out unnecessary disturbed areas (in addition to rehabilitation in ESCP)
Recording and reporting	Internal reporting for induction records, weed inspections and hygiene checklist Reporting to Weed Management Branch if any new weeds identified on the site Internal database for recording weed treatment and monitoring			
Responsibility	Contractor			

6.8.3 Occupancy

Many of the occupancy phase threats to biodiversity are directly related to other aspects of the project that are addressed under separate management plans, namely:

- Bushfire Management Plan (Section 6.10)
- Water Management Plan (Section 6.6)
- ESCP (Section 6.7)
- Air Quality Management Plan (Section 6.13)

Litchfield Council will be responsible for weed management in public open spaces within Noonamah Ridge. Under the *Weed Management Act*, residents are obliged to manage weeds on their own property. Guidance on this can be sought from DLRM for weed identification and treatment methods.

Green spaces

The management of parks and ovals will be the responsibility of Litchfield Council and, in these areas, the control of weeds should be adequately addressed through routine maintenance procedures and contracts. In contrast, the green spaces that incorporate significant biodiversity values will need to be carefully managed to ensure that the biodiversity values within them are not compromised by weed infestation, altered water quality or quantity, human disturbance and bushfire. Ongoing, active management will be needed, and responsibility for that is still to be determined.

C Some of the sites (particularly that in the north-west corner) contain such significant values (namely important populations of threatened species) that their management requires a level of experience and skill in natural resource management that is beyond that of both Intrapac and Litchfield Council. To ensure that these values are protected, Intrapac has committed to engaging the relevant authorities in a workshop to determine:

- The appropriate size of the green spaces enclosing them
- The optimum zoning within the *NT Planning Scheme* (and, as a consequence, who is responsible for their management)
- The level of public accessibility
- Management of the areas (including fire and weed management); monitoring programs (and who will undertake these)
- How to promote within the community an understanding and appreciation of the values that occur 'on their doorstep'.

This commitment will be incorporated with the requirement that management arrangements are resolved before the commencement of Stage 3 (scheduled to commence in 8 years' time).

Other areas that contain biodiversity values could potentially be managed by a 'Friends of' group, although issues with funding, capability and commitment for such groups can be problematic (and even a short period of inactivity in management could be deleterious to these values).

Addendum – Vegetation Clearing Management Procedure

This Vegetation Clearing Management Procedure provides:

- Details on the process involved in the removal of vegetation in preparation for development.
- Guidance to the fauna spotter-catcher (FSC) with respect to the threatened flora and fauna potentially affected by vegetation clearing activities.
- A Wildlife Rescue Procedure for the FSC to minimise the risk of injury or death to fauna affected by habitat loss.

The primary objective of the FSC is to minimise harm to wildlife during land clearing activities by relocating healthy animals, and preventing suffering of injured animals.

The FSC will be required under the *Territory Parks and Wildlife Conservation Act* to hold a *Permit to Take or Interfere with Wildlife*.

Responsibilities

The contractor will:

- Undertake a pre-clearing assessment to ensure that there are no control points or other survey markers, cultural heritage sites or groundwater monitoring bores that may be damaged by the clearing works.
- Ensure that clearing is only undertaken within designated areas.
- Advise the FSC when vegetation clearing is to take place.
- Ensure that the requirements of this procedure are followed by all personnel, contractors and visitors to the site.

The FSC will:

- Identify and assess potential habitat prior to any clearing works onsite, based on information provided by Intrapac and ground-truthing of clearing area.
- Undertake pre-clearing surveys; including habitat tree identification and trapping as required (see procedures below).
- Advise the contractor on appropriate clearing methods (including machinery type, directional/systematic approach etc.), with the aim of minimising, as far as possible, harm to wildlife.
- Assess the suitability of habitat within the project area for the relocation of fauna.
- Undertake site enhancement works at the release site using habitat structures, for example salvaged hollow logs, large rocks, etc.
- Inspect the clearing zone immediately prior to clearing.
- Ensure the supervisor of clearing activities is made aware of the location of habitat trees.
- Locate and capture any wildlife affected by clearing.
- Assess the health of captured wildlife and determine appropriate action, i.e. relocation/vet/carer/euthanise/prepare voucher specimen.
- Post-clearing records and reporting on findings; including deaths, relocations, sighting, injuries and recommendations for subsequent clearing activities.
- Prepare a Pre- and Post-clearance Report.

Pre-clearance tasks

- Prior to commencement of clearance works, the area to be disturbed is to be clearly delineated with pegs and/or flagging tape (unless a GPS system is being utilised by the land clearers).
- Equipment used for clearing purposes will be thoroughly inspected prior to operating in the area to ensure that it is not carrying any weeds or other contaminated materials from areas it has been previously working in.
- Silt fences or sediment traps will be installed where required in accordance with the ESCP to minimise the sediment load and erosion that may impact on adjacent wetland habitat.
- No more than 48 hours prior to clearing the FSC is to thoroughly inspect the area to be cleared. Any significant habitat features– including any trees containing hollows, active nests, burrows, hollow ground logs, potential dens, and debris piles – that will be inspected immediately prior to clearing, retained and/or relocated, are to be marked with flagging tape and the location marked with a GPS.
- The FSC is to inspect potential release sites prior to clearing to ensure that relocated wildlife will have habitat that affords them adequate protection from predation, as well as adverse environmental conditions. Where possible, the release site is to be as similar as possible to the animal's former habitat.

Vegetation clearing

- All contractors are to attend a pre-clearing meeting to ensure that the clearing plan is established and understood by all relevant personnel, the lines of communication are established between the FSC and the clearing operators, and methods are established to ensure significant habitat is avoided during clearing works.
- All safety procedures are to be implemented including safe exclusion zones and attentive communication via signalling and radio communications. The FSC needs to be in direct contact (i.e. radio) with operators during the operation, as machinery may need to be halted whilst fauna is captured.
- The FSC is to undertake an initial walk-through of the area to be cleared to identify and relocate any fauna present.
- Clearing should be done in the morning when most small reptiles are active.
- Clearing should be directed from disturbed areas toward intact habitat.
- All vegetation other than habitat features (i.e. hollow-bearing trees) are to be cleared first using equipment with a stick rake where possible to minimise impacts on smaller ground-dwelling fauna. Initial clearing should only be done using the 'raised blade' technique so that the vegetation layer is removed and the FSC can see any fauna in the area.
- Habitat features (i.e. hollow-bearing trees) should be left overnight to allow fauna to self-relocate.
- Habitat features (such as fallen hollow tree branches or logs) which may afford protection to relocated species are to be transferred to the release site. Remaining vegetation is to be pushed into windrows for eventual use in rehabilitation works and/or disposal.
- Vegetation in windrows is to be left for 24 hours to allow any animals trapped inside to escape and move into the adjoining woodland. However, as cleared vegetation that is left in windrows for more than 48 hours can become potential refuge habitat for fauna affected by clearing operations, it is recommended that an FSC also be present for when this vegetation is disturbed.

