

Tiwi Island Economic Development

Bio-Physical Resources of North East Bathurst Island

Summary Report

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Department of Land Resource Management

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Executive Summary

This report is a summary of soil and land suitability mapping, ground and surface water investigations and a biodiversity assessment of north east Bathurst Island. The report is supported by the map *Summary of the Bio-Physical Resources of North East Bathurst Island*.

Approximately 6 000 ha of land is considered moderately suitable for a range of crops. The availability of water will be a limiting factor in determining the extent and type of crops that will be productive and economically viable. Water source options to support potential development have been identified across the 6 000 ha area. The groundwater investigation indicated an aquifer with bore yields varying from low in the south to a maximum of 20 L/s in the north, where the potential for saline intrusion would need to be managed. The development of the groundwater resource would require the strategic location of bore fields with ongoing management, including monitoring. A surface water investigation identified creeks in the southern area where flows could also be utilised for irrigation.

The biodiversity assessment identified seventeen flora and fauna species listed as threatened under Northern Territory and Australian Government legislation. The habitat of ten of the threatened species is monsoon forests and thickets which are not located on suitable agricultural soils, but which are generally Groundwater Dependent Ecosystems. Seven threatened species occur in the Eucalypt woodland, with four species widespread in areas assessed as suitable for agriculture. The occurrence and distribution of an additional threatened mammal species requires confirmation.

If development did proceed, the potential indirect impacts from water extraction, fire, weeds and potential soil erosion would need to be carefully managed.

This summary is supported by a technical report which describes the methodologies, results and conclusions of investigations undertaken.

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Part 1. Overview

1. Introduction

1.1 Background

In early 2014, the Northern Territory Government's Department of Land Resource Management (DLRM) undertook a land suitability assessment, water resource investigation and flora and fauna evaluation in north east Bathurst Island to develop baseline information regarding these bio-physical resources.

The Department undertook a survey of land to identify up to 10 000 ha of land suitable for agricultural purposes. A preliminary land, water and biodiversity investigation in late 2013 identified several areas across the Tiwi Islands for further investigation as potential suitable agricultural land. The area targeted for detailed survey was selected in collaboration with other Northern Territory Government agencies and traditional owners. The resulting study area targeted an area of 14 100 ha on north east Bathurst Island.

The Northern Territory Government is committed to further developing and providing opportunity for growth across the NT. The *Framing the Future* Strategic Plan provides policy and direction for growth of an agricultural sector in the NT for all Territorians. Priorities for development include supporting agricultural enterprises, improved access and infrastructure, facilitating Indigenous partnerships and management while maintaining environmental values for sustainable development.

The Department of Land Resource Management further implements this policy through the DLRM *Strategic Plan 2013-17* to provide the best available information, assessment and interpretation of land and water resources to support development, growth and lifestyle of the Northern Territory.

1.2 Objectives

The objectives of the investigations were to:

1. Investigate the groundwater resources to inform potential water availability.
2. Investigate the surface water resources to inform potential water availability and development options.
3. Map and describe the soil landscape and interpret for agricultural land suitability, including assessment for crop suitability by the Department of Primary Industry and Fisheries.
4. Survey flora and fauna of conservation significance recognised under Northern Territory and Australian legislation and map significant vegetation communities.

These objectives enabled the Department to gain an understanding of the land and water resources and biodiversity values, as well as satisfying the requirements of the *Environment Protection Authority Indicative Terms of Reference Tiwi Island Investigation* (2014).

1.3 Study Area

The study area comprised approximately 14 100 ha of terrestrial landscapes in north east Bathurst Island, with an additional 4 700 ha of intertidal environments broadly mapped for acid sulfate soils. The location of the study area in the Northern Territory and Tiwi islands is presented in Figure 1 and Figure 2.



Figure 1: Location of the Study Area on the Tiwi Islands and within the Northern Territory



Figure 2: North East Bathurst Island Study Area

1.4 Climate

Dry season (May to September) temperatures range from 18-33°C and 31-33 °C during the wetter months (October to April). The annual average rainfall is 2 006 mm with the majority received during the wet season months from November to May. January is the highest rainfall month, averaging 415 mm (Bureau of Meteorology station, DR014142) located at Pirlangimpi Airport. These seasonal conditions represent a longer, wetter wet season than Darwin, which has an annual average rainfall of 1 730 mm.

1.5 Land Use

The majority of the study area was undisturbed native vegetation at the time of survey. In the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) Australian Land Use and Management (ALUM) classification it is classified as *Traditional Indigenous Uses*.

1.6 Legislative Context

The management of water resources is regulated under the Northern Territory *Water Act*. Northern Territory legislation (*Territory Parks and Wildlife Conservation Act, TPWCA*) and Australian legislation (*Environment Protection and Biodiversity Conservation Act 1999, EPBCA*) both apply to the management of biodiversity.

Part 2. Bio-physical Resources

2. Geology

There are two major geological units of significance in the study area. The Tertiary-aged Van Diemen Sandstone is extensive across the Tiwi Islands as a 50 to 100 m thick layer of sandstone deposited on the Cretaceous-aged Bathurst Island Formation. The Van Diemen sandstone is an important strata for groundwater investigations.

3. Geomorphology

The study area is mostly level to gently undulating plains formed on colluvium. These plains have broad lower sloping margins and occasional short steep slopes and cliffs adjacent to the coast. The elevation of the plains increases gradually towards the south of the study area then drops away abruptly as plateau side slopes. The northern portion of the plains features a system of swamps and spillways which are interconnected during the wet season. The plains are comprised of a series of broad shallow drainage depressions, drainage lines, seepage areas and springs which reflect the hydrological influence of the underlying geology.

4. Groundwater

The groundwater investigations focused on an aquifer in the Van Diemen Sandstone. Further investigations were also undertaken to establish the presence and potential of an aquifer at depth in a sandstone unit of the Bathurst Island Formation.

4.1 Methodology

The activities undertaken consisted of:

- Desktop review of existing data and reports;
- Investigation drilling and test bore construction;
- Geological and geophysical downhole logging and interpretation;
- Test pumping of bores to establish aquifer parameters;
- Groundwater sampling and ongoing monitoring.

The groundwater investigation field program (Figure 2) was undertaken between July and November 2014. This involved the drilling of 18 investigative bores located strategically across the study area to collect stratigraphic and aquifer data. Such data informs flow regime, seasonal behavioural patterns and water quality, and provides the information to calculate system recharge and discharge. In addition, four test bores and two observation bores were constructed to test the aquifer's hydraulic properties. The location of all bores is shown on the map *Summary of the Bio-Physical Resources of North East Bathurst Island*.



Figure 3:
Water Resources
drilling operation on
Bathurst Island

4.2 Assessment

The aquifer identified as suitable for future development is hosted in the sand, quartz gravel and clays of the Van Diemen Sandstone. This aquifer has a saturated thickness between 23 to 67 m, thickening to the north. The water quality is characterised by low salinity and slight acidity.

The lithological stratification of clay, sand and gravels create zones of varying permeability within the shallow aquifer vertical profile. Analysis of test data confirmed that the stratification has significant influence on the aquifer's response to pumping, exhibiting delayed drainage effects. The sandy strata, although productive, indicates low permeability. The aquifer is considered to have high water storage capacity.

Recharge to the aquifer occurs through direct infiltration of rainfall during the wet season. During the dry season, groundwater drains laterally to perennial springs and creeks in the coastal areas. Groundwater level monitoring data for at least one entire seasonal cycle (i.e. wet season and dry season) within the study area is required to quantify aquifer responses in terms of recharge and discharge processes. The data provided through the surface and groundwater investigation indicates annual rainfall recharge of between 50 000 to 70 000 ML.

Groundwater level data indicates the shallow aquifer flow regime mirrors topography. Flows are directed from the elevated surfaces towards the margins and breaks in slope, and finally towards the drainage lines and swamps. Where groundwater emerges at the surface, the river, wetland, spring and wet monsoon forest ecosystems developed are considered Groundwater Dependent Ecosystems (GDEs). Lateral discharge also occurs between the elevated surfaces and the marine environments, and this provides a natural freshwater-saltwater interface.

Continuous data logging systems have been installed into 10 bores to capture time series data of groundwater levels over the 2014-15 wet season and into the 2015 dry season. The distribution of the monitoring bore network will provide details of the natural groundwater flow regime across the study area. A number of bores were located near the coastal area to inform groundwater process at the seawater interface.