Habitat tree felling procedure

- Following initial vegetation clearing works, pre-identified habitat trees (i.e. containing habitat features of significance for fauna including hollow limbs, fractures and cavities, birds' nests, arboreal termite nests, sections of exfoliating bark, and any other areas providing a place for protected fauna to roost, breed, or shelter) are to be left standing overnight at a minimum, to allow fauna to self-relocate.
- Prior to felling, the FSC must first inspect such habitat features with a torch or burrow scope and remove fauna. If the hollows aren't able to be inspected before felling, the tree must be lowered in a controlled manner and then inspected by the FSC (ideally lowered with an excavator with vertical rotating grab). Significant habitat features can be gently lowered to the ground or moved to one side with an excavator using a grab attachment for inspection by the FSC.
- If an animal is residing in a tree hollow, the animal is to be captured directly, or the entire limb containing the animal is to be cut off with a chainsaw, whilst ensuring no injury is caused to the animal. The animal is then to be relocated at the FSC's discretion.
- With respect to active nests, it is preferable that nests are to be avoided until the nest is inactive, i.e. no eggs or dependent young remain in the nest. If possible, other areas are to be cleared in preference of habitat features containing eggs or dependent young. If this is not possible, then active nest removal will be at the discretion of the FSC.
- Once the tree is felled, habitat features (such as hollow tree branches or logs) which may afford protection to relocated species are to be relocated to the release site. Any habitat features should not be left in windrows due to the possibility of being colonised by other animals.

Post-clearance

- The FSC will inspect cleared areas immediately afterwards to retrieve any displaced, injured or dead fauna. Generally, the FSC will walk behind the bulldozer to undertake this.
- The FSC will assess the health of all captured wildlife to determine whether the animal is:
 - Suitable for relocation – all displaced but healthy fauna will be captured, recorded and released into appropriate habitat in a pre-determined release area.
 - Injured or orphaned – in which case the animal may need to be euthanised in-situ in accordance with the FSC's euthanasia procedures, or taken to a veterinary clinic for treatment, observation and/or euthanising. If an animal requires further treatment and rehabilitation in preparation for re-release, then the animal is to be taken to a wildlife carer if there is a suitable carer in the area.
- Any deceased fauna that are found in an undamaged condition and have been requested to be sampled by the NT Museum will be retained and lodged with the museum. The FSC will be responsible for the preparation and preservation of voucher specimens.

Threatened species

If any threatened fauna or flora species are present that have not been previously recorded within the project area, the FSC will mark the location with a GPS and contact Intrapac. Intrapac will notify DLRM and the, with that department's advice, review existing threatened species management measures to determine whether any additional actions or controls are required. Clearing should not proceed until this process has been followed.

Reporting

For each clearing event, the FSC will prepare a:

- Pre-clearance Report documenting the below information:
 - Recommended machinery to be used for clearing.
 - Direction of clearing to allow fauna movement into retained vegetation.
 - Localities of habitat significance for protection during clearing.
 - Habitat features requiring special attention during clearing.
 - Habitat requiring fauna trapping prior to clearing.
 - Suitable fauna relocation sites.
 - Clearing plan to establish access for processing hollow-bearing trees.
- Post-clearance Report documenting the following:
 - Area cleared
 - Number and species of fauna relocated or deceased
 - Locations in which release occurred.

6.9 CULTURAL HERITAGE

Cultural heritage refers to Aboriginal sacred and archaeological sites, as well as post-European settlement historic sites.

Legislation, standards and guidelines

Two types of heritage places and objects are protected under the NT *Heritage Act* – declared and prescribed. Places or objects listed on the Northern Territory Heritage Register are ‘declared’ and are protected under Section 33 of the Act – there are none of these within the project area. All other heritage places and objects are ‘prescribed’ and are protected under Sections 29 and 39 of the Act. Surveys have identified the presence of prescribed place and objects within the project area.

It is an offence under the Act to damage, destroy, alter or carry out work of any sort on declared or prescribed sites without the written consent of the Minister or Minister’s delegate. In a situation where impact is unavoidable and a proposal is put forward to disturb an archaeological place, the Heritage Branch will generally require the proponent to submit an application form describing what is proposed. If considered appropriate, the Heritage Branch may, on occasion, utilise the discretion available in the Act to give permission for small-scale disturbance (such as the relocation of isolated stone artefacts) without the need for a formal application. The discretion is allowed under Section 148 of the Act which, in effect, says that a heritage officer (such as an archaeologist) may undertake (or authorise) actions and that this is not construed as an offence. In such cases, the Heritage Branch will require the recording of places and objects prior to disturbance.

The *Northern Territory Aboriginal Sacred Sites Act* provides for the protection and registration of sacred sites. The Aboriginal Areas Protection Authority (AAPA) is responsible for administering the Act and records and maintains a sacred sites register. An Authority Certificate for works on or near Aboriginal sacred sites must be sought from AAPA.

The *Burra Charter* provides guidance on preserving and managing places and objects of cultural significance (Australia ICOMOS 2013). The *Burra Charter* emphasises conservation of places and objects of cultural significance through a process of investigating and understanding the significance, which then informs policies and management processes. The archaeological survey and report prepared for the Noonamah Ridge project area (see Appendix L), and consequent management and mitigation measures have all been undertaken with reference to the principles and guidelines within the *Burra Charter*.

Existing environment

An AAPA certificate (C2015/111) has been acquired for the project area – see Appendix M. It identifies a sacred site immediately to the south-east of the project area, with an associated Restricted Works Area that extends into the project area – see Figure 3-22. The sacred site (5172-61) features a spring and therefore the measures that will be put in place to protect groundwater resources (refer to Section 6.6 of this EMP) are also relevant to protecting this sacred site.