4.3 Potential

Bore yields across the study area are highly dependent on bore construction and the screened thickness of the aquifer. Therefore, individual bore yields potentially increase towards the north where the saturated thickness of the aquifer approaches 70 m. The potential yield of appropriately constructed bores in the deepest part of the aquifer is anticipated to be a maximum of 20 L/s. The estimated maximum potential bore yield is presented in the map *Summary of the Bio-Physical Resources of North East Bathurst Island*. The areas excluded from the estimate of bore potential are low lying areas which are considered susceptible to saline intrusion.

Production bore design and construction would need to incorporate measures to eliminate sand ingress problems and corrosion due to the acidic nature of the groundwater. It is recommended that proven bore construction methods in the Van Diemen Sandstone be adopted for production bores installed in this area.

There are risks associated with any extraction of groundwater resources in low lying areas adjacent to the coastline. These areas are considered to be susceptible to sea water intrusion and are expected to be underlain by saline groundwater. As a freshwater-saltwater interface underlies these areas, any groundwater extraction regime in proximity to the coast could potentially induce saline intrusion. Appropriate monitoring and management measures would need to be incorporated into any development program.

The groundwater recharge for the system cannot presently be calculated with precision due to the lack of complete seasonal water level data. However, it is estimated to be in the range of 50 000 to 75 000 ML/annum.

It is recognised that the aquatic and spring discharge ecosystems are dependent on perennial groundwater flow. In areas of potential future development, it is important that GDEs be identified where groundwater extraction may impact on either the quality or quantity of discharge to the springs.

5. Surface Water

The aim of the surface water investigation program was to establish an understanding of the local catchment hydrology, the streamflow regime and the interaction with the groundwater system. The information was used to identify potential surface water sources, assess the feasibility of water harvesting methods and identify strategic surface water monitoring requirements.

5.1 Methodology

Activities undertaken across the study area included:

- Desktop review of existing data and reports;
- Hydrological site investigations;
- Assessment of surface water sources;
- Flow analysis and water harvest options.

From June to October 2014, field investigations (Figure 4) were undertaken to capture dry season recessional flows and gauge streamflows at specific sites. Nine sites were set up for recording monthly flows. Flow measurements were also recorded at nine additional sites to characterise the flow pattern. The gauging locations are shown on the map *Summary of the Bio-Physical Resources of North East Bathurst Island*.

Flow analysis and long-term streamflow data from a nearby gauging station with similar catchment characteristics to the study area was used to assist the assessment. Bluewater Creek gauging station with 14 years of data is near Pirlangimpi on Melville Island, immediately across the Apsley Strait. Local rainfall data was also available from Bureau of Meteorology station at Pirlangimpi Airport.

5.2 Assessment

Surface water in the study area occurs as streams, perennial lakes, springs and wetlands. Three creeks were found to have significant perennial baseflows emanating from groundwater discharge in springs. Two of these creeks form part of the Dudwell Creek system, and the third is in the south-east of the study area. Gauge sites on these creeks are G8160017, G8160018 and G8165051 respectively. A number of other streams and small creeks in the study area were also surveyed for potential as water sources. These creeks generally have small (less than 6 km²) catchment areas, are shallow and have late dry season baseflows below 50 L/s, with most below 30 L/s. There were no significant pools identified in these creeks during field survey or from aerial imagery.

Three significant stream pools were identified in the Dudwell Creek system, as indicated on the map *Summary of the Bio-Physical Resources of North East Bathurst Island*, highlighting estimated minimum stream flows.

For the three creeks with significant perennial baseflows, the absolute minimum flow rates for any year were estimated at 260 L/s, 60 L/s and 40 L/s, respectively. The longer term Bluewater Creek data were used to model expected monthly flow rates, predicting the average (50 percentile) flow rates for November (when flow is usually at its lowest) as 370 L/s, 100 L/s and 70 L/s respectively.



Figure 4: Stream gauging

5.3 Potential

This study was based on limited spot flow measurement data in the 2014 dry season combined with longer term flow data from Bluewater Creek, so the estimated water availability results are indicative only.

Three creeks were identified as having potential for flow extraction. The average modelled flow volumes in the driest month (November) were 950 ML, 260 ML and 170 ML respectively. Flow volumes would vary due to seasonal variability. Two creeks contain waterholes that would allow direct pumping. The third creek in the south-east of the study area, which contains Gauging Station G8165051, may have potential to meet small water supply requirements. The environmental requirements of Groundwater Dependant Ecosystems would need to be considered when determining sustainable extraction volumes.

Off-stream storages may be an option for storing water extracted during the wet season. The cost-effectiveness of this option would need to be examined.

6. Land Resources

The primary aim of the land resource investigation was to map and describe the soil landscapes and interpret this information for an agricultural land suitability assessment. A secondary aim was to map significant vegetation communities. Both were achieved by mapping land units, a technique used widely in the Northern Territory for mapping land resources.

6.1 Methodology

Areas with a uniform pattern of landform, soil and vegetation were delineated using aerial photography interpretation in conjunction with satellite imagery to derive mapping boundaries. Field work was conducted to collect soil and vegetation data and other observational information. This information was used to derive descriptions of the land units and verify the mapping boundaries.

Key soil and landform attributes of each land unit informed an agricultural land suitability assessment. These attributes included slope, rock outcrop, soil depth, soil drainage, erosion risk and acid sulfate soil risk.

6.2 Land Units

Landform, soil and vegetation associations were used for landscape classification, resulting in the definition of 18 land units over the study area. Landforms ranged from steep plateau margins in the south to gently undulating plains with steeper lower slopes and swamps, springs and drainage systems to the north. The coastal perimeter of the project area is fringed by tidal flats, salt flats and beach ridges. A summary of the landforms and associated land units is presented in Table 1.

Table 1: Summary of landforms and land units of the study area

Land Class	Land Units*	Area (ha)*	% of project area
Low hills and rises	5a, 6a, 7a	1 067	6
Plains with well drained soils	8a, 8a1, 8b, 8d	9 301	49
Plains with poorly drained soils	8c, 8c1	1 832	10
Drainage systems	10a, 10b, 10c	1 612	8.5
Swamps	11a, 11b	287	1.5
Marine flats	12a, 12b, 12c, 12d	4 733	25

* Land units are described in the supporting technical report

6.3 Soils

The dominant soil orders in the study area are Kandosols (10 345 ha) and Hydrosols (8 488 ha). The Kandosols are predominantly deep and red with sandy loam surface horizons grading into sandy clay loam subsoils and clays in the deeper subsoils (Figure 5). These soils are commonly referred to as sandy Red Earths.



The Hydrosols include a range of wet soils, both tidal and those subject to prolonged waterlogging associated with the wet season. The Hydrosols associated with tidal areas were not considered for further investigation. The Hydrosols associated with swamps, drainage systems and poorly drained plains include a range of red, brown and yellow soils. They have similar field textures to the Red Kandosols but differ in subsoil colours and the presence of mottling. The mottling combined with the associated vegetation characteristics indicate a period of saturation during the annual wet season.

Chemical testing revealed soils (Kandosols and Hydrosols) are acidic and strongly leached, and consequently very low in all plant nutrients. The Red Kandosols have a moderate to high infiltration rate in the surface soils and this decreases with depth.

Figure 5: A sandy deep Red Earth (Red Kandosol) typical of soil across the gently undulating plains

6.4 Vegetation

The most extensive vegetation is tall woodlands and tall open woodlands of eucalypts and bloodwoods. These occur on the gently undulating plains with deep well-drained Red Kandosols. A summary of the broad vegetation types is presented in Table 2.

Five significant vegetation communities were identified that are particularly sensitive to disturbance - specifically fire, invasive plant species, feral animals or domestic stock, infrastructure and development. These communities are riparian vegetation, wetlands, Melaleuca forests, monsoon forest and thickets, and mangroves.