An archaeological survey was conducted in November 2014 – see Appendix L for full report. Seven stone artefact scatters were found, predominately on low laterite ridges adjacent to creeks. One of the scatters was found in a rock shelter, sufficiently large enough to hold deep deposits. The site is of high significance because of the excavation potential it offers. The remaining artefact sites are regarded as being of medium or low significance.

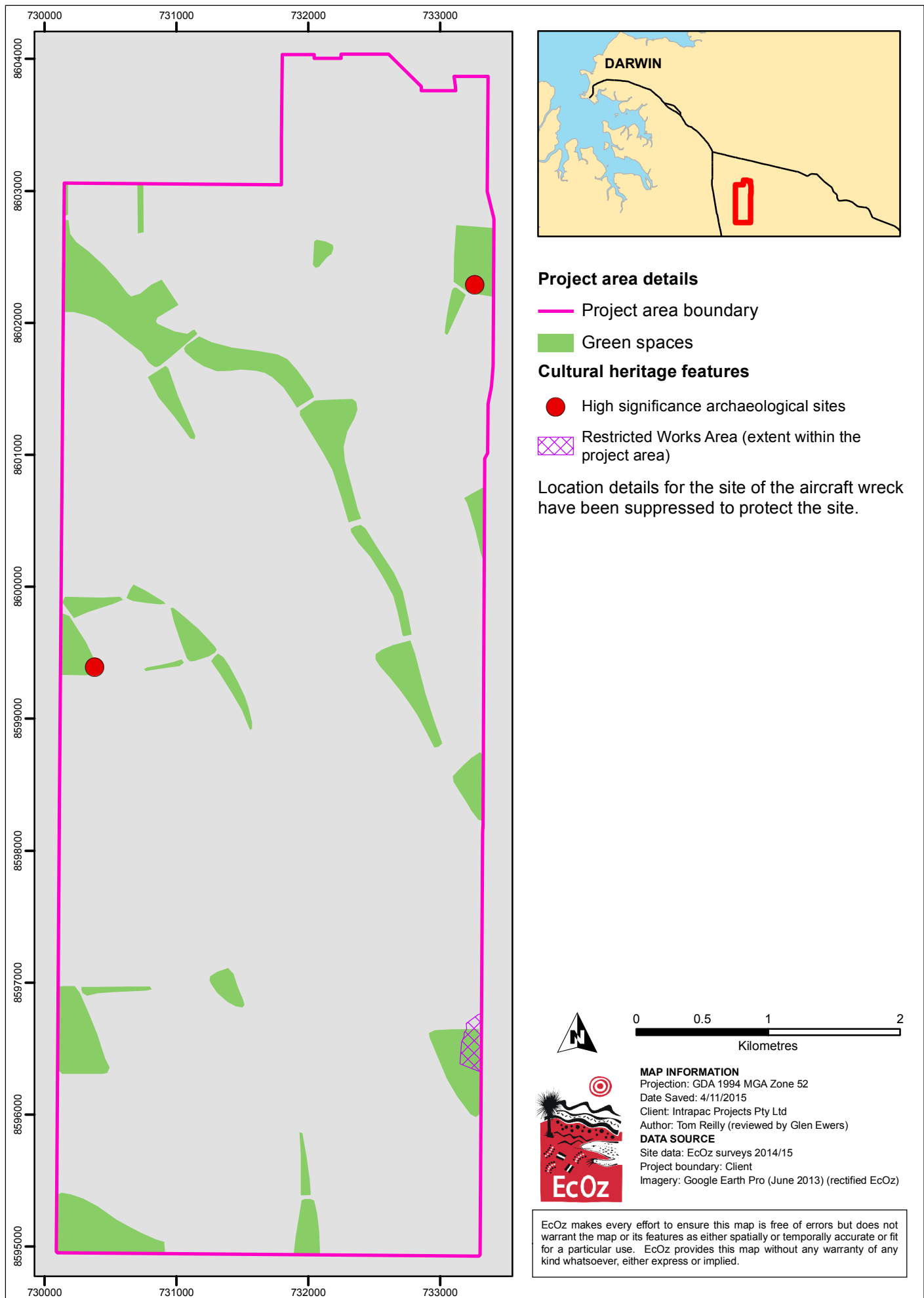
A World War II (WWII) bomber crash site is located within the project area. The wreck is of a 15 tonne B-25D 'Mitchell', a twin-engine medium bomber. The pilot was killed in the crash and was buried in an Indonesian cemetery; the site is therefore not a war grave. Despite its intrinsic significance, the aircraft, its crew and the crash event is poorly known, and the site is not listed on the Northern Territory Heritage Register.

Potential impacts

The main potential impacts concerning cultural heritage are damage to, or loss of, archaeological and cultural sites during construction, and/or deliberate disturbance/vandalism of heritage sites protected within the green space network during occupancy.

6.9.1 Design and planning

C The Area Plan and subsequent master plans for the project will include cultural heritage reserves within the development's green spaces network. The reserves will allow for a buffer around sites of high significance (see Figure 6-4). The Restricted Works Area in the south-east of the project area will also be buffered within the green space network. The quality and quantity of groundwater for the downstream sacred site to the east of the project area will be maintained as per the measures described in Section 6.6.



Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\EZ14400 - Noonamah Ridge Estates EIS\01 Project Files\EMP\Greenspaces.mxd

Figure 6-4. Map of the significant archaeological sites and the green space network

6.9.2 Construction

C A Heritage Management Plan will be required as part of the CEMP for each subdivision, and this will need approval from the consent authority prior to commencement of works. The following over-arching guidance will be used to inform the development of subdivision specific heritage management requirements.

Aboriginal sacred site

C According to the AAPA Certificate (Appendix M), within the area marked Restricted Works Area 1 on Annexure 'A' no work is permitted to take place and no damage can occur.