Table 2: Broad Vegetation Types of the study area

Vegetation	Area (ha)	Area (%)
Eucalypt dominated open woodland to woodland	10 303	59
Mixed species open woodland	1 110	6
Monsoon forests and thickets	463	2.7
Sedgeland	459	2.3
Melaleuca forest and woodland	1 488	9
Mangroves and saltflats	3 438	19.8

6.5 Land Evaluation

Approximately 5 900 ha of the study area is considered moderately suitable for a number of potential crop types. The majority of this land occurs on level to gently undulating plains with deep well-drained soils. They have a moderate erosion risk due to the high rainfall, gently inclined slopes and pulverulent (powdery) nature of the surface soils. The pulverulent condition is also a limitation for trafficability which was noticeable on the temporary access tracks. These areas would require appropriate management to mitigate against potential erosion. The remainder of the study area is considered marginal or unsuitable for agricultural development due to severe or extreme soil landscape limitations.

A summary of the agricultural land suitability classes and their extent are provided in Table 3 and the accompanying map, *Summary of the Bio-Physical Resources of North East Bathurst Island*.

Table 3: Agricultural Land Suitability classes and their extent in the study area

Agricultural Land Suitability	Land Units*	Area (ha)	Area (%)
Highly suitable (minimal limitations)	-	0	0
Moderately suitable (moderate limitations)	8a	5 908	31
Marginally suitable (severe limitations)	8a1, 8b, 8c, 8c1, 8d	5 226	28
Not suitable (extreme limitations)	5a, 6a, 7a, 10a, 10b, 10c, 11a, 11b, 12a, 12b, 12c, 12d	7 699	41

* Land units are described in the supporting technical report

7. Biodiversity

The Tiwi Islands have very high biodiversity conservation values, including high plant species diversity, endemic and range-restricted species, and the presence of 51 listed threatened species. The flora and vertebrate fauna of the Tiwi Islands is moderately well known from previous studies, although data for northern Bathurst Island is sparse. Surveys in 2014 aimed to clarify the distribution and abundance of significant flora and fauna species, particularly targeting listed threatened species for which the study area is likely to contain important habitat.

7.1 Flora

Methods

Surveys in the late wet season (March to April 2014) targeted two endangered, cryptic, ephemeral herb species (*Typhonium jonesii* (Figure 6) and *T. mirabile*) occurring in eucalypt woodland and open forest. The sampling method was designed to allow species occupancy modelling using a range of environmental and landscape features. The abundance of cycad species was also recorded, as well as additional localities for significant species found during traverses between sites.

Surveys in the late dry season (October 2014) targeted monsoon forest and thicket patches. Plant species lists were compiled for 31 patches along with a population estimate for each species of conservation significance within each patch.

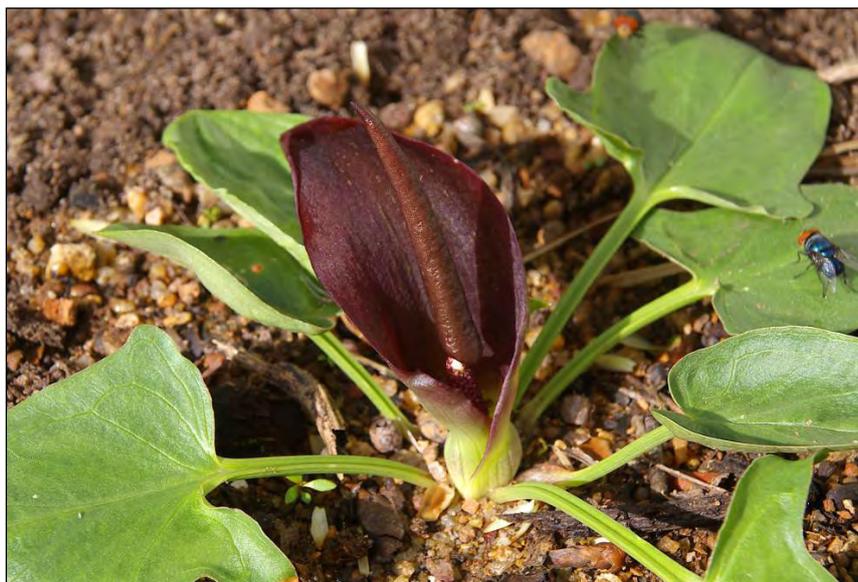


Figure 6:
Typhonium jonesii

Results

Based on the 2014 surveys and previous data, a total of 13 threatened plant taxa occur within the study area. The status and preferred habitat of each species is summarised in Table 4. Ten threatened plant species occur in monsoon forest patches, mostly with very small local population sizes. Individual monsoon forest patches in the study area contained up to five threatened plant species. These patches are on land units considered not suitable for agriculture, but are generally Groundwater Dependent Ecosystems.

Of the three threatened plant species occurring in eucalypt forest and woodland, *Cycas armstrongii* was widespread in the study area. *Typhonium mirabile* was relatively common but most strongly associated with the margins of the elevated land units in the south east, which are not considered suitable for agriculture. *Typhonium jonesii* (Figure 6) occurred in 10% of sample sites but was too rare to determine more specific habitat requirements. An additional 19 near-threatened and data-deficient plant taxa were also recorded in the study area, with the majority occurring in monsoon forest and thicket patches.

7.2 Fauna

Methods

Field surveys were conducted from May to June 2014 and October to November 2014, targeting five threatened vertebrate species known or likely to occur in eucalypt open forest and woodland habitat in the study area. Trapping for mammal species was undertaken at 40 sites, using a combination of cage traps and Elliott traps, pitfall buckets with drift fences, 20 litre pitfalls with drift fences and motion-sensing cameras. Red Goshawks were censused by visual search for their distinctive nests whilst Masked Owls were censused at night by broadcasting calls. Records of significant vertebrate species from this survey were combined with existing data for the Tiwi Islands. Species' distributions within the Tiwi Islands were spatially modelled using a range of environmental and landscape features.

Results

Brush-tailed Rabbit-rat (Figure 7), Pale Field-rat and Tiwi Masked Owl were frequently recorded during the survey and occurred throughout the study area, except the Pale Field-rat was not recorded in the far north. Butler's Dunnart was not trapped but was provisionally identified on camera trap photographs from three sites. Red Goshawk was not positively detected, although there were two uncorroborated sightings of birds and there are two previous records for this species just south of the study area.



Figure 7: Brush-tailed Rabbit-rat

Species distribution modelling showed that “high-likelihood” habitat for each of Brush-tailed Rabbit-rat, Pale Field-rat and Tiwi Masked Owl occupies approximately 60% of the study area, and represents between 10-20% of all such uncleared habitats on the Tiwi Islands. High-likelihood habitat for the Red Goshawk occupies 8% of the study area and the distribution of Butler's Dunnart is uncertain.

Table 4: Listed threatened plant and animal species recorded or likely to occur within the study area, showing preferred habitat and status under the *Territory Parks and Wildlife Conservation Act* (TPWCA) and *Environment Protection and Biodiversity Conservation Act* (EPBCA). Eucalypt forest species that occurred widely in land units suitable for agriculture are in bold.

Habitat: EF=eucalypt forest or woodland, MF=monsoon forest and thickets, R= riparian

Conservation status: CR=Critically Endangered, E=Endangered, V=Vulnerable. (e) Indicates the species or subspecies is endemic to the Tiwi Islands and (d) that within the NT it occurs only on the Tiwi Islands.

Species	Habitat	TPWCA	EPBCA
<i>Cycas armstrongii</i>	EF	V	
<i>Dendromyza reinwardtiana</i>	MF	V (d)	
<i>Elaeocarpus miegei</i>	MF	CR (d)	
<i>Endiandra limnophila</i>	MF	V	
<i>Freycinetia excelsa</i>	MF	V	
<i>Hoya australis oramicola</i>	MF	V (e)	V
<i>Luisia corrugata</i>	MF	V	
<i>Mitrella tiwiensis</i>	MF	V (e)	V
<i>Tarennoidea wallichii</i>	MF	E	
<i>Thrixspermum congestum</i>	MF	V	
<i>Typhonium jonesii</i>	EF	E (e)	E
<i>Typhonium mirabile</i>	EF	E (e)	E
<i>Xylopia monosperma</i>	MF	E	E
Brush-tailed Rabbit Rat <i>Conilurus penicillatus melibius</i>	EF	E (e)	V
Pale Field Rat <i>Rattus tunneyi</i>	EF	V	
Masked Owl <i>Tyto novaehollandiae melvillensis</i>	EF	E (e)	E
Red Goshawk <i>Erythroriorchis radiatus</i>	EF/R	V	V

7.3 Biodiversity Management

The eucalypt forests and woodlands in the study area provide habitat for four threatened vertebrate and three threatened plant species and four of these species are widespread in land units assessed as suitable for agriculture (Table 4). Monsoon forest and thicket patches in the study area support at least ten threatened plant species. These patches are on land units considered not suitable for agriculture, but are generally Groundwater Dependent Ecosystems.