Low and medium significance artefacts and sites

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
Collect and retain all artefacts within the project area to the satisfaction of traditional owners and the NT Heritage Branch	Prior to construction commencing, an archaeologist will (in consultation with the Heritage Branch) identify, collect, label, bag, group and bury all low and medium significance artefacts together in a sealed box at a keeping place within the project area	Records of all actions will be kept, including original locations, details of artefact, labels, treatment and burial site	No damage to, or loss of, low and medium artefacts as a result of development activities	Stop work and investigation into damage to, or discovery of, artefacts
	Subject to permission from the Larrakia people, some artefacts may be retained for display within the community facilities at the site	Incident reporting if any artefacts or sites are damaged		Consult with Heritage Branch and archaeologist
	If additional artefacts are uncovered, works will stop in the area and consultation with Heritage Branch will occur in relation to appropriate actions	Visual monitoring of construction areas for additional artefacts		Additional artefacts to be treated as per others (collected, recorded, bagged and buried) as appropriate
Include within site inductions information on the archaeological context of area and processes to be followed if objects are uncovered				
Recording and reporting	Reporting to be submitted to Heritage Branch Internal Incident Reporting procedures – any unapproved disturbance of artefacts and/or new discoveries to be reported to Heritage Branch			
Responsibility	Archaeologist for identification, categorisation and advice on heritage sites and artefacts Intrapac for consultation with Heritage Branch Contractor for devising Heritage Management Plan, inductions and implementing all procedures			

High significance sites

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
Conserve and preserve all high significance sites in-situ in their original condition	Buffer and flag locations of sites as no-go zones during construction	Visual inspection of no-go zone boundaries for evidence of intrusion Post-construction site assessment	No entry into no-go areas No damage to, or loss of, high significance sites	Stop work and investigation of damage
	Include in CEMP's a process for ensuring no-go zones are abided by			Consult with Heritage Branch and archaeologist
	If additional sites are uncovered, stop work in the area and consultation with Heritage Branch will occur in relation to appropriate actions			Re-instate no-go areas and re-induct workers
	Include within site inductions information on the archaeological context of area and the importance of respecting no-go zones			Any additional high significance sites to be conserved and preserved through buffering and reservation
Recording and reporting	Internal Incident Reporting procedures – any disturbance of artefacts and/or new discoveries to be reported to Heritage Branch.			
Responsibility	Archaeologist for identification, categorisation and advice on heritage sites and artefacts Intrapac for consultation with Heritage Branch Contractor for devising CEMP's, inductions and implementing all procedures			

6.9.3 Occupancy

High significance site reserves

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
Conserve, preserve and manage sites of high significance in their original conditions (pre-development)	Install interpretative signage to explain the significance and meaning of reserves	Regular visual monitoring for signs of damage or maintenance requirements	Reserve fencing and signage in place	Re-instate fencing and signage
	Establish bollards to restrict vehicle access in vicinity of sites and objects		No damage to, or loss of, sites or objects within reserves	Consult with Heritage Branch
	Maintain the reserves to preserve their fabric* from weeds and fires.			Implement site maintenance activities
	Investigate listing the aircraft wreck on the NT Heritage Register		Site fabric preserved	
Recording and reporting	Record keeping of maintenance activities Site disturbance to be reported to Heritage Branch Additional reporting related to potential heritage listing of aircraft crash site			
Responsibility	Intrapac for signage, bollards and reserve design Litchfield Council for ongoing maintenance of reserves (e.g. mowing and weed control, and visual inspections)			

* This is the term used in the Burra Charter (Australia ICOMOS 2013) and refers to all the physical material of the place – including components, fixtures, contents and objects.

6.10 BUSHFIRE

Legislation, standards and guidelines

- *Bushfires Act*
- *Fire and Emergency Act*

Existing environment

The project area is located within a rural, largely vegetated region that requires management for bushfires. Currently, fire management is undertaken by the Elizabeth Valley Fire Brigade on behalf of the landowner, and involves one annual (end of wet season) burn along the western, northern and southern-boundaries of the project area to create a firebreak. The remaining project area is frequently burnt in the mid-to-late dry season due to the actions of 'fire-bugs' deliberately lighting fires.

Bushfires NT is responsible for implementing the *Bushfires Act* and supporting rural landholders with fire mitigation. Urban fire management is overseen by the Northern Territory Fire and Rescue Service (NTFRS). Maintenance of higher density urban areas within the Municipality of Litchfield is managed by the Litchfield Council, who undertake activities such as slashing, mowing and spraying of verges and parks to reduce fuel loads. House fires are not covered by Bushfires NT or volunteer fire brigades, and the project area is outside of the emergency response area for the Darwin and Berrimah region. As such, NTFRS are obliged to prioritise house fires within the emergency response area before responding to house fires in the project area. During business hours, the nearest response brigade is the Humpty Doo Volunteer Fire Brigade, and after hours, the Palmerston Fire Brigade is closest.

Potential impacts

There are activities associated with the development that could increase the frequency and/or intensity of bushfires. The impacts of this may include some or all of the following:

- Risks to human life – including construction workers, residents, neighbours and local community.
- Damage to property and infrastructure.
- Reduced biodiversity due to loss of habitat or altered habitat quality.
- Increased burden on existing fire-fighting resources.

Bushfire impacts are relevant to both the construction and occupation phases of the project. Land clearing – especially in rocky areas – poses a risk of starting bushfires as sparks are created by bulldozer blades striking hard objects. Building sites create an increased bushfire risk from use of tools such as welders and grinders, in addition to stockpiling of flammable materials. Construction may also result in altered fire regimes as laydowns, access tracks and work areas are established. This could either reduce current fire intensities (i.e. by creating increased fire breaks) or result in increased risk of late, dry season burning as a result of fire avoidance to protect construction equipment and materials.

Whilst the provision of housing within a fire-prone area can pose a risk to human safety, the development will result in increased firebreaks and smaller scale fire management that could decrease overall fire impacts on biodiversity. Future conservation zones for conservation-significant habitats that are fire sensitive (e.g. sandsheet heath) will require targeted on-going fire management to minimise fire impacts – particularly from late, hot fires. Increased local population may increase the risk of 'fire-bug' activity, which inherently increases risks to human safety and biodiversity. Additionally, the variety of lot sizes within the proposed development will result in vegetated interfaces between rural and urban areas, which could produce unmanaged strips of land that carry fire, especially if infestations of Gamba Grass and Mission Grass become established.

6.10.1 Design and planning

The development has been designed and planned to minimise the impacts of bushfires in the following ways:

- **C** Development design will include allocation of emergency evacuation routes and Intrapac will consult with NT Fire and Emergency Services to expand the Darwin emergency response area to encompass the project area.
- **C** Lot layout will avoid creating unallocated strips and unmanaged interfaces between rural blocks (which will be managed by land owners and fall under Bushfires NT jurisdiction) and urban/higher density lots (which will be maintained by Litchfield Council) which may become a fire hazard in future (e.g. gaps/easements with no tenure).
- Any land that is not designated for housing lots or commercial purposes (e.g. green space, parks and reserves) will require agreement with the relevant authority on tenure and future fire management responsibilities prior to subdivision occurring.
- **C** There will be provision of land for a new volunteer fire brigade within Village One.
- Intrapac will lobby to have the emergency response area extended to include the project area.