Agricultural development may potentially impact threatened flora and fauna species directly through habitat destruction, and indirectly through reduction in habitat quality associated with spread of weeds and feral animals, or changes in fire regimes. Spring-fed or riparian monsoon forest patches and associated threatened plant species may be vulnerable to alteration of hydrological regimes by land clearing and local groundwater extraction. Weed, fire and feral animal management as well as erosion and sediment control plans would be

necessary to mitigate some of the risks associated with the indirect impacts of land use change.

A spatial “biodiversity risk” index was developed for the study area based on the location of monsoon forest and thicket patches and distribution of threatened species, and is presented on the map *Summary of the Bio-Physical Resources of North East Bathurst Island*. A 200 m buffer was applied to dry monsoon forests and thickets and a 400 m buffer to wet monsoon forests, consistent with previous EPBCA approvals for forestry developments on Melville Island. The score reflects the relative value of any area as potential habitat for listed threatened species. The highest values for the biodiversity risk scores are in the south-eastern and south-western portion of the study area, which generally are not associated with the moderately suitable agricultural land. The majority of the study area has a score of at least three, due to some threatened species occurring widely in eucalypt open forests. Additional survey work would be required to confirm the presence and distribution of Butler’s Dunnart.

A comprehensive biodiversity assessment should also consider biodiversity values of the study area within a broader regional context. For the entire Tiwi Islands, the modelled distribution of threatened vertebrate species associated with eucalypt forest habitats suggests that northern Bathurst Island and north-western Melville Island have particularly high biodiversity value. This is likely linked to a number of factors including the higher annual rainfall, soil types suitable for taller eucalypt forests and woodlands, and a high density of wet monsoon forest patches associated with springs around the margins of the elevated land surfaces.

Part 3. Plant Industry Opportunities

8. Crop Suitability

The Department of Primary Industry and Fisheries (DPIF) has provided crop suitability information, which is presented in Table 5. The commercial success of plant industries in the Northern Territory is dependent on several factors, including available markets, prevailing prices, input costs, logistics, difficulty of management and the skills and tenacity of the grower. For north east Bathurst Island there are a number of limiting factors related to land suitability. The agricultural land suitability assessment shows there is a significant area of well drained gently undulating land with deep soil. However, this soil is sandy, has limited structure, and very low levels of available essential plant nutrients. Based on existing successful plant industries from the Top End of the Northern Territory, most enterprises would need input of water and nutrients, as well as grower motivation and expertise, to be successful on Bathurst Island.

Most agricultural, horticultural or forestry crops that are adapted to a tropical climate would not grow and yield commercial quantities without relatively high levels of inputs such as fertiliser. In the Top End climate, sustainable development requires soil conservation measures to mitigate potential soil erosion risk. Any enterprise that included cultivation of trees or crops over the wet season would need a cyclone risk strategy, and trees growing over the dry season would require management of fire risk.

If these requirements are fulfilled, the following crops may have potential across the moderately suitable soils.

Table 5: Description of potential crops (provided by DPIF)

Crop group	Potential	Comments
Tropical exotic fruit trees	Wet tropic natives are at the edge of preferred conditions and include rambutan, jackfruit, durian, cocoa, coffee, pepper and mangosteen	<p>Growing season - all year round</p> <p>Irrigation requirement - High water requirements over the dry season (5-10 ML/ha/yr)</p> <p>Fertiliser requirement - high</p> <p>Logistics - Highly perishable and require cool chain transport systems to accompany cultivation</p> <p>Note</p> <p>Currently grown at a small scale in the Northern Territory.</p>
Sub-tropical to semi-arid tropical fruits	Some examples of fruit with a wider climatic tolerance include banana, mango, citrus, papaya and papaw, passionfruit, pitahaya or dragonfruit and pineapple	<p>Growing season - all year round</p> <p>Irrigation requirement - High water requirements over the dry season (5-10 ML/ha/yr), however, some crops including mango, pitahaya and citrus can tolerate</p>

Crop group	Potential	Comments
		<p>less irrigation.</p> <p>Fertiliser requirement - High</p> <p>Logistics - Highly perishable and require cool chain transport systems to accompany cultivation</p>
Ornamentals	Some examples include heliconias and ornamental gingers	<p>Growing season - all year round</p> <p>Irrigation requirement - High water requirements over the dry season (5-10 ML/ha/yr)</p> <p>Fertiliser requirement - High</p> <p>Logistics - Highly perishable and require cool chain transport systems to accompany cultivation.</p>
Vegetables, herbs, annual fruits	<p>Examples of temperate “summer” crops successfully grown around Darwin:</p> <p>Vegetables include pumpkin, cucumber, bitter melon, snake gourd, hairy melon, winter melon, long melon, sin qua, luffa, snake bean, chili, taro, yam bean and okra.</p> <p>Herbs include basil, kankong, coriander and parsley.</p> <p>Annual fruit crops include watermelon, rockmelon, honeydew melon and hami melon</p>	<p>Growing season - dry season (April to November). Erosion from wet season rainfall, pressure from insects and diseases restricts production to dry season</p> <p>Irrigation requirement - Medium to high water requirements over the dry season (3-8 ML/ha/yr)</p> <p>Fertiliser requirement - High</p> <p>Logistics - Highly perishable and require cool chain transport systems to accompany cultivation.</p> <p>Note</p> <p>Bathurst deep sandy soils offer potential for sweet potato as this is not currently produced in the Top End, primarily because of gravelly soils.</p>
Hay and fodder crops	Tropical introduced grasses Rhodes Grass or Sabi Grass, Aerobic (non-paddy) rice; tropical legumes such as cavalcade or fodder peanuts produce their own nitrogen.	<p>Growing season - Wet season rain fed crops or irrigated dry season crops (typically dry season crops have higher yields due to more sunlight).</p> <p>Irrigation requirement - Low to medium in the dry season (3-6 ML/ha/yr)</p> <p>Fertiliser requirement - Medium</p> <p>Logistics - These are high volume, low value crops. The cost of transport can consume revenue generated by the crop. Hay is not perishable once dry, so can use low cost and non-refrigerated transport methods to market</p>

Crop group	Potential	Comments
Grains and pulses	Previous crops grown in the Top End include; rice, grain sorghum, corn and peanuts, however need appropriate inputs of water and fertiliser	<p>Growing season - Wet season rain fed crops or irrigated dry season crops (typically dry season crops have higher yields due to more sunlight).</p> <p>Irrigation requirement - Low to medium in the dry season (3-6 ML/ha/yr)</p> <p>Fertiliser requirement - Medium</p> <p>Logistics - These are high volume, low value crops. The cost of transport can consume revenue generated by the crop. Grains are not perishable once dry, so can use low cost and non-refrigerated transport methods to market. Likely to need silo storage and some point between production and market.</p>
Fibre and industrial crops	Fibre: Kenaf, Ethanol: Cassava Biodiesel: oil palm Industrial gels/gums: Guar	<p>Growing season - Wet season rain fed crops or irrigated dry season crops (typically dry season crops have higher yields due to more sunlight).</p> <p>Irrigation requirement - Low to medium in the dry season (3-6 ML/ha/yr)</p> <p>Fertiliser requirement - Medium</p> <p>Logistics - These are high volume, low value crops. The cost of transport can consume revenue generated by the crop. Storage and transport would vary between these types of crops.</p>
Forestry	Cypress Pine and <i>Acacia mangium</i> are two possibilities, as are improved eucalyptus varieties.	<p>Growing season - Wet season rain fed</p> <p>Fertiliser requirement - Medium</p> <p>Logistics - need harvesting and port facilities to transport to market. May need minimal processing on site (e.g. wood chipping)</p>
Native fruits	Kakadu Plum could have potential, however it was not common during field survey.	<p>Growing season - Wet season rain fed</p> <p>Fertiliser requirement - unknown if this species will respond to fertilisation</p> <p>Logistics - somewhat perishable, but does not necessarily need refrigeration</p>