6.10.2 Construction

C The CEMP for each stage will include construction-specific management measures to comply with fire and emergency regulations, with content guided by the actions described below.

Safety of workers and residents

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
No increased risk to health and safety of workers and residents as a result of bushfires	Establish firebreaks around all laydown, stockpile and central work areas in line with Fire and Emergency Regulations	Visual inspections of fire breaks and surrounding areas	Fire breaks in place	Slash or clear fire breaks
	Slash or back-burn areas surrounding work zones to reduce accidental fire risk from use of power tools/sparks		No bushfires started as a result of works	
	Stockpile/store flammable material in line with Fire and Emergency Regulations	Visual inspections of stockpile and laydown areas	Stockpiles and storage areas in accordance with regulations (e.g. maximum height, spacing)	Re-design of stockpile or storage areas as required
	Undertake all welding/spark works in a combustible-free zone	Daily pre-starts/Take 5 meetings	Combustible-free zone established No incidents related to accidental sparks	Review and re-enforce procedures
	Obtain a Permit to Burn from Bushfires NT for any planned back-burning prior to commencing construction	None required	Permit obtained	If back-burning is undertaken without a permit, investigate incident and implement corrective actions in consultation with Bushfires NT



	Monitor fire danger ratings and NAFI website for bushfire risk and fires in the region, and ensure that 'hot' activities are not undertaken during Total Fire Bans	Daily fire danger and NAFI website checks during fire (dry) season	Discussed at daily pre-start meetings during fire season	Investigate reason for lack of fire information Assign one employee the task of checking the NAFI website
	Report all fires to Bushfires NT or local fire brigade	None required	All fires reported	Re-enforce requirements through inductions and daily pre-starts
	Develop Emergency Response Plan (including emergency contacts, response and identification of evacuation routes in event of fire) and provide this in a map/poster format in meeting and crib rooms	None required	Emergency Response Plan approved prior to construction commencement	None required
Recording and reporting	Records of clearing, establishing fire breaks and visual inspections Internal incident reporting procedures for any fires Permit to Burn and records of back-burning activities Pre-start minutes/notes of discussions points Communications log			
Responsibility	Contractor			

Ecosystems

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
No increased occurrence of fires within project area and surrounding environment	Establish fire breaks around all work areas in line with Bushfire Regulations to minimise risk of accidental fire	Visual inspections of fire breaks	Fire breaks in place No bushfires started as a result of works	Assess proximity of activities to fire-prone areas Assess and maintain fire breaks as required
	Maintain spot fire response capability (i.e. fire extinguishers and water truck) to prevent fires from spreading	Inspections of fire response capability	No fires spreading from outside of a work area	Review and improve fire response capability
	Implement CEMP weed management actions to ensure grassy weed species do not proliferate and increase fire risk	See weed management (Section 6.8)	No new weed infestations	Weed control and prescribed burning
	Include within inductions training about the importance of avoiding fire	Visual inspections of work practices	All staff inducted in fire management and avoidance	Training and signage about fire hazards and risks of bushfires
Recording and reporting	Records of inspections Internal induction records Internal incident reporting for any fires Pre-start minutes/notes of discussions points			
Responsibility	Contractor			

6.10.3 Occupancy

Consultation with Litchfield Council for this development indicates that future fire management of urban and higher density public areas will fall under the jurisdiction of Litchfield Council, specifically involving activities such as spraying and mowing of verges and other open space areas to reduce fuel loads.

During the occupational phase of the development, rural and rural living lots must be managed for fire by owners or occupiers as per the *Bushfires Act* and associated regulations. Firebreaks are required to be established and maintained by lot owners around all lot boundaries. Individual lot owners may undertake burning off on larger lots in accordance with a Permit to Burn. Monitoring of this is undertaken by Bushfires NT.

Emergency response will be managed by NTFRS and volunteer fire organisations.

Health and safety of residents, neighbours and community

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
No increased risk of fire to future residents, surrounding neighbours and communities as a result of the development	Provide education material to lot owners regarding maintenance of 4 m boundary firebreaks by rural lot owners in line with Bushfires Regulations.	Bushfires NT conduct fire break inspections	To be managed by Bushfires NT	
	Maintain all verges and parks through slashing, mowing and spraying to reduce fuel load	To be managed by Litchfield Council		
	Undertake back-burning around green spaces early in the dry season to establish fire breaks*	Inspection of fuel loads around green spaces	Fire breaks in place around green spaces No uncontrolled bushfires through green spaces within project area	Consult with Bushfires NT and NTFRS to improve or implement fire breaks around green spaces
Recording and reporting	To be managed by Bushfires NT and Litchfield Council			
Responsibility	Future lot owners or occupiers for rural lot fire breaks and fire management Bushfires NT for inspections and advice on rural fire management Litchfield Council for maintenance of public open spaces			

* Note that as the project area is within the Vernon Control District a Permit to Burn is required from Bushfires NT prior to any back-burning activities. Burning should be undertaken by, or in consultation with, Bushfires NT and the NTFRS to ensure burns are controlled and maintained within planned area. Burning should only be undertaken by suitably-qualified people.

Ecosystems

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
No loss of habitat or change of habitat due to altered fire regimes in region, particularly significant habitat (e.g. sandsheet)	Establish fire breaks and conduct controlled back-burning annually to minimise risk of bushfires within and surrounding project area	Annual visual inspections of fire breaks	To be managed by Bushfires NT	
	Green spaces will have annual fire breaks (either slashed or burnt) to reduce risk of late dry season fires	NAFI records of burning to indicate extent of early fires	No late dry season fires within green spaces	Review management of areas to allocate resources for future years
	Undertake patchwork burning within green spaces – strategy to be	NAFI records	Sufficient patchwork burning	Review burning strategy; consult

	devised in the development of reserve management plans	Records of burning activities	to reduce fire loads within green spaces	with Bushfires NT and fire experts to improve strategy
	C Install signage within all bushland green spaces to inform residents about fire impacts	Visual inspection to confirm installation	Presence of visible, clear signs	Installation or maintenance as required
Recording and reporting	To be determined once management of the green spaces is determined			
Responsibility	Bushfires NT for monitoring and advice on fire breaks Litchfield Council for maintenance (e.g. mowing/slashing) of public open spaces Management of other green spaces to be determined			

6.11 BITING INSECT

Legislation, standards and guidelines

- *Public and Environmental Health Regulations*
- *Guidelines for Preventing Biting Insect Problems for Urban Residential Developments or Subdivisions in the Top End of the NT (DoH 2014a)*

Existing environment

An assessment of biting insects within the project area was completed by Medical Entomology, Department of Health (see Appendix K). The survey trapping identified 21 mosquito species. Certain species that can be vectors for mosquito-borne diseases were abundant. Breeding sites were identified within the project area – including borrow pits, vehicle tracks in grassy drainage lines and swamps in the south-west corner. Additionally, the large seasonally-inundated areas external to the project area in the north and west appear to provide significant breeding habitats.

Potential impacts

There are activities associated with the development – in particular the establishment of stormwater drainage infrastructure and lakes – that could increase the exposure of people to mosquitoes. The impacts of this exposure could be:

- Reduced health of employees and contractors due to the contraction of mosquito-borne diseases during construction.
- Reduced health of residents and neighbours due to the contraction of mosquito-borne diseases.
- Reduced social amenity due to pest mosquitoes.

6.11.1 Design and planning

The development will be designed and planned to minimise the impacts of biting insects in the following ways:

- **C** The standard clause currently imposed on rural living lots in the greater Darwin region in relation to living close to mosquito breeding areas will be incorporated into contracts of sale, as well as by way of covenant on property titles. Conditions may also be imposed on the development permit requiring specific mitigation of affected properties through the installation of appropriate screening.
- **C** Dwellings located within an identified buffer from a potential mosquito breeding area will be subject to architectural guidelines requiring the installation of appropriate mosquito screening on all external doors and windows, as well as recommendations to screen outdoor entertainment areas (see Section 2.2.3).

- **C** In accordance with the DoH guidelines, where possible larger lots will be located closest to seasonally-flooded areas and smaller lots located furthest from seasonally-inundated areas to create a rural or industrial buffer around major sources of biting insects.
- **C** Drainage will be rectified in all onsite mosquito-breeding areas within 1.6 km of the village centres (as identified in the *Biting Insect Assessment* in Appendix K). Specific actions will be to drain and/or fill borrow pits, scrapes and disturbed seasonally-waterlogged areas to reduce mosquito breeding habitat.
- **C** Ponds, retention basins and wetlands will be designed as per DoH guidelines to ensure free drainage and easy maintenance, and to ensure that lakes are sufficiently sized and constructed to reduce mosquito-breeding habitat (steep sides, creation of fish habitat).
- **C** Irrigation from community-scale wastewater treatment will involve beneficial reuse of treated wastewater where possible (e.g. irrigation of amenity areas), avoiding the possibility of pooling and consequent creation of mosquito breeding habitat.

6.11.2 Construction

C The CEMP for each stage will include drainage work, housekeeping, inductions and management actions to minimise construction workers exposure to mosquito-borne diseases, with content guided by the actions described below.

Health of workers

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
No workers and contractors to contract mosquito-borne diseases because of exposure in the project area.	Undertake drainage work to avoid creating ponding water within development areas	Weekly wet season inspections of laydowns and stockpiles for pooling water	No pooling water in laydowns or stockpiles	Amend site drainage to remove pooling water
	Undertake housekeeping to remove materials which may hold water (e.g. drains and pipes)			Assess risk and implement actions such as:
	Conduct inductions and training regarding personal protection (long sleeves, repellent etc.)	Observation of work practices	No staff to contract mosquito-borne diseases Low exposure to biting insects	• Altered hours of operation in peak mosquito season (usually Dec-June) • Provision of repellent and other PPE to reduce exposure
	Minimise work at dusk and night, when mosquitos will be most prevalent			
Recording and reporting	Internal complaints register Weekly inspection checklists			
Responsibility	Contractor			

6.11.3 Occupancy

Amenity and health of residents and/or neighbours

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
No creation of mosquito breeding habitat as a result of development	Maintain stormwater drainage and lakes to remove vegetation and sediment which create pools*	Routine inspections of stormwater drains and lakes Biting insects monitoring by DoH	No ponding occurring No increase in biting insects from baseline conditions	Spraying of insecticide in mosquito breeding areas if required Notifying residents of potential mosquito nuisance through signage and information sheets
	Notify residents how to avoid potential mosquito nuisance through signage and information sheets	None required	None required	None required
	Manage and maintain sewerage treatment plant irrigation to minimise ponding*	Visual inspections of irrigation areas for ponding	No ponding water	Drainage amendments, vegetation removal and rotating irrigation areas
Recording and reporting	Maintenance and inspection records			
Responsibility	Intrapac for design of drainage, waterways and effluent irrigation areas Litchfield Council for maintenance of public open space Installer and manager of sewerage treatment plant			

* Refer to the DoH guidelines for specific measures

Management of potential offsite mosquito breeding habitat, as identified in the *Biting Insects Assessment Report* (in Appendix K), will be difficult because the sites are on private land. The most prudent approach is to rectify potential habitat onsite first, consult with residents and Medical Entomology as to whether there remains an ongoing problem with high levels of biting insects and, if so, then discuss management options with neighbouring landholders.

6.12 NOISE

Noise is only a concern during the construction phase of the development. Post-construction the site will return to noise levels expected within a rural residential area. No ongoing management is required.

Legislation, standards and guidelines

- *Public and Environmental Health Act*
- *Waste Management and Pollution Control Act*
- *Noise Guidelines for Development Sites in the Northern Territory* (NTEPA 2013b)
- *AS 2436-2010 Guide to noise and vibration control on construction, maintenance and demolition sites* (Standards Australia 2010)
- *AS 1055.1-1997 and AS 1055.2-1997 Acoustics – description and measurement of environment noise* (Standards Australia 1997a and 1997b)
- *NOHSC 1007: National Standard for Occupational Noise* (NOHSC 1007)

- *AS/NZ 1269 Set: 2005 Occupational noise management series* (Standards Australia & Standards New Zealand 2005)

Existing environment

The noise amenity in the vicinity of the project area comprises natural noise sources (e.g. birds and insects), traffic along Redcliffe and Goode Road, use of motorbikes and quad bikes on the site, and occasional noise associated with residential rural living. On the eastern side of the project area there is also an operating quarry with associated blasting and truck traffic.

In terms of noise receptors – the areas north and west of the project area are more populated, with a greater number of rural residences. Areas east and south of the project area are relatively undeveloped, with the exception of the quarry east of the project area. Excessive noise exposure (either sudden or over time) also poses a risk to workers and contractors during the development phase.

Potential impacts

The main potential impacts of noise are from construction activities producing nuisance noise levels that impact upon neighbours, residents and/or construction workers. Deterrence of local fauna and hearing damage to construction employees and contractors are also potential impacts. The potential impacts of noise may be greater during the dry season when prevailing winds from the south and/or east could carry noise towards more populated areas. The prevailing north-westerly winds during the wet season are from the north-west which will carry noise away from populated areas.

6.12.1 Design and planning

Noise impacts and management strategies are largely attributed to the construction phase of development and, as such, no specific design or planning measures are required.

6.12.2 Construction

C Specific noise management actions will be outlined in the CEMP's required for each stage of the subdivision; however, general principles and standard measures are provided here for guidance in future management. Under the NT planning process, CEMP's are required to be assessed and approved by the relevant NT government departments prior to commencement of any works.

Amenity/social

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
No noise generated above 55-60 dB(A) (total noise limit; EPA 2013)	Maintain and operate machinery and vehicles to minimise noise generation (e.g. noise-attenuation devices, vibration dampening) in accordance with <i>AS/NZ 1269 Set: 2005</i>	Complaints received If valid noise compliant received: • Noise monitoring to be undertaken at sensitive receptors in accordance with <i>AS 1055.1</i>	No valid noise compliant received by the EPA. If complaint received, noise monitoring indicate compliance with EPA noise limits	Investigate noise complaint Implement corrective actions such as: • Machinery/equipment maintenance or modification • Relocating activities away from receptors • Installing noise barriers
	Use stockpiles and natural terrain as noise barriers	• Results to be compared to EPA total noise limit guidelines		



	Induct all staff into noise reduction techniques (e.g. designated vehicle routes, operating hours)	Observation of work practices	All staff inducted and informed of noise minimising methods	Retraining and/or signage if required
Plan noise-generating activities to minimise impacts on neighbours.	Retain vegetation buffers between development areas and existing neighbours	Clearing records Inspection of cleared areas	Vegetation buffers maintained	Investigate and implement corrective actions for next clearing required (e.g. more flagging)
	Locate construction traffic routes to minimise impacts on neighbouring residents	Observation of work practices Complaints received	No valid noise compliant received by the EPA If complaint received, noise monitoring results will indicate compliance with EPA noise limits	
	Plan and locate major noise sources (e.g. rock crushers) to be the maximum practicable distance from noise-sensitive receptors and use natural acoustic barriers (e.g. elevated terrain, vegetation buffers).	None required	No valid complaints received from EPA*	Investigate reason for noise complaint and assess hours of operation.
	Undertake consultation prior to, and during, construction to inform stakeholders and neighbours about dates, times, and nature of potential noise-generating activities and implemented mitigation measures	Consultation log		Consult with neighbours to determine improved management strategies
	Limit hours of construction and blasting (as per NTEPA 2013b), and advertise blasting at least 12 hours prior to commencement	None required		Implement improved management as required
Recording and reporting	Operation records (i.e. vehicle movements, clearing records) Induction register Maintenance records for plant/machinery Complaints register, consultation log and internal incident investigation process If required, noise monitoring, analysis and reporting will be undertaken by an appropriately-qualified acoustic monitoring consultant Reporting to EPA if complaint received			
Responsibility	Contractor			

* A designated contractor will be a representative for receipt and follow-up of noise complaints.

Health (hearing)

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
No health impacts on construction workers through exposure to hazardous noise levels	Engineer and plan operations to minimise exposure to noise	If complaint received from staff, a noise assessment will be completed in accordance with AS 1269.1	No internal complaints from staff regarding exposure to excessive noise	Undertake a noise assessment (including monitoring and exposure assessments) Implement controls (e.g. removal of loud machinery, PPE)
	Provide information to workers about the risks associated with exposure to hazardous noise levels		Noise assessment to indicate noise exposure not exceeding 85 dB(A) over 8 hours (or equivalent noise exposure) (SWA 2011)	
	Separate noise-generating activities			
	PPE – hearing protection			
Recording and reporting	Internal complaint log and incident investigation reports If required, noise monitoring, analysis and reporting will be undertaken by an appropriately-qualified acoustic monitoring consultant			
Responsibility	Contractor			

Environmental

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
Minimise noise impacts on habitat and fauna in areas surrounding development	Maintain vegetation buffers and corridors for wildlife to move to areas of lower disturbance	Assessment of vegetation clearing and maintenance of buffers	Clearing maintained within planned areas, and buffers and corridors in place	Internal investigation into unapproved clearing Inductions and training for staff
	All management actions listed in <i>Amenity/social</i> (above) will also apply	As per <i>Amenity/social</i> (above)		
Recording and reporting	Internal incident reporting and records of land clearing activities Complaints register and operations records			
Responsibility	Contractor			

6.13 AIR QUALITY

Air quality includes airborne dust (which is measured as total suspended particulates), deposited dust and fine particulate matter.

Legislation, standards and guidelines

The NT Government does not currently prescribe legislative dust level limits for construction/development sites. The following legislation, guidelines and standards have been referenced in the preparation of this plan:

- *Public and Environmental Health Act*
- *Soil Conservation and Land Utilisation Act*
- *Waste Management and Pollution Control Act*
- *National Environmental Protection Measure for Ambient Air Quality*
- *AS 3580.10.1-2003 Methods for sampling and analysis of ambient air; method 10.1: determination of particulates – deposited matter – gravimetric method* (Standards Australia 2003c)
- *AS 3640-2009 Workplace atmospheres – method for sampling and gravimetric determination of inhalable dust* (Standards Australia 2009a)
- *AS 3580.9.6-2003 Determination of suspended particulate matter – PM₁₀ high volume sampler with size selective inlet-gravimetric method* (Standards Australia 2003a)
- *AS 2985-2009 Workplace atmospheres – method for sampling and gravimetric determination of respirable dust* (Standards Australia 2009c)
- *AS 3580.9.3-2003 Determination of total suspended particulates (TSP) – high volume sampler gravimetric method* (Standards Australia 2003b)
- *NOHSC:1003 Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment* (NOHSC 1995)
- *AS 3580.11-2006 Guide to siting air monitoring equipment* (Standards Australia 2006).

Impact assessment criteria have been taken from the NSW Department of Environment and Conservation document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (DEC 2005).

Existing environment

The site is located immediately adjacent to the Darwin airshed where the major air pollutant of concern is particles from bushfire smoke in the dry season (April – October). The ambient air quality within the project area can be considered equivalent to that of any natural environment setting, influenced by natural dust kicked up by wind and smoke from proximate burning-off and bushfires during the dry season. These conditions may be augmented by dust produced from the quarry on the eastern side of the project area.

Potential impacts

The main potential impacts concerning air quality relate to effects of dust from construction on human health, safety and amenity, as well as biodiversity. Airborne dust mainly impacts visual amenity and visibility, which can reduce the safety of work sites. Depositional dust can be a nuisance when depositing onto neighbouring properties, and can also smother vegetation, impact upon habitat quality and contribute to sediment loads during first-flush rainfall events. Respirable dust (i.e. < PM₁₀) is considered a health hazard as the particulate matter can be inhaled and may carry harmful materials (such as silica).

Odour from sewage treatment could also impact on amenity, although the system proposed for use at Noonamah Ridge minimises odour impacts by treating wastewater in sub-surface channels. Accidental or controlled burning, during both the construction and occupancy phases of the development, may produce smoke.

The operation of machinery results in greenhouse gas emissions. These are considered inherent and as having a relatively low potential impact; as such they have not been addressed in this risk assessment.

6.13.1 Design and planning

The development will have community-scale sewage treatment plants that are designed to minimise odour emissions (see Section 2.10.3). Detailed design and planning of the sewage treatment system will include assessment and mitigation of potential odour impacts during the design and siting phase. The final system design and location will require approval by DoH and through the subdivision development approval process.

6.13.2 Construction

C Specific air quality management actions will be outlined in the CEMP's required for each stage of the subdivision, taking into account the sensitive receptors relevant to that particular phase of construction. General principles and standard measures are provided here for guidance in future management. Under the NT planning process, CEMP's are required to be assessed and approved by the relevant NT governmental departments prior to commencement of any works.

Dust – amenity and social impacts

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
No unacceptable impact from depositional dust on neighbouring properties No visible plumes/dust clouds leaving project area	Implement dust suppression with water trucks Cease activities when wind is excessive and causing visible dust plumes Induct and train staff in clearing techniques, dust suppression, machinery use and relevant management actions Provide a designated contractor for receipt and follow-up of air quality complaints Locate quarrying, crushing and dust-generating activities away from boundaries of property to minimise impacts on neighbours. Apply speed limits on tracks Limit clearing to those areas planned, flagged and surveyed and use blade up technique to retain ground cover where possible Retain vegetation buffers around boundaries and riparian zones to minimise visual impacts and provide filtration of dust emanating from the construction areas	Visual monitoring of active areas for excessive dust Depositional dust monitoring for 12 months prior to construction (to provide a baseline) Monitoring of BOM website for weather conditions and wind speeds	No complaints to external agencies Depositional dust below 4g/m ² /month	Investigate incident Implement necessary management actions including: • Alternative access routes • Increased use of water trucks • Decreased speed limits • Review of wind speed trigger levels
Recording and reporting	Dust monitoring, analysis and reporting will be undertaken by an appropriately-qualified environmental health/dust monitoring consultant Complaints received will be logged in the complaints register Incidents, investigations and corrective actions will be recorded through the internal incident investigation process Outcomes of investigations to be reported to the EPA			
Responsibility	Contractor			

Dust – environmental

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
No impact from depositional dust on surrounding environment, including downstream waterways, from dust	Minimise clearing to that required for each sub-stage	Visual monitoring of cleared and stabilised/landscaped areas	Construction activities commence within the same dry season as clearing	Stabilise areas with natural/synthetic cover or other controls until construction commences
	Use water trucks for dust suppression	Visual monitoring of ambient dust and dust deposition	Minimal visible depositional dust on vegetation surrounding works area	Increase use of water trucks Install water sprayers (irrigated)
	Maintain riparian vegetation buffers surrounding waterways	As per the Water Management Plan (Section 6.6), specifically turbidity	No pattern of increasing turbidity above background levels	Review dust controls Stabilise cleared areas not under construction
	Undertake progressive stabilisation and/or landscaping of cleared land following construction	Inspections of regrowth in landscaping areas	Plant growth in landscaped areas	Re-assess landscaping techniques and adapt as required in consultation with qualified professionals
Recording and reporting	Records of water truck activities (daily vehicle logs) Visual inspection records for clearing and visible dust monitoring Internal incident reports for any issues identified through visual inspections Water quality to be recorded in the water quality database			
Responsibility	Contractor			

6.13.3 Occupancy

Air quality is only a concern during the construction phase of the development. Post-construction, the area will likely have improved air quality due to reduced incidences and intensities of bushfires. This may be offset, however, by an increase in vehicle use and exhaust emissions. No ongoing management is required.

Odour – amenity

Objective	Management actions	Monitoring	Performance indicators	Corrective actions
Wastewater treatment (individual lot and community-scale systems) will not generate odour	Install and maintain individual lot systems as per relevant DoH guidelines	Design will be reviewed and approved by DoH, Systems installed by suitably qualified person	No complaints to external agencies	DoH to investigate and advise on management/improvement works
	Design treatment plants for adequate capacity and odour reduction	Design will be reviewed and approved by DoH	Approval from DoH No complaints to external agencies	Review and re-design to ensure odour reduction is addressed
	Operate treatment plant and irrigation area as required to	Complaints from residents	No complaints to external agencies	Investigate complaint

	minimise odour			Implement corrective actions to minimise odour
Recording and reporting	Design and approval from DoH Future operational and maintenance logs			
Responsibility	Individual rural lot owners for installation and maintenance of individual lot systems Intrapac for installation and operation of wastewater management system Ongoing maintenance and operation of community-scale systems to be determined after commissioning period			

Residential occupancy may result in generation of smoke during back-burning or accidental bushfires, which could impact visibility, visual amenity and/or air quality. Refer to the Bushfire section of this EMP (Section 6.10) for ongoing management requirements for bushfires.